PD-ABK-702
935421
Mr. J. Sheppard
(3)

AGRICULTURAL RESEARCH DEVELOPMENT LOAN

PAKISTAN

1974

PAKISTAN: AGRICULTURAL RESEARCH LOAN

Table of Contents

		Page
Summary and Recommendations		1
I.	BACKGROUND	3
II.	PAKISTAN'S AGRICULTURAL PROBLEMS AND RESEARCH PRIORITIES	5
	A. Pakistan's Agricultural Problems	5
	B. Research Priorities	9
III.	PROJECT DESCRIPTION AND PURPOSE	11
IV.	PRESENT AGRICULTURAL RESEARCH SYSTEM	13
	A. Institutions	13
	B. Deficiencies in Existing System	14
V.	NEWLY PROPOSED RESEARCH SYSTEM	18
	A. Development of Priorities and Resource Allocation	18
	B. Role of ARC and the National Research Center	19
	C. Promoting Multidisciplinary Research	20
	D. Developing Linkages among Researchers	21
	E. Developing Professional Leadership	21
	F. Improving Facilities	21
	G. Upgrading Staff Competence	22
	H. Foreign Technical Assistance	22
	I. Linkage of Research and Extension	23
	J. Full Utilization of Research Capability within Educational Institutions	23
	K. Increasing Institutional Effectiveness	23
VI.	PROJECT COSTS	25
	A. Foreign Exchange Costs	25
	B. Local Currency Costs	31
VII.	FINANCIAL PLAN	33

		Page
VIII.	ECONOMIC AND SOCIAL IMPACT OF PROJECT	35
IX.	IMPLEMENTATION PROCEDURES	38
	A. Decision Process and Procedures for Approving Priority Research	38
	B. Commodity Procurement	39
	C. Technical Assistance	40
	D. Training	41
	E. Role of Intermediaries and Source of Procurement	43
	F. Project Implementation Committee	44
X.	EVALUATION SYSTEM	45
	A. Annual Workshop	45
	B. Evaluation Panel	45
XI.	LOAN TERMS AND CONDITIONS	47

TABLES

1.	Pakistan's Agricultural Production - 1960-1973	7
2.	Estimated Cost Distribution of Commodity, Technical Assistance and Training	26
3.	Foreign Exchange Costs by Major Category	27
4.	Foreign Exchange Costs of Commodities by Institution	28
5.	Training Costs	30
6.	Local Currency Costs by Major Category	32
7.	Source of Funds	34
8.	Training Schedule	41
9.	Estimates of Technical Assistance Required	44

APPENDICES

I. Estimate of Training Needed to Support Major Research Programs by Institution.

II. Estimate of Commodities Needed to Execute Major Research Programs During First Two Years, By Institution.

III. Approximate Distribution of Technical Advisors by Institution and Man Years.

IV. Estimate of NRC Construction Funding, by Year.

V. Estimate of Staffing Pattern of NRC by Program and Year.

VI. Estimate of Commodities Needed for National Research Center.

VII. Estimate of Buildings Needed for National Research Center, with Costs.

VIII. Estimate of Housing Needed for ARC and NRC Staff with Funding Schedule.

PAKISTAN: AGRICULTURAL RESEARCH LOAN

Summary and Recommendations

1. Borrower: The Government of Pakistan. The program will be executed by the Agricultural Research Council which is charged with the responsibilities for stimulating, promoting and coordinating agricultural research in Pakistan.

2. Loan Amount: $7,600,000

3. Terms: Repayment in 40 years, including 10 year grace; 2% during the grace period and 3% thereafter.

4. Purpose: To upgrade and expand Pakistan's agricultural research capability, both national and provincial, to effectively deal with problems in priority commodity/crop areas so as to increase agricultural production for domestic consumption and exports.

5. Project Description: A five-year program to develop and upgrade Pakistan's agricultural research institutes and colleges and to establish and equip a National Research Center to coordinate and carry out priority research projects. Commodities, expatriate technical advisors (including intermediaries) and academic and practical training for professionals and sub-professionals will be financed over a five-year period. An evaluation system, including workshops and an evaluation panel will permit assessment of research work undertaken and implementation progress.

6. Total Costs: The total cost of the expanded research program is estimated at $19.6 million, of which $9.6 million is for foreign exchange costs and $10.0 million for local currency costs. Of the foreign exchange costs, 30% is for commodities, 42% for technical advisory assistance and 28% for training.

7. Financial Plan:

	Foreign Exchange	Local Currency*	Total
	(in $1,000 equivalent)		
A.I.D. DL	7,600	-	7,600
A.I.D. DG	1,500	-	1,500
GOP Grant	520	2,700	3,220
Mondale Grant		7,348	7,348
Total	9,620	10,048	19,668

(*Rs. 10 = U.S. $1.00)

8. Other Sources of Financing: The agricultural research program has been discussed with other multilateral and bilateral donors including IBRD, FAO, UNDP, Ford and Rockefeller Foundation. It is clear from these discussions that while other multilateral donors will continue contributing in modest way as they have been in the past, they are not in a position to make the major input required and which has been requested of AID.

9. Issues: None

10. Statutory Criteria: All statutory criteria have been satisfied. (see annex)

11. Recommendations: It is recommended that a loan to the Government of Pakistan be authorized in the amount of $7.6 million to finance the foreign exchange costs of U.S. and Code 941 category country procurement of commodities, technical assistance and training on the following terms and conditions:

(a) Repayment will be made in US dollars within 40 years from the date of first disbursement with a 10-year grace period.

(b) Interest at the rate of 2% per annum during 10-year grace period and 3% per annum thereafter.

(c) This loan shall be subject to such other terms and conditions as set forth in section XI of this paper.

I. Background

USAID and other donors, recognizing research as an essential component of a developing agriculture, have encouraged Pakistan's import and adaptation of available technology and the development of an indigenous capability for technology generation. The efforts in wheat, rice, maize and university development have helped Pakistan develop its technology generating capability.

In 1968, a joint Pakistani-American team reviewed the extant research capability in Pakistan and recommended a course of action to upgrade Pakistan's research capability. Since 1970, USAID staff have worked closely with the Ministry of Agriculture, the Agricultural Research Council, provincial agricultural officials, and provincial research stations and scientists, to jointly identify the type of research system most suitable for Pakistan, the major constraints, and a strategy for alleviating the limiting factors. Since July 1970, USAID has supplied a research administration advisor to GOP and a Mondale Rupee Grant of Rs. 3.4 million to ARC.

The effort was reinforced in March 1973 with a second joint Pakistani-American review, at the request of the Secretary of Agriculture, GOP. The consensus of expert counsel is that Pakistan should systematically upgrade the provincial institutes, improving their capability to respond to province needs, and that the ARC should become actively involved in a few major research programs of national importance, assuring their successful execution through a multi-disciplinary, coordinated approach to priority problems. This would develop a research system that emulates the Indian and U.S. systems wherein states and federal governments share the responsibility for development of agricultural technology.

Expert counsel is that this effort will require additional training local currency budget and FX commodities for the provincial institutions, the development of a national research center, and expatriate advisors for some major coordinated research programs.

The proposed research capability development program was developed by the staffs of the Pakistan Agricultural Research Council, GOP and USAID, in frequent consultation with the directors and scientists of the major provincial research stations throughout Pakistan.

The appraisal of the need and capability to execute the proposed program is based on the evaluation by the February/March 1973 joint Pakistan-American Agricultural Research Review Team; evaluations made by the USAID Agriculture Office through continuing contact with Pakistani program officials, scientists and farmers; and evaluations and reports by other foreign technicians including those of Ford and Rockefeller Foundations. On the basis of these assessments and review by the Mission Loan Committee, a conclusion has been reached that the proposed program is realistic and has outstanding prospects for success.

II. Pakistan's Agricultural Problems and Research Priorities

A. Pakistan's Agricultural Problems

Pakistan's economy is heavily dependent upon the agricultural sector, which employs 56% of the labor force, produces 44% of the GNP, and 65% of the foreign exchange earnings. An appraisal of the Pakistan Agricultural Sector was completed June 23, 1972, entitled "Pakistan's Agricultural Sector Analysis" and is available on request The problems relating to agriculture center on the practical necessity of producing sufficient food and fiber to meet domestic demand at an acceptable price, and on the earning of foreign exchange to offset import requirements. The agricultural problems include: the supply of inputs, including water, technology, fertilizer, credit, pesticides, etc. increasing the efficiency of resource use (especially water); and policies that affect production efficiencies, resource use and input availability.

Performance within the agricultural sector varies greatly from commodity to commodity from geographical area to area and in effectiveness with which different resources are utilized and different rural groups benefitted. Table 1 sets forth Pakistan's Agricultural Production, 1960 to 1973.

Illustratively, a great deal of effort (including research) has gone into development of agriculture in irrigated areas, but little has gone into rainfed areas. Of the commodities, cotton and wheat, rice and maize have received emphasis, while pulses, livestock and oilseeds received little attention. Changes in yields, and in total production and domestic supply situation, reflect these imbalances in emphasis Cotton yields have been increasing steadily and total output growing at an annual rate of about 10 percent. Yields of rice have been increasing at about 5 percent rate and total production at a 10 percent rate. Both cotton and rice are now heavily dependent on outside markets. Wheat production has increased by 90 percent in 10 years, but demand (stimulated by artificially low prices) has also grown very rapidly, and Pakistan continues to import wheat to the tune of about a million tons per year. Maize production has grown at about 3-4 percent per year but still is insufficient for domestic food, feed and processing requirements.

In contrast with these commodities, production of pulses has been declining over the last several years (at about 5 percent per year) and recently, prices of pulses have been going up rapidly. Total production of edible oils has varied widely from year to year. Despite significant increases in prices, the country has had to import increasing amounts each year. The bill for the current year's vegetable oil imports of 100,000 M. T. will be $40 to 50 million. A further concern is the increasing percentage

of total oils coming as a by-product of cotton lint production. Most of Pakistan's lint is exported in raw or processed form. Cotton production consequently is thus vulnerable to world fluctuations in cotton production and prices, which affect demand for the major product of the crop. Thus the vegetable oil supply will decline if exports of lint decline, causing a double problem of increased oil import requirements while foreign exchange earnings are falling. Cotton currently accounts for 50-60 percent of total exports.

Sugar production has been almost stagnant with supplies inadequate to satisfy needs.

Livestock development probably has been the most neglected of the major commodity groups. Yield of meat and milk per head is almost unbelievably low, particularly for cattle and buffalo. As a result, despite a large ruminant population relative to human population, meat and milk are in very short supply. These shortages and poor quality of meat and milk are of increasing concern both because of the consumption habits favoring meat and milk, and the recognized importance of animal protein in the diet. The development of sheep, goat and poultry industries, particularly in the arid and semi-arid lands of Baluchistan and N. W. F. P., appear favorable. Also possibilities are seen for some exports of meat both to nearby Arabian countries and to Europe, Japan and the U. S.

Sorghum, which currently accounts for about 3 percent of total cereals, has been making some progress in yield and total output, but millet has been declining. It is quite probable that a major improvement could be made with both these crops under barani conditions, where they now are grown.

Problems other than inadequate and imbalanced commodity growth rates are evident. Major emphasis has been placed on development of water resources and crops for irrigated areas. Unfortunately, no comparable emphasis has been placed on efficient use of irrigation water after it leaves the major canals. Combined losses from delivery systems and inefficient and use of water may allow only 25-50% total efficiency in water use. Waterlogging and salinization are common resulting problems.

Areas dependent solely on rainfall (which make up 85% of the total), receive very little attention. Similarly, the small farmers and tenants appear to be less well served by research, credit, inputs, markets and government service, and encounter the greatest difficulties in modernizing.

Look for

TABLE 1 - AVERAGE, YIELD AND PRODUCTION OF MAJOR CROPS - PAKISTAN
~~AVERAGE 1960-64 AND 1965-73~~

	1960-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
Wheat										
Production in 000 tons	3,979	4,518	3,854	4,266	6,317	6,513	7,179	6,374	6,759	7,600
Acreage in 000 acres	12,110	13,140	12,738	13,205	14,785	15,221	15,393	14,771	14,478	14,710
Yield/Acre in maunds	8.9	9.4	8.2	8.8	11.6	11.6	12.1	11.7	12.7	
Rice										
Production	1,093	1,329	1,296	1,343	1,475	2,000	2,363	2,165	2,168	2,224
Acreage	3,006	3,350	3,443	3,483	3,508	3,842	4,008	3,715	3,642	3,738
Yield/Acre	9.9	10.8	10.2	11.4	11.7	14.2	16.1	15.8	16.2	16.2
Maize										
Production	477	520	531	578	779	616	657	706	694	658
Acreage	1,180	1,202	1,339	1,368	1,502	1,523	1,600	1,581	1,563	1,494
Yield/Acre	10.9	11.8	10.8	11.5	14.1	11.0	11.1	12.2	12.0	
Jowar (sorghum)										
Production	235	288	270	273	286	258	279	324	307	306
Acreage	1,199	1,446	1,467	1,380	1,444	1,170	1,212	1,378	1,253	1,244
Yield/Acre	5.3	5.4	5.0	5.4	5.4	6.0	6.3	6.4	6.7	6.7
Bajra										
Production	359	439	364	365	407	325	297	355	354	277
Acreage	1,958	2,250	2,075	2,069	2,258	1,819	1,560	1,881	1,876	1,607
Yield/Acre	4.9	5.3	4.8	4.8	4.9	4.9	5.1	5.1	4.7	
Barley										
Production	115	116	82	87	106	95	107	90	101	103
Acreage	461	458	382	400	429	385	399	348	387	395
Yield/Acre	6.8	6.9	5.8	5.9	6.7	6.9	7.3	7.0	7.1	-
Total cereal production	6,258	7,210	6,397	6,912	9,370	9,807	10,882	10,014	10,383	11,168
Total acreage under cereals	19,914	21,846	21,444	21,905	23,926	23,960	24,172	23,674	23,199	23,188
Total Pulses production	698.4	736.8	595.2	701.1	556.0	585.5	560.5	569.5	597.7	-
Acreage	3,365	3,423	3,044.5	3,534.1	3,282.8	2,803	2,683.4	2,688.7	2,924.7	-
Cotton (000 bales)	1,981.9	2,123.8	2,330.8	2,604.8	2,910.8	2,966.7	3,012.3	3,050.5	3,979.0	3,947.4
000 Acres	3,418.2	3,624.4	3,858.2	4,003.3	4,411.3	4,313.0	4,338.3	4,283.5	4,837.4	4,968.5
Yield mds. per acre	2.7	2.8	2.9	3.1	3.1	3.3	3.3	3.4		
Sugarcane production	14,980	18,373	21,957	21,635	18,365	21,624	25,953	22,801	19,647.7	21,069.7
Acres 000 acres	1,137.5	1,243	1,476	1,605	1,245	1,336	1,523.2	1,571.5	1,364.7	1,422.8
Yield/Acre	372.1	402.3	366.9	366.9	401.5	440.6	461.1	394.9		
* Production of vegetable oils (000 tons)										
Cottonseed oil		75.68	83.23	93.02	104.85	108.70	107.00	109.40		
Rape and Mustard oil		66.31	55.99	62.56	84.46	68.50	77.00	76.89		
Sesamum oil		3.35	2.60	2.60	3.35	3.00	2.00	3.70		
Linseed oil		1.33	1.00	1.00	1.33	1.00	1.00	1.10		
Groundnut oil		6.00	8.70	13.42	21.90	15.60	16.00	13.80		
Total		152.67	151.52	172.60	215.89	198.80	203.00	194.00	234.00	

* Estimated by Planning Unit, Ministry of Agriculture and Underdeveloped Areas, GOP, Islamabad

Agricultural research can help Pakistan solve its agricultural problems through the supply of new technology, increasing the efficiency of resource use and supplying information affecting policy decisions. Obviously, research will not solve all the problems. In some instances (i.e., sorghum production), new technology generated by an effective research program can be applied and increase production substantially without changing other production factors.

In a few instances (i.e., sugarcane), only limited new technology can be used without changes in policy or without changes in the supply of other inputs. In such situations the research program can identify factors having policy implication and thus affect policy, but the magnitude of investment and direction of research programs must be governed by expected limitations of policy and other input supply.

Other investment opportunities within the agricultural sector include purchases of additional inputs (i.e., imports of fertilizer, pesticides, machinery) or improved efficiency of resource use. The GOP is implementing a plan to make credit more readily available and has made arrangements for supply of fertilizer for the short run. Improvements in efficiency of resource use (water and land), are being approached through the precision land levelling and the barani programs.

Investments in additional inputs tend to move production along a given production - function curve, while new technology (the product of research), changes the shape of the production - function curve, allowing a greater output from a constant input or a larger increase in output with a given increase in input. Too, changes in technology are effective over a longer period of time than are increased supplies of physical inputs.

While the return on investments in a specific research program cannot be accurately forecast, the U.S. experience has been that investments in agricultural research have an average return of 40-50% per annum. It is reasonable to assume that by concentrating the investment on major problems of important commodities, the expected returns would be much higher. Investment return on physical inputs can seldom approach these levels.

During the Spring of 1972 the USAID Mission in collaboration with the Central Ministry of Agriculture, provincial Departments of Agriculture and provincial Planning Departments carried out an agricultural sector assessment 1/ to identify major issues and constraints to agricultural development and to identify potential project areas for U.S. assistance. The central conclusion of the analysis was that needed future increases in agricultural productivity in Pakistan were possible primarily from two sources:

1/ Pakistan Agriculture Sector Analysis, June 23, 1972 (mimeographed, 41 pages plus annexes).

(a) a stream of new technology emanating from effective agricultural research and

(b) improvement in the efficiency of the use of the most scarce of agriculture's natural resources -- water.

In the listing of the half dozen "major issues and constraints" for agriculture in Pakistan, the need for a stream of new technology -- for more and better research -- was given highest priority, in the virtually unanimous belief that "Agricultural research is the single most important element for long run, sustained agricultural growth in Pakistan."

B. Research Priorities

With a severe shortage of research resources, Pakistan's priority research areas are delimited by the necessity of solving those problems that substantially inhibit the production of sufficient food and fiber to meet the basic biological requirements of her people, and the earning of a major part of the foreign exchange required to offset imports. Pakistan must make full use of importable technology and concentrate her resources on adapting and augmenting that technology to her conditions and needs.

Pakistan must place priority on the solution of problems affecting the cereal and feed grains, cotton, pulses, oilseeds and sugar crops, and on increasing the availability of milk and meat. In a few regions, the agroclimatic conditions are highly favorable for the production of speciality crops, including deciduous fruit and vegetable seed. The limited agricultural capabilities, depressed conditions of the people, and the surplus labor available, make research relating to the production, marketing and processing of these crops of high priority for these areas.

In all these programs the emphasis must be on research to solve immediate problems related to commodity production, marketing or utilization and on increasing efficiency of resource use.

The research priorities supported by this assistance program and the research emphasis in each commodity group are as follows:

Wheat	-	production economics, introduction and development of better varieties, crop nutrition, water management, tillage practices and pest controls;
Forages	-	production economics, introduction of varieties, crop nutrition, and tillage practices;
Livestock	-	production and marketing economics, breed testing, animal nutrition and pest control;
Oilseeds	-	introduction and development of improved varieties, nutrition, water management and pest control;
Sugar Crops	-	production and marketing economics, varietal testing, nutrition, water management, tillage and pest control;
Pulse Crops	-	economics, introduction and development of improved and higher yielding varieties, soil management, pest and disease control;
Water and Soil Management	-	on-farm management of water and soil (including saline and sodic soils), infiltration, conveyance systems, consumptive use, etc.;
Soil Fertility	-	fertilization procedures, including organic and inorganic sources, placement, timing, etc.;
Maize	-	production economics, nutrition, water management, tillage, varietal development and testing for barani areas;
Rice	-	Water management, tillage, pest control and milling;
Sorghum and Millets	-	production economics, varietal testing, nutrition and tillage;
Socio-Economics	-	cropping patterns, use of inputs, marketing of produce, problems of low income farmers, land tenure, rural reconstruction, price policy.
Deciduous Fruits	-	marketing economics, varietal testing and pest control;
Vegetables	-	marketing economics, varietal testing and pest control;
Fish	-	production and marketing (with emphasis on inland fisheries).

III. Project Description and Purpose

The purpose of this research assistance program is to develop Pakistan's institutional research capability to supply the technology needed to deal with production bottlenecks so as to advance its agricultural sector. This is to be done through the development of efficient and effective commodity research programs that address the most important problems associated with the production, marketing and utilization of major agricultural commodities in Pakistan.

The achievement of these objectives will involve the establishment of national goals relevant to agriculture, the translation of these goals into research objectives and the refinement of these objectives into actionable research programs that focus on the important impediments to increased efficiency of production, marketing and utilization of specific commodities or required resources.

The effective development and execution of priority research programs will require additional resources (including commodities, technical assistance and training), and the development of a national research system that effectively concentrates scarce resources on the solution of major problems.

The additional resources will be used to upgrade the capabilities of the provincial research institutions and colleges working on priority research problems and to provide the inputs necessary for new applied agricultural research. The added resources will also be used to establish the National Research Center and to finance equipment, materials and advisory assistance needed for the NRC. A key element in this system will be the development (re-establishment in the case of wheat), of research problem area or commodity committees that will plan, execute and evaluate specific research programs that reflect major objectives and address major problems. The TA, training and commodities provided in this assistance program will center on the effective functioning of these commodity committees and assure the efficient execution of the research programs developed by them.

Expert counsel (see second joint team report) and experience in other countries indicate that a national research center (NRC) is an essential component of an effective research system in Pakistan. The proposed assistance provides for the initial development of a NRC having specified functions that will complement the existing provincial research institutions. The development of NRC as an integral part of the ARC framework will promote the desired movement of ARC from a small advisory and granting role into an active research organization, also considered essential for Pakistan.

Associated objectives include the alleviation of certain institutional impediments, (including more effective personnel management, communication, purchasing capability, utilization of educational institutions, linkage of research and extension, use of multidisciplinary approach, linkage among researchers, and development of professional leadership), which are recognized as deterrents in the present research system.

Proposed is a five year program of financial assistance, academic and practical training for both professionals and subprofessionals, and commodity and equipment support to ARC in development of a National Research Center to carry out key research projects not adequately handled by the Provinces, and through ARC to the various provincial institutes to expand and improve efficiency, quality, and relevance of their research programs. The ARC, through stimulation of cooperative research, will ensure that all of the key elements in solving critical problems are provided, and that unfruitful duplication of efforts is minimized.

Technical committees drawn from the ranks of top professional personnel in various commodity and other research problem areas, will focus on identification of critical problems and establishment of coordinated research programs to overcome constraints that can be dealt with through scientific research (e.g. new and better genetic materials and cultural practices.)

IV. Present Agricultural Research System

A. Institutions

Most of the agricultural research work in Pakistan is sponsored by the 4 provinces and carried out at the headquarters of the research institutes located at Tarnab (NWFP), Lyallpur (Punjab), Quetta (Baluchistan), and Tandojam (Sind). The institutes also have field stations, varying in number from one for Baluchistan, to forty for Punjab, where some field testing is carried out.

The staffs of the institutes are organized along a combination of commodity specialist (usually geneticists), and discipline groups (e.g. soil fertility, entomology, pathology, etc.). The groups of geneticists concentrate on a single commodity, but their interdisciplinary support must be obtained from the staffs of various disciplines. The discipline staffs, usually with one or a few qualified researchers, are responsible for a great many commodities and other projects. Consequently, interdisciplinary support obtained tends to be weak and often uncoordinated. There is little day to day contact between the geneticists (who normally has principal commodity responsibility) and personnel from the other disciplines.

The substations of the institutes are staffed mostly by subprofessionals and visited periodically by scientists from the parent institutes. However, a few of the substations do have professionally trainied researchers assigned on a full time basis.

Funds for operating the Institutes come from provincial budgets, central budget and grants from Agricultural Research Council (ARC), PL-480, etc. Budgets are sub-divided into "development" and "non-development." New programs are funded from the "development" budget for up to 5 years, then from the "non-development" budget, if continued. In the research institutes, salaries of staff (excluding labor) take about 60% of the total budget.

The educational institutes contributing to agricultural research include Agricultural University, Lyallpur (AUL), (formerly WPAU), and the Colleges of Agriculture at Peshawar and Tandojam. They are controlled by their respective provincial Departments of Education. The staff organization is along discipline lines, reflecting their teaching functions. Staff members at AUL are expected to allocate 25% of their time to personal research. Due to the combination of discipline orientation in teaching and small amount of time devoted to research, most research projects involve scientists from only a single discipline.

Most of the provincial budget for the educational institutions is earmarked for pay of staff and other fixed costs. Additional funds, allowing a greater expenditure for equipment and contingencies are solicited from PL-480, ARC or other grant sources.

A few specialty institutes are doing research related to agriculture in Pakistan. These include the water management research at Mona project area under the Water and Power Development Authority, the Cotton Research Institute (Multan), the Commonwealth Institute of Biological Control (Rawalpindi), the Irrigation Research Institute (Lahore), the Forest Research Institute (Peshawar), the Atomic Energy Research Center (Tandojam), and the Radiation Genetics Institute (Lyallpur).

B. Deficiencies in the existing system

a. National Priorities - Some national priorities and targets for agriculture are rather specifically stated, for example, targets for output of wheat and use of fertilizer. However, it does not appear that alternatives are examined systematically, with economic, social and political aspects considered and major biological or former economic constraints to alternatives identified or adequately evaluated in establishing commodity targets. With the lack of definition, research programs often focus on obvious and narrowly defined goals, (such as maximum possible yields per acre under optimum cultural conditions), rather than substantial systems suited to resource and farmer constraints. Poor communication among disciplines, lack of leadership and physical isolation contribute to the difficulty of a researcher obtaining the overview needed to make better decisions on his research time. Organization tends to foster rather than discourage isolation of individual researchers from other disciplines. Most of the commodity research is led by geneticists specialized in that commodity. What should be the cooperating disciplines are organized to deal with resources or special problems (of water, soil fertility, entomology).

Consideration of social and economic impact of a particular research program is constrained by the absence of economists and sociologists on the staffs at the research institutes. Because of the lack of economic input, few experiments are designed to permit economic evaluation of alternatives.

b. Communication - Communication among scientists working on the same or related problems is infrequent. Few institutions have developed effective communication linkages intramurally within the same institution. Communications among institutions and provinces has been minimal, but in the past few months, the ARC has started holding national workshops to promote effective communication among scientists.

Most scientists are essentially isolated from the world scientific community. In only a few cases do linkages exist between researchers in Pakistan and researchers in foreign or multinational institutes, and, these for the most part continue on an informal basis frequently through a resident expatriate. Few scientists have an opportunity to travel abroad and few have access to technical journals. Library facilities at AUL approach adequacy, but other institutions lack minimal libraries.

Communication between research scientists and extension personnel are still limited but increasing in frequency and efficacy. However, none of the research programs include an outreach capability in association with extension workers. An extension "subject matter specailist" as such, is unknown. A few research programs (rice, wheat, maize) have started systematic training of extension personnel through "short course" and "field day" channels.

c. Agroclimatic areas served - The major crops research facilities are at Peshawar, Lyallpur, Quetta, and Tandojam. There is a rice station at Dokri and one near Lahore and a cotton station at Multan. In addition to these major facilities there are several substations. All the major stations and most of the substations are in irrigated areas and the current research is primarily for irrigated agriculture.

Although Pakistan is noted for its irrigated cropland (30 million acres), there are about 17 million cropped acres that are rainfed, about 5 million acres are forested and over 140 million acres are range land or waste land. GOP plans to develop a research program for arid and semi-arid zones with one major station and several substations. The program will emphasize range and flock management reflecting the current view on potential use of those unirrigated areas receiving less than about 10 inches annual precipitation.

The major area, not being served by existing or heretofore planned research facilities, is the rainfed (barani) cropland, mostly in northern Punjab and North-West Frontier. This area of about 7.5 million acres, has from 10 to 40 inches annual rainfall, with a seasonal distribution pattern that should permit much higher crop and forage yields than those currently obtained. The rabi season field crops (October-November planting) cover nearly 6 million acres, while kharif (July planting) crops cover about 1.7 million acres. The major rabi crops are wheat, chickpea, rape, and mustard, and the major kharif crops are pearl millet, maize, sorghum, and mungbeans. Of these crops, only wheat and maize are currently served by a reasonably adequate research program, and even in these programs the emphasis is on irrigated cultivation.

d. Technical Manpower - Technical manpower available in most institutions is inadequate. Within the major research institutes there are about 300 research officers, including 18 with doctorate degrees. Only the AUL approaches a critical mass of qualified researchers, with a total of about 80 doctorates in the staff. Some of the staff having master or bachelor level training have been well trained, but many have received masters degree training that did not adequately prepare them for research positions. The current staff at the major research institutions is shown in the following table:

Current Staff Training Levels at Seven Major Agricultural Research Institutions in Pakistan

Institutions	Senior Staff*	Training Levels M.Sc.	Ph.D.
Agricultural Research Institute, Lyallpur	136	158	16
Agricultural Research Institute, Quetta	23	26	0
Agricultural Research Institute, Tandojam	65	140	1
Agricultural Research Institute, Tarnab	68	45	1
College of Agriculture, Peshawar	37	29	2
College of Agriculture, Tandojam	38	70	3
Agricultural University, Lyallpur	217	222	79
Total	584		

*Class I and II or equivalent, some M.Sc. are junior staff (research assistants).

e. Facilities available - Apart from the research program needed for the barani areas including forage legumes and grasses, and perhaps some specialized facilities (such as a cold water rice nursery in NWFP), the land area available on research stations is generally adequate. Most of the stations lack a comprehensive plan for facility development. Some major stations do not have an assured water supply for research on irrigation crops. Many field research plots are not effectively managed for production of reliable data. In some cases the management failure results from impact of unanticipated factors. Field plots often fail despite a good initial research plan because of lack of control in accordance with the research plans, improper, or non-uniform soil or seed-bed preparation, variation in planting rates, improper application of water and fertilizer, ineffective weed, insect or pest control, etc. While some of these are not within the control of the researcher because of either monetary or administrative restrictions, frequently it is a matter of recognizing the important controllable variables and adequate supervision of field hands. Most institutions have inadequate field equipment and what is available is assigned to individual departments where it is inefficiently used. Maintenance facilities are lacking and essential equipment replacement is not programmed, nor resupplied.

Laboratory facilities are often insufficient to support practical research programs. A few laboratories lack electrical power and other utilities. Needed equipment is frequently inoperative due to lack of small amounts of foreign exchange for parts or of servicing expertise. Rupee availability also hampers maintenance of equipment.

Budgets for agricultural research institutions allow about Rs. 28,000 per senior scientist. About 65% is spent for salaries, the remainder for contingencies, including nearly all labor. Labor is considered cheap, but research supplies and equipment in Pakistan are available only at or above world market prices. The Pakistani scientist thus has the equivalent of about $900 purchasing capability, compared to about $10-15,000 for a U.S. scientist doing similar work. Rupee budgets thus severely limit the effective working of scientists in Pakistan. An efficient budget for a productive scientist in Pakistan would be about Rs. 80-100,000 per annum. (The ICRISAT center at Hyderabad, India, anticipates about $10,000 per scientist)

Foreign exchange availability to research institutes is negligible. The largest institute has about $75 per senior scientist, a smaller one has $11 in FY 73. This does not suffice for even spare parts. The procedure for purchasing FX items is laborious, frequently taking a year or more after the allocation of FX.

These deficiencies, and recommendations for their alleviation, are discussed more fully in Agricultural Research in Pakistan, Report of the Second Joint Pakistan-American Team, of March 1973, pp 1-10, and in Agricultural Research in Pakistan, by ARC and USAID, of February, 1973.

V. Newly Proposed Research System

The additional resources supplied by this loan will be used to develop an operational agricultural research system which effectively translates broad policy guidelines into specific action oriented research programs for priority areas, and executes these priority programs.

A. Development of Priorities and Resource Allocation

The Executive Committee of the ARC, with emphasis on national policy and resources available, will supply guidelines of priorities in agricultural research. These guidelines will be conveyed to the Director General, ARC, and through the Directors to the commodity or research problem area committees.

The Directors of ARC will encourage the formation of multi-disciplinary commodity and research problem area committees, composed of the research scientists working in these areas at the various research institutions. Under the leadership of the appropriate Director, ARC and the national coordinator, these committees will meet at least annually to review progress, identify impediments to program development, and plan their future research program. These plans will include major objectives, approach to be used, resources available in each participating institution, new resources essential for program execution, all budget resources related to the program and recommendations for the removal of factors impeding progress.

The research program plans developed by the commodity committees will be forwarded to the Director of each institution involved in the program and to the Director General, ARC. The Director General, ARC, will forward the plans to the Executive Committee, with his comments.

The Directors of the involved provincial institutions will forward the plans to their provincial research board with their recommendations and comments, including the relationship of the specific program to the institution's overall program, its priority within the institution, the resources available and the additional resources required for program execution.

The provincial research boards will forward the programs to the Director General, ARC, with their approval, approval with modification or disapproval, and if approved, with a statement of provincial resources available for program execution.

The Executive Committee of ARC will assess the programs, considering the comments of the Director General, ARC and of the provincial research boards, the resources available to ARC, and the relationship of the program to national objectives, and recommend specific actions regarding each program to ARC.

Upon approval by the ARC, the Director General, ARC will take appropriate action to assure the orderly flow of resources to participating institutions as approved in the planned programs.

These major programs are expected to continue indefinitely, changing objectives over time to reflect evolution of priority emphasis and technical program demand. The annual workshop will constitute a technical review process and will identify procedural constraints.

B. Role of ARC and the National Research Center (NRC)

The strategy for developing Pakistan's agricultural research capability places the ARC in a demanding but essential role. The ARC, currently housed in a few scattered offices in Karachi, will be moved to Islamabad. It has been reorganized, assigned new responsibilities, and new staff is being appointed. In its new role (closely paralleling that of the Indian Council of Agricultural Research), ARC will become an active research organization.

It is essential that Pakistan have a national research center (NRC) as a focal point for research in Pakistan. The site for the NRC has been selected near Islamabad where 1000 to 1500 acres are under GOP control and available. The NRC will initially focus on a few essential services including:

1. Development of research programs in:

   a. soil management and farming systems for the barani area;

   b. pest management, with emphasis on integrated control of major serious pests and diseases;

   c. sorghum and millets, with emphasis on the barani areas;

   d. dairy management, with emphasis on provision of adequate quantities of nutritious feeds and forages and on identification of principal diseases, parasites and related factors responsible for low fertility and development of control measures;

   e. forage legumes and grasses, with emphasis on increasing productivity in barani areas and in areas with limited irrigation capability;

   f. socio-economic research with emphasis on cropping patterns, use of agricultural inputs, marketing of produce, problems of low income farmers, and public policy.

2. Development of a plant introduction center.

3. Operation of a national professional communications center, including library, reprint service and technical journal editing.

4. Development of a training facility, concentrating on short term practical training for scientists, extension personnel and government officers.

5. Serve as a resource base for scientists deputed to provincial institutions by agreement.

6. Serve as a focal point for research in Pakistan, including an official linkage between Pakistan's research network and the world research community.

In the development of its research programs NRC will fully integrate the capabilities and activities of other central and provincial elements in Pakistan's research network. Thus the involvement of NRC in the wheat research program would be primarily its contribution in rust pathology (program transferred from the Plant Protection Department and substantially strengthened), while the research to serve the barani areas would include major inputs by NRC in the areas of soil management and tillage equipment development, but would rely on the wheat breeding program in provincial institutes if special varieties were needed for the barani area. Similarly, the dairy research program would be linked to the breeding work at Bahadurnagar and the animal nutrition work at AUL. In most instances the capability of provincial institutions will be strengthened to allow them to contribute significantly to a larger integrated program, and the proliferation of institutes will be discouraged.

The ARC will be responsible for the operation of the NRC, and its new offices will be on the NRC campus.

C. Promoting Multidisciplinary Research

Multidisciplinary, problem solving approaches to priority problems will be fostered. The ARC will have a key role in this procedure, linking the technical programs of the several institutions within Pakistan to each other and to the international research community. The sponsorship by ARC of annual commodity or research problem area workshops will play an important part in the effective functioning of these programs as will the selective strengthening of provincial institutions for the execution of priority programs. During the workshops the scientists will review their past year's work, identify major impediments of effective program functioning, plan the research program for the following year, and recommend actions by the ARC and institution Directors to overcome impediments.

D. Developing Linkages Among Researchers

The linkages formed among institutions within Pakistan and with the international research community will promote the import of relevant technology and its adaptation to Pakistan with maximum efficiency. The ARC will become a formal channel through which the Pakistani scientists can develop beneficial linkages with colleagues in other countries and international institutes. Unessential duplication of efforts within Pakistan will tend to be minimized as work loads increase and mutual trust among researchers develops. The role of foreign advisors in initiating these linkages is crucial to the process.

A key element of these cooperative research programs, which must have time to evolve, is the development of interdependent research networks wherein individual institutions or provinces recognize that they can meet their objectives more effectively by sharing a total research effort with other institutions, than by assuming that their institution must supply answers to all aspects of a problem.

E. Developing Professional Leadership

Leadership development among working groups of scientists will be promoted by having ARC employ well qualified scientists to serve as national program leaders. These leaders, whether based in Islamabad or at a provincial institution, will work throughout Pakistan to facilitate the work of their fellow scientists, encourage exchange of information and materials, arrange for workshops, insure effective linkages with the international community, and assist the provincial scientists in solving their operational problems. In most instances the development of this leadership capability will require the assistance of a foreign advisor.

F. Improving Facilities

Facilities, including budgets for both Rupee and FX commodities and services, will be strengthened in the research institutions through the national and regional priority programs. Essential items and services needed at each institution to execute a portion of a total program will be identified during the research planning phase, and ARC will augment budgets (Rupee and FX), as required for the efficient execution of the major programs.

Equipment and supplies (FX) made available to provincial institutions will be primarily for support of specific major research programs which have been selected for priority action. During the first two years of the 5-year program, in most instances the first priority will be for field equipment needed for the effective functioning of the research station (tractors, tillage implements, planters, threshers, etc.).

The ARC will develop a FX commodity purchasing cell, expected to function beyond the life of the project. The provincial institutes will be able to utilize their current procedures for purchasing FX commodities with their own funds, or if they choose, can use the ARC procurement capability. It is expected that ARC will become the primary procurement source for FX commodities required by the agricultural research community in Pakistan.

X G. Upgrading Staff Competence

The competence of scientific staffs will be enhanced by the provision of practical and degree training by ARC. Trainees will be nominated by the Directors of institutions to ARC. ARC will determine which trainees are of highest priority and arrange for their training within Pakistan, at international institutes, in 941 category countries, or in the U.S., as appropriate. ARC will thus sponsor a limited number of degree and non-degree training programs each year. The priority for training will be in direct support of the national and regional research programs. Roughly half the supported doctoral candidate training will be done at AUL, the remainder at U.S. universities or international institutes. It is anticipated that master's degree candidates supported under the program will go mainly to AUL and American University, Beirut, but exceptions will be made when justified. International institutes are expected to provide a major share of the practical training done outside Pakistan. Intensive practical training courses within Pakistan will also be organized, drawing upon internal and external expertise.

H. Foreign Technical Assistance

Technical assistance will be supplied through ARC by contractual arrangements with international institutes, 941 category country sources, USDA and U.S. Universities. In most instances the foreign advisors will support major national or regional research programs. In exceptional circumstances, technical assistance may be supplied to a research program involving a single province or institution, if the research program is of highest priority to that province (i.e. deciduous fruit production-marketing in NWFP), or when the supply of technical assistance to a single institution would lead to a substantial contribution by that institution to Pakistan's current or future research capability (i.e. animal or human nutrition at AUL).

Most foreign technicians will thus work throughout Pakistan, contributing know-how, assisting in the development of major research programs and fostering the development of research leadership among Pakistani scientists.

I. Linkage of Research and Extension

Linkage of the research programs to the extension service and directly to the farmers will be facilitated by including an "outreach" capability in each major program. The equivalent of "subject matter specialists" in each program will be responsible for developing communication channels, including short courses, brochures and field days, and be responsible for the on-farm testing program. Most of the research scientists would be expected to participate in the training programs.

Direct farmer-scientist communication will be fostered through a substantial program of "off-station" testing. These tests, involving extension and research personnel, will be the final step before releasing a technology innovation, and will serve to keep the scientists and extension workers aware of the daily problems and decision factors affecting the farmers.

J. Fuller Utilization of Research Capability Within Educational Institutions

Educational institutions, including AUL and the Colleges of Agriculture at Tandojam and Peshawar, currently play a peripheral role in priority research, yet AUL has the greatest concentration of research talent in Pakistan. Educational institution development is not a major objective of this program, but the talent in these institutions will be actively encouraged to participate in priority research programs, and their capability to do important research will be strengthened as for research institutes.

K. Increasing Institutional Effectiveness

Major elements of the development strategy also include the alleviation of important institutional impediments (including adoption of more effective personnel management procedures where possible, the substantial strengthening of communication capabilities, the development of a more efficient FX commodity procurement system), the development of research networks within Pakistan, the incorporation of selected educational institutions into the mainstream of research, the development of effective linkages between research and extension, and the increased funding of research.

1. Personnel management within the ARC-NRC will be improved by adopting personnel evaluation and promotion procedures designed to reward excellence of performance. It has been agreed informally with Min Ag that this will be attempted with ARC remaining as a line organization within the Ministry of Agriculture. A pool of unassigned, vacant positions at each of the higher classifications will be maintained, thus a scientist deserving promotion will not have to await a vacancy at the higher level. The use of approved research projects will allow scientists to be evaluated annually on the basis of how effectively they have executed an approved approach to a research problem.

The NRC will begin operations without departmentalization and will establish a precedence of having several officers of equal rank working on a single program. This is possible, but not practiced, under the current system. The Ministry of Agriculture has suggested that if these operating guidelines are found insufficient for effective personnel management, the ARC will be given semi-autonomous status.

The current personnel hiring procedures (rules of recruitment) used by the ARC, wherein all positions are filled by open recruitment, appear satisfactory.

2. Communication among scientists working on the same or related problems will be substantially strengthened through the national research programs. In addition, ARC will develop a technical literature reprint service to keep the scientists abreast of the world literature. ARC will import journals, send copies of tables of contents of a few journals to each department head, his staff will select the articles needed in their work, these will be reproduced by ARC and sent to the department. The scientists will thus have at least functional access to 5-10 of the most relevant international journals in their fields, with a minimum FX cost.

Communication will also be fostered by the regular publication of at least one reputable technical journal for agricultural research in Pakistan. If necessary, the ARC will take leadership in the publication of this journal by supplying a chief editor and funds for publication. The development of professional societies and eventually publication of additonal journals, will also be encouraged by ARC.

3. Commodity procurement capability will be strengthened by the supply of both FX funds and the development of a procurement system. ARC will establish a small cell for procurement of offshore commodities to support research. A foreign technical consultant will be supplied to assist the procurement cell in developing procedures and learning the relevant commodity market. Major commodities needed to support priority research programs and to develop basic central service facilities in major stations will be requested from the ARC, with justification for each item. Decision on purchasing will rest with ARC.

To alleviate the problem of supply of spare parts and low cost research commodities the ARC will establish a FX "line of credit" for each major institution. The Director of the institution will be able to order items (below a specified amount, probably $500) through the ARC, at his discretion, against his institution's line of credit.

VI. Project Costs

The total cost of the 5-year program is estimated at $19.6 million of which $9.6 million is for foreign exchange costs and $10.0 million is for local currency costs. These resources will finance the commodity, technical assistance and training requirements needed to support the 5-year program.

A breakdown of total costs of commodities, technical assistance and training, by institution are set forth in Table 2, and their derivations shown in appendices I-VIII.

A. Foreign Exchange Costs

Of the $9.6 million, 30% is for commodities, 42% for technical assistance and 28% for training.

Table 3 below shows the breakdown of foreign exchange requirements over the 5-year period.

Table 2 - Estimated Cost Distribution of Commodity, Technical Assistance, and Training costs, by Institution (in U.S. $1,000 equivalent)

INSTITUTION 1/	COMMODITIES 2/		TECH. ASST. 2/		TRAINING 2/		TOTAL	
	FX	LC	FX	LC	FX	LC	FX	LC
Agr. Res. Institute, Lyallpur	245	700	800	240	553	165	1598	1105
Agr. Res. Institute, Tandojam	225	700	550	165	392	165	1167	1030
Agr. Res. Institute, Tarnab	175	700	750	225	427	165	1352	1090
Agr. Res. Institute, Quetta	195	350	250	75	154	83	599	508
Nat. Res. Cntr. Islamabad	1700	4310 3/	800	240	-	-	2500	4550
Livestock Res. Institute, Bahadurnagar	75	300	150	45	56	-	281	345
Agr. University, Lyallpur	50	400	350	120	588	-	988	520
College of Agr. Tandojam	25	100	-	-	196	83	221	183
College of Agr. Peshawar	25	100	-	-	245	83	270	183
Others 4/	275	390	250	60	119	84	644	534
TOTALS	2990	8050	3900	1170	2730	828	9620	10048

1. Amounts are for planning purposes only and do not constitute commitment to individual institutions.
2. Approximate, based on percentage of total.
3. Includes construction costs.
4. Includes Plant Protection Department, Min. of Agriculture, Pakistan Forest Research Institute, Veterinary Research Institute-Lahore, and other research entities.

Table 3 . Foreign Exchange Costs, by major category.

Component	Year 1	2	3	4	5	Total
			(in $1,000)			
Commodities						
Provincial stations	280	310	240	230	230	1290
National Research Center	400	450	450	200	200	1700
Subtotal	(680)	(760)	(690)	(430)	(430)	(2990)
Training						
Practical	210	280	280	140	140	1050
Degree	49	154	259	364	854	1680
Subtotal	(259)	(434)	(539)	(504)	(994)	(2730)
Technical Assistance	375	975	1000	900	650	3900
Total	1314	2169	2229	1834	2074	9620

1. Commodities

Foreign exchange costs for major commodities to be supplied to provincial research institutes were developed by considering the types of research needed in each major institution as that institution's expected contribution to the priority program areas, the types of equipment needed to execute those programs and approximate costs of the specific equipment needed in each institution to upgrade its capability during the first two years of project operation. In most instances the first demand is for basic services equipment essential for the effective functioning of several programs. During the last 3 years of the project, the equipment needed will be more directly associated with specific research programs (i.e., more specialized), and for expansion and replacement of basic services equipment. The level of demand for commodities in each institution during the last 3 years is expected to be considerably higher than will be supplied. The project will supply a level of FX commodities that can be expected to be continued by GOP beyond the project period.

Foreign exchange costs for minor commodities, supplies, materials and publications to be supplied to provincial institutions to facilitate research programs were estimated by considering the current level of FX available to the entity, the involvement of the institution in major programs and by a somewhat arbitrary assignment of a minor commodity level to each institution. (See Section IX on Implementation Procedures).

An estimate of commodity requirements by institutions over the 5-year program is set forth in table 4 below.

Table 4 . Foreign Exchange Costs of Commodities by Institution

Institution	Year 1	2	3	4	5	Total
			(In $1, 000)			
ARI-Lyallpur	45	55	55	45	45	245
ARI-Tandojam	65	55	35	35	35	225
ARI-Tarnab	35	35	25	35	45	175
ARI-Quetta	55	65	25	25	25	195
Agric. Univ. Lyallpur	10	10	10	10	10	50
College Agric. -Peshawar	5	5	5	5	5	25
College Agric. -Tandojam	5	5	5	5	5	25
Livestock R.I. Bahadurnagar	15	15	15	15	15	75
Others	45	65	60	55	50	275
National Research Center	400	450	450	200	200	1700
Totals	680	760	685	430	435	2990

1. Amounts are for planning purposes only and do not constitute commitment to individual institutions.

The commodity requirements for the NRC are estimated at $1.7 million as follows:

National Research Center

Commodities	Year	1	2	3	4	5	Total
				(In $1,000)			
Farm equip.		250	100	100			
Mobility equip.		150		50			
Glasshouses			100	100	200	299	
Laboratory equip.			100	100			
Bldg. constr.			150	100			
Total		400	450	450	200	200	1700

These FX costs were estimated by: developing an equipment list considered essential for a research station having about 1000 acres and the types of research programs specified; estimating the numbers and specialists of scientists needed, then assuming $10,000 for each laboratory; assuming a continuing demand during years 3-5 for FX commodities at a level of $5,000 per year per senior scientist; and by including estimated costs of imported air conditioning equipment and glasshouses.

2. Technical Assistance

The foreign exchange costs of technical assistance were developed by estimating the man years of TA required in support of major research programs and for the continued development of AUL in specific areas; then by assuming a FX cost of $50,000 per man year. The tabulation below shows the man-year requirements and estimated costs of technical assistance.

Technical Assistance

Year	1	2	3	4	5	Total
Man years	7.5	19.5	20	18	13	78
Costs						
(FX, $000)[1]	375	975	1000	900	650	3900
(LC, Rs.000)[2]	1130	2920	3000	2700	1950	11700

1. At $50,000 per man year
2. At Rs. 150,000

3. Training

The foreign exchange costs of training were estimated by determining the training required in each major institution in support of priority programs, by assuming that all practical training must be done outside Pakistan at a cost of $7,000 per man and by assuming that about half of the doctoral training would be done outside Pakistan at a cost of $28,000 per candidate. No FX costs are programmed for Masters level training, which will be done within Pakistan (and at American University, Beirut, under an existing grant program).

Table 5 shows the foreign exchange requirements for training (and local costs) as indicated.

Table 5 Training Costs

Program	Year	1	2	3	4	5	Total
Practical ($000)[1]		210	280	280	140	140	1050
Masters (Rs. 000)[2]		256	552	592	592	738	2730
Doctorate ($000)[3]		49	154	259	364	854[5]	1680
(Rs. 000)[2]		120	280	440	600	960	2400
Transportation (Rs. 000)[4]		555	825	825	525	420	3150
Total ($000)		259	434	539	504	994	2730
(Rs. 000)		931	1657	1857	1717	2118	8280

1. At $7,000 per trainee
2. At Rs. 5,000 per trainee per year, plus Rs. 3,000 per trainee per year for non-Punjab trainees.
3. At $7,000 per trainee per year
4. At Rs. 15,000 per trainee
5. All costs to be incurred beyond year 5 are included in year 5.

B. Local Currency Costs

Rupee costs, while not financed by this dollar loan, will form an indispensible part of the total program of increasing research capability. The current budget level in relevant research institutions is too low to permit a positive return from most research programs. A few programs, although funded far below optimum return level, produce technology to offset the negative expenditures on other programs.

The objective in providing additive Rupee support to specific priority programs is to assure the efficient functioning of those programs, but the results obtained are also expected to demonstrate to decision makers that inadequately funded research programs are a poor investment while appropriately funded and efficiently executed research programs have an extremely high investment return rate.

Research institution directors are aware of the inadequacy of Rupee funds. Their judgement, which we share, is that the major insititutions must have and could effectively use a 10-15% per annum increase in operating funds This increase will result in an approximate doubling of operating funds at the end of the project period, moving from Rs. 27,000 per scientist man year to about Rs. 50,000. A more rapid escalation of research funds probably would not be utilized effectively.

The local currency requirements over the 5-year period by major category are set forth in Table 6 below.

Table 6 . Local Currency Costs, by Major Category
(In Rs. 1,000)

Component	Year 1	2	3	4	5	Total
Priority Research Programs in existing institutions	3300	5000	7000	9600	12500	37400
Operation of NRC	500	2000	3000	3500	4000	13000
Training	931	1657	1857	1717	2118	8280
Technical Assistance Support	1130	2920	3000	2700	1950	11700
NRC Construction	3400	2500	2400	300		8600
ARC-NRC staff housing	7000	7000	7500			21500
(Rs. 000)	16261	21077	24757	17817	20568	100480
(US $000 equivalent)	1626	2107	2475	1781	2056	10048

The estimates for total Rupee requirements over the project period include assumed increases in provincial research allocations at about 5% per annum, the increases in ARC fund availability allow:

a. The equivalent of 10% per annum increase in operational budgets of major provincial institutes;

b. specified allocation of approximately 10% of the current operating budget of AUL and the colleges of agriculture for research at these institutions plus a research budget increase of 10% per annum;

c. funds for the operation of a national research center, calculated at Rs. 100,000 per scientist man year;

d. funds for support of in-country training;

e. funds for support of local costs of TA;

f. funds for the building of NRC facilities;

g. funds for provision of housing for ARC-NRC staff.

VII. Financial Plan

The total cost of the expanded Agricultural Research Program is estimated at $19.6 million, equally divided between foreign exchange and local currency costs. Table 7 below sets forth the source of funds by foreign exchange and local currency.

The foreign exchange cost estimated at $9.6 million will be financed by a $7.6 million AID Development Loan, an AID Development Grant of up to $300,000 per annum for a five year period, or $1.5 million, and a $520,000 five year grant input from the Government of Pakistan (GOP). The AID Development Grant is subject to annual AID appropriation.

In the course of early negotiations, the GOP urged that in expanding the Agricultural Research Program that AID not reduce its annual grant input for agricultural research becuase this would make a development loan less attractive. The GOP further emphasized that the grant input would be used to offset the high costs of U.S. technical advisors (about $50,000 per man year) and the high costs of financing U.S. intermediaries (including related overhead).

The AID Development Grant would be applied to the technical assistance category under which the technical assistance would be financed on a prorata basis allocated 60% to the AID Development Loan and 40% to the AID Development Grant. A procedure will be set up under a Federal Reserve Bank Letter of Credit under which technical assistance expenditures (grant and loan) will be financed. The AID Controller will have responsibility for distributing the expenditures in the above ratio to the loan and grant accordingly.

The local currency requirements are estimated at about 100,000,000 rupees (U.S. $10.0 million) of which about 3/4 will be funded under a Mondale Grant involving PL-480 generated, U.S. owned rupees and the remainder from GOP grants. The Mondale Grant will primarily cover the costs of NRC construction, ARC-NRC staff housing and a portion of the amount for direct support for research programs. The 73 million rupee grant will be made available to ARC under ProAg amendments. The allocation of the Mondale Rupee Grant will require consultation with the Agriculture Committees of the Congress and review and formal allocation by OMB, with clearance from other agencies.

Table 7 : SOURCE OF FUNDS: Foreign Exchange and Local Currency

(in U.S. $1,000 and Rs. 1,000)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
			(in U.S. $1,000)			
Foreign Exchange Source						
AID Development Loan	1014	1849	1879	1384	1474	7600
AID Development Grant 1/	300	300	300	300	300	1500
GOP Grant	0	20	50	150	300	520
TOTAL	1314	2169	2229	1834	2074	9620

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
			(in Rs. 1,000)			
Local Currency Source						
Mondale Grant	15,261	19,077	20,757	9,817	8,568	73,480
GOP Grant	1,000	2,000	4,000	8,000	12,000	27,000
TOTAL (Rs. 1,000)	16,261	21,077	24,757	17,817	20,568	100,480
(U.S. $1,000) 2/	1,626	2,107	2,475	1,781	2,056	10,048

1/ Subject to annual AID appropriations.

2/ Rs. 10 = U.S. $1

VIII. Economic and Social Impact of Project

The proposed project will increase the amount of local currency resources available to the national research system from Rs. 15.5 million in 1972 to Rs. 35-40 million in the last year of operation. In addition, by the end of the period, institutions will be benefitting from substantially improved facilities provided by dollar financed imports, and from Mondale rupee financed goods and services obtained locally. Most important, the system will benefit from better trained and more experienced staff, working under streamlined administrative procedures with continuing coordination and linkage among institutes and between researchers, extension workers and farmers. Further, through improved internal training programs and facilities, and linkages with foreign research and educational centers, the research system should have achieved a capability for self-sustaining growth These improvements will continue to yield benefits in removing technological constraints to adequate rates of agricultural growth as well as improvement in the balance of future growth among socio-economic groups in the population, among commodities and among areas of the country.

Analyses of returns to invement in agricultural research in the U.S. reveal very high returns to some projects and a high overall benefits to cost ratio, but some projects provide no returns. Returns to resources to be invested under this project should be higher than typically true in the U.S., since the resources will be applied to only high priority programs. In addition, much of the basic investment already exists and the need is for relatively small amounts of incremental inputs, strategically applied, to make the entire system function effectively. Further, many relatively simple problems heretofore neglected should have unusually large and predictable results.

The benefits already obtained from modest investments in introduction, testing, adaptation and related research on higher yielding varieties of wheat and rice are indicative of the potential. Wheat yields have increased by almost 50% or 4 maunds per acre over the total area and more on the irrigated lands, with the dissemination of higher yielding varieties and fertilizer. Admitting that increased fertilizer and water account for part of the gain, still the introduction, testing and adaptation of improved seed, and some related research, should be credited with at least one maund of increase in yield per acre. Similarly rice yields have increased by over 50% (over 6 maunds per acre). Thus, conservatively, on the 18 million acres in wheat and rice, the returns to investment in research would be about Rs. 450 million per year. This is 30 times the total current annual Pakistan budget for agricultural research. Of course the possibilities for such simple adoptions are limited and their yields can be sustained only by continuing research on new problems (e.g., new strains of rust) as they emerge.

Maize and sorghum have shown increases of about 1.5 maunds per acre over the past decade, but still have yields of only 10-20% of U.S. levels. Using the U.S. level as a possible goal in yields, there is scope for improvement of 5 to 10 fold in these and in many other crops as well as in livestock production.

It is reasonable to expect the identification and testing of forages grasses and legumes, and simple improvements in management would make possible a several fold increase in yields under rainfed conditions. A rate of adoption sufficient to increase forage yields by 5% - 10% by 1978-80 seems possible. Since little input other than labor is required, and labor has little alternative employment, the returns could be attributed largely to research and extension efforts. An increase of 5% in milk production alone would mean an increase of about 350,000 M.T. worth Rs. 200 million per year. Programs which are in the formative stage to improve forage and to export beef to Iran and other nearby countries, could conservatively result in the export of 50,000 beef carcasses a year by the end of this period. This should have a foreign exchange value of at least $5 million per year.

Significant increases in yields of maize, sorghum and pulses should be forthcoming. A yield increase of only 0.1 maund per acre on coarse grains and pulses would have a value of Rs. 15-20 million per year. Ten times this is still a conservative goal as adoption begins to accelerate. Vegetable oil for which the country would otherwise be spending over U.S. $50 million per year (on 100,000 tons) by mid 1970's, could be produced locally with adequate research. Given the relatively modest fertilizer needs of oilseeds and pulses, a fairly large share of returns for these should properly be attributed to research.

In summary, the returns as measured in increased output over the period of the project after adjusting for other inputs, should be several times the total resources to be invested and the improvement in balance of trade position will amply justify the foreign exchange commitment.

Expected Social Impact

Social impacts of the proposed program are less easily estimated than economic impact. However, the program, aimed at restoring balance in research allocation among different problem areas, will help relatively more those socio-economic groups which to now have least benefited from improved technology. For the most part these include smaller farm units and areas with poorer quality unirrigated land, where personal incomes are lowest. Improved practices on crops, feed and forage and livestock production, which also have been neglected, will require substantially increased labor inputs. Shift of even small tracts from migratory uncontrolled grazing to improved, well managed, forage with proper harvesting and good livestock care would involve a manifold increase in

labor per unit of area. (In the AMUL Dairy Cooperative in India, where considerable progress has been made on improved feeding and productivity of milking buffalo, the average number of milking buffalo per family is between one and two. There are over 100,000 producers in the cooperatives. Most of the cattle are tended by women with in most cases, income and a suitable alternative to field work provided for one woman in the family.)

Employment also will be generated off the farm as agricultural output is increased as has occurred with HYV of wheat and rice. Many very low income farm operators families, especially in barani areas will benefit directly from technology suitable to the crops they raise and from the introduction of new crops and rotations which will substantially increase yields and farm income. Considering the current output per worker in the barani areas achievement of self-sufficiency in cereals and oilseeds through expanded barani production should provide well over a million additional jobs on the farm and provide an increase in income about Rs. one million after adjustment for costs of fertilizer. This assumes an increase of 1.2 million M.T. of wheat and 300,000 tons of oilseeds.

A plausible rate of increase in pulses, in dairy and other livestock production which is labor intensive, could easily add another million jobs on the farm, indicating two million jobs as a reasonable goal for increase in on-farm employment. This would generate a significant amount of off-farm employment in industry, trade and services. Jerry Eckert, et al in An Employment Strategy for Rural Areas of Pakistan[1/] estimated a current level of 750,000 rural unemployed and 2,250,000 rural under-employed. Thus developments as suggested above could go far in providing much more adequate rural employment opportunities. Investment in research would be needed, of course, but research must provide the technical basis for these developments.

1/ Islamabad, May 1973 pp 1-2.

IX. Implementation Procedures

A. Decision process and procedures for approving priority research.

1. Priority establishment among commodities and/or research problem areas and guidelines for research program formulation will be the responsibility of the Executive Committee of ARC.

2. The development of research programs in specific commodity or research problem areas will be the responsibility of the appropriate Director of ARC, in conjunction with the national coordinator and the scientists involved with research in these areas. (Commodity Committees).

3. Technical programs, depicting the research objectives, approaches and resources required in each involved institution will be forwarded by the commodity committee to the directors of the involved institutions and to the D.G., ARC.

4. The directors of provincial institutions will forward the technical programs to their respective provincial research boards with their recommendations and comments, including the relationship of the program to the institution's overall program, its priority, the resources available, and the additional resources required for program execution.

   The D.G., ARC will forward the technical programs to the Executive Committee of ARC with his comments and recommendations.

5. The provincial research boards will forward the programs to the Executive Committee, ARC, with their recommendations for approval, approval with modification, or disapproval, and if approved with a statement of the provincial resources available for program execution.

6. The Executive Committee, ARC will assess the programs, considering the comments of the D.G., ARC, and of the provincial boards, the resources available to ARC, the relationship of the program to national priority objectives, and recommend specific actions to ARC.

7. Upon approval by ARC, the D.G., ARC will take appropriate action to assure the orderly flow of resources to the program as approved by ARC.

B. Commodity procurement

Major commodities - Considering the priority research programs at each institution as approved by ARC, the D.G., ARC - and at least two Directors of ARC will consider requests for specific major commodities with justification as forwarded by the Directors of the involved institutions. Approved requests will be forwarded to the ARC procurement office for action (see below). Upon receipt, the commodities will become the property of the recipient institutions, or remain ARC property as otherwise agreed by ARC and the requesting institution.

Minor commodities for provincial institutions - upon request by the Director of the specified institutions, ARC will procure small items of equipment, supplies and publications up to the established dollar limit per annum for that institution. No item costing more than $500 will be considered under this procedure. The eligible institutions and the limits of expenditure per annum are:

A.R.I. Lyallpur, $5,000; A.R.I., Tandojam, $5,000; A.R.I., Quetta, $5,000; A.R.I., Tarnab, $5,000; College of Agriculture, Tandojam, $5,000; College of Agriculture, Peshawar, $5,000; College of Animal Husbandry, Lahore, $5,000; Agricultural University, Lyallpur, $10,000; Forestry Research Institute, Peshawar, $3,000; Veterinary Research Institute, Quetta, $2,000; Veterinary Research Institute, Lahore, $5,000; Veterinary Research Institute, Peshawar, $2,000; Livestock Research Institute, Bahadurnagar, $3,000.

The mecahnics of procuring both major and minor commodities are as follows:

a. ARC will contract for the services of an experienced procurement officer (probably from USDA-ARS), to assist in writing specifications and establishing acceptable procurement procedures.

b. ARC will establish a cell for procurement of off-shore commodities consisting of one procurement officer and essential clerical personnel.

c. The Director General of ARC will be appointed by GOP as the Borrower's Authorized Representative (BAR).

d. For each year the BAR will request AID/W to open a letter of commitment in a U.S. bank to cover costs of commodities expected to be purchased during that year. For the first year this will be approximately $1,221,000. Letters of commitment will be requested in each fiscal year in time to allow orderly scheduling of procurement.

e. Using AID Capital Project Guidelines procurement procedures and assisted by the advisor, the procurement officer will arrange for the purchase and shipment of commodities.

f. Purchase orders will be issued to the supplier, and Letters of Credit opened on U.S. bank to pay for purchases.

g. The procurement officer will arrange for clearing the commodities and onward shipment to the end user, who will receipt delivery.

h. All items will enter Pakistan duty free and upon delivery will become the property of the end user (provincial institute) or ARC, as appropriate.

C. Technical Assistance

Recommendations on the form and amount of TA to be supplied to a specific program will be included in the programs as developed by the commodity committees and decisions on TA will be made as for other resource allocation, by the ARC.

Considering the priority programs, the DG, ARC will determine the source of TA to be used, and in those instances wherein TA is to be funded through this loan, will arrange contracts with international institutions, USDA, U.S. Universities or category 941 countries to supply the required TA. These contracts will be reviewed by AID before execution to assure compliance with AID regulations. Professional and personal logistical support for TA personnel will be supplied from the Mondale Grant.

D. Training

Recommendations on the form and amount of training to be supplied to a specific institution in support of a given commodity or research problem area will be made by the commodity committees as are other resource requirements.

Considering the training required for a specific program and the place of that training in the institution's development, the Director of the institution will apply for training through the D.G., ARC. An annual training schedule by type of program is set forth below as Table 8 .

Table 8 Training Schedule

Trainees departing by year:

Program	Year 1	2	3	4	5	Total
			(by number)			
Practical	30	40	40	20	20	170
Masters						
AUL 1/	10	15	15	15	5	60
AUB 2/	25	25	25	25	25	125
Doctorate						
AUL	15	20	20	20	0	75
USA 3/	7	15	15	15	8	60

1/ Agricultural University, Lyallpur

2/ American University, Beirut.

3/ Includes international institutes.

The D.G., at least two Directors of ARC, and a representative of USAID, will meet as needed but not less than every six months, to consider training applications. Training needed for effective functioning of national, regional or provincial research programs, and supporting the development of the institution, will receive priority. The principal officer of each institution will be notified of the approved training applications relating to his institution and will be responsible for meeting all clearance formalities.

International Travel for approved trainees (except AUB), will be paid by ARC, restricted to round trip economy fare, (usually by most direct route).

Practical training, including observation, on-the-job and specialized training, will be arranged at international, U.S. or third country institutions as required.

Training of master's degree candidates will be sponsored at Agricultural University, Lyallpur (AUL) and at American University, Beirut (AUB), when possible. Training of doctoral level candidates will be sponsored at AUL, AUB, or when required, at U.S. universities. Training at U.S. universities will be limited to those training fields unavailable at AUL or in consideration of other compelling reasons. It is assumed that about half the doctoral level training required can be done at AUL.

To encourage research institutions to train their staff, ARC will endeavor to assist selected institutions defray part of the costs associated with training sponsored by ARC. For each regular staff member receiving full time training at other than his employing institution, the ARC will grant the employing institution Rs. 5,000 per annum, plus capitation fees charged by AUL to all non-residents of Punjab province. Grants for each student will be limited to two years for a master's degree candidate and to four years for a doctoral candidate.

E. Role of intermediaries and Source of Procurement

The major intermediary functions will be the supply of technical personnel and training. In a few instances, commodities may also be supplied through the intermediary. Services of intermediaries, including USDA, will be procured by contracts arranged between the intermediary and the Agricultural Research Council, Ministry of Agriculture, GOP, with appropriate review, approval and liaison by AID.

The supply of technical assistance in the form of program advisors/leaders will be a major intermediary role. These advisors will work primarily as counterparts to the national coordinators of the major research programs, assisting the coordinators and other scientists in planning and executing the programs.

The estimated man years of technical assistance required, its timing and sources are presented in Table 9 below. About 75 percent of the TA will be procured from the U.S., the remainder from international institutes and other institutions located in 941 category countries.

Training - Most of the practical training and some of the degree training will be done under contract between ARC and the international research institutes (CIMMYT, IRRI, etc.), located in 941 category countries. These institutes have ongoing practical training programs as well as limited arrangements for degree training in cooperation with U.S. Universities. The training required in the U.S., including university and federal and state experiment stations, will be arranged by AID on the basis of established procedures with the International Training Office, Foreign Development Division, ERS, USDA. About 60 percent of the training costs will be incurred in the U.S.

Commodities - Most of the commodities supplied will be items of basic equipment and will be purchased by ARC from U.S. suppliers. A few commodities, including experimental rice mills, rice threshers, small tractors, and implements for testing, are unavailable in the U.S. and will be purchased from 941 category countries. About 90 percent of the commodities are expected to be purchased in the U.S.

The GOP foreign exchange grant will be applied primarily to commodity imports which will not be eligible for financing under the AID loan (e.g. non-code 941 source). AID will require that the GOP apply its foreign exchange first to the commodity imports to permit a sharing which will build up in later years whereby the GOP share will increase and be carried on after the AID financed program is completed.

TABLE 9 - ESTIMATES OF TECHNICAL ASSISTANCE REQUIRED, TALENT, MAN YEARS, SCHEDULE AND SOURCE

Program	Talent	Man Years	Schedule: Year 1	Year 2	Year 3	Year 4	Year 5	Possible Source
Commodity Procurement		3						USDA
Wheat	Pathology or Agronomy	4						CIMMYT
Sugarcane	Agronomy	3						USDA
Sugarbeets	Agronomy	3						USDA
Research Station Development	Engineer and short-term Architect	4						
Production Economics	Economics	4						USDA
Production Systems	Agronomy, Engineering	8						ICRISAT
Pulses	Pathology and Agronomy	4						USDA
Sorghum-Millets	Agronomy, Breeding	8						ICRISAT
Oilseeds	Agronomy	4						USDA
Forage grasses and legumes	Agrostology	16						USDA
	Agronomy							
	Pathology							
	Microbiology							
AKC Development	Research Organization	3						AID/DH
Dairy-AUL	Herd Management	2						Cornell
Fodder-AUL	Dairy Nutrition	2						Cornell
Nutrition-AUL	Human Nutrition	2						Kansas
Extension Methods-AUL	Methods Evaluation	1						Kansas
Unforeseen and short-term	Various	7						Various
Total		78						

F. Project Implementation Committee

In order to expedite program development during the early life of the project, and recognizing that most of the commodities supplied during the first two years of the project will provide basic facilities, a project implementation committee as described below will substitute for the project approval and commodity allocation process as outlined earlier. The functions of the Project Implementation Committee are to be absorbed in the decision process as outlined above as rapidly as possible by the commodity or research problem area committees.

The major function of this Committee is to follow closely progress in the early phases of project implementation to ensure that operational plans and procedures are developed in a timely and coordinated fashion and that they meet GOP and AID quality standards and administrative requirements. The Committee will review the commodity committee plans, recommendations and plans for equipment and facilities to be provided for the NRC and the various provincial institutions as these plans relate to the AID financed research program.

The Committee will be composed of the officials of the Government of Pakistan, including the Director General of ARC, and the Financial Advisor to the Ministry of Agriculture, and USAID including the Assistant Director for Agriculture, and the Agricultural Research Advisor.

The Committee shall be organized and functioning within 30 days of loan authorization in order to deal with problems and issues prior to loan signature and will function during at least the first 18 to 24 months of project operation.

The scope and procedures governing the Project Implementation Committee will be reflected in the first implementation letter.

X. Evaluation System

A. Annual Workshop

Evaluation of specific commodity or research problem area programs will be done by the participating scientists in an annual workshop. The progress of the technical program and the technical and procedural problems encountered will be succinctly stated, with suggestions for solutions. The evaluation will include but not be limited to a consideration of:

a. The major problems related to a commodity or research problem area, and the extent to which research can help solve these problems;

b. the extent to which these major problems are reflected in research programs;

c. the adequacy of resources allocated to the solution of these problems, including field and laboratory facilities, training, communication capability, manpower, etc.

d. the adequacy of procedures to effectively mobilize available resources;

A report will be completed during the workshop and sent to the Director General, ARC and to the Assistant Director, Agricultural Program, USAID. The report will be signed by the appropriate Director, ARC and by the program coordinator.

B. Evaluation Panel

Evaluation of the overall research program will occur annually, beginning about 18 months after loan agreement. The Director General and Directors, ARC, one representative of AID/W, one representative of the international research community, and two representatives of USAID will form the evaluation panel. The Director General, ARC will chair the panel and be responsible for preparing a report of progress, problems encountered, remedial steps to be taken, and when appropriate, recommendations for action by Ministry of Agriculture or other parties. Copies of the report will be supplied to MinAg., EAD and USAID. The report will contain a specific recommendation for the continuation, conditional continuation or discontinuance of further expenditure of funds under this program. The panel will consider, but not be limited to, the following factors:

a. The progress of individual commodity or research problem area programs in relation to the plan for program development as recommended by the commodity committees;

b. the relative defacto emphasis in each program in the context of addressing the more important problems facing a commodity or research problem area;

c. the progress being made in solving administrative or procedural problems as identified by the commodity committees;

d. the degree to which research programs reflect consideration of national and provincial planning priorities, including national and provincial budget allocation.

XI. Loan Terms and Conditions

To assure full understanding by all parties to the loan of the contributions and responsibilities of each as we move toward loan approval into the GOP/AID expenditure process, this section will identify the critical points at which specific performance is required for a successful research project.

First, prior to loan authorization, agreement must be reached with the concerned agencies of the Government of Pakistan relative to the purpose of the project, its essential components and what is expected of each. The parameters of the project including financial requirements are spelled out in this loan paper and will be made available together with the draft loan agreement to the concerned GOP agencies to be followed by detailed discussions of its content and the fullest understanding of the responsibilities of all parties. Assuming agreement is reached on the loan, AID will proceed with loan authorization and thereafter loan agreement signing.

During the negotiations in Islamabad, the following determinations should be made:

1. Sufficient authority, manpower and resources have been given to the ARC to assure its functioning as a major decision-maker in resource allocation, priority establishment and coordination of research activities.

2. An acceptable plan for improvements in personnel management has been developed to insure that capable scientists are recruited and retained in ARC/NRC.

3. Adequate progress is being made in acquisition and assignment of the proper amounts and types of land for the National Research Center.

4. Adequate progress is being made in commitments to the construction and staffing of the NRC physical facilities.

5. Adequate provision has been made by the Government of Pakistan to provide for its foreign exchange and local currency commitments established in the project plan.

Conditions Precedent to Initial Disbursement

1. Legal opinion of the Minister of Justice.

2. Authorized representative designated.

3. The establishment of an evaluation system of annual reviews of individual projects and the overall program, together with the criteria of evaluation to be used. Project funding and releases would be done in tranches keyed to the annual reviews.

4. Establishment of plans for (a) selection of participants for loan-financed training; (b) selection, assignment and contracting procedure for technical advisors, and intermediaries and (c) procurement procedures for loan financed commodities.

5. Establishment of an overall project plan, designating responsibilities of involved agencies and institutions, identifying funding sources and uses, and setting out an approximate time-table for project activities and evaluation.

Conditions Precedent to Particular Disbursement

1. Before any disbursement to NRC for development of its facilities, it must be demonstrated that adequate land is unconditionally assigned to that agency.

2. No disbursements for general facility improvement prior to presentation of overall plans for provincial station improvement.

Covenants

1. The Government of Pakistan agrees to carry out the project with diligence and efficiency and in accordance with agreed to plans.

2. The GOP will promptly provide, as needed, all funds in addition to the loan to carry out the project.

3. The GOP will review and establish each year or such other agreed to period, its national research priorities.

4. The GOP will provide both FX and local currency for investments in research to permit research programs to continue after the termination of loan funding.

5. The GOP covenants that no more than 20% of any one category (commodities, technical assistance or training) should be transferred to another category.

6. The GOP agrees to assist the provincial research institutions in formulating plans for the continued development of their resource base, including physical facilities and technical manpower.

APPENDIX I

ESTIMATE OF TRAINING NEEDED TO SUPPORT MAJOR RESEARCH PROGRAMS BY INSTITUTION

Institution	Program	Training		
		Practical	M.Sc.	Ph.D.
Agricultural Res. Institute, Lyallpur	Wheat	12	6	6-agronomy (2), pathology, soils, chemistry (2)
	Rice	12	6	4-breeding, soils, entomology, pathology.
	Maize	12	5	3-agronomy, pathology, entomology
	Sorghum	8	5	3-agronomy, pathology, entomology
	Oilseeds	6	3	3-entomology, agronomy, chemistry
	Sugar	2	6	3-agronomy, soils, entomology.
	Vegetables	2	2	2-breeding, agronomy
	Forages	0	6	1-agronomy
ARI-Sind	Wheat	10	4	2-agronomy, breeding
	Rice	10	10	9-breeding, soils, agronomy, chemistry milling, pathology, entomology.
	Sorghum	5	5	1-agronomy
	Sugar	2	8	4-agronomy, pathology, economics, entomology.

Institution	Program	Training		
		Practical	M.Sc.	Ph.D.
	Pulses	2	6	2-agronomy, entomology
ARI-Sind	Oilseeds	2	6	3-agronomy, entomology, pathology.
	Forages	-	2	1-agronomy
ARI-Tarnab	Wheat	6	4	2-breeding, agronomy
	Sugar	2	4	5-agronomy, soils, pathology entomology
	Rice	6	3	2-breeding, agronomy
	Forages	-	2	1-agronomy
	Oilseeds	3	3	2-breeding, agronomy
	Pulses	2	5	3-breeding, agronomy, pathology
	Maize	10	5	4-agronomy, pathology, entomology
	Sorghum	6	5	3-agronomy, pathology, soils.
	Deciduous Fruits	1	5	4-horticulture, pathology, entomology, marketing.
ARI-Quetta	Wheat	4	3	2-breeding, pathology
	Forages	-	2	1-range mgt.
	Fruit	3	4	3-horticulture, pathology, entomology.
	Vegetables	2	4	2-agronomy, pathology
	Sorghum	4	4	1-agronomy

Institution	Program	Training		
		Practical	M.Sc.	Ph.D.
Forestry Res. Institute, Peshawar	Range Management	?	?	1-range management
Livestock Res. Institute, Bahadurnagar		-	6	6-genetics, disease control, agronomy, chemistry, processing, marketing.
Plant Protection Dept.		6	6	4-pathology (2), entomology (2)
Agric. Univ., Lyailpur		20	-	20-unspecified
College of Agric.-Sind		10	30	20-unspecified
College of Agric.-Peshawar		20	30	15-unspecified

APPENDIX II

ESTIMATE OF COMMODITIES NEEDED TO EXECUTE MAJOR RESEARCH PROGRAMS DURING FIRST TWO YEARS, BY INSTITUTION

Institution	Program	Commodities	Cost ($000)
Agricultural Research Institute, Lyallpur	General	Tractors and Implements (3)	36
		threshers (6)	12
		trucks (6)	18
		maintenance equipment	5
		plot planters	3
		sprayers	3
	Sugar	lab equipment	3
	Forages	lab equipment	5
		chopper, drier	5
			(90)
ARI-Sind	General	tractors and implements(2)	24
		threshers (5)	10
		trucks (6)	18
		lab equipment	10
		sprayers	3
		plot planters	3
		maintenance equipment	5
	Rice	mills	10
		lab equipment	10
		tractors (2)	24
			(117)

Institution	Program	Commodities	Cost ($000)	
ARI-Tarnab	General	tractors and implements (2)	24	
		sprayers	5	
		trucks (6)	18	
		lab equipment (soils)	15	
		plot planters	3	(65)
ARI-Quetta	General	tractors & implements (2)	24	
		trucks (2)	6	
		lab equipment	5	
		plot planters	2	
		glasshouse	40	
	Fruit	processing equipment	15	
		sprayers	5	
	Vegetables	lab equipment	15	
				(112)
N. R. C.	General	farm equipment	485	
		lab equipment	200	
		building construction	250	
		glasshouses	200	
				(386)
Others, and minor items			305	
TOTAL			1440	

55

APPENDIX III

APPROXIMATE DISTRIBUTION OF TECHNICAL ADVISORS

BY INSTITUTIONS AND MAN YEARS

TECHNICAL ADVISOR (MAN YEARS)

Program	Institutions								
	NRC	ARC	ARI-L	ARI-Q	ARI-S	ARI-T	AUL	LRI	Totals
Wheat	1		1	1/2	1/2	1/2	1/2		4
Commodity procurement	1		1/2	1/2	1/2	1/2			3
Sugarcane			1		1	1			3
Sugarbeets			1			2			3
Research Sta. Develop.	3		1/4	1/4	1/4	1/4			4
Economics	1		1		1/2	1/2			3
Prod. Systems	2		2	1	1-1/2	1-1/2			8
Pulses	1		1		1/2	1	1/2		4
Sorghum-Millets	2		2		2	2			8
Oilseeds			1		1	1	1		4
Forages	4		4	2	2	4			16
Dairy							1	1	2
Fodder							1	1	2
Nutrition							2		2
Extension Meth.							1		1
Research Admin.		4							4
Unforeseen	1		1	1	1	1	1	1	7
Totals	16	4	16	5	11	15	8	3	78

APPENDIX IV

ESTIMATE OF NRC CONSTRUCTION FUNDING, BY YEAR
(Rs. 000)

Component	Year 1	2	3	4	5	Sum
Central laboratory	1000	920				1920
ARC Admin. Bldg.	1920					1920
Training Unit		400	400			800
Dormitory		400	400			800
Plant Materials Bldg.		240				240
Field Services Bldg.			120	120		240
Machinery Storage	240					240
Engineering Bldg.		100	100			200
Workshop	120	120				240
Warehouse	120					120
Headhouse				80		80
Plant Introduction Unit			150			150
Library & Commun.		125	125			250
Poultry Unit				175		175
Subtotals	3400	2065	1535	375		
Inflation @ 7%		145	225	75		
Subtotals	3400	2210	1760	450		
Architect fees @ 10%	340	220	175	45		
Total by FY	3740	2430	1935	495		8600

APPENDIX V

ESTIMATE OF STAFFING PATTERN OF NRC BY PROGRAM AND YEAR

Program	Year 1			Year 2			Year 3			Year 4		
	P	A	L*	P	A	L	P	A	L	P	A	L
Station Management	1	5	20	0	5	20	0	5	40	0	10	20
Training				1	0	0	0	0	1			
Plant Introduction				1	1	0	1	1	1			
Economics				1	0	0	1	1	0			
Communications	1	1	1	1	1	1	0	1	0			
Dairy	1	0	0	1	1	0						
Forage & Fodder	1	1	0	0	1	0						
Pest Management	2	1	0	7	5	1						
Sorghum & Millet	1	1	0	2	2	1	2	3	0			
Production Systems	1	0	0	2	2	1	2	4	0			
Wheat	1	0	1	4	4	0						

*
P=Professional

A=Assistants

L=Secretarial, Clerical, and Labor

ESTIMATE OF COMMODITIES NEEDED FOR NATIONAL RESEARCH CENTER

	($ 000)
Land forming equip. (including heavy tillage function	179
Farm operations	
Wheel traction	68
Implements, primary tillage	21
Implements, secondary tillage	20
Implements, cultivating	6
Implements, harvesting	44
Misc.	20
Vehicles	135
Shop equipment	33
Shop supplies	6
Subtotal	(532)
Air conditioning components	
ARC office building	60
Main laboratory	70
Training building	90
Glasshouses	200
Laboratory equipment	200
Unforeseen	128
Unspecified general equipment in years 4 and 5	400
TOTAL	1700

APPENDIX VII

ESTIMATE OF BUILDINGS NEEDED FOR NATIONAL RESEARCH CENTER, WITH COSTS

	000 sq. ft.	Cost/sq. ft.	Rs Cost (000)
Central laboratory	24	80	1920
ARC Amin. Building	24	80	1920
Training Unit	10	80	800
Dormitory	10	80	00
Plant Materials Building	6	40	240
Field Services Building	6	40	240
Machinery Storage	6	40	240
Engineering	4	50	200
Workshop	6	40	240
Warehouse	3	40	120
Headhouse	2	40	80
Plant Introduction	3	50	150
Library & Communications	5	50	250
Poultry Unit	5	35	175
TOTAL			8,605

ESTIMATE OF HOUSING NEEDED FOR ARC AND NRC STAFF WITH FUNDING SCHEDULE

	No. Units	Covered Area	Rs/Sq. Ft.	Total (Rs. 000)
ARC Staff				
Sr. Class I	17	2,700 sq. ft.	55	2,516
Class I	9	2,160 "	55	981
Class II	5	1,350 "	55	370
Class III	98	945 "	45	4,214
Class IV	35	600 "	45	945
Sub Total				9,026
NRC Staff				
Sr. Class I	20	2,700 sq. ft.	55	2,960
Class I	15	2,160 "	55	1,635
Class II	25	1,350 "	55	1,850
Class III	45	945 "	45	1 935
Class IV	100	600 "	45	2,700
Sub Total				11,080
				20,106

FUNDING BY YEAR

Component	Year 1	Year 2	Year 3
ARC	3,026	3,000	3,000
NRC	4,080	3,500	3,500
Sub Total	7,106	6,500	6,500
Inflation Factor @ 7%		455	942
Sub Total	7,106	6,955	7,442
TOTAL			21,503