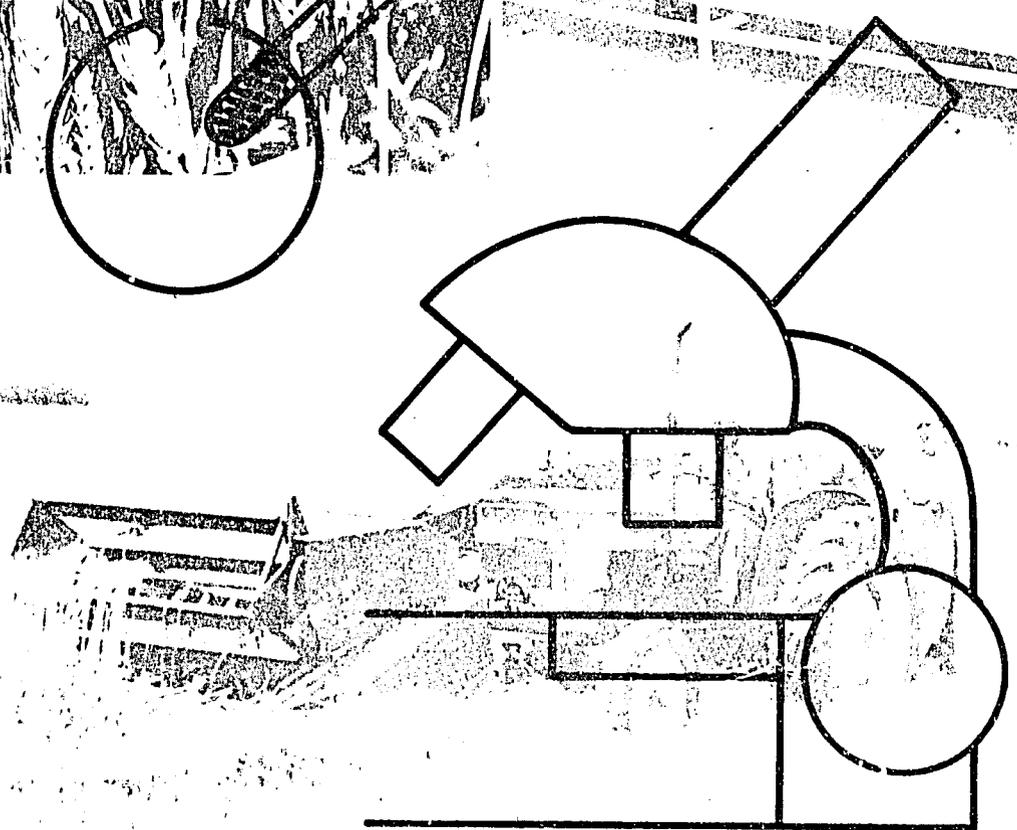
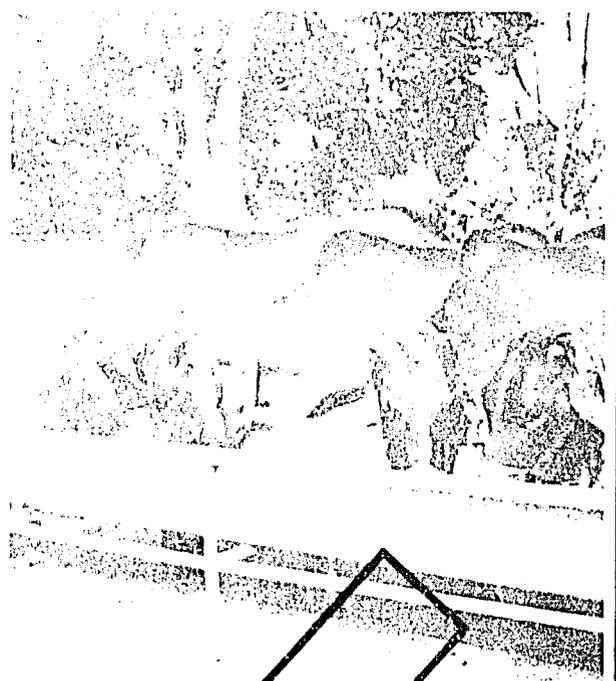


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# AGRICULTURAL RESEARCH IN PAKISTAN



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REVIEW  
OF  
AGRICULTURAL RESEARCH SYSTEM  
IN  
PAKISTAN

By

Abdul Wahid  
T.I.

PAKISTAN AGRICULTURAL RESEARCH COUNCIL (PARC)

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## FOREWORD

This report has been prepared by Dr. Abdul Wahid, Senior Research Program Analyst in the Office of Agriculture and Rural Development (ARD) USAID/Islamabad, at my suggestion.

Dr. Wahid is a retired Director of Research (Animal Husbandry), Pakistan Agricultural Research Council (PARC) and has the unique distinction of having the longest (over 30 years) association with agricultural research in the country both at the provincial and the federal levels. This, in fact, is the first comprehensive report on agricultural research in Pakistan prepared exclusively by a Pakistani Scientist based on his personal broad and long experience of agricultural conditions obtainable in the country. It, therefore, argues for careful consideration.

I am extremely grateful to USAID/Islamabad for permitting Dr. Wahid to accomplish this task and for providing other necessary facilities therefor.

Although Dr. Wahid frequently discussed with me and USAID officials of ARD to clear his thinking about some of the intricate issues involved, the views expressed herein are his own and do not necessarily reflect the views of USAID or PARC.

Dr. Amir Muhammed  
Chairman,  
Pakistan Agricultural Research  
Council,  
ISLAMABAD.

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## PREFACE

This report is intended to (1) provide background information on Pakistan's agriculture (prospects and limitations); (2) discuss current status of agricultural research, education and extension; (3) identify weaknesses/deficiencies in the various components of existing agricultural research system; (4) indicate broadly the role of PARC in overall national agricultural research program; and (5) make tentative recommendations on various aspects of agricultural research for the consideration of research scientists and administrators.

The findings/suggestions made in the report are based on my personal observations of the shortcomings of the present system of agricultural research and extension during the normal course of my duties and responsibilities as Former Director of Research and Consultant, Pakistan Agricultural Research Council (PARC).

Dr. Amir Muhammed, Chairman, PARC, Dr. John A. Naegele, Dr. Ronald V. Curtis and Dr. J. Raymond Carpenter of USAID, Islamabad, have been very helpful in the preparation of this report. The assistance provided is gratefully acknowledged. Special thanks are due to Dr. Russel O. Olson, Davis, Kalifornia, for the pains taken in editing this report and Dr. H. Hasnain for going through the manuscript and making useful suggestions.

Abdul Wahid.  
T.I

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## Chapter 1

### BASIC FACTS ON PAKISTAN'S AGRICULTURE

#### INTRODUCTION

Pakistan has a geographical area of 796,095 square kilometers. It lies between 23 and 27 degrees north latitude and 61 and 76 degrees east longitude in the northern hemisphere. It is bounded by Afghanistan to the north and north-west, Iran to the west and India to the east and south-east. On the south is the Arabian Sea, which washes the shore line for about 350 miles. On its northern end it has a common border with China. A very narrow strip of Afghanistan separates Pakistan from Tadghikistan of the U.S.S.R.

Administratively the country is divided into four provinces - NWFP (Northwest Frontier Province), Punjab, Sind and Baluchistan plus the State of Azad Kashmir and several federally administered tribal areas located in the north-west. (Fig.1).

#### CROP ECOLOGICAL ZONES

The important ecological factors influencing crop production are physiography, climate and soils. FAO in 1976 (1) classified the areas of nine countries of the Near East region including Pakistan into various crop ecological zones. It also indicated relative suitability of the zones for various crops to optimize agricultural production from the land and water resources of the country and to protect the natural resources of land and vegetation from deterioration. The following information is a summary from the FAO publication referred to above.



FIG. 1. PAKISTAN POLITICAL DIVISIONS

### Physiography

The country has three distinct physiographic regions:

a. Mountain region; b. Indus plain region; c. Sand plain region.

a. The mountain region covers the western half of the country and a small part in the north. In the west it comprises 1,500 to 3,000 meters high mountain ranges and large intermountain valleys. The mountains have steep to very steep rocky slopes but the valleys are level to gently sloping or undulating. In the north, the mountains are 2,000 to 4,000 meters high, with some peaks even higher, with steep to very steep slopes. The valleys are generally narrow with steep slopes.

b. The Indus plain region covers about one fourth of the total area of the country and extends to the south and east of the mountain region. It is approximately 1,600 kilometers long and about 150 to 350 kilometers wide. The land surface is nearly level with a very gentle slope from the north and north east to the south west and south.

c. The sand plain region covers a long strip along the eastern border of the country as well as the area between the Indus and Jhelum rivers. The eastern strip, a part of the Great Indian Desert, is about 1,000 kilometers long and about 40 to 80 kilometers wide. There are stable sand ridges of different shapes, ranging in height from 10 to 50 meters. In between the large sand ridges there are nearly level valleys with sand hummocks.

### Climate

a. Rainfall - Lying in the desert belt between 24 degrees and 37 degrees north latitude, Pakistan has mainly a desert or semi-arid climate; only a small part in the north is sub-humid. The mean annual precipitation varies from less than 100 mm in the Central Indus plain to about 1,400 mm in the lower hills of the Himalayan Mountain Range in the north. During summer the precipitation occurs as a result of monsoon storms originating from the Mediterranean Sea. Although the country gets precipitation from both the monsoons and the western disturbances, it lies almost at the extreme of both these influences. The Indus plain and the northern hilly areas east of the Indus River receive about 70 per cent of the total annual precipitation in summer, mainly from mid-June to mid-September, and the rest in winter from mid-November to mid-March. The western hilly part receives 50 to 70 per cent of the total annual precipitation in winter.

The Himalayan Mountain Range in the north has a great influence on the rainfall - the mean annual precipitation is the highest in the southern slopes of the Himalayas and gradually decreases in the south west direction. The southern Himalayan hills (Murree Hills), get 1,200 to 1,500 mm of mean annual precipitation; a 50 mile wide belt of the north eastern Indus plain gets 500 to 800 mm; and the next 120 mile wide belt to the south west gets 200 to 500 mm rainfall. The rest of the Indus plain gets less than 200 mm annual rainfall, except a small part in the south-eastern corner where the rainfall is about 300 mm. The western hilly region gets 200 to 400 mm mean annual precipitation in the northern half, extending north of Quetta, and 50 to 200 mm in the southern half.

b. Temperature - Summer is very hot in the plains as well as in the southern and extreme western parts of the mountain region where the altitude is less than 1,000 m. From June to August the daily maximum temperature normally remains above 40° C. During June, the hottest month, the average daily maximum temperature is around 45° C in the central part of the Indus plain and a few degrees lower in the northern and southern parts. The summer heat is slightly milder in the coastal belt extending up to about 100 kilometers from the sea. In the mountains it is pleasantly warm (not hot) because of the high altitude, but cold in winter.

Considering the physiography, climate and soils, the country has been divided into 17 crop ecological zones which are shown on the map (Fig. 2). After describing each zone in terms of physiography, climate, soils and drainage, suggestions are given about the most suitable crops and cropping systems. This information would be useful in zoning of crops for realizing the production capability of each area. It would also be useful for planners and agricultural scientists.

### Land Use Suitability

A summary of the recommended uses for each zone is given below:

a. Thatta zone - It covers the Indus Delta with clayey and silty soils. Drainage is a problem, but clayey soils can become very productive if drainage is provided. The climate is marine sub-tropical. With proper drainage the most suitable crops are: coarse rice, sugarcane, summer pulses (Phaseolus spp.), rapeseed, sorghum (fodder) and berseem. Wheat is moderately suitable. Banana, papaya and guava are the suitable fruits.

b. Hyderabad zone - It covers the frost-free part of the Indus Flood Plain. The soils are well drained, clayey and loamy. The most

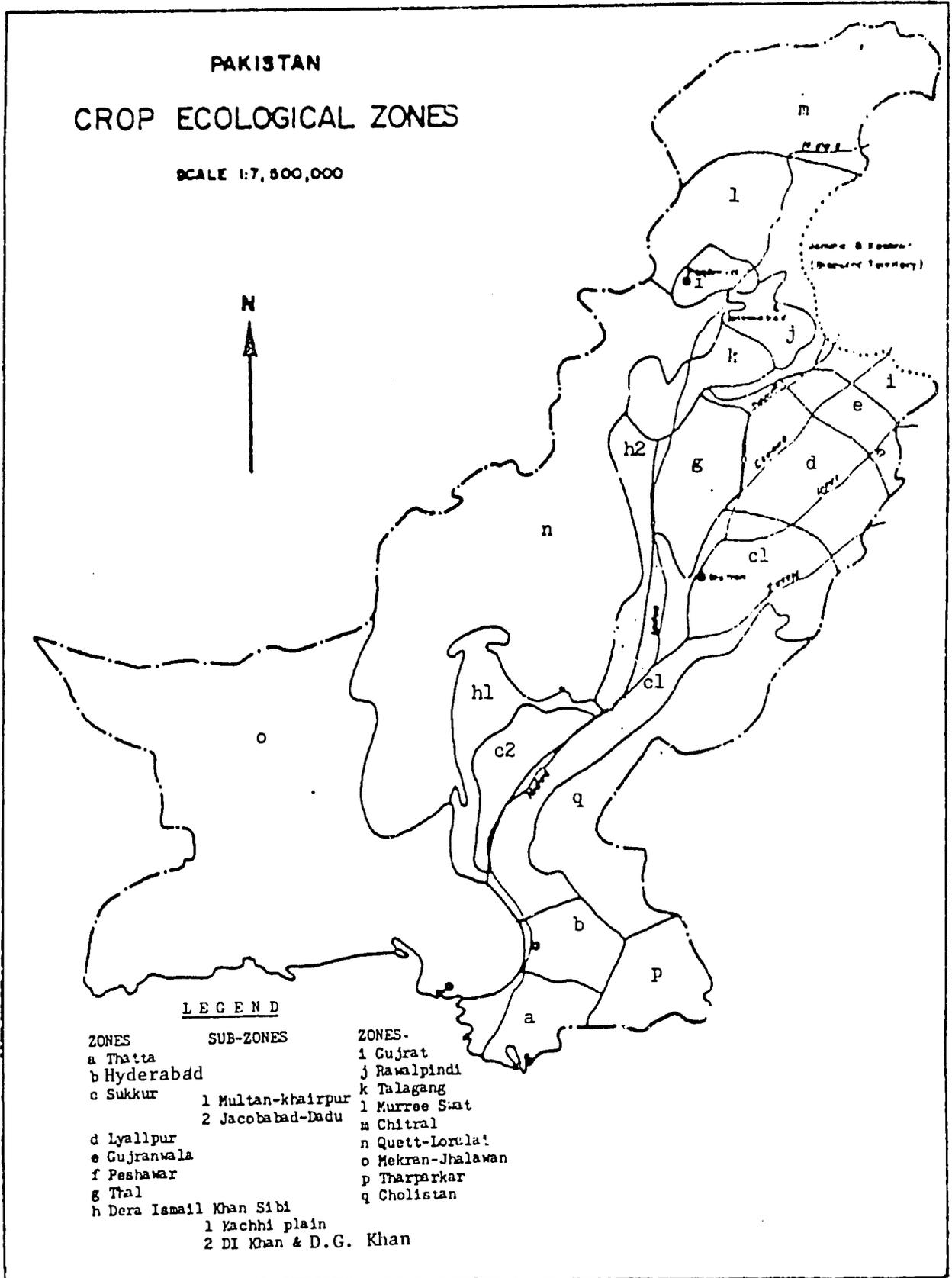


FIG. 2. CROP ECOLOGICAL ZONES

suitable crops are: sugarcane, maize, soybean, rapeseed, wheat, lentils, sorghum (fodder), alfalfa, berseem and onion. Cotton has only moderate suitability because of disease problems caused by high humidity. Among fruits, mango and guava are highly suitable, but banana and papaya have only moderate suitability.

c. Sukkur zone - This zone covers the arid part of the Indus plain with less than 200 mm rainfall and has a very hot summer and a mild, but not frostless winter. Because of significant differences in soil drainage, it has been divided into two sub-zones:

1.) Multan-Khairpur sub-zone - It covers the well drained area with clayey and loamy soils. The most suitable crops are cotton, gram, alfalfa, wheat, sorghum (fodder) and onions. Sugarcane, maize and rapeseed have moderate suitability. Dates are highly suitable but mangoes are only moderately suitable because of frost-damage.

2.) Jacobabad-Dadu sub-zone - Having restricted drainage and mainly clayey soils. It is highly suitable for rice, gram, onions and wheat. Sorghum is suitable for water shortage areas. Sugarcane and rapeseed are moderately suitable.

d. Lyallpur zone \* - Covering the semi-arid belt (rainfall 200 to 400 mm) of the Indus plain, it has loamy and clayey well drained soils. May and June are very hot, but dry, and July and August are hot with high humidity.

The most suitable crops are wheat, maize, soybean, berseem and summer pulses (Phaseolus spp.). Sugarcane and cotton have moderate suitability. Citrus, especially 'Kinnow' (a mandarin) is highly suitable, but mango and guava are only moderately suitable.

\*(now Faisalabad)

e. Gujranwala zone - This region covers the sub-humid part (rainfall 400 to 500 mm) of the Indus plain and has clayey soils with restricted drainage and loamy soils having good drainage. May and June are hot and dry, but July and August are hot and humid. December, January and February are also rainy.

For the seasonally poorly drained clayey soils, the most suitable crops are: fine rice (basmati), wheat and berseem; for the well drained loamy soils: maize, soybean, sunflower, groundnuts, wheat, berseem and millets (fodder) are suitable. Gram has moderate suitability because of blight. Rust is a problem for wheat. Sugarcane has moderate suitability.

f. Peshawar zone - This region covers the Peshawar valley with a mild, early summer and a cold but rainy winter. It has clayey soils in the central part but loamy soils on the sloping sides. The central part has a high incidence of frost, while the sloping sides are nearly frost-free.

For the clayey soils with high incidence of frost, the suitable crops are: maize, soybean, summer pulses (Phaseolus spp.) sugarbeet, berseem and wheat. Pears and peaches are the suitable fruits. For the loamy soils of the nearly frost-free sloping sides, maize, soybean, sugarcane, Potatoes, tomatoes, summer pulses (Phaseolus spp.) and wheat are suitable. cotton and gram are moderately suitable. Oranges have high suitability.

g. Thal zone - Because this is an area of sand ridges, it has sandy soils. Small patches of sandy loam cover a small proportion of the area. The climate is arid to semi-arid sub-tropical (rainfall 150 to 300 mm). It has been subdivided into two sub-zones: (a) with 300 to 350 mm rainfall and (b) 150 to 300 mm rainfall.

In the sub-zone of higher rainfall, gram is a moderately suitable crop under dry-farming; groundnut is moderately suitable for patches of sandy loam soil. In the lower rainfall sub-zone, gram has low suitability. However, the best use of the area is grazing. The patches of sandy loam soils may be used for fodder production with irrigation from small tubewells.

h. Dera Ismail Khan-Sibi zone - This is a long strip of piedmont plain on the west bank of the Indus River. It is an arid area which depends upon the storm water of the streams originating in the Sulaiman mountain range. Two sub-zones have been recognized.

1.) The Kachhi plain sub-zone - With canal irrigation, the clayey soils of this region are suitable for coarse rice, gram, rapeseed and sorghum. Cotton is moderately suitable.

2.) The Dera Ismail Khan-Dera Gazi Khan sub-zone - This zone is located on loamy soils under torrent-watered cultivation. Sorghum, millet, gram, wheat and mustard 'Taramira' give poor to moderate yields. With canal irrigation, cotton, sorghum, wheat, gram and alfalfa are suitable crops.

i. Gujrat zone - It covers the Himalayan piedmont plain with a gently continuous slope and receives 500 to 1,000 mm rainfall (70 percent in summer; 30 in winter).

For the clayey soils under canal irrigation, the most suitable crops are: fine rice, wheat and berseem. Under rainfed cultivation, the suitable crops are: groundnuts, wheat, rapeseed and pulses (Phaseolus spp.) for loamy soils and millet, wheat and rapeseed for clayey soils. Guava is a suitable fruit.

j. Rawalpindi zone - It covers the sub-humid part (rainfall 500 to 900 mm) of the Pothwar upland which has silty soils formed in loess

(wind-deposited silt). Under rainfed cultivation the suitable crops are: groundnuts, summer pulses (Phaseolus spp.) and wheat for loamy soils, and millet, pulses and wheat for clayey soils. For areas having 750 to 900 mm rainfall, maize and soybean are also suitable. Wheat must be grown in rotation with self-regenerating medicago. In the gullied land part grasses and trees may be planted, thus providing grass for feeding livestock.

k. Talagang zone - It is the semi-arid part of the Pothwar upland, with 300 to 500 mm rainfall and mainly loamy soils.

The land is most suitable for cattle production; hence, a sorghum-alfalfa mixture or other suitable forage crops are grown. Crops having moderate suitability are: wheat, mustard 'Taramira' and groundnuts. Wheat in rotation with self-regenerating medicago would be the proper cropping system for this zone.

Gram would be more suitable than wheat, if gram blight were controlled. The gullied land is suitable only for regulated grazing.

l. Muree-Swat zone - It comprises sub-humid and humid (precipitation 500 to 1,400 mm) highlands - 1,000 to 5,000 meters high, with steep slopes of 40 to 100 percent. Only a small proportion of the area has gentle or moderate slopes. The summer is pleasant but winters are cold.

The suitable crops are: maize, soybean and vegetables such as potato, tomato, cucurbits, etc. Apples and pears have moderate suitability, hailstorms in early summer posing a limitation.

The major part is suitable for pine forests.

m. Chitral zone - It is an arid and semi-arid area of high mountains (more than 3,000 m high) with precipitation of 150 to 500 mm.

The steep and shallow soils of the zone should be used for grazing. Only the deep soils on lower parts of hill slopes and in gently sloping valleys are suitable for wheat and maize at altitudes of 1,600 to 2,000 meters, and only wheat at 2,000 to 2,600 meters altitude. Wheat may be rotated with some legumes. Apples, apricots, mulberries and grapes are also suitable.

This zone would be ideally used for grazing, fruit orchards and fodder production for livestock.

h. Quetta - Loralai zone - It is a mountain area with large, nearly level valleys and 200 to 300 mm precipitation. The soils in the valleys are deep, highly calcareous loams. The hill slopes are mostly bare; the lower part has stony and gravelly soils.

As livestock production and irrigated cropping are the two main land uses of this area these should be properly integrated.

Suitable crops to be grown under irrigation are: potatoes, tomatoes and other vegetables, as well as wheat. Apples, plums, peaches, apricots and grapes are also very suitable.

Under torrent-watered\* cultivation, wheat, melons and alfalfa are suitable crops.

In the area of 300 to 400 mm precipitation, the system of growing wheat in rotation with self-regenerating medicago may be tried.

o. Mekran - Jhalawan zone - It is a plateau, 500 to 1,500 meters high. About half the area comprises hill ranges with steep slopes, but the remaining half is nearly level or gently sloping. The climate is arid sub-tropical with 50 to 300 mm rainfall. The soils in the plains are mainly highly calcareous loams.

\* Flood-watered

As the main land use is grazing, cropping should be integrated with livestock production. Torrent-watered areas should be used for fodder production (sorghum, lucerne and grasses). A part of the irrigated area should also be used for growing alfalfa for use as fresh fodder and hay.

Suitable crops grown under irrigation are: sorghum, alfalfa and wheat. Under torrent-watered cultivation, mustard (Eruca sativa), wheat and gram are suitable crops.

p. Tharparkar zone - It is an area of sand ridges with 200 to 300 mm rainfall, occurring mostly in July and August. In summer a south-westerly sea breeze is an important feature of the climate. The soils are very sandy.

It is mainly a cattle raising area, cropping being a subsidiary land use. Proper management of grazing land by regulated grazing and reseedling of suitable grasses and legumes is the priority need of this area. Millet and guava are the suitable dry-farming crops. Improved varieties of these crops are needed.

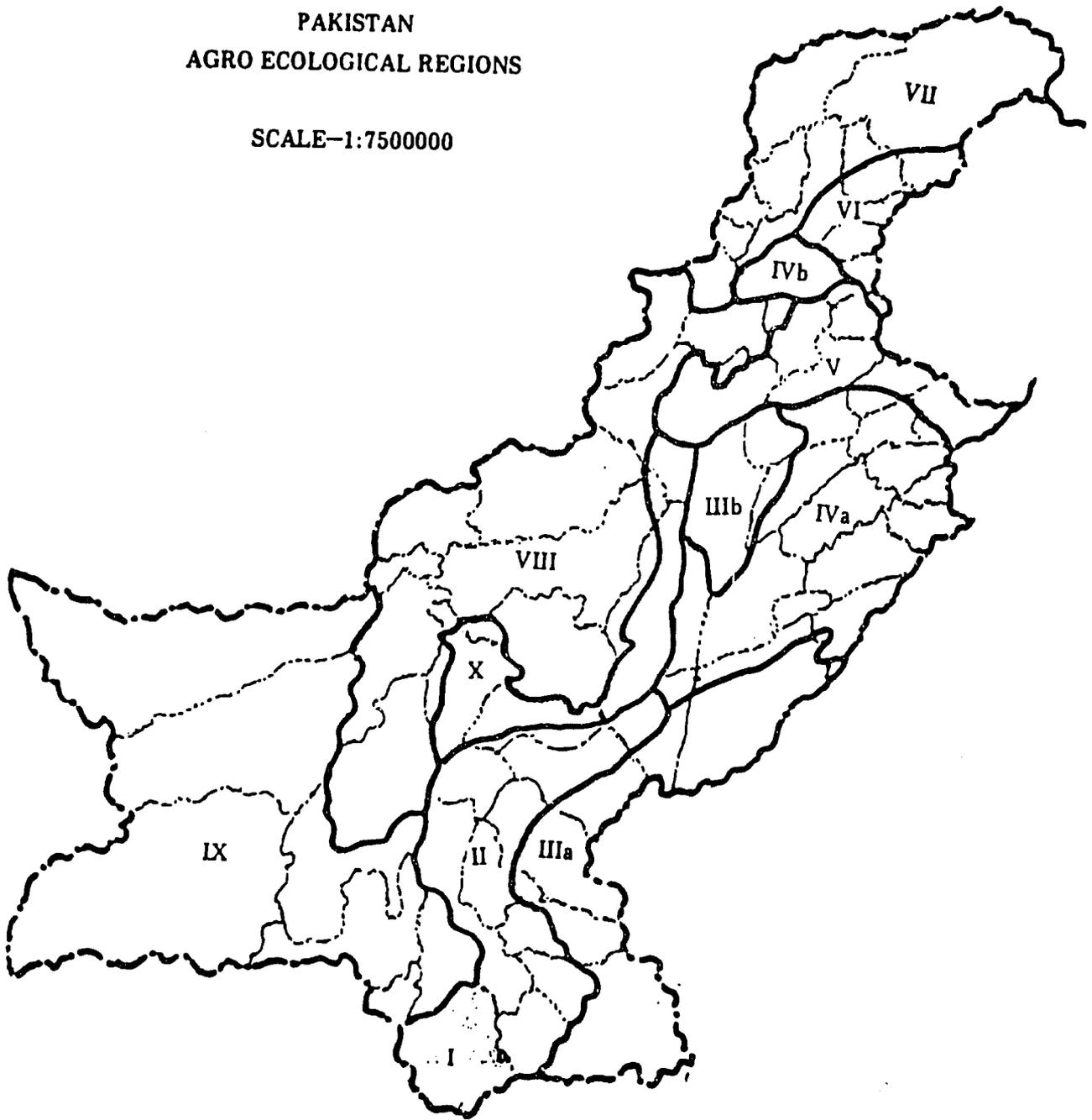
q. The Cholistan zone - It is an area with an arid climate and sandy ridges.

The only land use is seasonal grazing in autumn and winter. The ecological conditions indicate that this area cannot stand grazing for more than two or three months. Livestock production can be increased by production of fodder with canal irrigation in the adjacent area of the Indus Plain. The graziers may be allotted irrigated land for this purpose.

Based on the survey carried out by FAO, Pakistan Agricultural Research Council (PARC) delineated the country into 10 Agro-ecological regions in 1980 ( 2 ).

PAKISTAN  
AGRO ECOLOGICAL REGIONS

SCALE-1:7500000



- |                                     |                             |                          |
|-------------------------------------|-----------------------------|--------------------------|
| I Indus Delta                       | II Southern Irrigated Plain | III Sandy Desert (a & b) |
| IV Northern Irrigated Plain (a & b) | V Barani (Rainfed) Areas    | VI Wet Mountains         |
| VII Northern Dry Mountains          | VIII Western Dry Mountains  | IX Dry Western Plateau   |
| X Sulaiman Piedmont                 |                             |                          |

FIG. 3. PAKISTAN AGRO-ECOLOGICAL ZONES

The classification was made on the basis of physiography, climate, soils, land use and other factors affecting agricultural production as listed below: (Fig. 3)

- I Indus Delta
- II Southern Irrigated Plain
- III Sandy Desert (a & b)
- IV Northern Irrigated Plain (a & b)
- V Barani Lands
- VI Wet Mountains
- VII Northern Dry Mountains
- VIII Western Dry Mountains
- IX Dry Western Plateau
- X Sulaiman Piedmont

#### POPULATION - BASIC CHARACTERISTICS

Pakistan's population suffers from a high birth rate, low per capita income, a high-dependency ratio, under employment, low participation of the labour force, poor health, sub-standard hygiene, and low literacy standards. While the crude death rate came down from 30 to 13 per thousand between 1947 and 1970 the crude birth rate declined only slightly from 50 to 42.6 per thousand, thereby pushing the population growth rate from 2 percent in the fifties to 2.96 percent in the sixties.

The population has shown more than a five fold increase during the last 80 years (1901-1981). It was 32.5 million at the time of Independence, and rose to 65.3 million in 1972, or a rise of 100%. The current (1981) population is expected to double over the next 24 years if the current rate of growth of 3 percent prevails. Pakistan's population as given in the census of 1981, excluding Azad Kashmir, is 83.7 million as contrasted

to 65.3 million in 1972, indicating an annual growth rate of slightly over three percent. This figure (83.7 million) does not include approximately 2.3 million registered Afghan refugees residing in Pakistan, nor about two million Pakistanis working abroad.

The density of population has increased per square kilometer from 82 persons in 1972 to 105 persons in 1981. Shown below is data on rural-urban population given in the census of 1951, 1961, 1972, and 1981, respectively.

Table 1. Population by Rural-Urban Areas

	1951		1961		1972		1981	
	(000's)	(%)	(000's)	(%)	(000's)	(%)	(000's)	(%)
Pakistan	33,740	100.0	42,880	100.0	65,309	100.0	83,700	100.0
Rural	27,785	82.4	33,225	77.5	48,716	74.6	60,097	25.4
Urban	5,955	17.6	9,655	22.5	16,593	25.4	23,603	28.2

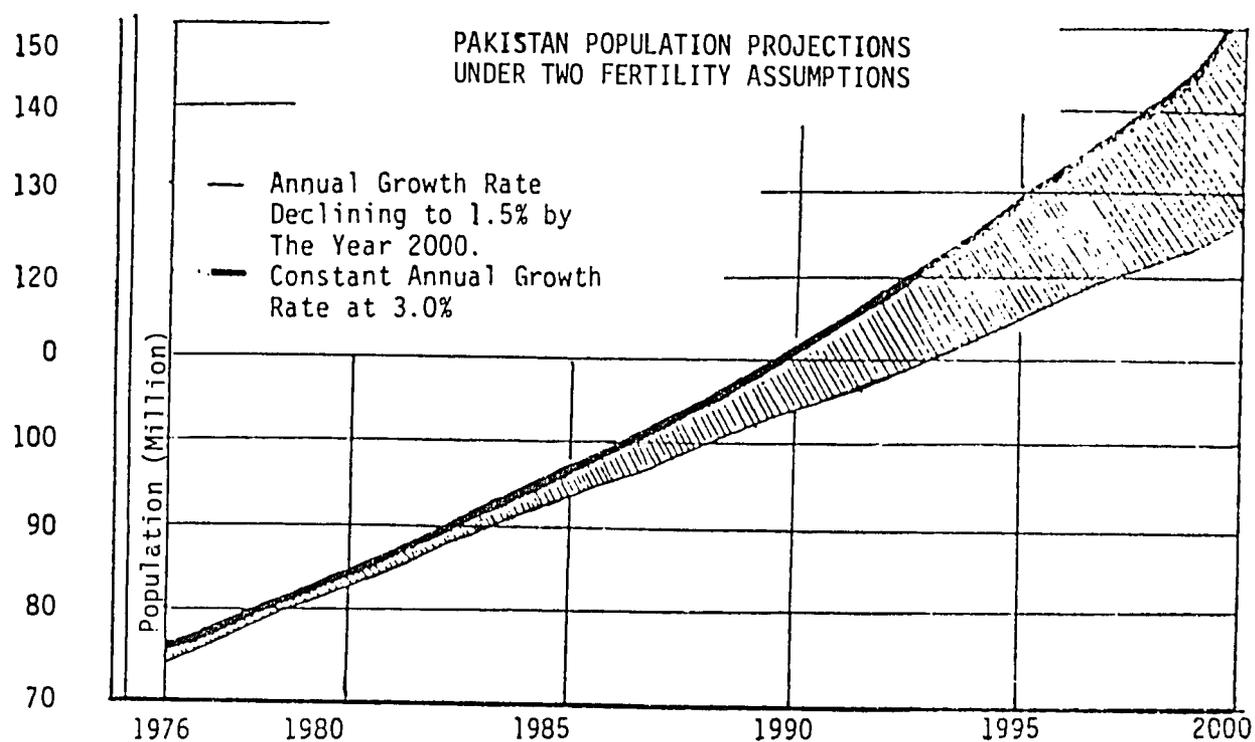
Source: Census Organization, Statistics Division.

The urban population increased from 25 percent in 1972 to 28.2 percent in 1981. The population of major cities, according to the census of 1981, is: Karachi-5.1 million; Lahore-2.92 million; Faisalabad-1.09 million; Gujranwala-0.597 million; Peshawar-0.555 million; Sialkot-0.296 million; Sargodah-0.294 million; Quetta-0.285 million and Islamabad Federal Area-0.335 million.

Table 2. The population of the provinces in 1981 and the percent of increase over 1972

Provinces	Population in million 1981	Percent increase over 1972
N.W.F.P.	10.885	28.28
Punjab	47.11	25.28
Sind	18.96	33.98
Baluchistan	4.30	77.23
Islamabad Fed. Area	0.335	42.55
Tribal Areas	2.175	

The projections in the following chart are approximations of minimum and maximum population levels based on alternative assumptions: (1) that fertility and mortality rates will decline steadily resulting in a population growth rate of 1.5 percent by the year 2000 and (2) that the population growth rate will remain constant at the current 3.0 percent. In the year 2000 the population will almost certainly be more than 125 million and less than 150 million. If the projections were carried for another generation, the differences would be much greater. For example, if Pakistan maintained its 3 percent growth rate through the year 2000 and then reduced the growth rate to 1.5 percent, the population of Pakistan would be about 260 million in 2025, and still growing.



**FIG. 4. POPULATION PROJECTIONS OF PAKISTAN 1976 THROUGH THE YEAR 2000**

The above population projections imply the changes in 25 year period (1976-2000) as shown in Table 3.

**Table 3. Changes in Population Characteristics and Basic Needs (1976-2000)**

	1976 (Actual)	2000 (Projected)	
		Min.	Max.
1. Health Services (million participating)	10	125	140
2. School Going Children (million)	5.4	9.3	18.8 for universal education
3. Wheat	8.5 million tons	15.0	18.0 million tons
4. Population Density of Most Populated Districts	870 per sq. mile	1550	1760 per sq. mile
5. Women of Reproductive Age (million)	14	24	29

FOOD POSITION

Food is the most critical factor in the economic development and political stability of a country. The tables below show the food supply position (calories and protein) in the various continents and in India and Pakistan.

Table 4. Calories Per Capita Per Day

	<u>Total</u>		<u>Vegetable Products</u>		<u>Animal Products</u>	
	1966-68	1976-77	1966-68	1975-77	1966-68	1975-77
World	2457	2590	2033	2149	423	441
Africa	2221	2308	2053	2140	168	157
N.C. America	3135	3215	2048	2195	1087	1020
South America	2535	2565	2069	2077	466	488
Asia	2075	2276	1904	2077	172	200
Europe	3274	3410	2298	2315	976	1095
Oceania	3095	3204	1946	2026	1150	1177
China	2082	2439	1878	2183	204	256
India	1885	1949	1787	1848	98	100
Pakistan	2045	2255	1763	1974	282	281
U.S.S.R.	3286	3443	2492	2505	794	938

Source: FAO Production Year Book, 1979 Vol. 33

Table 5. Protein Per Capita Per Day (Grams)

	Total		Vegetable Products		Animal Products	
	1966-68	1975-77	1966-68	1975-77	1966-68	1975-77
World	66.0	69.3	43.4	44.8	22.7	24.4
Africa	57.1	58.7	45.2	46.7	11.9	12.0
N.C. America	92.3	92.7	35.8	36.2	56.5	56.5
South America	68.1	66.2	39.9	36.8	28.3	29.3
Asia	53.2	58.3	42.7	46.2	10.6	12.1
Europe	91.0	96.0	45.6	43.2	45.4	52.8
Oceania	88.9	95.8	33.3	33.3	55.7	62.5
China	54.3	63.4	43.1	50.2	11.2	13.3
India	47.5	48.4	42.6	43.2	4.9	5.2
Pakistan	56.9	62.0	41.2	46.3	15.7	15.6
U.S.S.R.	96.1	103.2	54.9	52.1	41.2	51.1

Source. IBID

In terms of calories and protein per capita per day, India is the lowest in the world. Pakistan ranks far higher than India in both calories and protein and almost equals Asia in calories. It, however, ranks higher than Africa and Asia in protein supply, but has a long way to go to even approach the level of advanced countries in total food supply.

#### RURAL INCOMES

A sample survey of Pakistan households in 1971/72 provides information on size of households and monthly incomes per household for rural and urban areas. Table 4 shows the average size of household for various monthly income groups and the percentage of households falling in each income group.

Table 6 - Size of an Average Household by Monthly Income Groups

Monthly Income Groups (Rupees)	No. of Sample Households	Percentage of Households	Average No. of	
			Members per Household	Family Members per Household
1	2	3	4	5
<b>PAKISTAN (a)</b>				
<u>ALL GROUPS</u>	<u>7,294</u>	<u>100.0</u>	<u>5.8</u>	<u>5.8</u>
Less than 50	20	0.4	2.9	2.9
50 - 99	350	6.9	3.1	3.1
100 - 149	996	17.3	4.2	4.2
150 - 199	1,366	21.9	5.1	5.1
200 - 249	1,205	16.6	5.8	5.8
250 - 299	877	11.4	6.6	6.6
300 - 399	1,108	12.7	7.3	7.3
400 - 499	522	5.4	8.1	8.1
500 - 749	488	4.5	8.8	8.6
750 - 999	153	1.3	10.0	9.9
1000 - 1499	117	0.9	9.1	9.0
1500 - 1999	44	0.3	8.0	7.6
2000 - above	48	0.4	9.7	8.8
<b>RURAL AREAS (b)</b>				
<u>ALL GROUPS</u>	<u>2,770</u>	<u>100.0</u>	<u>5.8</u>	<u>5.8</u>
Less than 50	12	0.4	2.8	2.8
50 - 99	229	8.3	3.1	3.1
100 - 149	548	19.8	4.3	4.3
150 - 199	663	23.9	5.3	5.3
200 - 249	460	16.6	6.0	6.0
250 - 299	306	11.0	6.8	6.8
300 - 399	305	11.0	7.7	7.7
400 - 499	118	4.3	8.6	8.6
500 - 749	86	3.1	9.0	9.0
750 - 999	21	0.8	11.7	11.6
1000 - 1499	13	0.5	10.0	10.0
1500 - 1999	3	0.1	7.7	6.3
2000 - above	6	0.2	11.2	9.8
<b>URBAN AREAS (c)</b>				
<u>ALL GROUPS</u>	<u>4,254</u>	<u>100.0</u>	<u>5.9</u>	<u>5.9</u>
Less than 50	8	0.2	3.0	3.0
50 - 99	121	2.7	2.6	2.4
100 - 149	448	10.0	3.7	3.7
150 - 199	703	15.5	4.4	4.4
200 - 249	745	16.5	5.1	5.1
250 - 299	571	12.6	5.9	5.9
300 - 399	803	17.7	6.6	6.6
400 - 499	404	8.9	7.5	7.5
500 - 749	402	8.9	8.5	8.3
750 - 999	132	2.9	8.7	8.6
1000 - 1499	104	2.3	8.5	8.4
1500 - 1999	41	0.9	3.1	8.0
2000 - above	42	0.9	18.6	8.1

Source: Household Income & Expenditure Survey 1971-72  
 Statistical Division, Ministry of Finance  
 Government of Pakistan.

The figures in Table 6 (a,b & c) are for the year 1971-72. No regular survey on the subject on an all-Pakistan basis has been undertaken since. Moreover, no line of demarcation was drawn in the report for monthly incomes on the basis of which households could be classified into low, middle and high income groups. Assuming the cost of basic needs (food, clothing, shelter, health and education), even at a very conservative estimate, at Rs. 299 per average household per month for rural and Rs. 399 for urban areas, about 80% of the households in rural and 75% in urban areas were below the poverty line in 1972. The position does not seem to have materially changed since, as with the increase in per capita income in recent years, there has been proportionate increase in cost of living as well. The need for increasing real income of the rural population and achieving a more equitable distribution of the benefits of research and development among the farming community can hardly be over emphasized.

#### CURRENT PATTERN OF LAND USE

About two thirds of Pakistan's total area consists of rugged mountainous area or deserts. Another 25 million acres are patterned in such a way as to preclude agricultural exploitation. The remaining 76 million acres are cultivable, though less than 48 million acres are actually cultivated (about 24 percent of the total land area and 63 percent of the cultivable area). There are about seven million acres of exploitable forests lying outside the cultivable area. Though most of these are exploited for timber and fuel by local people, around one million acres are in managed reserves.

The distribution among different land categories is shown in Table 7. The lack of water for crop growth is evident by the apparent under-utilization of land with perennial supplies of irrigation water. The perennial canal commanded area covers 21 million acres, but only about five million acres are cropped in both the kharif (spring planted) and rabi (fall planted) seasons. Irrigated crops based solely on tubewell water are grown on 417 million acres, while wells, Persian wheels and other methods irrigate another 3.2 million cropped acres. About a million acres of land irrigated by tubewells are cropped in both seasons. The total cropped area on irrigated lands is about 33 million acres, while that cultivated is 33.5 million acres, yielding a cropping intensity of 99 percent.

An additional 14 million acres are cultivated under barani (rainfed) conditions, with an annual cropped area of ten million acres and an intensity of 71 percent. Using cultivated land as a base, then, the average cropped area is 43 million acres on 47.5 million acres of cultivated land.

The principal crops are wheat, rice, cotton and sugarcane which were sown on a total of 26.2 million acres (61 percent of the cropped area) in 1976-77. In terms of cultivated area, fodder is another important crop sown in both the rabi and kharif seasons on a total of seven million acres. Physiographic and climatological differences between important agricultural zones in Pakistan have led to significantly different cropping emphases in different areas. The most important part of the acreage cropped in the rabi season is sown to wheat and fodder, while the dominant kharif crop is either rice or cotton, depending on the zone. Irrigation

practices and cropping intensities also vary widely among zones. In the non-perennial irrigation rice zones of Sind, fields are flooded early in the kharif season when water supplies are plentiful (pancho<sup>a/</sup>irrigation). On some of these lands, drainage conditions and residual soil moisture permit the sowing of crops in the rabi season (dubari<sup>b/</sup>cropping) or rabi cultivation after a single watering at the end of kharif season. In these zones, cropping intensities are as high as 138 percent; however, further improvements are limited by waterlogging and salinity associated with the pancho irrigation technique.

a/Flooding of fields

b/Double

Table 7. Land Area and Current Land Use<sup>1/</sup>

	Cultur- able land <sup>4/</sup>	Culti- vated land <sup>2/</sup>	Cropped Area
1. Culturable with Access to Irrigation:			
Canal and canal + tubewells perennial	21.3		
Non-perennial	13.2		
Cropped one season	--	13.6	13.6
Cropped both seasons	--	5.3	10.6
Current fallow	--	6.1	--
Not cultivated	(9.5) <sup>3/</sup>		
Tubewells, wells and tanks	9.0	--	--
Cropped one season	--	7.0	7.0
Cropped both seasons	--	0.9	1.8
Current fallow	--	0.6	--
Total land with access to irrigation	43.5	33.5	33.0
2. Rainfed Culturable Land	--	--	--
Cropped	--	10.0	10.0
Current fallow	--	4.0	--
Not cultivated	(18.1) <sup>3/</sup>	--	--
Total rainfed culturable land	32.1	14.0	10.0
3. Total Culturable Land	75.6	47.5	43.0
4. Land Unsuitable for Crops	121.1	--	--
5. Total Land in Pakistan	916.7	--	--

<sup>1/</sup>Estimates based on statistics provided by the Planning Division, Govt. of Pakistan.

<sup>2/</sup>Cultivated land is defined here as net sown area plus current fallow.

<sup>3/</sup>Not added vertically to avoid double counting.

<sup>4/</sup>Culturable land is defined as arable.

LAND TENURE

Table 8. Classification of Farms by Tenure Class and Size of Farm

Size of Farm ( acres )	Number of Farms			
	Owner	Owner-Cum-Tenant	Tenant	Total
Private Farms - Total	1,568,618	896,602	1,296,468	3,761,688
Under 1	119,993	3,750	32,719	156,462
1 to 2.4	243,755	27,108	93,292	364,155
2.5 to 4.9	268,504	94,115	157,802	520,421
5.0 to 7.4	229,012	137,604	213,308	579,924
7.5 to 12.4	270,155	243,439	407,253	920,847
12.5 to 24.9	247,782	250,461	295,685	793,928
25.0 to 49.9	110,980	99,388	78,798	289,166
50.0 to 149.9	50,285	36,164	16,192	102,641
150.0 and above	10,151	4,593	1,419	16,163

## PERCENTAGE DISTRIBUTION

Size of Farm ( acres )	Tenure Class							
	Owner		Owner-Cum-Tenant		Tenant		Total	
	Number	%	Number	%	Number	%	Number	%
Private Farms - Total	1,568,618	42	896,602	24	1,296,468	34	3,761,688	100
Under 1	119,993	77	3,750	2	32,719	21	156,462	100
1 to 2.4	243,755	67	27,108	7	93,292	26	364,155	100
2.5 to 4.9	268,504	53	94,115	17	157,802	29	538,421	100
5.0 to 7.4	229,012	39	137,604	24	213,308	37	579,924	100
7.5 to 12.4	270,155	29	243,439	26	407,253	44	920,848	100
12.5 to 24.9	247,782	31	250,461	32	295,685	37	793,928	100
25.0 to 49.9	110,980	38	99,388	34	78,798	27	289,146	100
50.0 to 149.9	50,285	49	36,164	35	16,192	16	102,641	100
150.0 and above	10,151	65	4,593	28	1,419	9	16,163	100

Source: Pakistan Census of Agriculture 1972, Vol. I - All Pakistan Report, Agricultural Census Organization, Ministry of Food and Agriculture.

The Agricultural Census for 1972 gives province-wise information on average farm size by type of tenure for the canal command areas of the provinces, as shown in the following table.

Table 9. Farm Size (Acres) and Tenure Classes by Provinces (Canal Command Areas)

	<u>Owners</u> (acres)	<u>Owner-Cum-Tenant</u> (acres)	<u>Tenant</u> (acres)	<u>Average</u> (acres)
Punjab	11.2	16.2	12.1	12.8
N.W.F.P	5.4	10.6	5.8	6.6
Sind	16.5	18.1	10.2	12.6

Source: Pakistan Census of Agriculture 1972

Table 10. Distribution of Farm Land by Farm Size

Farm Size (acres)		Category	Farm Numbers		Farm Area	
			million	percent	million acres	percent
Below	7.5	below subsistence	1.64	43.53	5.99	12.2
7.5 -	12.4	subsistence	0.92	24.49	8.91	18.2
12.5 -	24.9	small	0.79	21.10	13.06	26.6
25.0 -	49.9	medium	0.29	7.70	9.22	18.8
50.0 -	149.9	medium-large	0.10	2.74	7.40	15.1
150.0 and above		large	0.02	0.44	4.48	9.1
			<u>3.76</u>	<u>100.00</u>	<u>49.06</u>	<u>100.0</u>

Source: Pakistan Census of Agriculture 1972, Vol I - All Pakistan Report, Agriculture Census Organization, Ministry of Food and Agriculture.

Table 11. Cropping Intensity, by Farm Size

Farm Size (acres)		Category	Cropped Area		Land Use Intensity
			million acres	percent	percent
Below	7.5	below subsistence	5.54	13.6	92.5
7.5	- 12.4	subsistence	8.32	20.5	93.4
12.5	- 24.9	small	11.78	28.9	90.2
25.0	- 49.9	medium	7.74	19.0	83.9
50.0	- 149.9	medium-large	5.24	12.9	70.8
150.0 and above		large	2.07	5.1	46.2
			<u>40.69</u>	<u>100.0</u>	

Source: Pakistan Census of Agriculture 1972, Vol I - All Pakistan Report, Agriculture Census Organization, Ministry of Food and Agriculture.

About 90 percent of the farms could be classified as small farms, including subsistence and sub-subsistence farms.

On the basis of area 10.0 percent of the farms, those in classes 25 acres and above, have 43 percent of the total area, while the 68 percent of the farms in classes with less than 12.5 acres have only 30 percent of the total area. It is, therefore, imperative that major attention should be given to small farmers while planning for research and development.

CROPPING PATTERNS

Pakistan's cropping pattern is dominated by food grains (Wheat, rice, maize, millet, sorghum and barley), the principal crops being wheat and rice. The most important non-food crop is cotton. Other important crops are sugar cane, tobacco, pulses and oil-seeds. The cropping pattern of Pakistan for 1959/60 and 1979/80 (Provisional) is compared below.

Table 12. Cropping Pattern

	<u>1959/60 Area</u>		<u>1979/80 Area</u>		<u>% of Cropped Area</u>
	<u>1000 hectare</u>	<u>%</u>	<u>1000 hectare</u>	<u>%</u>	
<u>Food Grains</u>					
(Wheat, Rice, Maize Millet, Sorghum and Barley)	8,043	54.8	10,791	57.4	+ 2.6
<u>Cash Crops</u>					
(Cotton, Sugarcane, Tobacco, Jute)	1,778	12.1	2,849	15.2	+ 3.1
<u>Pulses</u>					
(Gram, Mong, Mash, Mattor and other pulses)	1,696	11.6	1,551	8.3	- 3.3
<u>Oilseeds</u>					
(Rape, Mustard, Sesamum, Groundnut, Linseed, and Castorseeds)	610	4.1	534	2.8	- 1.3
<u>Vegetable including Potato</u>	103	0.7	172	0.9	+ 0.2
<u>Condiments</u>					
(Chillies, Onion, Garlic, Coriander, Turmeric, Ginger and others)	41	0.3	130	0.7	+ 0.4
<u>Fruits</u>	89	0.6	287	1.5	+ 0.9
<u>Others</u>	2,326	15.8	2,486	13.2	- 2.6
<u>Total Cropped Area</u>	14,686	100.0	18,800	100.0	-

Source: Agricultural Statistics of Pakistan, 1980

### LIVESTOCK STRUCTURE

The total population of livestock as of the census of 1972 and 1976 with percent increase during the four year period is given in the following table:

Table 13. All Pakistan Livestock Population (,000)

Species	1972	1976	% increase over 1972
Cattle	14,674	14,855	1.2
Buffaloes	9,751	10,551	8.2
Sheep	13,667	18,937	38.6
Goats	15,581	21,693	39.2
Camels	731	789	7.9
Asses	1,901	2,157	13.5
Horses	391	439	12.3
Mules	55	61	10.9
Poultry	17,715	31,033	75.2

Source: Agricultural Statistics of Pakistan, 1980, Livestock Division, Islamabad

Important species of livestock in Pakistan are cattle, buffaloes, sheep, goats and poultry. The population of cattle virtually remained constant, while that of buffaloes increased by 8.2%. Sheep and goat population increased almost equally - 38.6% and 39.2% respectively; however, the highest increase (75.2%) was recorded in poultry population between 1972 and 1976. "

Province-wise distribution of livestock in 1976 is given below:

Table 14. Livestock Population (,000) by Provinces (1976)

Species	Punjab	%	Sind	%	NWFP	%	Baluch- istan	%	N. Areas	%	Total
Cattle	8108	54.6	2854	19.2	3000	20.0	684	4.6	209	1.4	14,855
Buffaloes	7919	75.1	1834	17.4	762	7.2	33	0.3	3	0.02	10,551
Sheep	8037	42.4	1829	9.6	3675	19.4	5075	26.8	321	1.7	18,937
Goats	7767	35.8	4237	19.5	4686	21.6	4441	20.5	562	2.6	21,693
Camels	338	42.8	144	18.3	95	12.0	212	26.9	-	-	789
Asses	1,139	52.8	373	17.3	381	17.7	244	11.3	20	0.9	2,157
Horses	286	65.1	94	21.4	29	6.6	23	5.3	7	1.6	439
Mules	29	47.5	2	3.3	28	45.9	2	3.3	-	-	61
Poultry	13,783	43.0	6,295	19.7	9,708	30.3	1,958	6.1	289	0.9	32,033
Total	47,400	46.6	17,662	17.4	22,364	22.1	12,672	12.5	1,411	1.4	101,515

Note: Livestock numbers, including poultry, have not been converted into animal units.

The provinces differ widely in geographical area and human population. For instance, Baluchistan has 43.6% of the geographical area, but only 5.13% of the total population. The correlation of livestock to human population is a better indicator of the importance of a species of livestock in a province than the geographical area. This is given below:

Table 15. Correlation of Livestock to Human Population

Species	Per Capita Livestock Population				
	Punjab	Sind	N.W.F.P.	Baluchistan	N. Areas
Cattle	0.17	0.15	0.27	0.15	0.09
Buffaloes	0.16	0.09	0.07	0.007	0.001
Sheep	0.17	0.09	0.33	1.18	0.014
Goats	0.16	0.22	0.41	1.03	0.25
Camels	0.007	0.007	0.08	0.05	-
Asses	0.02	0.02	0.03	0.05	0.009
Horses	0.006	0.005	0.003	0.005	0.003
Mules	0.0006	0.0001	0.003	0.0005	-
Poultry	0.29	0.33	0.89	0.45	0.13

### FOOD AND AGRICULTURE PRODUCTION

The following tables compare increases in agricultural production over the last decade with increases in other countries.

Table 16. Index<sup>1/</sup> of Food and Agricultural Production 1969 and 1980

	Food Production		Total Agricultural Production	
	1969	1980	1969	1980
World	97	126	97	125
Africa	98	120	98	118
North & Central America	98	124	98	122
South America	97	144	98	139
Asia	97	132	97	131
Europe	97	122	97	122
Oceania	98	123	98	116
China	96	137	96	138
U.S.S.R.	94	115	94	115
India	95	127	96	127
Pakistan	97	138	97	136

<sup>1/</sup>1969-71 = 100

Source: FAO Production Yearbook, 1980, Vol. 34

Table 17. Index <sup>1/</sup> of Per Capita Food and Agriculture Production 1969 and 1980

	Per Capita Food Production		Per Capita Total Agricultural Production	
	1969	1980	1969	1980
World	99	105	99	104
Africa	100	91	100	89
N. and C. America	99	107	99	106
S. America	100	112	100	108
Asia	100	108	100	107
Europe	98	116	98	116
Oceania	100	105	100	99
China	98	119	97	119
U.S.S.R.	95	105	95	106
India	98	101	98	101
Pakistan	100	101	100	99

<sup>1/</sup>1969-71 = 100

Source: FAO Production Yearbook, 1980, Vol. 34

Although Pakistan's increases in food and total agricultural production indexes were among the highest in 1980 compared to 1969, per capita production remained virtually stationary because of the rapid increase in population.

#### AGRICULTURE IN PAKISTAN'S ECONOMY

Agriculture is the main foundation and the pivotal sector of Pakistan's economy. Although its contribution to the Gross Domestic Product (GDP) has shrunk over the years due to structural changes and relatively faster growth in non-agricultural sectors, yet it is the mainstay of the country's economy and is likely to remain so for a long time to come. It accounts for 32% of the GDP, employs 55% of the total labour force (72% of rural and 6% of urban), supports directly or indirectly about 70% of the population, contributes 80% (36% from agricultural and 44% from agro-based commodities) of the foreign exchange earnings and provides raw materials for major industries like cotton textile and sugar as well as for medium/small-scale industries. It is therefore evident that the prosperity of the country and the welfare of the vast majority of the people are intimately interwind with the efficient harnessing of the agricultural resources of the country.

There is a general impression that with the rapid industrialization made recently and implementation of ambitious industrial development programs in the future, agriculture would soon lose its importance in Pakistan. This is not likely to happen in the foreseeable future. Industrial development in Pakistan has, so far, depended primarily on consumers in urban areas and raw materials from the agricultural sector. Future accelerated industrial growth would mainly depend on the effective

demand of the vast rural population, who derive their income chiefly from agricultural pursuits. A sharp increase in population or in income levels, and further development of the jute, cotton, rice, vegetables, fruits, oil, sugar, milk, meat and wool industries would also need increased supplies of agricultural materials. It is, therefore, unrealistic to believe that there can be any significant economic development in Pakistan without radically increasing productivity of agriculture. In fact, agricultural development, overall economic development of the country and social welfare of the majority of the population are critically inter-dependent in Pakistan. Agriculture has, therefore, to be given high priority in planning for research and economic development.

#### Imports and Exports

a. Imports - The total imports during 1978-79 were valued at Rs. 36,280 million. Of these, agricultural commodities, including fertilizers and agricultural equipments, constituted 30.44% of the total imports. Major commodities imported comprise wheat (9.64%), tea (3.31%), edible oil (7.30%), dairy products (0.72%), and agricultural equipments (1.96%). The following table shows imports of agricultural commodities during 1977-78 and 1978-79.

Table 18. Import of Agricultural Commodities of Pakistan During 1977-78 & 1978-79

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1. <u>AGRICULTURAL COMMODITIES</u>	<u>1977-78</u>			<u>1978-79</u>			<u>Percent change</u>
	<u>QUANTITY</u>	<u>VALUE<sup>1/</sup></u>	<u>PERCENT</u>	<u>QUANTITY</u>	<u>VALUE<sup>1/</sup></u>	<u>PERCENT</u>	<u>OVER 1977-78</u>
Wheat (000 M.T.)	1152	1336.6	4.81	2236	3505.1	9.64	+162.3
Tea (000 kgs.)	61932	1257.9	4.52	58722	1204.9	3.31	- 13.8
Edible Oil (000 kgs.)	267788	1053.3	3.79	411548	2653.2	7.30	+ 51.9
Dairy Products (000 kgs.)	37859	316.6	1.14	17897	176.2	0.48	- 44.3
Milk for infants (000 kgs.)	2232	47.5	0.17	4233	88.1	0.24	+ 85.5
Coffee (kgs)	58000	0.79	-	60584	1.76	-	+123.1
Ginger (M.kgs.)	0.02	0.75	0.04	3.89	22.13	0.06	+105.9
Potato Seed (M.kgs.)	1.16	7.16	0.03	-	-	-	-100.0
Tamarind (M.kgs.)	3016	6.84	0.02	1.98	4.85	0.01	- 29.1
Fertilizer (000 Tonnes)	496	1047.9	3.77	1499	2679.1	7.37	+155.7
Agric. Equipment (000 Nos.)	15	643.3	2.31	20	709.2	1.96	+ 10.2
Total	-	5728.6	20.60	-	11044.5	30.44	+ 94.0
2. <u>OTHER PRODUCTS</u>	-	22085.1	70.40	-	25236.4	69.56	+ 14.3
Grand Total	-	27813.7	100.00	-	36280.9	100.00	+ 30.7

<sup>1/</sup>Value in Million Rupees

Source: Pakistan Economic Survey 1978-79, Ministry of Finance, Economic Advisor Wing, Islamabad.

b. Exports - The total exports during 1978-79 (July-May) were valued at Rs. 14,596 million. Agricultural and agro-based commodities were valued at Rs. 11,765 million and constituted about 80% of the total exports. Major commodities exported include rice (23.0%), raw cotton, yarn, thread and fabrics (31.6%), sugar products (1.7%), leather (8.2%), carpets and rugs (0.5%), fish and fish products (30.0%). Comparative figures for 1977-78 and 1978-79 are shown in table 19.

Table 19. Earnings from Major Exports in Pakistan during 1977-78 &amp; 1978-79

<u>AGRICULTURAL CROPS AND CROP BASED COMMODITIES</u>	<u>1977-78</u>		<u>1978-79</u>		<u>PERCENT CHANGE OVER 1977-78</u>
	<u>VALUE<sup>1/</sup></u>	<u>PERCENT</u>	<u>VALUE<sup>1/</sup></u>	<u>PERCENT</u>	
Rice	2408.5	18.5	3354.6	23.0	+ 39.3
Raw Cotton	1093.6	8.4	657.3	4.5	- 39.7
Cotton Waste	16.1	0.1	7.9	0.1	- 50.9
Cotton Yarn	1059.5	8.2	192.9	13.2	+ 81.9
Cotton Thread	70.7	0.5	-	-	+100.0
Cotton Fabrics	1741.2	13.4	2009.4	13.8	+ 15.4
Guar Products	202.6	1.6	244.4	1.7	+ 20.6
Oil Cakes	98.9	0.8	50.9	0.3	+ 48.5
Tobacco Raw & Manufactured	126.1	1.0	54.9	0.4	- 56.4
Potatoes	-	-	21.3	0.2	+100.0
Rape & Mustard	-	-	50.9	0.3	+100.0
Total	6817.2	52.5	8379.5	57.4	+ 22.9
<u>LIVESTOCK ORIGIN COMMODITIES</u>					
Hides and Skin	-	-	12.02	0.1	+100.0
Raw Wool	72.8	0.6	96.90	0.7	+ 33.1
Leather	630.5	4.9	1197.80	0.2	+ 89.9
Foot Wear	71.6	0.5	73.49	0.5	+ 2.6
Animal Casings	26.4	0.2	21.50	0.2	- 18.6
Carpets & Rugs	1170.8	9.0	1538.0	10.5	+ 31.4
Total	1978.1	15.2	2939.7	20.2	+ 48.6
<u>FISHERIES</u>					
Fish and Fish Products	341.4	2.7	445.3	3.0	+ 30.4
Industrial Products	3843.7	29.6	2831.6	19.4	- 26.3
Total	4184.1	32.3	3276.9	22.4	- 21.7
Grand Total	2980.4	100.0	14596.1	100.0	+ 12.4

<sup>1/</sup>Value in Million Rupees

## AVAILABILITY AND DISTRIBUTION OF PRODUCTION INPUTS AND SERVICES.

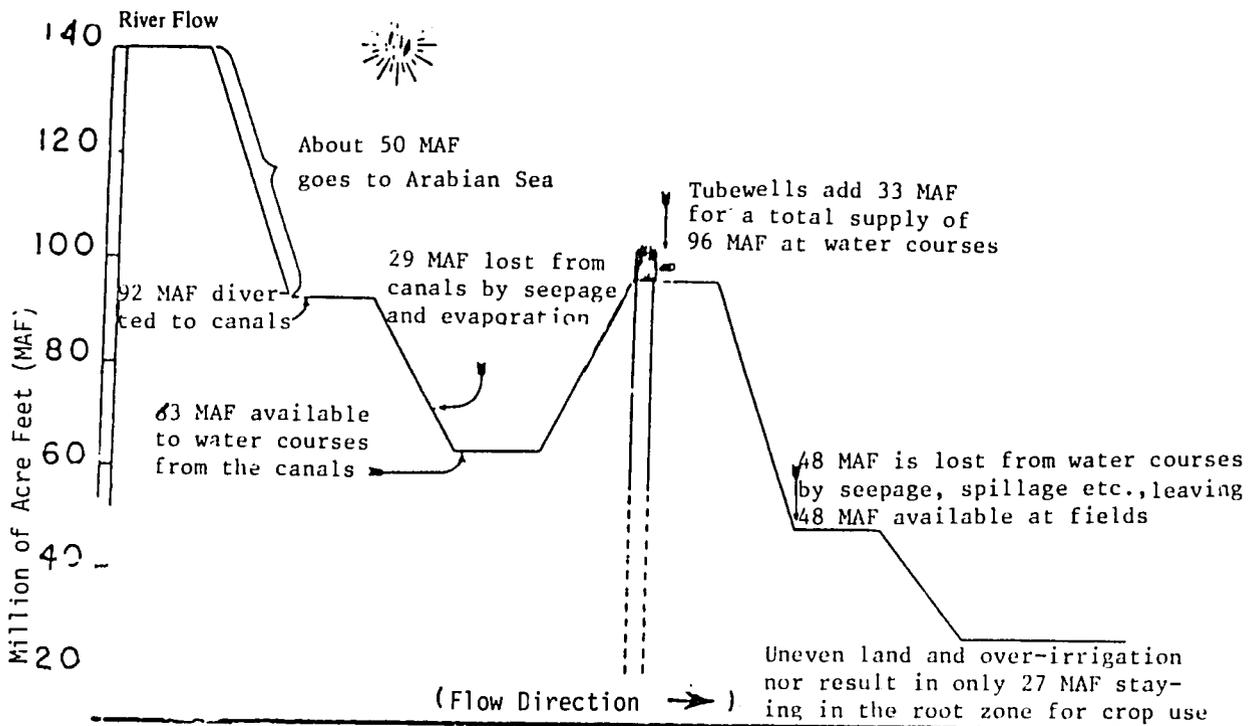
### Irrigation Water

Most of the water in Pakistan's huge irrigation system is going unused (Fig. 5). The Indus system is the largest integrated irrigation system in the World. It involves a highly complex network of dams, barrages, link canals, irrigation canals and ditches to carry the flow of the Indus, Jhelum and Chenab Rivers to irrigate 33 million acres on several million farms. Creation of the system has cost a tremendous amount in financial resources and human effort.

Measurement of the efficiency of water use indicates that Pakistan is achieving only a small fraction of the potential from this system. The low efficiency is mainly attributed to the large losses in the last two miles of the delivery system and on farmers' fields. These losses are major cause of water-logging which takes a heavy toll each year in the form of reduced crop yields. About 142 million acre feet of water enters into the system from the three rivers and 32 million acre feet of ground water are added by tubewells.

However, of this 174 million acre feet of water, less than 20 per cent is used by plants. If this ratio holds for the water stored by Tarbela Dam, less than two million of the nine million acre feet to be stored yearly will be available at the plant roots for the production of crops. Another one million acre feet of the water lost to seepage in the delivery system may subsequently be recovered by tubewells for crops use.

### WATER AVAILABILITY AND UTILIZATION IN PAKISTAN



**FIG. 5. WATER AVAILABILITY AND UTILIZATION IN PAKISTAN**

Watercourse improvement by farmers in pilot improved water management project areas has reduced seepage and other losses by 50%. Precision land leveling coupled with improved cultivation practices on the fields themselves can save more. Together, these practices can double the amount of water available for plant growth, making it possible to greatly increase average crop yields and reduce wastage of costly fertilizer.

The Government is making concerted efforts to increase irrigation facilities and optimise utilization of scarce water resources by installing new tubewells, improving water courses, land levelling and expanding irrigation extension services. The subsidy on tubewell installation has been increased to Rs. 24,000 for barani areas, Rs. 20,000 for Sailaba<sup>1/</sup> and Rs. 16,000 for canal commanded areas. 358 water courses were improved in the country and 126,000 water courses rehabilitated - 12,000 in Punjab and 600 in N.W.F.P. 8,783 tubewells were installed during 1979-1980 and another 8,820 are estimated to be installed during 1980-81.

Water availability at the farm gate was estimated at 96.43 MAF during 1980-81 (surface water 61.64 MAF and ground water 34.79 MAF) - an increase of 7.7% over the previous year. Releases from Tarbela were estimated at 8.41 MAF during 1980-81 compared to 7.18 MAF during 1979-80<sup>2/</sup>.

The total water availability at the farm gate during the five years (1975-76 to 1979-80) increased from 85.94 MAF to 94.14 MAF as given in Table 20.

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<sup>1/</sup>Sailaba is an urdu term meaning land covered with flood waters.  
<sup>2/</sup>Economic Survey of Pakistan, 1981.

Table 20. Water Availability at Farm Gate 1975/76 to 1979/80

Year	(Million Acre Feet)				
	Surface Water		Ground Water		Total Water Availability
	At Canal Head	At Farm Gate	Public T/wells	Private T/wells	
1975-76					
<u>Kharif</u>	62.91	37.75	3.08	9.71	51.55
<u>Rabi</u>	36.00	21.60	3.08	9.72	34.39
<u>Total</u>	98.91	59.35	6.16	19.43	85.94
1976-77					
<u>Kharif</u>	58.47	35.08	2.82	10.26	48.16
<u>Rabi</u>	38.86	23.32	2.83	10.26	36.41
<u>Total</u>	97.33	58.40	5.65	20.52	84.57
1977-78					
<u>Kharif</u>	64.53	38.72	3.11	10.80	52.63
<u>Rabi</u>	38.86	22.90	3.10	10.81	36.81
<u>Total</u>	102.69	61.62	6.21	21.61	89.44
1978-79					
<u>Kharif</u>	60.10	36.06	3.31	11.40	50.77
<u>Rabi</u>	36.53	21.92	3.31	11.39	36.62
<u>Total</u>	96.63	57.98	6.62	22.79	87.39
1979-80					
<u>Kharif</u>	68.22	40.93	3.52	11.98	56.43
<u>Rabi</u>	37.02	22.21	3.51	11.99	37.71
<u>Total</u>	105.24	63.14	7.03	23.97	94.14

Source: Agricultural Statistics of Pakistan, 1980.

### Fertilizers

Fertilizer application has played a key role in raising crop yields in Pakistan, largely in irrigated agriculture, since the advent of the green revolution, 1966-67. However, the annual increase in its use declined from 25 percent in the 1960's to 14 percent in the 1970's due primarily to rising prices of fertilizers relative to crop prices following the oil price shock of 1973. The offtake substantially increased from 1975-76 to 1979-80, but there was very little increase (3.4%) in 1980 over the previous year.

Fertilizer offtake (nitrogen, phosphate and potash) for the period 1971-72 to 1980-81 is given in Table 21 below:

Table 21. Fertilizer Offtake - Pakistan 1971-72 to 1980-81

(000, Nutrient tons)								
Period	NITROGEN		PHOSPHATE		POTASH		TOTAL	
	Quantity	Annual Percent- Change	Quantity	Annual Percent- Change	Quantity	Annual Percent- Change	Quantity	Annual Percent- Change
1971-72	344.0	-	37.2	-	0.7	-	381.9	-
1972-73	386.4	12.3	48.7	30.9	1.4	100.0	436.5	14.3
1973-74	341.9	- 11.5	58.1	19.3	2.7	92.9	402.7	- 7.7
1974-75	362.9	6.1	60.5	4.1	2.1	- 22.2	425.5	5.7
1975-76	443.4	22.2	108.5	79.3	1.9	- 9.5	553.8	30.2
1976-77	511.0	15.2	117.9	8.7	2.4	26.3	631.3	14.0
1977-78	554.1	8.4	157.3	33.4	5.8	141.7	717.2	13.6
1978-79	684.3	23.5	187.9	19.5	7.6	31.0	879.8	22.7
1979-80	806.0	17.8	228.5	21.6	9.6	26.3	1044.1	18.7
1980-81	842.7	4.6	226.9	- 0.7	9.6	-	1079.2	3.4

Source: National Fertilizer Development Centre, Government of Pakistan, 1981.

The domestic production of various kinds of fertilizers in Pakistan for the period 1975-76 to 1979-80 is shown in Table 22:

Table 22. Fertilizer Production in Pakistan

Variety	(Metric Tons)					
	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
1	2	3	4	5	6	7
Urea	603558	590048	596539	603715	619069	978943
CAN	70750	64500	69327	107911	198982	272671
AS	97257	100400	95395	97833	98868	96642
NP(23:23)	-	-	-	33465	137230	171378
SSP	59021	66000	83366	107025	101198	101814
Total	830586	820948	842509	949949	1155347	1621448
Nitrogen	316455	309276	312466	334007	388831	590900
Phosphorus	10624	11880	15006	26961	49778	57400

Source: Pakistan Fertilizer Statistics, NFDC, April 1980.

The local production being inadequate, the Government had to import substantial quantities of various fertilizers to make up the deficiency. Table 23 gives the import figures of fertilizers for 1975-76 to 1979-80.

Table 23. Import of Fertilizer 1975-76 to 1980-81

Year	(Metric Tons)					
	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
AS	-	-	-	-	-	-
AN	-	-	-	-	-	-
Urea	59893	120864	435674	653539	726262	479132
ASN	-	-	-	-	-	-
NP(20:20)	-	11.000	-	-	-	-
NP(23:23)	29092	180815	437751	442376	363905	255478
NP(24:24)	-	-	-	5565	-	-
MAP	11000	-	-	-	-	-
DAP	211356	209313	226277	221040	126489	481872
NPK(10:20:20)	-	-	-	4253	5333	-
NPK(15:15:15)	-	-	-	-	-	-
TSP	-	-	-	-	-	-
MOP	-	-	-	-	-	-
SOP	-	5000	4182	18027	5333	44000
Total	311341	526992	1103884	1344800	1227322	1260482
Nutrients:						
Nitrogen	73496	137061	341823	443922	441079	365898
Phosphorus	109195	140071	204770	205611	142948	280420
Potassium	-	2500	2091	2865	14074	22000
Total	182691	279632	548684	659398	598101	668318

Source: Pakistan Fertilizer Statistics, NFDC, 1981

The sale of fertilizers is subsidized to keep the prices at reasonable levels. The Government, however, had to increase the prices in February 1980 because of the rise in price in the International Market. The old and new prices are given in Table 24. These include a subsidy of Rs. 2,454 million.

Table 24. Sale Prices of Fertilizers Rupees per 50 kg bag

Varieties	Old Prices	New Prices <sup>1/</sup>
Urea	63.00	93.00
DAP	67.00	100.00
Am. Nitrate	36.50	50.00
Am. Sulphate	29.00	42.00
SSP	17.00	25.00
Nitro-Phos (23:23).	46.50	78.00
SOP	27.00	30.00

<sup>1/</sup>After February 1980

Source: Ministry of Food, Agriculture and Cooperatives.

Concerted efforts are being made to increase domestic production of fertilizers. A number of projects are under implementation. It is estimated that Pakistan would, to a considerable extent, become self sufficient in fertilizer production during the next five years.

### Improved Seed

Area under improved seed (wheat, paddy, maize and cotton) is being gradually increased. The quantity of improved seed distributed increased from 43.16 thousand M. Tons in 1975-76 to 61.06 thousand M. Tons in 1979-80.

Distribution of improved seeds through public agencies during the past five years (1976-78 to 1979-80) is given in Table 25.

Table 25. Distribution of Improved Seeds. (000,M.tons) 1975-76 to 1979-80

Province	1975-76	1976-77	1977-78	1978-79	1979-80
Punjab	33.18	65.69	40.65	38.79	50.55
Sind	6.76	23.21	5.43	6.00	6.27
N.W.F.P.	2.08	3.01	1.49	3.11	3.30
Baluchistan	1.14	1.64	0.85	1.06	0.94
Total	43.16	93.55	48.22	48.96	61.06

Source: Agricultural Statistics of Pakistan, 1980.

The following table gives crop wise distribution of improved seeds during 1975-76 to 1979-80.

Table 26. Cropwise Use of Improved Seeds. (000, M.tons) 1975-76 to 1979-80

Crop	1975-76	1976-77	1977-78	1978-79	1979-80
Wheat	26.35	50.84	30.21	29.78	41.01
Rice (Paddy)	1.31	2.91	0.69	1.36	0.78
Maize	1.53	0.97	0.59	0.22	0.39
Cotton	12.45	34.54	15.28	14.16	17.20
Gram	-	0.15	0.58	0.37	0.60
Potato	1.16	0.71	0.90	2.76	1.04
Oilseed	0.15	-	-	0.12	-
Others	0.21	3.43	0.17	0.19	0.04
Total	43.16	93.55	48.42	48.96	61.06

Source: Agricultural Statistics of Pakistan, 1980.

The International Bank for Reconstruction and Development (IBRD) is assisting in the Processing and distribution of quality seeds of important agricultural commodities. Three seed processing plants have been installed in the Punjab and one in Sind. In addition, three seed testing laboratories are being constructed at the plant sites to increase seed certification and testing facilities to 100 thousand tons per annum.

To encourage production of quality seed, the Government purchases approved seed from the registered growers at premium prices. Overhead charges on procurement and distribution of improved seeds are borne by the Government. The rates of subsidy and premium for the various crops in the four provinces are given in Table 27.

Table 27. Rates of Subsidy and Premium of Purchase of Improved Seeds

CROPS	Punjab		Sind		N.W.F.P.		Baluchistan	
	Subsidy	Premium	Subsidy	Premium	Subsidy	Premium	Subsidy	Premium
Cotton	10.00	10.00	-	4.0	19.00	-	-	-
Paddy	6.50	2.14	-	-	14.50	-	-	-
		5.35						
Maize	6.50	8.70	-	-	14.50	-	-	-
Wheat	7.48	2.50	-	8.50	14.50	6.00	6.17	8.0
		4.30						
Gram	6.50	2.00	-	-	-	-	-	-
Others	7.48	2.00	-	-	22.00	-	-	-

Source: Planning and Development Division

### Mechanization

Agriculture is being gradually mechanized. The use of tractors and improved implements is indispensable to increasing intensity of cultivation, bringing more area under the plough, making optimum use of rainfall in barani areas, meeting shortage of labour at sowing and harvesting time and saving drudgery to man and animals. The Government policy is to liberalise the import of tractors; arrange their supply, as well as spare

parts, to the farmers on cash or credit, standardise them and restrict import to only such makes as are economical and are best suited to local conditions. Arrangements have been made to import 150,000 - 29,000 tractors annually. 18,923 tractors were imported during 1979-80. Projects have been approved to, first, assemble and, later on, to manufacture tractors within the country. Most of the agricultural machinery and implements, including threshers and harvesters, are already being manufactured locally and widely used.

The Pakistan Agricultural Research Council, in collaboration with the International Rice Research Institute, has developed single shaft, axial flow. wheat threshers which are simple and easy to manufacture. Crop harvesters, paddy threshers, animal-drawn three-row grain seeders and three wheel farm carts are also being tested. Efforts are also being made to expand maintenance, repairs and training facilities in all the provinces.

Table 28 gives the number of tractors imported in Pakistan during the period 1968-69 to 1979-80.

Table 28. Number of Tractors Imported, 1968/69 - 1979/80

Year	Total (No.)	Cumulative Number
1968-69	4411	21534
1969-70	5696	27230
1970-71	3879	31109
1971-72	4224	35333
1972-73	1847	37180
1973-74	5216	42396
1974-75	7190	49586
1975-76	10809	60395
1976-77	15554	75949
1977-78	11902	87851
1978-79	15178	103029
1979-80	18923	121952

Source: Agricultural Statistics of Pakistan, 1980.

### Food Grain Storage

Shortage of food-grain storage capacity has been responsible for considerable post-harvest losses of cereals. The present Government has paid special attention in this regard and increased the storage capacity from 2.662 million tons in 1978-79 to 2.744 million tons in 1979-80. This is to be further increased to 3.338 million tons by the end of June 1981.

The National Logistic Cell is utilizing Rs. 120 million to complete 140,000 ton capacity binishell godowns and constructing wheat storage capacity of 30,000 tons in Punjab and Sind during 1980-81.

### Agriculture Credit

Credit facilities extended to the farmers during the five years (1975/76 to 1979/80) by the Agricultural Development Bank of Pakistan (ADBP) and the commercial Banks increased from Rs. 1340.3 to 2297.2 million, an increase of about 71%. Province-wise loan advances is given in the following table.

Table 29. Loans Advanced to Farmers by ADBP and Commercial Banks

Year	ADBP					Commercial Banks
	Punjab	Sind	N.W.F.P.	Baluchistan	Pakistan	
1975-76	353.9	123.3	26.1	28.9	532.2	808.1
1976-77	454.6	130.9	28.4	24.0	637.9	970.0
1977-78	329.0	73.2	25.8	1.8	429.8	1290.9
1978-79	292.1	87.7	32.2	4.4	416.4	1381.2
1979-80	538.4	137.6	29.4	4.4	709.8	1587.4

Source: Agricultural Statistics of Pakistan, 1980.

In addition, a substantial amount was advanced to the farmers in the form of taccavi loans - Rs. 69,792 million in five years time. However, the amount was reduced from Rs. 25.673 million in 1975/76 to Rs. 9.216 million in 1979/80 - as shown in Table 30.

Table 30. Taccavi Loans Advanced to Farmers

('000' Rs.)					
Year	Punjab	Sind	N.W.F.P.	Baluchistan	Pakistan
1975-76	11,700	6,581	2,441	4,951	25,673
1976-77	1,525	3,000	2,611	6,000	13,136
1977-78	1,920	1,070	2,861	3,150	9,001
1978-79	1,770	2,700	2,861	5,425	12,766
1979-80	1,437	2,170	-	5,509	9,216

Source: Agricultural Statistics of Pakistan, 1980.

Other important institutions which provide credit to the farmers are the cooperative societies. The loans advanced by these societies during 1978-79 and 1979-80 were Rs. 413.78 and 708.64 million, while the target for 1981-82 was fixed at Rs.2,694 million<sup>1/</sup>. The rate of interest was 12%. However, it was reduced by one percent for fixed agricultural investments, and for input loans up to Rs.5,000 a rebate of one percent was allowed if repaid within two months of harvesting.

The commercial banks, the biggest source of loans, have simplified procedures for granting production loans. The pass book system has been introduced and is being expanded. Small farmers owning 12.5 acres of land are granted input loans up to Rs.6,000 free of interest.

<sup>1/</sup>Source: Planning and Development Division

### Plant Protection

Losses in farm production due to various diseases and insect pests are estimated at 10-15 percent or more. Increasing attention is, therefore, being given to plant protection measures - both preventive and curative. The table below gives the area covered under aerial and ground operations during the last five years.

Table 31. Area Covered Under Plant Protection Measures

Year	(Million Spray Hectares)		
	Aerial Operations	Ground Operations	Total
1976-77	2.21	2.51	4.72
1977-78	1.32	2.62	3.94
1978-79	0.92	2.02	2.94
1979-80	0.38	1.74	2.12
1980-81 (Estimates)	0.52	3.04	3.56

Source: Planning and Development Division

The provincial governments (except Baluchistan) stopped the system of aerial spraying free of cost in February, 1980 because of rising cost of imported pesticides. The farmers have now to pay the cost of pesticides. The cost of operations is, however, provided free. The procurement and distribution of pesticides for ground operations has been transferred to the private sectors in the Punjab and Sind

The following measures are taken by the Government to improve the efficiency of the plant protection system:

- i) Supply of plant protection equipments at subsidized rates;
- ii) Training of farmers in plant protection operations;
- iii) Strengthening and further expansion of pest identification forecasting;
- iv) Supply of adequate credit for the purchase of pesticides and necessary equipment;
- v) Strengthening of research on the prevention and control of major pests and diseases;

The import and consumption of pesticides for the period 1975/76 - 1979-80 is given below:

Table 32. Import and Consumption of Pesticides 1975/76 to 1979/80

Year	Import		Consumption (M.Tons)
	Quantity (M.Tons)	Value ( '000' Rs.)	
1975-76	13258.3	310,415	
1976-77	16225.7	460,639	3404.3
1977-78	12754.4	254,464	4457.7
1978-79	7727.3	188,810	4096.1
1979-80	4419.1	167,655	1298.0

Source: Agricultural Statistics of Pakistan, 1980.

#### GOVERNMENT AGRICULTURAL DEVELOPMENT POLICIES

The Government Agricultural Development objectives and policy measures to achieve these, as stated in the fifth Five Year Plan (1978-1983) are to:

- (a) achieve a growth rate of 6.0 per cent per annum for the agriculture sector;
- (b) make a transition from self-sufficiency in wheat, as the main concern, to export, as the prime objective; increase production of rice for domestic consumption and export, and to increase export of other agricultural commodities to the extent feasible,

- based on proved natural advantages and world market prospects;
- (c) increase oilseeds production with a view to import vegetable oil;
  - (d) accelerate production of protein-rich foods such as pulses and meat, milk, egg and fish at a rate higher than the population growth in order to improve nutritional levels;
  - (e) accelerate production and productivity of cotton and sugarcane;
  - (f) accelerate fruit and vegetable production for local consumption and exports;
  - (g) upgrade agricultural production in the poorly endowed areas (arid, hilly, sailaba and barren) through integration; plans for exploitation of natural resources with a view to minimizing inter/intra-regional farm income disparities;
  - (h) improve productivity of small farmers in the irrigated areas who constitute majority of the farming community;
  - (i) diversify agriculture, possibly through multiple cropping system and by promoting such minor crops as soybean, sunflower, etc.; and
  - (j) increase and protect wooded area and develop range lands for livestock

The objectives were proposed to be achieved by taking the following major policy measures:

- (a) encouraging a cropping pattern which, in aggregate, helps meet plan targets, while promoting a regional cropping pattern best suited to soil and other local conditions; especially the acreage under wheat would be increased to maintain food self-sufficiency and area under cotton would be expanded to meet higher demand for industry and exports. A significant increase in area is

also planned for oilseeds, pulses, fruits and vegetables;

- (b) launching of vigorous breeding programs for evolution of new and improved varieties of seeds, particularly of oilseeds, pulses, feed/fodder, sugarcane crops, etc. and making radical improvements in the production and distribution of improved seeds;
- (c) ensuring timely availability at reasonable prices of such inputs as fertilizers, plant protection chemicals and equipments, primarily through local production, supplemented by imports when necessary;
- (d) maintaining a suitable relationship between input and output prices for adequate incentives for modernization and increased production, with gradual reduction in subsidies. The output prices of important crops would be supported by procurement, storage and marketing arrangements;
- (e) improving extension services and arrangements for training of farmers to promote rapid dissemination of farm skills and knowledge of improved farm practices;
- (f) coordinating more effectively farm-oriented research, education and extension services;
- (g) undertaking comprehensive rural development with special emphasis on agricultural production;
- (h) operating expanded, efficient, marketing cooperatives and credit programs;
- (i) evolving special programs and technologies for water management practices, particularly for small farmers, to increase production from irrigated agriculture;
- (j) evolution and introduction/adoption of suitable technology for

- the arid, hilly, rainfed and sailaba areas;
- (k) implementing extensive and intensive programs for the development and systematic exploitation of livestock, range and inland and marine fisheries resources;
  - (l) implementing well-planned programs of forest regeneration afforestation, including block and linear plantings, farm forestry and community planting with increased emphasis on forest management, conservation and environmental balance; and
  - (m) launching of extensive watershed management programs in suitable catchment areas.

Source: Fifth Five Year Plan (1978-83)

### Sectorial Priorities

The sector-wise break-up of the Public Sector program during the Fifth Plan (1978-83) is shown in Table 33.

Table 33. Sectorial Distribution of Public Sector Development Program 1978-83

(Billion Rupees)					
Sl. No.	Field of Development	Public Sector program		Total (Col. 3+4)	Percentage of Total
		ADP	Outside ADP		
1	2	3	4	5	6
1.	Agriculture	15.00	-	15.00	10.1
2.	Water	17.12	-	17.12	11.6
3.	Power	25.30	2.63	27.93	18.8
	(i) WAPDA	(21.47)	-	(21.47)	(14.5)
	(ii) KESC	-	(2.63)	(2.63)	(1.8)
	(iii) PAEC	(3.00)	-	(3.00)	(2.0)
	(iv) Others	(0.83)	-	(0.83)	(0.5)
4.	Fuels	3.87	1.72	5.59	3.8
	(i) OGDC	(3.72)	-	(3.72)	(2.5)
	(ii) Oil Exploration	-	(0.16)	(0.16)	(0.1)
	(iii) Gas Companies	-	(1.04)	(1.04)	(0.7)
	(iv) PARCO	-	(0.52)	(0.52)	(0.4)
	(v) Others	(0.15)	-	(0.15)	(0.1)
5.	Industry	13.10	7.90	21.00	14.2
6.	Minerals	1.00	1.00	2.00	1.3
7.	Transport and Communications	21.70	5.70	27.40	18.5
	(i) Railways	(6.77)	-	(6.77)	
	(ii) Highways	(7.73)	-	(7.73)	(5.2)
	(iii) Port Qasim	(1.97)	-	(1.97)	(1.3)
	(iv) Civil Aviation	(1.35)	-	(1.35)	(0.9)
	(v) Telegraph and Telephone	(3.70)	-	(3.70)	(2.5)
	(vi) Post Office and others	(0.18)	-	(0.18)	(0.1)
	(vii) RTCs	-	(1.75)	(1.75)	(1.2)
	(viii) KPT	-	(0.75)	(0.75)	(0.5)
	(ix) NSC	-	(2.00)	(2.00)	(1.4)
8.	Mass Media	0.75	-	0.75	0.5
9.	Physical Planning and Housing	8.80	0.98	9.78	6.6
10.	Education & Training	10.28	-	10.28	6.9
11.	Health	6.60	-	6.60	4.5
12.	Population Planning	1.80	-	1.80	1.2
13.	Tourism	0.50	0.02	0.52	0.4
14.	Manpower	0.70	-	0.70	0.5
15.	Social Development	0.20	-	0.20	0.1
16.	Rural Development Program	1.50	-	1.50	1.0

The agriculture and water sectors have been given an allocation of Rs. 32.12 billion - Rs. 15.00 billion for agriculture and Rs. 17.12 billion for water in the Fifth Five Year Plan (1978-83). This amounts to 21.7 percent of the total Plan outlay.

The main emphasis of the Plan has been on more rapid development of agriculture based on (a) efficient utilization of water resources, (b) expanded use of modern inputs and (c) creation of permanent institutions supporting continuous progress in this vital sector of the economy. Wheat self-sufficiency is to be attained during the plan period and substantial increases are projected for export of cotton and rice. New emphasis is placed on major crops and rainfed area development.

Substantial increases are provided in the allocation for drainage and reclamation, canal remodelling, new canals for better utilization of Tarbela water, continuous development of ground water resources and better on-farm water management. This would result in an increase of 2.5 percent per annum in the irrigated cropped acreage and considerable improvement in yield per acre.

Apart from the water development program planned, the yield improvement is based on greater use of fertilizer, improved seeds, disease and pest control, more credit and coverage by improved extension services. With suitable input and output pricing policies, these measures are expected to result in increased productivity.

The outlay of Rs. 17.12 billion in the water sector would help to provide an adequate supply of irrigation water, accelerate the anti-water logging and salinity program and undertake flood protection measures in the country during the Plan period.

### Price Strategy

The most important steps taken during 1980-81 by the Government to absorb the inflationary impact and stabilize prices of agricultural commodities are summarized below:

i) Imports.

These were restricted to only essential commodities to improve market availability and offset inflationary influence. These included wheat, tea, sugar, dairy products, edible oil and fertilizers.

ii) Production.

Due to rationalization of prices, commodity-producing sectors showed substantial gains during 1980-81. In the agricultural sector notable progress was made in wheat, sugar and cotton production. Similarly, major industrial items such as sugar, fertilizers, lumber, jute goods, cement, vegetable ghee, cigarettes also showed considerable increase.

iii) Distribution.

The streamlining of the distribution system materially contributes to stabilization of prices. Wheat flour and sugar are being distributed through ration depots at lower than the prevailing market prices. In addition, the Government has established 525 utility stores in the country which sell a wide range of agricultural and other commodities at reasonable prices.

A National Logistics Cell has been established at Karachi to ensure speedy transportation of essential agricultural and other commodities.

iv) Monetary

The Government monetary policy has been directed to boosting of domestic production and checking inflation. The use of credit for on-productive activities like hoarding and speculation is discouraged and monetary expansion is restricted.

v) Administrative.

The administrative measures adopted include:

- i) Surprise checking of stocks.
- ii) Requiring shopkeepers to display prices.
- iii) Periodic anti-profiteering drives.

vi) Others.

"Friday Bazars," originally started in Islamabad, have been extended to several cities and towns in the country. Here the primary producers sell their produce to the consumers at reasonable prices. It has helped to stabilize prices of many food and other essential commodities.

In the Punjab and Sind, an Agricultural Produce Market (Amendment) Ordinance has been promulgated under which functions of the market committees have been expanded to include establishment of cooperative stores, warehouses, and co-storage.

### Disadvantaged Groups

The policies of the Government, as laid down in the Five Year Plan, have emphasised measures to ensure: accelerated growth of agriculture; reduction in disparity of income and equitable distribution of the benefits of research and development within the farming community, particularly to include the small and landless farmers.

Both stated and apparent policies of the Government are designed to ameliorate the lot of disadvantaged groups. This is reflected in almost all government research and development activities. Preference is given to small farmers in the grant of loans on easy terms/free of interest and supply of seeds of high-yielding varieties, fertilizers, pesticides, and services of tractors, machinery/equipment at subsidized rates. Substantial assistance is also provided to encourage installation of tubewells. Policy directives are periodically issued by the Government to the federal and provincial research institutions to pay special attention to the the solution of problems of small and landless farmers. These are kept in view in project identification and formulation and in setting priorities.

Active participation of women in various economic and social welfare activities which are not in conflict with Islamic principles, is the declared policy of the government. A special division has been created at the federal level to look after the affairs of women and to promote their welfare. Training centres have also been established to impart training in certain skills to provide them productive employment. Other things being equal, women are given preference in employment, provided they fulfill the prescribed qualifications. The Government policy

is to provide equal opportunity for women in all walks of life, to protect their honour, to provide them facilities to lead respectable lives and to discourage discrimination against them in employment and socio-economic activities. They have the right to own agricultural and other property and to engage in farming and other productive activities of their choice. Poultry and dairy farming in rural areas are almost their exclusive concern. In most areas about fifty percent of the agricultural operations are performed by women and in certain areas their share in agricultural activities is even higher. Plans are near completion to establish two women's universities, with headquarters in Lahore and Karachi, to affiliate all women's colleges to these universities, and to provide them facilities for education in science and arts at the highest level.

### BRIEF REVIEW OF PREVIOUS REPORTS

Briefly reviewed below are important reports written during the past fifty years and dealing, either exclusively or partially, with the reorganization and improvement of agricultural research in the sub-continent before 1947 and in Pakistan after that date.

#### Report of the Royal Commission on Agriculture - 1926-27 (3)

This is the most comprehensive report thus far prepared on agricultural development and research in the sub-continent. It was the chief source for guidance in agriculture for a long time. However, most of its recommendations have already been implemented and it is now considered out-of-date.

#### Report of Sir John Russel and Dr. N. C. Wright - 1937 (4)

These two experts were invited by the Government of India to advise on agricultural and animal husbandry development in India. They made useful recommendations on development and research in the fields of agriculture and animal husbandry, particularly concerning dairying. Action on these recommendations have also been taken.

#### Report of Pakistan Agricultural Enquiry Committee headed by Lord Boyd-Orr - 1952 (5)

The main object of this committee was to suggest ways and means of increasing agricultural production immediately. It, therefore, dealt mostly with the development side of agriculture and did not make specific recommendations involving changes in the organization of agricultural research.

### Report of the Scientific Commission - 1959 (6)

This report dealt with the reorganization of the entire field of scientific research, including agricultural research. The Commission recommended, inter-alia, the establishment of five autonomous research councils, one of them being the Agricultural Research Council (ARC). The main recommendation regarding ARC was that it should be responsible for all research in the field of agriculture, including research in jute, cotton and tea, and that the present separate organizations for these crops should be merged into the ARC. This is one of the recommendations of the Scientific Commission on which action has not been taken as proposed.

### Report of Food & Agriculture Commission - 1959 (7)

This was a very comprehensive report. The Commission dealt in detail with almost all aspects of agricultural development in the country. A separate chapter was devoted to research, education and training and included 13 recommendations on the reorganization of agricultural research. Action on some of the recommendations has been taken either fully or partially. The recommendations which have not been implemented are:

i) Merging of Pakistan Central Cotton Committee (PCCC) and Pakistan Central Jute Committee (PCJC) with Agricultural Research Commission (ARC).

ii) Planning of research on a national basis.

iii) Creation of a separate section in the Agricultural Research Council for evaluation and publication of results of research.

All these points are discussed in detail later in this report.

Report of the Commission on National Education - 1961 (8)

This was a comprehensive document concerning national education. It dealt with all aspects of education including agricultural education. A few recommendations of a general nature were also made on agricultural research. These have been covered more adequately in subsequent reports.

Report of Brigadier Shaukat - Riza, T.Pk., and Lt. Col. F. B. Ali (1961) (9)

This report, too, dealt with the reorganization of all scientific research in the country including defence as well as agricultural research. Some of the general recommendations made in this report are valuable, and their implementation is bound to improve the pattern of scientific research in the country. They are worth reconsideration by the Scientific Committee now set up by the Government of Pakistan. As they do not deal exclusively with agricultural research, they are not discussed in detail in this report.

Agricultural Research Evaluation Committee, East Pakistan - 1962 (10)

This Committee was appointed by the East Pakistan Government in 1962, with the following terms of reference:

- i) To evaluate the work done by the various research sections;
- ii) To determine whether research facilities are adequate; whether the facilities available have been properly utilized; and what further facilities are required to increase the tempo of research;
- iii) To determine whether the extension workers have made full utilization of the results of other research work and whether results obtained have been utilized by farmers;

- iv) To suggest ways and means for improving (a) the quality and quantity of work, and (b) utilization of the results of research by the farmers and the extension workers.

The Committee was headed by Dr. M. O. Ghani, the then Vice-Chancellor, East Pakistan Agriculture University (EPAU) Mymensingh. An extensive review (388 pages) of agricultural research in East Pakistan was conducted by the Committee. As the subject has already been dealt with in a comprehensive manner, a fresh review of agricultural research in East Pakistan was not considered necessary. However, the recommendations made regarding improvement of agricultural research in East Pakistan have been taken into consideration in preparing this report.

Report of the Joint Pak-American Agricultural Research Review Team - 1968  
(II)

This is the latest report devoted exclusively to reorganization and improvement of agricultural research in Pakistan. It has been prepared jointly by Pakistani and American agricultural scientists. The Chairman, the Member/Secretary and two other members of the present Pakistan Agricultural Research Review Committee were associated with preparation of the report. The Joint Pak-American Team made 24 recommendations on reorganization of agricultural research. These have already been accepted by the Cabinet with minor modifications and are now in the process of implementation.

Report of the Ford Foundation Group - 1969 (12)

This was a brief report submitted by the experts of the Ford Foundation to the Government of Pakistan on the re-organization of agricultural research in Pakistan. Almost all the recommendations made by

this group were adequately covered in the report of the Pak-American Joint Agricultural Research Review Team.

A Note by Dr. Z. A. Hashmi, S.Q.A., to the President, Islamic Republic of Pakistan, on Re-orientation of Research to Develop a Science-based Agricultural Technology - 1967 (13)

In this note Dr. Hashmi made concrete recommendations regarding:

i) Re-organization of ARC to make it a viable organization;  
and

ii) Improvements in:

- (a) Research programs for the universities, research institutes and experiment stations.
- (b) Coordination of research.
- (c) Manpower for research.
- (d) Utilization of results of research.
- (e) Organization at the central government level for planning and policy-making; and
- (f) Allocation of funds for agricultural research.

Some of the recommendations by Dr. Hashmi have already been accepted by the Government. Others have been dealt with in the present report.

Report of Prof. Abdus Salam, F.R.S., Chief Scientific Advisor to the President of Pakistan "Towards a Scientific Research and Development Policy for Pakistan" - 1972 (14)

This report has drawn attention to the major weaknesses in Pakistan's research effort in science and technology, particularly:

- i) The diminutive scope of science in relation to the economy's technological needs and to the country's cultural sophistication.
- ii) The neglected development of the research effort in certain important spheres.
- iii) The lack of contact with international science.

These have been discussed in some detail and guidelines for remedial measures provided. They relate to the size of the national scientific effort; industrial research; agricultural research; linking of universities and research institutes; ending of isolation and administrative organization of Pakistan science.

The present report has been prepared keeping in view the guidelines provided by Prof. Abdus Salam in so far as they relate to agricultural research and development.

Report of Mr. Sami, A. Qureshi, C.S.P., on the Techniques of Agricultural Research Administration in the U.S.A. - 1971 (15)

This report deals with the facts about U.S. agricultural organizations for agricultural research at the federal and state levels and in the universities. The functions of the United States Department of Agriculture are discussed in detail. Also briefly discussed is the work of a few state universities, with particular reference to the cooperative research conducted in collaboration with the Federal Government and other agencies. The report concludes with 16 broad observations/recommendations for Pakistan. One of the major recommendations is the establishment of an agricultural university in N.W.F.P. and Sind Province and at least one more agricultural university in East Pakistan. Most of the recommendations

made are already covered in the report of the Joint Pak-American Team. The remainder are dealt with in the present report.

Report of the Joint Pak-American Agricultural Research Review Team - 1973  
(16)

Discussed in Chapter 3

Report of World Bank Mission - Pakistan, Agricultural Sub-Sector Review - 1980 (17)

Discussed in Chapter 3

Some Deficiencies of the Previous Reports (18)

Barring Joint Pak-American and World Bank Mission Reports.

- i) There has been no critical review of research conducted in the various fields of agriculture by commodity, discipline and institute during the past 30-40 years.
- ii) Most of the recommendations made previously were of a general nature, and were seldom supported statistically.
- iii) No effort has been made in the past to identify problems of economic importance requiring immediate attention to the various fields of agriculture to serve as guidelines for research in the future.
- iv) Some important administrative aspects of agricultural research, (have not been dealt within an adequate way) viz., the basis for allocation of funds, planning, evaluation, coordination, manpower, etc.
- v) Major emphasis in the previous reports had been on research and development of plant agriculture, and very little attention was given to animal agriculture or fisheries.

The present report takes these deficiencies into account. It encompasses knowledge of successful research and administrative mechanisms in the U.S.A. and in other countries, as well as observations made by the author (during the normal course of his duties and responsibilities) of the shortcomings of the present system.

## Chapter 2

SCOPE FOR AGRICULTURAL PRODUCTIONPOTENTIAL

Pakistan is blessed with a combination of geographical and climatological factors which provide it with a vast potential for increasing substantially agricultural production. The desired end is to adequately feed its large and rapidly growing population as well as to become a large exporter of food and other agricultural commodities.

The country has large areas of deep soil, favourable topography, suitable climatic conditions and waterwealth, which has already been developed into the largest canal irrigated system of the world to produce food, feed, and fibre crops in a multiple cropping system. The Indus River and its five tributaries constitute the lifeblood of Pakistan. The Indus basin is one of the world's greatest natural resources which, if properly developed, could be many times as productive as it is now. With about 50 million acres under cultivation and 100 m.a.f. of irrigation water at the farm gate, it should be possible to produce 100 million tons of food grains annually with these resources. At present it hardly produces one-sixth of that figure.

Out of 76 million acres of cultivable land, only 48 million acres are actually cultivated. The remaining 28 million acres can be brought under profitable cultivation by developing water resources, canal remodelling, improved water management, additional surface storage, introduction of suitable new varieties of crops and improved agronomic practices.

The yield per acre of major crops is far below their production potential. There is tremendous scope for increasing production with the

application of a science-based package of technology including high-yielding, disease-resistant, well-adapted improved varieties. At present, there is a 50-100 percent gap between yield per acre of major agricultural commodities normally obtained by average farmers using traditional methods compared to progressive farmers using the complete package of improved technology.

There are vast tracts of range lands - more than 50 percent of the country's land mass - which, if properly developed and judiciously exploited, could support a livestock industry of substantial size.

Pakistan is also fortunate in being the home of some fine breeds of cattle, buffaloes, sheep and goats, well-adapted to tropical and sub-tropical climatic and soil conditions. With the wide variation in their productivity, there is sufficient scope for exploitation of their genetic potential and available merit by selection as well as by crossing with suitable improved exotic breeds.

The country has vast inland marine fisheries resources, which are not being judiciously and fully exploited. There is considerable scope for the development of a sea and fresh water fishing industry by systematic surveys, research on breeding and seeding techniques, introduction of fast-growing species and improved fishing crafts and by development of better transportation and storage facilities.

The forest resources of the country are extremely inadequate, but they are of vital importance from the viewpoint of environmental protection, soil conservation and provision of timber and fuel wood. There is ample scope for the introduction/development of fast growing and early maturing species of trees for afforestation of dry lands, for increasing irrigated/sailaba plantations for production of medicinal herbs, and for

the improvement in watershed management to prevent loss of soil and silting of dams, built at colossal cost.

The following table gives the comparative yield per hectare of important agricultural crops in various continents/countries vis-a-vis Pakistan.

Table 34. Yields (kg/ha) Major Crops, by Continents and Selected Countries 1980

	Wheat	Rice (Paddy)	Sugar Cane	Cotton (Seed)	Maize
World	1873	2750	55671	1270	2995
Africa	1041	1714	64920	888	1222
N. & C. America	2125	4034	57647	1378	4734
South America	1297	1915	59330	939	1846
Asia	1631	2800	48850	1004	2242
Europe	3764	4890	67000	2139	4483
Egypt	3225	5752	84060	2675	4029
Turkey	1896	-	-	1892	2263
Mexico	3618	-	-	2323	1295
Japan	3052	5128	65764	NA	3000
India	1437	2049	48310	525	1103
Pakistan	1563	2400	38189	1002	1365

Source: FAO Production Year Book, 1980, Vol. 34.

### LIMITING FACTORS

Dispite the vast potential for increases in agricultural production, there are many obstacles.

Some of the main problems and limiting factors which constitute serious constraints in agricultural production are as follows:

- i) High pressure of population. The present (1981) population is about 83.7 million. It is projected to be about 130 million in the year 2000.
- ii) Fast increase in population - about 3% per annum. It is one of the highest in the world (world's average 2.5% per annum).
- iii) The man-land ratio of cultivated land is less than one acre per man.

- iv) Scope for bringing large additional areas under cultivation is limited.
- v) Yield per acre of major crops, per animal unit and per man is far below production potential.
- vi) Constant menace of water-logging, salinity and soil erosion by both wind and water.
- vii) Periodic occurrence of floods and droughts.
- viii) Wide-spread prevalence of insect pests and diseases of plants.
- ix) Continued deterioration of vast range lands and rapid devastation of arid and semi-arid tracts, which constitute two-thirds of the country.
- x) Forested areas are insufficient to meet the normal requirements of timber, fuel wood and other forest products.
- xi) Genetic potential of various classes of livestock is highly variable and, in the majority of cases, is below economic levels.
- xii) Performance of livestock is much below their optimum potential because of climatic stress, scarcity of balanced feed, wide-spread incidence of parasites and infectious diseases and a low level of husbandry.
- xiii) Lack of accurate information about potential commercial production under given conditions of sunshine, temperature, nutrients and oxygen supply to determine optimum output of fisheries.
- xiv) Lack of a well-organized, closely coordinated and properly integrated agricultural research system, particularly:

- a) Inadequacy of funds for agricultural research - 0.14% of the GNP compared to the minimum desired of 0.4 - 0.5% of the GNP.
- b) Serious shortage of trained manpower for research, particularly at the higher levels.
- c) Absence of effective linkage between education, research and extension.
- d) Lack of planning, coordination and evaluation of research at the various levels and weakness in collection, classification, publication and prompt dissemination of useful information to the farmers and other potential users.
- e) Absence of a communication, documentation and training centre for computer sciences and biometrics.
- f) Lack of an up-to-date service library in agriculture.
- g) Absence of a well-equipped centre for procurement, insufficient supplies and inadequate maintenance and repairs of sophisticated equipments.
- h) Lack of a well-organized germplasm introduction centre
- i) An excessive number of ill-equipped research stations, sub-stations, and laboratories, an absence of well-trained staff and inadequately funded national research institutes for major agricultural commodities/scientific disciplines.

- j) Lack of career advancement for promising and talented agricultural scientists with demonstrated capability for quality research.
- k) Lack of incentives for recognition of merit or production of scientific publications.
- xv) Continuous flow of population from rural to urban areas.

At present, the country is not producing enough food to meet even the caloric needs at the desired level. The availability of animal proteins is one of the lowest in the world. There is a chronic shortage of essential agricultural commodities like pulses, edible oils, tea, and dairy products, which have to be imported at a huge cost, involving a severe strain on the meager foreign exchange resources of the country and hampering the overall economic development of the country.

#### NEEDS FOR AGRICULTURAL RESEARCH

The exceptionally rapid growth in both economic demand and nutritional requirements for food in Pakistan would necessitate an annual growth rate of agricultural output of 4-5 percent. This will impose a heavy demand on limited agricultural resources and will require not only more intensive use of land, labour, water, fertilizers, herbicides, pesticides, machinery and equipments, but also greater efficiency of resource use output per hectare, per worker and per unit of input.

Incentives for higher production can come from higher product prices or lower production costs or both, but the incentives from higher prices are a burden on development, while those from lower costs are a source of development.

The major source of improvement in the overall efficiency of agricultural production will depend on the application of useful information and technology developed on the basis of carefully conducted research.

Expenditure incurred on agricultural research is one of the best forms of investment. Ghiliches (19) calculated that the return on the funds invested in the development of hybrid corn and related innovations provided a return of 700% annually. Arditto-Barletta (20) showed that from 1943 to 1963 Mexico received an annual benefit of 290% for every dollar spent on the cooperative corn and wheat improvement research program. Studies made in India by Evenson and Jha, Kahlon and Bah and Saxena and Jha (21) indicated rates of return of 40 to 60 percent for the economy as a whole. Apart from the rate of return, agricultural research has additional significance in that:\*

- it permits the substitution of knowledge for resources;
- it facilitates the substitution of less expensive and more abundant resources for more expensive or increasingly scarce resources;
- it releases the constraints on growth imposed by inelastic resource supplies;
- it diminishes hunger and ensures economic and political stability.

#### Research and Development (R&D) Defined

A bewildering number of terms appear in current literature to describe apparently different types of research. Some of these are speculative, fundamental, basic, academic, applied, operational, economic, developmental, utilization, problem-oriented, mission-oriented, production-oriented, curiosity-oriented, subject motivated, adaptive and market research, etc., causing considerable confusion

\*Ruttan, V. W. -

Paper presented at the A.I.D. Asia Bureau Agriculture/Rural Development Conference, January 13, 1981.

among the scientists. What their multiplicity really connotes is that research is a long and arduous process to be divided for convenience into several stages, all of which are likely to be part of a comprehensive research plan.

The definitions of R&D as a whole, and of three mutually exclusive categories of R&D as internationally agreed upon under the auspices of the Organization for Economic Cooperation and Development (OECD) and set out in the manual of standard practice for surveys of R&D are:

R&D AS A WHOLE

Creative work undertaken on a systematic basis to increase the stock of scientific and technical knowledge and to use this stock of knowledge to devise new practical applications.

BASIC RESEARCH

Basic research is original investigation undertaken in order to gain new scientific knowledge and understanding. It is not primarily directed towards any specific practical aim or application.

APPLIED RESEARCH

Applied research is also original investigation undertaken in order to gain new scientific or technical knowledge. It is, however, directed primarily towards a specific practical aim or objective.

EXPERIMENTAL DEVELOPMENT

Experimental development is the use of scientific knowledge in order to produce new or substantially improved materials, devices, products, processes, systems or services.

The adoption of these definitions in agricultural research would remove confusion among the researchers as well as the managers of research.

The research now being conducted in the universities is usually of an academic or a basic type and in the government departments/autonomous bodies it is of an applied nature, which, in most cases, is supposed to be economically worthwhile. A very small percentage of the basic

research is likely to pay-off immediately, but in a few cases it may lead to major or even revolutionary advances. However, at this stage of its agricultural development, Pakistan cannot afford the luxury of basic research on a large scale, especially when there is an extreme dearth of highly talented scientists, funds and sophisticated equipments. For the time being, the major emphasis will need to be on applied research. Nevertheless, a small percentage of investment in basic research would be highly desirable, as it is the only source of new ideas on which the practical advances for the future can be based and on which new contingencies can be effectively met:

#### Goals of Research

The quality and quantity of food, feed and fibre, available for the welfare of the people are dependent on information generated and technology developed through well-organized research. Continued agricultural research is necessary: (1) to open the way towards maintaining and improving production resources; (2) lowering cost of production; (3) improving quality; (4) finding newer uses of existing products; (5) evolving/introducing more profitable species/varieties/strains of plants and animals; and (6) devising new and better methods of growing, processing, distributing and utilizing farm products. Research should also find ways and means to control weeds, insect pests and diseases of plants and animals, to reduce wastages in production, and to improve transportation, storage and distribution. It must anticipate the economic problems involved in farming technology and help farmers to solve them. It should also anticipate industrial needs and arrange to meet them with adequate

and stable supplies of agricultural products. In short, agricultural research must find new agricultural efficiency in a combination of good farming, good marketing and good utilization.

### Chapter 3

#### THE AGRICULTURAL RESEARCH SYSTEM OF PAKISTAN

At present agricultural research is being conducted at both the federal and provincial levels (a mixed federal-state system) primarily by government departments, autonomous organizations and the three agricultural universities - one each at Faisalabad, Tando Jam and Peshawar. In addition, some traditional universities - Quaid-e-Azam University, Islamabad; University of the Punjab, Lahore; University of Karachi, Karachi; University of Sind, Jamshoro, and the University of Peshawar, also undertake research on certain aspects of agriculture.

#### EVOLUTION OF AGRICULTURAL RESEARCH IN PAKISTAN

Consequent on the introduction of the Montague Chelmsford Reforms in 1919, the Government of India vested the powers of superintendence, direction and control over "transferred" subjects, including agriculture and veterinary, in the provinces. No specific provision was, however, made in the constitution of 1919 for coordination of research either between the centre and the provinces or among the provinces.

Realizing the importance of research in agricultural development, the commission recommended the constitution of an imperial council of agricultural research to promote, guide and coordinate research throughout India; administer funds to supplement provincial activities in respect of agricultural research and training of research workers; act as a clearing house of information; establish bureaus for crops, animal husbandry, dairying and veterinary matters; and undertake publication work and arrange sectional meetings of experts in particular branches of agricultural sciences. After consideration of the recommendations of the commission, the

Government of India established the Imperial Council of Agricultural Research (ICAR) by a resolution dated 23 May, 1929. (23)

Before independence, the ICAR was mainly responsible for the promotion and coordination of research in the field of agriculture, animal husbandry, forestry and fisheries. In addition, there were a number of distinct and independent commodity committees, each having its own separate funds, organization and research stations.

#### The Food & Agriculture Committee

Soon after partition, the work of these organizations in the provinces which constituted part of Pakistan came to a stand-still. It was, therefore, considered necessary to make some arrangements to continue this work. A Food and Agriculture Conference was held at Lahore in October, 1947, to consider the problem, which recommended appointment of an Expert Committee to make recommendations for the establishment of a Pakistan Food and Agriculture Council to take over this work. The Expert Committee submitted its recommendations to the Government for the establishment of a comprehensive and fully representative Council.

It was felt that the implementation of the recommendations of the Committee would take considerable time because of financial and administrative difficulties involved. The Government of Pakistan, therefore, decided to set-up, as an interim measure, a small Food and Agriculture Committee, consisting of 16 members including the Minister-in-Charge of Agriculture as Chairman and the Secretary of Agriculture, Government of Pakistan as Vice-Chairman, vide Government of Pakistan, Ministry of Agriculture Notification No. F. 1-29/48-GC, dated 23rd October, 1948. The Committee had powers to co-opt other members as and when necessary.

The Committee was supposed to deal with all agricultural commodities except cotton and jute, for which separate committees were contemplated,

and after necessary legislation, is was to receive funds in the same way and from the same sources as the following organizations in undivided India:

- (i) Indian Council of Agricultural Research
- (ii) Indian Oilseeds Committee
- (iii) Indian Lac Cess Committee
- (iv) Indian Coconut Committee
- (v) Indian Central Sugarcane Committee
- (vi) Indian Central Tobacco Committee

The functions of the Committee included the functions of these organizations and in particular were:

- (i) to promote scientific, technological, social and economic research and education relating to food and agriculture;
- (ii) to coordinate agricultural research and to make recommendations regarding priorities among various research schemes; and
- (iii) to acquire and disseminate knowledge about food and agriculture.

It was also decided that the headquarters of the Committee would be at Karachi.

#### The Food & Agriculture Council

Later, the Food and Agriculture Committee was replaced by the Food and Agriculture Council, Pakistan, vide Government of Pakistan, Ministry of Agriculture Notification No. F. 1-31/51-FAC, dated 13th December, 1951, with the same functions. It consisted of 50 members and a Governing Body of 20 members. The Minister for Agriculture and the Secretary of Agriculture, Government of Pakistan, were made the Chairman and Vice-Chairman of the Council and the Governing Body, respectively.

It was also decided that the Council would have powers to set-up advisory committees of not more than seven members each in designated subjects.

As a result of integration of provinces of West Pakistan into one unit, revision of the constitution of "The Food and Agriculture Council, Pakistan" was considered afresh.

It was decided to: -

- (i) include Secretaries of Departments of Finance and Food and Agriculture of East and West Pakistan;
- (ii) include one Director of Agriculture and one Director of Animal Husbandry in West Pakistan in the Council as against Directors of Agriculture and Animal Husbandry of the various divisions now comprising West Pakistan;
- (iii) include Deputy Secretary (Agriculture Ministry) Surveyor General of Pakistan, Director/Deputy Director of Research, Animal Husbandry, in the Food and Agriculture Council, Pakistan Secretariat and one more representative of Ministry of Food in the Council;
- (iv) increase the number of representatives of growers from 4 to 6;
- (v) increase the number of representatives by one on account of the establishment of Rajshahi University in East Pakistan;
- (vi) have two members to be nominated by the Central Government instead of three as at present;
- (vii) exclude representatives of states and ministers previously in charge of Agriculture in divisions now comprising West Pakistan.

The number of members in other cases and those of the Governing Body remained unchanged. The Council then consisted of 56 members as against 59.

The constitution of Food and Agriculture Council Pakistan was again revised in 1959 and the number of members was reduced to 39 in order to make it a business-like organization.

### The Agricultural Research Council

The Food and Agriculture Council, Pakistan, continued to perform the functions assigned to it up to 1964, when in pursuance of the recommendations of the Food and Agriculture Commission (1960) it was replaced by the Agricultural Research Council vide Government of Pakistan Notification No. 4-4/62-ACI/E-III, dated 26th November, 1964 and the following functions were assigned to it:

- (a) to organize, coordinate and promote scientific research in various fields of agriculture and allied subjects;
- (b) to arrange for the utilization of the results of research conducted in institutes and laboratories associated with the Council;
- (c) to review the need of agricultural research on a national basis, and, if necessary, establish, with the prior approval of the Standing Organization Committee research institutes or other organizations for the purpose of undertaking special studies and research in agriculture and allied fields;
- (d) to publish, or otherwise disseminate, technical and general information on scientific matters relating to the research work of the Council;
- (e) to establish a scientific liaison with other national and international organizations connected with the scientific duties of the Council;
- (f) to accept fees, donations, grants, endowments; and
- (g) to make grants and award fellowships and scholarships for training in the field of agricultural research.

It consisted of 24 members. Mian M. Afzal Hussain, H.Q.A. was appointed as part-time Chairman of the Council. He resigned in May, 1966 due to reasons

of health. Minister for Agriculture and Works, Government of Pakistan was then appointed as Chairman of Agriculture and Works as its Vice-Chairman. Later on, it was decided that the provincial Ministers of Agriculture should also be appointed as Vice-Chairman of the Council to ensure association of the provincial governments with the Agricultural Research Council at the highest level. As the Agriculture Produce Cess Act 1940, under which the Agricultural Research Council was set-up, provided for the appointment of only one Vice-Chairman, the Act was amended by the National Assembly of Pakistan in 1968 to permit appointment of more than one Vice Chairman of ARC and the two Provincial Ministers for Agriculture were appointed as Vice-Chairman of ARC.

#### The Joint Pak-American Review Teams

In order to give real support and impetus to agricultural research, it was felt necessary that without a strong and viable research strategy the program could not succeed. In order to achieve tangible and meaningful results through the agricultural research and extension network, the Government appointed a Joint-American Agricultural Research Review Team in 1968 to make critical appraisal and evaluation of past and present research work and to recommend strategies for the future. Most of the recommendations of the Joint Team were approved by the Cabinet. On the basis of one of the major recommendations of this team, the Agricultural Research Council was re-organized with a view to make it a viable and effective agricultural research organization at the national level with the following functions:

- (a) to serve as the technical arm of the Ministry of Agriculture;
- (b) to identify problem areas, develop and finance well-balanced and closely coordinated programs of agricultural research, on a long-term basis;

- (c) to establish research centres as and when necessary, to fill in the gaps in the overall program of agricultural research;
- (d) to organize seminars, symposia, conferences and group discussions of research workers to enable them to review progress and plan their work along profitable lines;
- (e) to award scholarships or fellowships and training grants for subjects within the sphere of the Council to foster the upgrading of research personnel;
- (f) to finance travelling of suitable research workers abroad to attend conferences and to visit research institutes and laboratories, where outstanding work in their respective fields is being conducted;
- (g) to act as a clearing house of information and support the publication of results of research;
- (h) to establish liaison with international organizations concerned with the activities of the Council;
- (i) to establish or assist in establishing:
  - 1) libraries
  - 2) museums
  - 3) herbaria
  - 4) plant introduction centers and germplasm banks
- (j) to maintain national registers for:
  - 1) research workers in agriculture and allied fields
  - 2) research projects underway
- (k) to accept grants, fee, donations and endowments, and
- (l) to perform any other function which may be assigned to the Council by the Federal Government.

The second Pak-American Team again reviewed the position in 1973 and strongly felt that there was urgent need for strengthening of agricultural research capabilities in the country. Consequent upon their recommendations a loan agreement was made with USAID on the subject with specific objectives and targets in 1974. The USAID approved project consisted of:

- i) a dollar loan in the amount of \$6,200,000 (the 'Loan') obligated by the Loan Agreement dated April 30, 1974 (the 'Loan Agreement') to finance technical assistance, training and commodities.
- ii) dollar grants aggregating \$762,000 (the 'Grants') obligated by AID Project Agreements Nos. 74-4, 75-1 and 76-3 (the 'Project Agreement') to finance technical assistance, and
- iii) a rupee grant in the amount of Rs. 115,000,000 (the 'Rupee Grant') obligated by Project Agreement No. 74-4 to help finance local costs of new facilities, implementation of research programs and operational costs.

The performance of the Council was reviewed in 1977. The implementation of the project was considered rather unsatisfactory, and it was felt that major changes were needed in the overall administration and management of the agricultural research system in Pakistan. The project was, therefore, redesigned and divided into phase-I and phase-II. The main purpose of phase-I in the redesigned project was establishment of an institutional base. The activities to be completed by July, 1980 were specified and are enclosed as Annex.IV. An in-depth evaluation of phase-I was conducted in May-June, 1979 in accordance

with detailed terms of reference, guidelines and indicators concerning the tasks to be accomplished by the Agricultural Research Council to determine whether to proceed to Phase-II of the project.

The replies furnished indicated that most of the tasks assigned to ARC were accomplished and documentary evidence was furnished in support thereof. These were carefully considered and the Joint Evaluation Team was of the view that satisfactory progress had been made in establishing a research management system and recommended approval of the project to proceed to Phase-II.

#### Greater Functional Autonomy for the Council

In order to strengthen the agricultural research system and provide greater autonomy and flexibility, the following steps were taken by the Government of Pakistan.

- a) The Council was made an almost fully autonomous body at the Federal level to work in close coordination with the Ministry of Food and Agriculture, provincial agriculture departments, agriculture institutes and the agriculture universities.
- b) An outstanding scientist was appointed as a whole-time Chairman with the status of Federal Secretary to Government of Pakistan for a term of five years.
- c) A special notification No. 2-1/78-E-III (ARC) dated September 17, 1978 was issued (Annex.V) which, inter alia, included:
  - 1) reconstitution of the ARC primarily consisting of scientists and progressive farmers.

- 2) establishment of an Executive Board comprising the Chairman, ARC as its Chairman and four other members - Member (Plant Sciences), Member (Animal Sciences), Member (Social Sciences) and Member (Finance), who are also whole-time members of ARC.
- d) ARC was re-named as PARC (Pakistan Agricultural Research Council) vide Govt. Notification No. F.2 (2)/79-ARC dated 7.1.79.
- e) A separate Agricultural Research Division was created in the Ministry of Food, Agriculture and Cooperatives and Dr. Amir Muhammed was appointed as Secretary to Government of Pakistan for the newly created Division in his personal capacity for a period of two years on contract basis.
- f) A new ordinance was passed to provide greater functional autonomy to PARC, redefine its mandate and functions as a national organization, remove the anomaly created by the abolition of the former Attached Department to provide for the transfer of the civil servants working thereunder to the Council, etc. Annex. I (A) & Annex. I (B).

#### World Bank Mission (22)

The Government of Pakistan (GOP), recognizing the need to upgrade the agriculture research system, requested the World Bank to send an international team to review the research sub-sector. In October-November, 1979, a team, led by Sir Charles Pereira, identified problem areas in the organization, management and execution of agricultural research and made recommendations for improvement in line with the country's development priorities.

The Identification Mission in February, 1980, also led by Sir Charles Pereira, found that it was practical to implement some of the recommendations of the sub-sector Review Mission within the context of an immediately realisable investment project. Following proposals outlined by the Identification Mission, PARC prepared a project on strengthening PARC's capability to manage an enhanced national research effort and also to expand and initiate research facilities and programs in some agreed areas of joint federal/provincial concern at an estimated cost of about Rs.400 million including a foreign exchange component of Rs. 240 million (US\$ 24 million), for a period of five years.

Broad objectives of the project proposal were to:

- a) strengthen PARC as the central organization responsible for initiating, planning, coordinating, monitoring and evaluating research in Pakistan;
- b) establish national research institutions to cover gaps in the present research effort and encourage the development of a national outlook in selected research institutions;
- c) increase the input from agricultural economics at the federal and provincial research level;
- d) promote cooperative research schemes involving staff and facilities from both federal and provincial institutions;
- e) provide the trained manpower necessary to ensure adequate growth in the agricultural research sub-sector; and
- f) provide experts to develop research programs in areas neglected because of lack of trained personnel.

### THE PAKISTAN AGRICULTURAL RESEARCH COUNCIL (PARC)

PARC is the premier agricultural research organization in the country. Formerly, its charter did not include in-house research under its own administrative control. Its activities were mainly confined to promotion/financial support of agricultural research and to acquisition and dissemination of information relating to agriculture. The first Pak-American Agricultural Research Review Team (1968), inter alia, recommended allocation of the following additional function to PARC:

"...to establish research centre as and when necessary to fill in the gaps in the overall programs of agricultural research."

This was approved by the Government and included in the functions assigned to PARC.

At present the PARC has the following research establishments directly under its control:

- a) National Agricultural Research centre (NARC), Islamabad
- b) Cereal Diseases Research Institute (CDRI)
- c) Arid Zone Research Institute, Quetta (AZRI) with Sub-stations D. I. Khan (NWFP), Bahawalpur (Punjab) and Umerkot (Sind).
- d) Plant Protection Research Units, Karachi
- e) Vertebrate Pest Control Center, Karachi
- f) National Herbarium and Museum.

The National Agricultural Research Centre: NARC is located in the Islamabad Federal Capital Area near Rawal Dam. Total area of the Centre is about 560 hectares.

The main objective of NARC is to conduct research in areas of national importance where such research is currently not being undertaken

or is seriously inadequate and where the research can best be done at a central institution. Special emphasis is being placed on the agricultural problems of the rainfed areas. The in-house research under various national coordinated programs is also being conducted at this centre.

Besides research facilities in various disciplines, the centre will have an up-to-date reference library, a germplasm introduction centre and an Agricultural Economics Research Institute on the main campus. It will also organize special courses for the provincial scientists and organize national-level symposiums and workshops on various subjects.

Cereal Diseases Research Institute: This institute is located at Islamabad, with sub-stations at Murree and Karachi. The institute conducts research on cereal diseases, as well as on diseases caused by viruses, nematodes and bacteria. An important role is being played by this institute in the screening of disease-resistant crop varieties, particularly of wheat.

Arid Zone Research Institute: The Arid Zone Research Institute, with headquarters at Quetta (Baluchistan) and sub-stations at Bahawalpur (Punjab), D.I. Khan (NWFP), and Umerkot (Sind) has been established to develop techniques for efficient land use and increased agricultural productivity in arid areas of Pakistan. The institute plans to develop an integrated approach to devise farming systems for different types of arid areas in the country.

Plant Protection Research Units: A small plant protection research station has been established in Karachi. It comprises several research units dealing with pesticide analysis, locust research, plant pathology and

stored grain entomology. A National Insect Museum and a National Mycological Herbarium are also located at Karachi. It is planned to link all the research stations in the country dealing with various aspects of pest management with a National Pest Management Research Institute, which will be located in Islamabad.

Vertebrate Pest Control Centre: This is a UNDP - assisted project. It is located on the campus of the University of Karachi, but is under the administrative control of PARC. It deals with research on vertebrate pests of field crops and also provides training facilities to agricultural extension workers for the control and eradication of vertebrate pests in the country.

National Herbarium and Museum: The Council maintains a small herbarium at Islamabad. At present, the collections comprise about 60,000 mounted specimens. Accounts of 131 families have already been printed and work on the approximately 70 remaining families is in progress. It is planned to expand the unit into a national herbarium which will be located at the NARC and will provide adequate facilities. A small mycological herbarium containing important species of fungi is also being maintained at Karachi. An insect museum which also contains collections received from the Indian Council of Agricultural Research, Delhi at the time of the division of India, was set up at Karachi. The collections represent the insect fauna of both Pakistan and India.

National Coordinated Research Projects: The following National Coordinated Research Projects are currently in operation under the auspices of PARC:

- a) Wheat, Barley and Triticale
- b) Rice

- c) Maize, Millet and Sorghum
- d) Oilseeds
- e) Potato
- f) Forage and Fodder
- g) Improving Water Measurement and Control System Development.

In addition, proposals for coordinated projects on the following topics have been formulated. These are being processed and are expected to be started during 1981-85:

- a) Pulses
- b) Sugarcane and Sugarbeet
- c) Horticulture
- d) Spices, Medicinal and Aromatic Plants
- e) Research and Development of Farm Machinery
- f) Post-harvest Technology
- g) Water Management and Soil Salinity
- h) Soil Fertility and Micro-nutrients
- i) Barani (Rainfed) Research System
- j) Integrated Control of Insect Pests
- k) Dairy Cattle Cross Breeding
- l) Animal Nutrition
- m) Reproductive Physiology

PARC is also engaged in active research on the following projects:

1. Pest management studies and research for the development of integrated pest control program, for major field crops (paddy, maize, cotton and sugarcane).
2. Estimation of the consumptive use of water for major crops in Pakistan under optimum management conditions.

3. Research on honeybee management in Pakistan.
4. Research on special crops such as jute, tea, coffee and ginger.
5. Research on improvement of dairy animals.
6. Research on fisheries production in Pakistan.
7. Storage stability of pesticides and their residues on crops in Pakistan.
8. Studies on the long-term effects of gamma rays on some important pests of stored cereals.
9. Further studies of economically important plant families of Pakistan.
10. Plant introduction.

Collaborative Research Programs: The Pakistan Agricultural Research Council is the coordinating agency for all PL-480 agricultural research Projects in Pakistan in collaboration with The United States Department of Agriculture (USDA).

Collaborative agricultural research projects between Pakistan and USDA are commonly known as PL-480 agriculture research projects and were started in 1967. The major fields covered by these projects are:-

Crops,  
Range Management and Forestry,  
Plant Protection  
Soil and Irrigation  
Agricultural Economics  
Animal Husbandry including Poultry

There are 90 PL-480 research projects under execution in 35 government departments, universities, research institutes and colleges.

Since 1967, a total of 121 research projects have been completed. At present 88 research projects are under execution and 20 are being negotiated with USDA. Over 500 university professors, scientists and research workers are engaged in the execution of these projects. These scientists are assisted by more than 1,000 workers involved in the collection and analysis of data. About 100 eminent U.S. scientists who regularly review the progress of research collaborate in the research work carried out by the Pakistani scientists.

#### OTHER ORGANIZATIONS

In addition to PARC, other main organizations/institutes engaged in certain aspects of agricultural research at the federal level are:

a) Ministry of Food, Agriculture & Cooperatives

- 1) Pakistan Central Cotton Committee, Karachi.
- 2) Pakistan Forest Institute, Peshawar.

4. Department of Plant Protection, Karachi.
  - 3) Soil Survey of Pakistan, Lahore.
  5. Directorate of Marine Fisheries, Karachi.
- b) Ministry of Commerce  
Pakistan Tobacco Board., Peshawar.
- c) Ministry of Science and Technology.
1. Pakistan Council of Scientific and Industrial Research  
- Karachi, Lahore and Peshawar.
  2. Pakistan Science Foundation, Islamabad.
  3. Pakistan Leather Board. Karachi.
  4. Irrigation, Drainage & Flood Control Research Council.  
Islamabad.
- d) Ministry of Water and Power  
Water and Power Development Authority
- e) Atomic Energy Commission
1. Atomic Energy Agricultural Reserach Centre, Tandojam.
  2. Nuclear Institute for Agriculture and Biology, Faisalabad.
  3. Nuclear Institute for Food and Agriculture, Tarnab.

These receive funds from various sources and develop their programs independently, with little or no coordination with federal or provincial agricultural research institutes.

#### FEDERAL/PROVINCIAL RESEARCH ESTABLISHMENTS

Sixty-five institutes (19 federal and 46 provincial) have been established in the country to undertake research in the various sub-sectors of agriculture as per details given below:

A map of the principal Agricultural Research Establishments is given on next page.

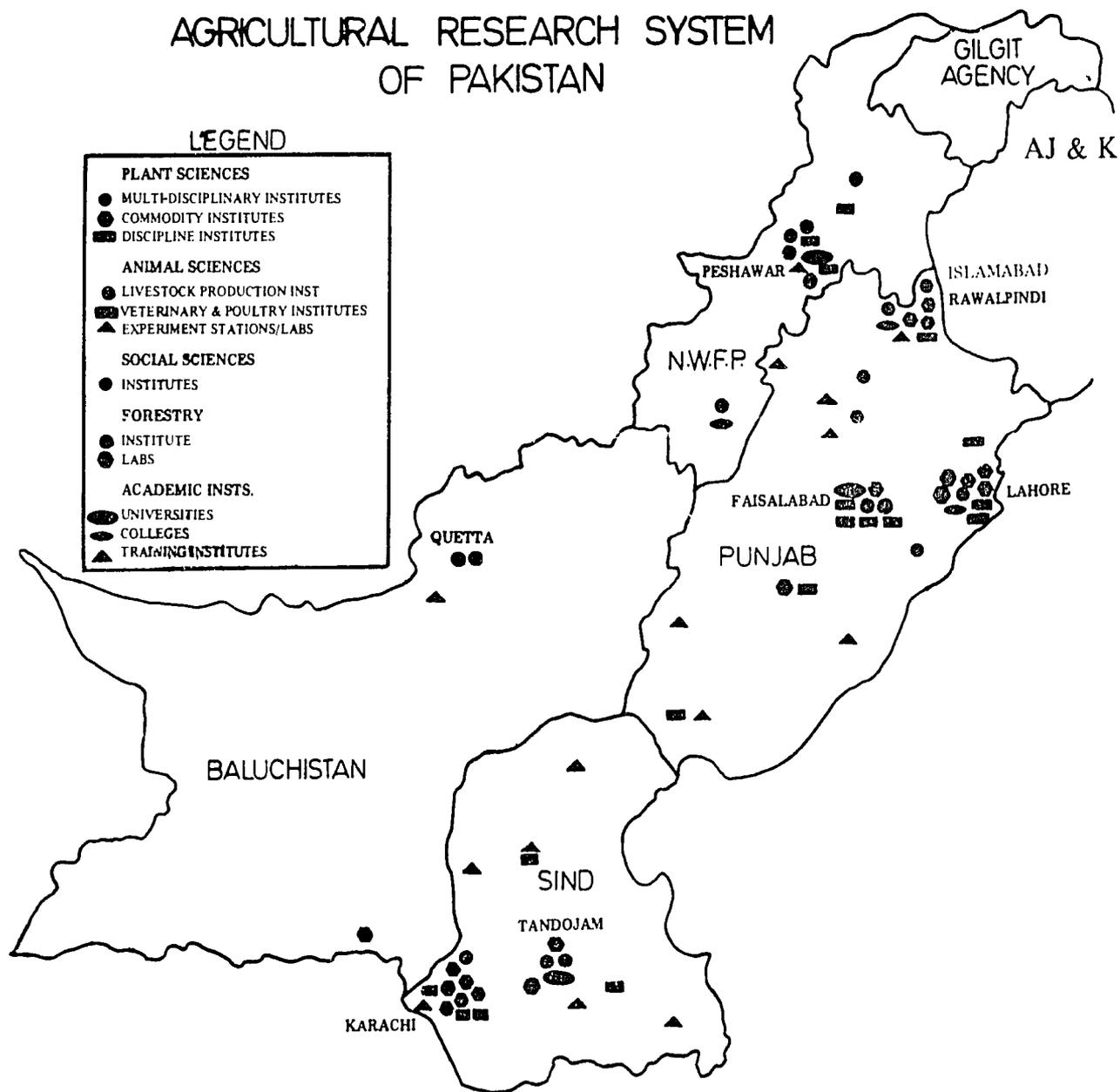


FIG. 6: AGRICULTURAL RESEARCH SYSTEM OF PAKISTAN

Table 35. Sector-wise Number of Federal and Provincial Research Institutes

Sector	Federal	Provincial				Total
		Punjab	Sind	N.W.F.P.	Baluchistan	
Agriculture	17	11	4	2	1	35
Livestock	-	11	7	2	-	20
Forestry	1	2	1	-	-	4
Fisheries	1	1	-	-	-	2
Universities/ Colleges	-	2	1	1	-	4
<b>Total</b>	<b>19</b>	<b>27</b>	<b>13</b>	<b>5</b>	<b>1</b>	<b>65</b>

Source: Directory of Research Establishments in Agriculture, National Science Council (unpublished).

Of the 19 federal research establishments, three are located in the Federal Capital, six in the Punjab, six in the Sind, three in NWFP and one in Baluchistan. Annex. (II) gives details of research institutes with respect to their locations, manpower and annual budget for the year 1977-78.

In addition, a large number (162) of stations, sub-stations, centers, sub-centres and laboratories have been established by the federal and provincial governments in the various parts of the country - 21 have been established by six federal government agencies and 141 by 16 provincial government agencies (Annex. (III)).

The main weaknesses observed are:

- a) The research institutes are not equitably distributed to cater to the specific needs of various agro-ecological zones;
- b) There is an excessive number of research establishments. Most of these are neither well-staffed nor properly equipped to undertake worthwhile research;
- c) In several cases the research efforts are so thinly dispersed that returns are zero or even negative.
- d) The status of agricultural research is particularly weak in the Sind, NWFP and Baluchistan.

## RESEARCH RESPONSIBILITIES - FEDERAL/PROVINCIAL GOVERNMENTS

There are three main systems for management of agricultural research in most of the Asiatic Countries. Under the "concentrated" management system, agricultural research and extension are highly centralized and the educational institutions play only modest roles in agricultural research.

Under the "diffuse" management system, agricultural research is conducted by a diverse group of research institutes, centres, colleges, universities and commissions with little coordination among them.

Under the "mixed" management system, agricultural research is conducted by both federal and provincial research institutes, centres, colleges and universities of agriculture. This system is currently in operation in India and Pakistan but with the difference that, whereas there is effective coordination of agricultural research and education at the national level by the Indian Council of Agricultural Research, such is not the case in Pakistan. There is an urgent need for delineation of responsibilities between the federal and provincial government and for a suitable mechanism for close and effective coordination among all organizations engaged in agricultural research.

The question of responsibility between the federal and provincial governments was thoroughly debated at the time of framing the present Constitution of Pakistan (1973). The Fourth Schedule (Article 70(6) of the Constitution of the Islamic Republic of Pakistan (1973) (24) provides a federal legislative list stating functions relating to agricultural research, training and education that are the exclusive responsibility of the federal government, and a concurrent legislative list of functions which are the concurrent responsibilities of the federal and provincial governments. According to these lists, the establishment of libraries,

museums and herbaria; institutes for research, technical training and special studies; planning and coordination and undertaking surveys at the national level, including fishing and fisheries beyond territorial waters, are the exclusive responsibilities of the Federal Government, while environmental pollution and ecology; development of curricula, syllabi, establishment of Centres of Excellence; maintenance of standards of education and statistics on all subjects, including agricultural research, are the concurrent responsibilities of the Federal and the Provincial Governments.

The PARC's main functions center around the following:

- a) Promote research in the field of agriculture and allied subjects by funding mission-oriented research projects submitted to PARC for financial assistance.

This function has never been challenged. In fact, the provincial governments always insist on greater financial assistance by PARC. However, the Council meets its obligations to the extent possible within its limited financial resources.

- b) Undertake both applied and basic research as well as experimental development pertaining to the problems of barani, arid, semi arid and high-altitude dry areas of the country and other areas where provincial research is either non-existent or is seriously inadequate.

There is difference of opinion on this item and, therefore, it needs elaboration:

This question was thoroughly debated in the joint meeting held at Islamabad and attended by the provincial secretaries of agriculture, Vice-Chancellors of agricultural universities and other top-ranking agricultural scientists of the federal and the provincial Governments. It was chaired by

the Secretary to Government of Pakistan, Ministry of Food and Agriculture, to consider the recommendations of the First Pak-American Joint Agricultural Research Review Team (1968). The Joint Committee, inter alia, recommended the following to be included in the functions of the Council. "To establish research centres as and when necessary to fill in the gaps in the overall program of agricultural research." This was approved by the Cabinet vide memo. No. 36/CM/70 Dated 29.12.70, and is in line with the constitutional provision (entry 16 of Federal Legislative List refers).

PARC's main object is to supplement and not supplant the provincial efforts in the field of agricultural research to ensure overall balanced development of agriculture in all the provinces.

The Council would like to make up the deficiencies primarily in cooperation/collaboration with the provincial governments by developing nationally-coordinated research projects and strengthening the research capability of the provinces, especially the smaller provinces whose status of agricultural research is particularly weak.

- c) Determine priorities, plan, coordinate and review agricultural research at the national level.

This item also needs clarification and elaboration:

Firstly, the planning and coordination of scientific and technological research are the responsibilities of the Federal Government (Entry 32 of the Federal Legislative List refers) to be discharged by a federal agency.

Secondly, there is need for planning, coordination, and review of agricultural research at the national level, which has already been discussed and adequate justification provided therefor.

Thirdly, the main object of this function is to identify deficiencies in the provincial agricultural research wherever they exist and provide the necessary financial and technical support to implement their research programs along profitable lines.

Fourthly, the members of the Council (a majority from the provinces) have repeatedly emphasized the need for the formulation of a 5-year National Agricultural Research Plan (both short and long-term) by the PARC, which should be sufficiently flexible to permit modifications as and when needed in the light of changing circumstances or new contingencies which may arise from time to time.

A centralized planning/coordination and decentralized execution system of agricultural research in a country with a federal form of government is more desirable than isolated planning and compartmentalization of research.

- d) Develop and implement Nationally-Coordinated Research Projects relating to major commodities/areas/disciplines in cooperation with the Provincial Governments.

A number of nationally-coordinated commodity research projects are already in operation and more will be gradually developed in cooperation with the provinces as funds and trained manpower become available. All provincial governments have agreed to this arrangement. In fact, they have asked for expansion of activities in this regard.

- e) Maintain liaison and develop collaborative agricultural research projects with international organizations engaged in agricultural research.

Liaison with international organizations on agricultural research can only be maintained by a federal agency like PARC through the Economic Affairs

Division, as required in the Rules of Business. It, therefore, does not need any further elaboration.

- f) Maintain and continuously update statistics on various aspects of agricultural research. This function is currently not being performed by any organization in the country.

PARC is the only organization which can and should undertake this task on an 'All Pakistan basis' and supply the requisite information to all concerned.

- g) Strengthen the research capability of the provincial governments by providing facilities in the form of library services, research information, advanced training within the country and abroad with international assistance, supply of sophisticated equipments, its maintenance and repairs and services of experts as and when needed by the provinces for specific tasks, and supply of improved exotic germplasm both of plant and animal origin.

This hardly needs any elaboration as it is most beneficial and useful for the provinces, provided the obligations listed are effectively discharged by PARC.

- h) Organize seminars, symposia, workshops and conferences at the national and international levels.

Whereas seminars, symposia, etc., at the provincial level are organized by the provincial governments in their respective jurisdictions, those at the national and international levels have to be organized by PARC, for obvious reasons. This is the current practice and there is no difference of opinion on this subject.

- i) Establish a national museum and a national herbarium in cooperation with provincial governments.

National museums and herbaria are maintained by almost all countries of the world to act as repositories of all specimens available in the country for reference, record and training. The provinces do not object to this and are cooperating with PARC in this undertaking.

It would thus be seen that most of the functions assigned to PARC are so designed as to promote, provide supporting services and strengthen the research capability of the provincial governments. PARC proposes to undertake in-house basic research and applied research only in those areas where provincial research does not exist or is seriously inadequate and that, also, will be conducted mostly in cooperation with, and active participation of, the provincial governments in the form of Nationally-Coordinated Agricultural Research Projects.

#### FUNDING OF AGRICULTURAL RESEARCH THROUGH PARC

The PARC has the following sources of funds available for research:

- 1) Cess Funds
- 2) Government of Pakistan Funds
- 3) PL-480 Funds
- 4) Funds from other agencies

Until recently (1981) the PARC had its own sources of funds generated through the Cess Funds. These funds were collected by the Custom Department and passed on through the Federal Government's accounting agencies, i.e. the Accountant General's office, to the PARC. With the promulgation of the new ordinance, cess collected on export of agricultural commodities will no longer be available to PARC. The Council has, however, been assured adequate financial support by the Federal Government as grant-in-aid.

Projects financed by Government of Pakistan Funds are first approved by the Government through the regular planning process, i.e. the

projects are submitted for approval to the Government on a PC-1 form. They are first examined by the Ministry of Food and Agriculture and then by the Central Development Working Party. After their approval, if the amount is beyond its authority (Rs. 20 million or above), it is sent to the Economic Committee of the National Economic Council. Once a project is approved, yearly allocations are made by the Government of Pakistan in its Annual Budget. These allocations are released to the PARC in monthly installments. The PARC releases this amount to the projects in quarterly installments. The projects are to submit quarterly reports which are scrutinized by the Accounts Department of the PARC. Auditors of the Government of Pakistan audit the accounts of these funds annually.

The PL-480 financed projects are governed by the U.S. Foreign Agricultural Research Grant Program. These funds are earmarked after a project has been approved by the regular procedure as laid down by U.S. Department of Agriculture. The detailed rules and procedure relating to use of these funds is given in Annex. (V.)

As regards funds from other sources, the main source is the USAID Funds. The USAID is at the moment sponsoring a project known as the 'Strengthening of Agricultural Research Capabilities in Pakistan'.

According to the established procedure of Government of Pakistan, all foreign aid is negotiated by the Economic Affairs Division and passed on to the beneficiary concerned through the budgetary mechanism so that they are reflected in the Federal Government Accounts. In accordance with the Government instructions in force at present, the aid received from USAID is negotiated by Economic Affairs Division and after the agreement for the loan/grant is signed, the cheque for the aid/loan is issued by USAID in the name of Secretary, Ministry of Finance. The Finance

Division then sends the cheque to State Bank of Pakistan for crediting the amount to Federal Government Account No. 1 (Non-Food) under the head 'Foreign Aid Deposit Account' in section 'P-Deposits and Advances' under advice to Agriculture Ministry for placing the amount at the disposal of Pakistan Agricultural Research Council with reference to budget provision in the relevant grant. Necessary administrative sanction for the release of a specified amount is then issued by the Ministry of Food and Agriculture to the AGPR. Islamabad/Rawalpindi is to place the said amount in the Personal Ledger Account of the Pakistan Agricultural Research Council with Government Treasury/Bank. When the funds are placed in the Personal Ledger Account of this Council, the required amount is withdrawn/utilized, keeping in view the annual budget against such funds, after receipt of proper expenditure sanction issued by the competent authority of the Council.

#### Procedures for Expenditure of Research Fund

PARC is charged with the responsibility of promoting scientific, technological, social and economics research and education relating to food and agriculture. Its function is also to coordinate agricultural research and to acquire and disseminate knowledge about food and agriculture and its allied fields. The activities of the organization have been mainly confined to financing of research schemes submitted by provincial governments, central government, departments and universities and institutions of agriculture, animal husbandry, fisheries and forestry, etc. The schemes which are considered of economic importance and are technically sound, are being approved by the Council and financed out of Cess Funds. The schemes or projects are considered by a technical committee and the finances needed for the completion of the schemes are worked out

along with the schedule. These schemes are put up to the Executive Board, where the Member (Finance) has an opportunity to comment upon the costing of the schemes. When it is approved, it is passed on to the finance side for providing budget support. The amount financed for the year is allocated sector-wise and the Finance Department is informed about the allocation. The budget as a whole is approved by the Council.

The procedure of payment under provincial, central universities and institutions schemes are as under:-

(1) Provincial Schemes--the existing procedure for financing the schemes sponsored by the provincial governments is:

- a) The Council will advance 75% of its share of annual expenditure of the sanctioned schemes to sponsoring authorities for the implementation of the scheme. Due to financial stringency the funds are now being released quarterly instead of being paid 75% advance.
- b) The drafts, cheques, etc. received from the PARC should be deposited in the treasury under respective head of account.
- c) The provincial governments should make necessary provision for each year's expenditure on the scheme in their own budget.
- d) The administrative approval should be issued by the provincial governments for the implementation of schemes.

These central schemes are being made after pre-auditing the bills in the PARC in the same manner as is being done by the AGPR in respect of Central Departments paid out of general revenue.

(2) Universities/Institutions Scheme--Under university schemes, 75% of the first-year budget provision of the scheme is being advanced under the project at the time of issuing its sanction, enabling the authorities to

implement the scheme. Monthly expenditure statements of the scheme are submitted to PARC regularly on the prescribed proforma which is supplied to them along with the sanction letter. These incoming expenditure statements facilitate the account section of the Council to watch the expenditure under the project and release further advances in time. The accounts of the schemes are also being audited by the audit party of the Council.

## Chapter 4

CRITICAL ELEMENTS OF AGRICULTURAL RESEARCH IN PAKISTAN

In this chapter basic elements of Pakistan's agricultural research system are examined critically, especially with respect to funding, planning, coordination and staffing. Suggestions for improvement are offered.

FUNDING OF AGRICULTURAL RESEARCH

The total annual budget allocation of agricultural research establishments (1977-78) including that of agricultural universities/colleges was Rs. 277.4 million - federal 119.00 (42.9%) and provincial Rs. 158.4 million (57.19%).

Sectorwise allocation of funds are given in the following table.

Table 36. Annual Budgetary Grant for Agricultural Research

Level	Sector of Performance (In Million Rs.)				Total	Univer- sities/ colleges	Total (6+7)	Percent
	Agri- culture	Live- stock	Fisher- ies	Fores- try				
Federal	131.8	-	3.1	4.9	139.8	-	139.8	40.8
Punjab	88.0	24.1	0.4	1.2	113.7	32.3	146.0	42.7
Sind	18.0	4.0	-	0.2	22.2	11.5	33.7	9.8
NWFP	14.0	1.9	-	-	15.9	3.3	19.2	5.6
Baluchistan	3.6	-	-	-	3.6	-	3.6	2.3
Total Provincial	123.6	30.0	0.4	1.4	155.4	47.1	202.5	59.2
Total Federal + Provincial	255.4	30.0	3.5	6.3	295.2 (0.17 of GNP)	47.1	342.3	100.0

Source: Directory of Research Establishments in Agriculture, National Science Council (unpublished).

The total GNP of the country (1977-78) was Rs. 168,761 million and the contribution of agriculture to the GNP was Rs. 49,370 million, about 30%. The total expenditure on agricultural research - federal and provincial comes to 0.17% of the GNP. This does not include the expenditures on universities/colleges, as these organizations are primarily concerned with teaching and training and have little specific financial allocation for research. Even if it is assumed that 10% of the funds of agricultural educational institutes are spent on research, the position regarding expenditure on agricultural research as a percentage of the GNP is not altered significantly.

There is no hard and fast rule to determine an optimal level of expenditure for research. The advanced countries have, however, realized that science and technology are extremely powerful tools which help them in achieving their national goals. As a consequence, large resources, amounting to 2-4% or more of the GNP, are allocated for research. By contrast, modern science has not been pursued to the same extent in developing countries. At present, as a group, they hardly allocate 0.1 - 0.3% of their GNP to research, which is far below the production threshold need.

PROGRESS OF BUDGET POSITION OF PARC  
1973-74 to 1982-83

The total annual budget of PARC in 1973-74 including development, non-development, P.L. 480 funds, Cess Fund and contribution of donor agencies was Rs.11.12 million. This was increased to Rs.61.71 million in 1978-79 (Annual average Rs.63.17 million). Thereafter with concerted efforts of Dr. Amir Muhammed who, was appointed as whole-time Chairman of PARC, the budget position was substantially increased to Rs.202.17 million in 1982-83 during the short period of five years - an increase of about 1718 percent over 1973-74 with an annual average of Rs.145.8 million (details in Annex-XIII.)

<u>BUDGET POSITION OF PARC(73-74 TO 82-83)</u>				
Years	Rs. million	Year	Rs. million	% Increase
73-74	11.12	78-79	67.18	504
74-75	43.07	79-80	92.06	114
75-76	73.74	80-81	125.29	70
76-77	124.23	81-82	246.52	98
77-78	61.71	82-83	202.17	228
Total:	313.87		729.22	132
Annual Average	63.17		145.8	130

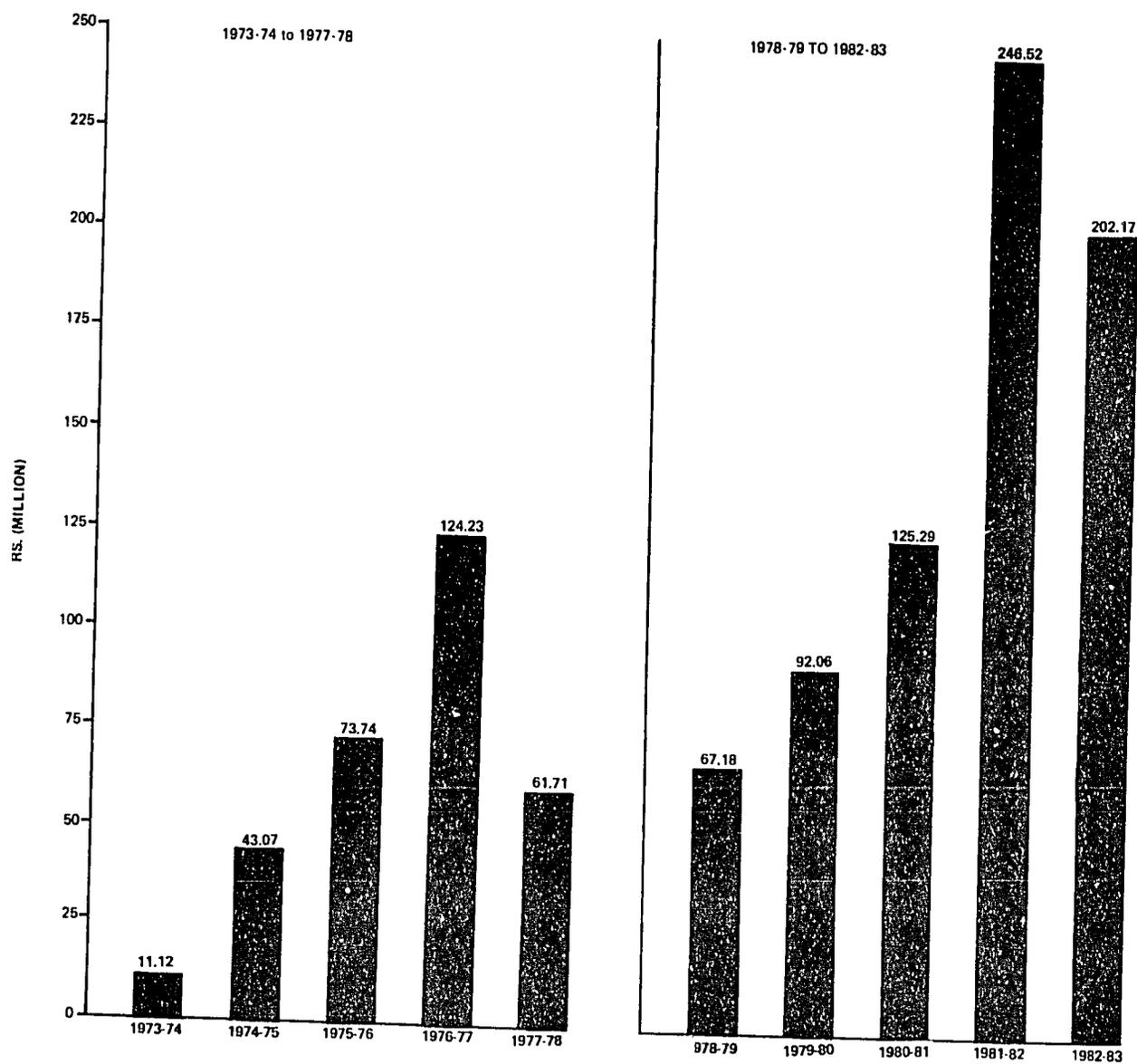


FIG. 7. PROGRESS OF BUDGET POSITION OF PARC – 1973-74 TO 1982-83

Table 37. Share of Agriculture GDP as % of GDP/GNP at Current/Factor Cost (1979-1980/Provisional)

	Million Rupees Current Factor Cost 1979-80 Provisional	(Million Rupees) Constant Factor Cost 1979-80 Provisional
Gross Domestic Product (GDP)	210,604	50,189
Gross National Product (GNP)	217,617	53,193
Agr. GDP	66,272	15,851
Agr. GDP as % of GDP	31.47	31.58 or 32%
Agr. GDP as % of GNP	29.12	29.80 or 30%

Source: Economic Survey of Pakistan, 1979-80.

Table 38. Expenditure for Research and Development as % of GNP

<u>Africa</u>			<u>Europe</u>		
Egypt	(1973)	0.8	Belgium	(1977)	1.4
Ghana	(1976)	0.9	Bulgaria	(1978)	2.2
Kenya	(1975)	0.8	Czechoslovakia	(1978)	4.2
Madagascar	(1971)	0.9	Denmark	(1979)	1.0
<u>North America</u>			Finland	(1979)	1.1
Canada	(1977)	1.1	France	(1977)	1.8
U.S.A.	(1979)	2.3	Germany	(1977)	2.1
<u>South America</u>			Fed. Rep.		
Argentina	(1980)	0.9	Hungary	(1979)	3.2
Brazil	(1978)	0.6	Netherlands	(1978)	2.0
<u>Asia</u>			Norway	(1978)	1.5
India	(1977)	0.5	Celani	(1975)	0.8
Iran	(1974)	0.3	Switzerland	(1977)	2.2
Israel	(1978)	2.5	United Kingdom	(1975)	2.1
Japan	(1979)	2.1	Yugoslavia	(1978)	1.1
Korea	(1979)	0.6	<u>Oceania</u>		
Turkey	(1979)	0.6	Australia	(1976)	1.0
Pakistan	(1980)	0.14	New Zealand	(1975)	0.9
			USSR	(1979)	4.9

Source: UNESCO Year Book, 1981.

The rate of development of a country is directly proportional to the amount invested in research. It is now generally admitted that at least 1% of GNP should be allocated for research if a reasonable rate of sustained growth is to be assured.

The question now arises as to what percentage of the proposed expenditure should be allocated for agricultural research in Pakistan. Some of the criteria with merit consideration in this regard are:

- i) Contribution of agriculture to G.N.P. (30%).
- ii) Contribution of agricultural and agro-based commodities in foreign exchange earnings (80%).
- iii) Scope for further development of agriculture (50-200%).
- iv) Percentage of population whose welfare is linked with agricultural development directly or indirectly (70%).
- v) Importance of agriculture in maintaining the stability and integrity of the country (next only to defence).

The main deficiencies currently observed in allocation of funds for research are:

- i) The funds allocated for agricultural research to PARC, research institutes and colleges/universities (0.17% of GNP) are unrealistic and far too inadequate compared to the place of agriculture in the economy of the country and the need and scope for its further development.
- ii) Separate allocation for research is not made in the agricultural educational institutions.
- iii) Funds allocated for operational research are extremely small (5-10%).
- iv) Funds are mostly allocated on a yearly basis and lapse at the end of the year.
- v) The annual income of PARC from cess on export of agricultural commodities has been about 4-5 million. PARC's responsibilities include undertaking and promotion of research in the field of crops (food and cash), vegetables, fruits, livestock (including poultry), forestry, range management, fisheries

(marine and fresh water) agricultural engineering and soil sciences. The funds allocated to PARC in the past have been highly inadequate to discharge its obligations in an effective manner. However, this year the Government has assured allocation of adequate funds to PARC as grant-in-aid to make it an effective and viable organization.

#### Research Institutes/Establishments

65 research institutes (19 federal and 46 provincial) have been established in the country to undertake research in the various sub-sectors of agriculture as per details given below:

Table 39. Sectorwise Number of Federal and Provincial Research Institutes

Sector	Federal	Provincial				Total
		Punjab	Sind	N.W.F.P.	Baluchistan	
Agriculture	17	11	4	2	1	35
Livestock	-	11	7	2	-	20
Forestry	1	2	1	-	-	4
Fisheries	1	1	-	-	-	2
Universities/ Colleges	-	2	1	1	-	4
<b>Total</b>	<b>19</b>	<b>27</b>	<b>13</b>	<b>5</b>	<b>1</b>	<b>65</b>

Of the 19 federal research establishments, 3 are located in the federal capital, 6 in the Punjab, 6 in Sind, 3 in NWFP. and one in Baluchistan (Annex.II).

In addition, a large number (158) of stations, sub-stations, centres, sub-centres and laboratories have been established by the federal and Provincial institutes in the various parts of the country - 22 have been established by 6 federal and 136 by 16 provincial governments (Annex.III).

Even a cursory study of the research establishments reveals that there is an excessive number of research establishments.

#### Funds for Operational Research

Studies of budget allocations of a few selected research establishments in Pakistan by primary units of budget appropriation i.e. pay of officers, pay of establishments, allowance and honoraria and other charges, revealed alarming imbalances in that 3/4th of the funds were spent on the pay of staff/allowances and honoraria and only 1/4th was available for other charges. These included rent, electricity, water, gas, stationary and printing, sundries, TA/DA, telephone, maintenance and repair of buildings, a contributory provident fund, a benevolence fund, group insurance and staff care expenses which together constituted about 60 to 70 percent of other charges. In this way the amount left for experimental work and materials was nominal and grossly inadequate. It was further observed that the enhancement in budget grants over the years has not been commensurate with the price escalation of various commodities required for research, which has further worsened the situation regarding the supply of research materials and facilities.

There is an urgent need to:

- i) enhance allocation of funds for agricultural research in proportion to their contribution to GNP and importance in the economy of the country.
- ii) allocate additional funds to research institutes, keeping in view their needs based on carefully prepared plans and their ability to utilize funds most profitably.
- iii) allocate separate funds for research to the agricultural universities.
- iv) augment the income of PARC from cess by including additional items like rice, guar, molasses, etc. in the schedule to the proposed PARC Ordinance.

### PLANNING AGRICULTURAL RESEARCH

At present agricultural research is not being conducted on a well-planned basis in Pakistan. Some of the important deficiencies noted are:

- i) Clearcut policy decisions have not been taken at the highest level, either by the provincial governments or the federal government, in the light of the needs of the country for the next 5-10 years and the trend of agricultural production in other countries of the world.
- ii) Precise guide-lines have not been provided to various agricultural research organizations to concentrate research efforts where the need is greatest, where facilities for research in a particular field/subject/discipline commodity are adequate and where there are prospects of success.
- iii) A closely coordinated and well-integrated research plan, say 5 years, has not been prepared even in broad outline at any important agricultural research institute.
- iv) There was no evidence from enquiries made that:
  - a) the problems for research at the agricultural research institutes and the universities were selected in consultation with the farmers, extension workers and scientists engaged in research on similar problems in the country.
  - b) due regards were given to the intrinsic scientific importance of the work and its relevance to achieve the national goals.
  - c) full advantage was taken of similar work done in the past in Pakistan or elsewhere in the world in selecting problems for study.

Pakistan is a developing country with limited manpower and material resources. It is, therefore, imperative that the available resources are utilized to the best advantage of the country. This calls for the preparation of an overall National Agricultural Research Plan with well defined objectives, strategies and inputs to synchronise with the National Development Plan.

The following procedure is proposed for the formulation of the National Agriculture Research Plan.

Policy decisions should be taken at the highest level regarding:

- a) Relative importance to be given to research on food-crops, cash crops, oil-seed crops, livestock, forestry and fisheries during the next 10 years.
- b) Relative weight to be given to basic and applied research.
- c) Funds as percentage of the GNP to be allocated for agricultural research.
- d) Division of appropriate areas of responsibility between the federal and the provincial government departments, the universities and other autonomous bodies in carrying out agricultural research programmes.
- e) Development of a basis for provincial and federal cooperation in planning and implementing inter-provincial and international research programs.

A working paper on the subject should be prepared by PARC in consultation with all the provincial and federal organizations engaged in agricultural research and submitted to the agricultural research division for further processing. Each organization should critically review the work done in the past in the various fields of agriculture to ascertain what work has already been done on the various problems, what more is required to be done on these problems, what are the new problems on which research should be initiated, and what facilities are available in men and material for research on different problems in the various research institutes. The review made by the committee up to 1966 should be brought up to date, and thereafter, similar reviews should be conducted every five years.

Each research organization/university should prepare its tentative research plan in broad outline - both, short-term and long-term, for 5 years in the light of the policy decisions taken by the federal and

provincial governments concerned.

The problems for research should be selected in consultation with the farmers, extension workers and other scientists engaged in research on similar problems in the same or other organizations of the country with due regard to work done in the past, in Pakistan and elsewhere in the world, and that they meet the national/provincial goals.

Priorities should be accorded according to the urgency, economic importance, scope and size of the problem considering area, people and the units affected, benefits of research in relation to cost, likelihood of extensive and immediate adoption of results of research and availability of adequate facilities in men and materials to pursue the proposed studies in an efficient manner and within a reasonable time.

The tentative research plans of all agricultural research institutes should be submitted to the PARC, where these should be examined carefully to avoid unnecessary overlapping and wasteful duplication of scientific efforts and to iron out other imperfections, if any, in consultation with the organizations concerned. The Council should then prepare a modified overall Agricultural Research Plan of the country for consideration and approval by the Agricultural Research Division and the Inter Provincial Coordination Committee.

The research plan should be sufficiently flexible as to permit minor modifications/alterations to be made by the institute itself as and when considered necessary. Major changes in the approved plan should be made in consultation with the research board concerned and the PARC.

A comprehensive proforma with explanatory notes somewhat on the pattern of PC-I should be prepared by the PARC and sent to all research institutes to ensure preparation of tentative research plans on a uniform

pattern. The PARC should, inter alia, adequately strengthen the research capability of the provincial research institutes in the form of providing training facilities, expertise, equipment, additional funds, scientific information,, library and documentation services, etc.; to enable them to undertake worthwhile research.

#### RESEARCH COORDINATION

At present there is a large number of research institutes/stations/sub-stations/centres/laboratories engaged in agricultural research in the country. These institutes are financed from different sources. They develop their research programs independently, which creates islands of research cut off from almost every kind of cooperative effort except for cross-service advice, and an occasional seminar. It has been observed that, on occasion, parallel research is being conducted by institutes/stations which may be situated near each other, but which operate under different authorities.

Coordination is not merely an exchange of material or information between scientists in different disciplines and institutes to minimize unnecessary duplication, but rather, in its widest application, means working together in analyzing problems, evaluating needs, analyzing and interpreting results and, finally utilizing research findings.

Coordination at various levels - local, provincial, national and international - will not only lead to well planned research and development efforts, but will also avoid unnecessary duplication, will eliminate wastage of scarce resources and will ensure optimum utilization of trained manpower. Coordination at the institute/university level should be provided by the head of the organization in preparing research plans on a well-integrated basis for the institute/university as a whole in consultation with heads

of various sections/divisions concerned.

#### Provincial Agricultural Coordination Boards

All the provincial governments have set up agricultural research coordination boards for coordination of research work in their respective jurisdictions. The boards are composed of members drawn from major research organizations engaged in agricultural research in the province.

Although the boards were established in 1977, excepting Punjab the boards have not functioned, chiefly for want of supporting secretariat facilities.

The PARC's procedure requires clearance of the provincial research projects by the board concerned before these can be further processed and approved. As the boards either did not meet or met at long intervals, there was invariably extra-ordinary delay in the processing of the research projects by PARC.

In the first meeting of the reconstituted Council (PARC), held on July 2, 1979, at Islamabad, it was inter alia, decided: " In case no information is received from the Provincial Research Coordination Board within the specified period (two months) it will be assumed that the project has the approval of the board and will be processed further by PARC in the normal manner".

In order to streamline and rationalize the processing and implementation of research schemes, the Punjab government has recently reconstituted the Provincial Research Coordination Board and assigned it responsibility to set priorities, assign projects to research workers, approve methodology, and to monitor, inspect and evaluate research work.

The Punjab Board is headed by the Vice-Chancellor of the Agricultural University, Faisalabad, as its Chairman and with the Secretary of

Agriculture as its Vice-Chairman. The board has a full-time senior officer as secretary. The board is comprised of five executive directors in charge of (i) Agriculture, (ii) Livestock, (iii) Agricultural Engineering and Technology (iv) Agricultural Economics and Marketing and (v) Agricultural Information and Logistics.

Administrative secretaries to the government of Punjab for the Agriculture Department and the Department of Livestock, Fisheries and Dairy Development are the executive directors for the disciplines of Agriculture and Livestock, respectively. The executive directors of the other three disciplines are the senior-most professors of the respective faculties in the University of Agriculture. Each executive director has a separate secretariat staff. Attached to the board secretariat is a full-fledged budget, audit and accounts section. The entire funds for research projects, excluding salaries and allowances, are channelled through the Research Coordination Board. Three inspection teams headed by senior scientists have been appointed. The members of the inspection teams have powers to inspect the projects, closely watch implementation and check progress of work. The projects are formulated on regular PC-I, processed in accordance with government rules, and the progress reports are furnished on PC-II.

The board has started functioning, and it is hoped that, under the new system, there will be considerable improvement in the management of research in the Punjab province. It is imperative that other provinces - Sind, N.W.F.P. and Baluchistan - also reorganize their research coordination boards along similar lines.

### Coordination at the National Level

Coordination at the national level between provinces and the international organizations should be provided by the PARC. PARC has established a number of technical committees consisting of specialists in the various fields/disciplines of agriculture to advise it on planning, approval and evaluation of research projects sponsored/financed or operated by the Council. In this way the Council provides a forum in which all aspects of research are thoroughly discussed. This helps in the preparation of research projects on a closely coordinated and well integrated basis to avoid unnecessary overlapping and wasteful duplication of research efforts under the Coordinated Agricultural Research Planning system (CAREPLANS) and the National Agricultural Commodity Research System (NACREP) .

PARC has established linkage with the international research institutes of CIMMYT, IRRI, ICRISAT, ICARDA and the International Potato Research Centre. Thus, there can be technical cooperation, exchange of information and research material, utilization of training facilities and services of high-level expertise and the holding of international symposia and conferences. An IRRI-PAK Collaborative Machinery and equipments best suited to Pakistan farming conditions. The Chairman, PARC, has recently been appointed as a member of the Board of Trustees of ICARDA.

### LINKAGE AND COORDINATION BETWEEN EDUCATION, RESEARCH & EXTENSION.

The importance of effective linkage and coordination between education, research and extension at all levels has been keenly felt, but no workable plan has yet been evolved to ensure effective linkage and coordination between them. This can be improved to a considerable extent if:

- i) senior members of the institutes act as part-time teachers and junior members register with the university for higher degrees

- ii) there is reciprocal membership of senior scientists of research institutes in the various committees/councils of the university and those of senior officers of the university in the important committees of the institutes
- iii) there is regular exchange of information
- iv) library and research facilities are freely available to research workers, teachers and students at the universities and the research institutes on a reciprocal basis
- v) research workers on the projects of the Agricultural Research Council are encouraged to spend some years of service in teaching at an agricultural university, while on the pay roll of the Council
- vi) appointment of research and extension workers as part-time teachers in universities and making of other similar reciprocal arrangements
- vii) seminars are jointly held by education, research and extension people at periodic intervals
- viii) coordination, at the national and international level between federal/provincial research institutes/universities and international organizations is provided by the PARC and Agricultural Research Division.

The linkage between research, extension and education in agriculture is very weak in Pakistan at present. India has developed an efficient mechanism for this purpose where all the agricultural institutes are closely linked with ICARDA and their research and teaching programmes are properly integrated with the overall national effort for agricultural development. The PARC should also effect a closer coordination of agricultural production system somewhat similar to India's.

#### SCIENTIFIC MANPOWER

Human resources are more important in scientific research than any other single factor. It was observed that where a suitable scientist with the requisite qualifications and experience was appointed as principal investigator, the research project invariably produced the desired results within a reasonable period; where sufficient care was not exercised in

this regard there was almost complete wastage of time, money and energy spent on the project. The importance of scientific manpower for agricultural research can, therefore, be hardly over-emphasized.

Total scientific manpower engaged in agricultural research in 1977-78 was 3,169. Of these, 250 held Ph.D., 1,637 M.Sc. and 1,282 B.Sc. degrees (Annex.II). The percentage of doctorate level workers was about 8% compared to 80% in the U.K. Agricultural Research Council's professional staff, indicating a basic weakness of the agricultural research system in Pakistan. The largest number of scientists - 2,757 (87.0%) were working on crops, followed by animal husbandry - 299 (9.4%), forestry - 79 (2.5%) and fisheries - 34 (1.1%).

Table 40. Number of Scientists Engaged in Research and Development in Selected Countries

Country	Scientists/10,000 Population
Czechoslovakia (1979)	33.9
Egypt (1973)	3.0
France (1978)	12.8
F.R. Germany (1977)	18.1
Hungary (1979)	23.6
India (1977)	0.5
Japan (1979)	36.1
Pakistan (1973)	0.6
U.K. (1975)	14.0
U.S.A. (1979)	28.5
U.S.S.R. (1979)	50.7

Source: UNESCO Year Book, 1981.

### Growth of Technical Manpower in PARC

The most single crucial factor in agricultural research is the availability of well qualified and adequately trained technical manpower capable of solving the complex problems of agricultural production. Consequent on his appointment as whole-time Chairman of PARC in July, 1978, Dr. Amir Muhammed, inter alia, concentrated his efforts on gradually building up a cadre of high - level trained manpower, providing them additional advanced training needed and grooming them to undertake basic and problem - oriented research to unearth new knowledge of benefit to the farmers.

The efforts made met with great success and during the short span of four years the technical staff (Grade 16 and above) was increased from 160 in 1978 - 79 to 780 in 1982 - 83 an increase of about 400%.

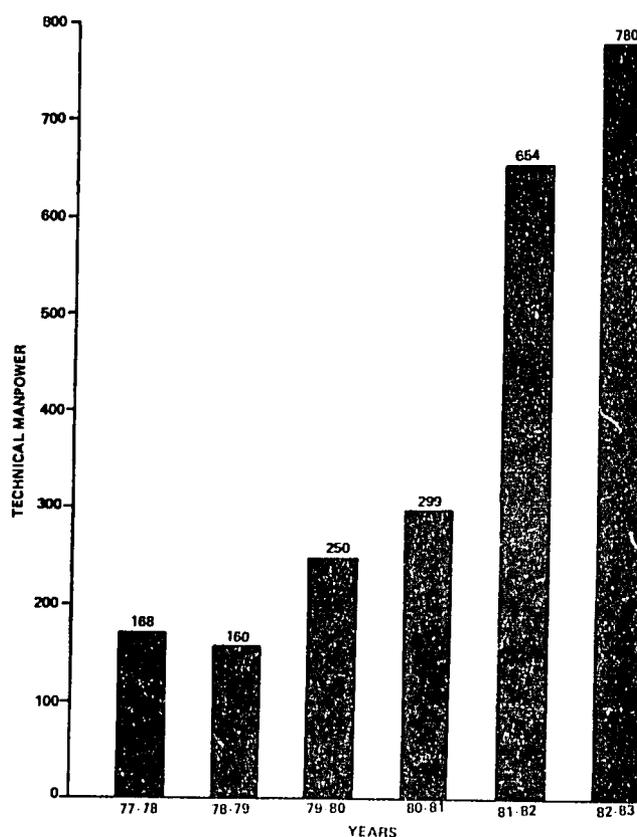


FIG. 8. GROWTH OF TECHNICAL MANPOWER IN PARC (GRADE 16 AND ABOVE) 1977-78 TO 1982-83

According to a World Bank Policy paper on research systems in countries where agriculture is the key economic sector, an expenditure of 2% of agricultural G.D.P. on research is appropriate.

Analysis of manpower at the Ph.D. level indicates that:-

- i) Out of 65 research institutes, 29 (8 agricultural, 17 livestock, 3 forestry and one fisheries) do not have the services of a single Ph.D.
- ii) 138 of 250 Ph.D.'s are working in research institutes/ agricultural university in Faisalabad.
- iii) 120 Ph.D.'s are employed by four agricultural universities/ colleges and only 130 are engaged in research in agriculture on a full time basis in 61 research institutes and 162 stations/sub-stations, etc.
- iv) Out of 130 Ph.D.'s working on a full-time basis, 117 are working in agriculture, 7 in livestock, 5 in forestry and one in fisheries research institutes.
- v) 80 of the full-time Ph.D.'s working in agriculture are employees of the 19 institutes at the federal level, while the rest of the 37 are serving in the 46 provincial institutes and 162 stations/sub-stations.
- vi) In 20 livestock experiment stations, including poultry institutes, the services of only 7 Ph.D.'s are available. Of these, six are working in the Punjab and one in N.W.F.P. Six livestock experiment stations/farms located in the Sind do not have the services of even an M.Sc.

#### Selection of Scientists

Rules and regulations have been framed for all appointments, which, inter alia, include the method of recruitment for each post. There is a quota for departmental promotions in provincial/federal posts as well as in the central posts in the various provinces. Government appointments to Grade-16 and above are made by selection on the advice of federal/provincial public service commissions. In PARC and other autonomous bodies, appointments are made on the advice of the Selection Board concerned, subject to limitations imposed by the Government.

The public service commissions generally advertise the posts and select the candidates on criteria which they have found valid through long experience. They invariably coopt specialists to select candidates for technical posts. A representative of the department is invariably nominated as coopted member at the time of selection.

Departmental promotion committees select candidates for promotion on the basis of seniority, qualifications, experience, pay and confidential reports of the candidates. It has been observed that too much emphasis is given to seniority and academic qualifications and very little to performance. Consequently, in the majority of cases, the senior-most man is selected. The difficulty is that complete information about the precise performance of an individual scientist in his respective field of specialization is not available, and even the confidential reports are quite often vague and lack accurate classification of the research worker on the basis of his overall performance. Furthermore, weighted criteria to select candidates for different posts are not fixed in advance, to classify the candidates with a reasonable degree of accuracy. The result is that promotion by selection is generally not made on merit, with all the undesirable consequences. It is felt that the recommendations made later on the evaluation of individual scientists, if followed strictly, would materially help in selecting the right type of scientist for a particular job. This subject will be discussed further in Chapter 6 under "Recruitment of Scientists."

#### Career Advancement

It is not only difficult to select a scientist best suited for a particular post, but even more difficult to retain him in his post, if there is no built-in mechanism in the research organization under which competent scientists with demonstrated ability for quality research of an international

standard can advance. At present no such mechanism/system exists in the agricultural research organizations in the country. As a consequence scientists of high calibre get frustrated, their creative abilities are impaired and they lose interest and their sense of devotion to their chosen fields. They are always on the outlook for a better job and manage to leave the parent organization at the earliest opportunity. The consequences are not difficult to judge. It requires years to develop research leaders capable of organizing teams of workers exclusively devoted to the solution of problems hampering the progress of agricultural production. A sudden disruption in team work affects adversely the quality of research and it takes very long to make up the deficiency. The need for introducing a system of "Merit Promotion", therefore, deserves serious consideration. This will be discussed in more detail in Chapter 6 under "Merit Promotion."

#### Brain Drain and Maladjustments

Some well qualified and experienced scientists occasionally migrate to other countries. Although their number in the field of agriculture is not very large, Pakistan, at this stage, cannot afford to lose even a few really competent and highly talented scientists. The main reasons for this brain drain are:-

- i) Harassment (of talented and self-respecting scientists) by the heads of departments.
- ii) Limited number of prospects for promotion.
- iii) Appointment of candidates to posts not suited to their qualifications.
- iv) Lack of proper facilities and suitable environment for research in their field of specialization.
- v) Temporary nature of posts.
- vi) More attractive salaries abroad.

Quite often scientists are appointed/promoted by virtue of their seniority regardless of whether or not their qualifications justify the promotion. This type of promotion leads to inefficiency and frustration among scientists who are denied promotion to a post for which they are best qualified by virtue of their training and experience.

#### RESEARCH INFORMATION FROM ABROAD

In almost all fields of agricultural research, Pakistan is far behind other advanced countries of the world. The quickest and the most economical way to bridge this gap is to obtain the information on problems proposed to be undertaken for investigation from as many sources as possible, find out the extent to which work on these problems has already been done, whether the work done can be adopted with minor modifications to suit local conditions and, if not, what more is required to be done. This would save time, labour and money enormously and would enable us to find answers to our problems in the quickest way.

It is a duplication of time and energy to begin work on a problem if work has already been done elsewhere, under similar conditions, which may be wholly or partially applicable to our set of conditions. Most of the research institutes in almost all the advanced countries are only too willing to supply the requisite information which is available for the asking. They are willing to establish permanent liaison with their counterpart institutes for the regular exchange of information and of research workers, and to provide training facilities.

Agricultural research has now become a vast activity, and there is an abundance, rather than a dearth, of literature in all fields of agriculture in the advanced countries of the world. A large-scale effort in collection, classification and dissemination of requisite information, whether for an

institute or for an individual scientist, would definitely avoid unnecessary duplication and pointless work and would provide the guidance to solve problems under study on more sound scientific lines. It is felt that it would be the best investment and will prove most economical in the long run. In fact, it is an essential pre-requisite of agricultural research in the country.

PARC is in the best position to provide this service to the agricultural research institutes in the country, as one of the important functions of the Council is to act as a clearing house of information and support the publication of results of research. Necessary action proposed to be taken in this regard by PARC will be discussed in Chapter 6.

#### UTILIZATION OF RESULTS OF RESEARCH

The ultimate object of agricultural research is to unearth new knowledge of benefit to agriculture and the farmers.

Our immediate aim is to increase agricultural production to meet the present needs for domestic consumption and for export to earn the much needed foreign exchange. The domestic demand for food, feed and fibre is likely to increase substantially due to current growth in population, which is likely to double by the end of the century, and the impact of economic and social development programs. This would necessitate a proportional increase in agricultural production. It is anticipated that agricultural production will have to be more than doubled by the end of the century to meet the need of increased population and rising standards of living.

With our limited resources and limited scope for horizontal expansion, major emphasis will have to be placed on vertical expansion by increasing yields per land unit, per animal unit, per man and per crop season. This will require intensification of research and development efforts.

The bulk of our population lives in the villages or semi-settled tribal groups in certain areas. The agricultural systems adopted in most areas are still predominantly traditional in their methods and practices. In order to modernize agriculture they must increasingly depend on the findings of science and the application of improved technology. Scientific research in agriculture and related fields applied through technological innovations has revolutionised agriculture in most of the developed countries and farmers have now become much more efficient and productive. For example, one farmer in the United States produces enough food for himself and for more than 40 other persons, as compared to one farmer producing food for 3-10 persons in most of the developing countries. In Pakistan we are not producing enough foodgrains even to meet our domestic needs at a moderate level and, therefore, have to depend on imports, which create considerable difficulties, political complications and, above all, a large drain on our scarce foreign exchange earnings, which indirectly impedes progress and development in other sectors of the economy.

A developing country must provide an effective organization to realize the benefits of science and technology. It is largely a matter of bringing the necessary services and technical know-how to the farmers' doorsteps and teaching them to use these to their utmost advantage within the frame work of their resources.

The main difficulties and weaknesses currently observed in the utilization of results of research are:

- (a) The majority of the farmers are illiterate and are often superstitious.
- (b) The land holdings are small, fragmented and the farmers are under the influence of landlords, moneylenders, and

middlemen, who flourish at their expenses.

- (c) Most of the farmers operate either at subsistence or below subsistence level. They are, therefore, afraid to experiment with new techniques of farming which, according to them, are of questionable value.
- (d) The farmers think that all Government workers come to the villages to collect taxes, maintain law and order, solicit petty favours or procure their crops at fixed price, which may be below the market price and, therefore, they are suspicious of even extension workers.
- (e) Most of the extension workers are not well enough trained and experienced to demonstrate in a practical way the advantages of applying improved technology and methods of farming. The farmers, therefore, have no confidence in poorly trained workers with only theoretical knowledge.
- (f) The majority of the extension workers are not equipped with the necessary tools for extension service, viz., transportation, appropriate literature, visual aids and demonstration materials.
- (g) Most of the extension workers are selected without due regard to their background and aptitude for the uplift of the farmers in the villages.
- (h) The number of extension workers in several areas is much less than required for an effective extension service.
- (i) Development plans are seldom prepared in consultation with the farmers to ensure their active participation in their implementation.

- (j) Quite often extension staff is transferred more frequently than is desirable.
- (k) There is little or no coordination between the research institutes and the extension staff. No regular meetings are held between them to have dialogue on problems of agricultural development and finding solutions thereof.
- (l) There are no extension sections in the research institutes to act as liaison agencies between the research institutes and the extension staff, or for conducting field trials of research findings before applying them on a mass scale.
- (m) There is no regular arrangement to bring the farmers to the research institutes periodically to enable them to see for themselves what the scientists are doing for their welfare.
- (n) The information service of most of the agricultural research institutes is very weak.
- (o) Activities of research workers are mostly confined to the laboratories and research institutes.
- (p) Plans for agricultural development are mostly prepared at the top level and are often thrust upon the farmers.

## Chapter 5

NARC'S PROGRAM - PRESENT AND PROJECTED

Agricultural research in Pakistan has been primarily discipline-oriented, with the result that the required inter-disciplinary team work has not been as strong as is necessary to solve major problems and to achieve national goals. The discipline-oriented approach leads to compartmentalization and is not best suited to solve problems, especially when talents and resources are scarce and limited. The new concept in agricultural research is that it should be multi-disciplinary and problem-oriented with a high degree of coordination among various institutions to avoid unnecessary duplication and insure adequate attention to top priority problems. This approach fosters a close liaison and collaboration among scientists of various disciplines and permits sharing of physical facilities required for the execution of research programs. This approach, in addition to reducing wasteful duplication and overlapping, conserves human and financial resources, which are a major constraint in research.

NARC'S CONCEPT OF RESEARCH

Since the Pakistan Agricultural Research Council is to provide leadership to the scientists and research institutions in the Country it should, as an example, utilize the multi-disciplinary approach to problem-solving at the National Agricultural Research Centre. It should also set an example in conducting its activities in fullest collaboration with provincial and other research entities.

The multi-disciplinary approach requires that the research priorities or areas of emphasis be clearly defined, and that action-oriented national research programs with specific objectives be developed. Research programs

reflecting the problems of barani areas should be implemented at PARC through National Coordinated Programs and the research programs of the Agricultural Research Council. In this program, scientists from all disciplines should participate jointly under the national leadership and should share facilities with other programs. The facilities, such as laboratories, store houses, maintenance, farm equipment, etc.. at NARC should be centralized to serve needs of various programs and projects.

The process to be followed is first to identify problems related to production systems, decide priorities, and then to develop the research projects.

The goal of PARC is to conduct research in areas of national importance where such research is not currently being undertaken or is seriously inadequate and where the research can best be done at a central institution operated by the Government of Pakistan.

#### THE NARC PROGRAM

In support of the above goal, the National Agricultural Research Centre (NARC) will conduct research within the framework of the following program elements:

1. Farming-Production Systems
2. Crop Improvement
3. Pest Management
4. Soil and Water Management
5. Socio-Economic Studies
6. Forage, Fodder and Range Management
7. Livestock/Poultry Health & Production
8. Agricultural Machinery Design
9. Germplasm Centre and National Herbarium

10. Communication, Documentation and Training Centre

11. Research Service Centre

In order to provide direction and visible thrust to NARC programming, the "Farming-production System Program" will be the central or lead program, providing the integrating force and multi-disciplinary flavour to the NARC.

Farming-Production Systems Program

Objectives:

To determine the efficiency and productivity of production systems under barani conditions including variables such as varieties, rotations, tillage, pests, soil and water management, input costs, etc. To evaluate all research projects for their contribution to the improvement of barani systems and provide statistical design and computational support.

Examples of Activities:

- a. Describe all known barani production systems.
- b. Identify biologicals of economically feasible and viable alternatives in barani systems.
- c. Identify constraints to efficiency and cost effectiveness and recommend cost effective solutions.
- d. Review research proposals for their solution to barani problems.

Crops Improvement Program

Objectives:

The crops improvement program will emphasize research at NARC on barani crops including winter cereals, coarse grains, oilseeds, legumes and pulses, forage and fodder crops, vegetable and fruit crops.

Examples of Activities:

- a. Assemble, introduce, increase, preserve and distribute germplasm from national and international sources on selected crops in cooperation with the germplasm centre.
- b. Serve as a location for national and international variety tests on selected crops.
- c. Carry out multi-disciplinary research to improve varieties and seed production technology.
- d. Provide service type analysis for other stations.
- e. Supply seed to breeders and preserve the purity of superior varieties in selected crops in cooperation with the germplasm centre.

All the crop improvement programs should have as their principal objectives: "to determine and develop varieties and agronomic practices appropriate to the improvement of barani culture".

Examples of Activities:

Wheat, Barley, Triticale

- a. Distribute and evaluate germplasm under local conditions.
- b. Develop production technology under barani conditions, in cooperation with the Production System Program inputs and technology.
- c. Maintain plant nurseries.
- d. Where appropriate, develop tissue culture technique for improving plant characteristics and extend to other crops. This will include: cell and tissue culture research for genetic manipulation of desirable characteristics of different plant species, genera and families and cell fusion or

DNA recombination technique for genetic manipulations.

- e. Screen winter cereal varieties against fungal diseases, rust race identification, and disease monitoring.

#### Maize, Sorghum, Millet

- a. Improve yield capability through introduction and testing of varieties. Maintain a germplasm pool and distribute varieties to other research stations.
- b. Develop improved short season and drought-tolerant varieties.
- c. Improve germination, emergence, and plant stand through better tillage, planting, and soil and water management techniques.
- d. Develop the best crop husbandry practices for sustained reliable yield under barani conditions.
- e. Develop improved disease and insect resistant varieties for barani areas through screening and evaluation trials.
- f. Increase breeder seed lots of selected lines.
- g. Develop high yielding quality protein varieties of maize and sorghum (minor emphasis).

#### Oilseeds

Emphasis will be given on cruciferous crops, soybean, sunflower, safflower and ground-nuts.

- a. Distribute and evaluate varieties and germplasm under local conditions.
- b. Develop production technology under barani conditions and its economics.
- c. Study the aphid complex on cruciferous oilseed crops with emphasis on pest control and selection of resistant varieties.

- d. Cooperate with CDRI in study of serious local disease of oilseed crops.
- e. Cooperate with Research Services Centre to provide service type analysis, which requires expensive or/complicated equipment such as fatty acid analysis, oil content analysis using NMR.

#### Legumes and Pulses

- a. Collect, distribute, preserve and document germplasm of grain legumes and pulses.
- b. Develop and distribute different nurseries, viz., disease nurseries, insect nurseries, preliminary observational nurseries and yield nurseries.
- c. Identify and test efficient rhizobia, legume combinations.
- d. Develop production technology for legumes and pulses under rainfed conditions.
- e. Study factors affecting photosynthetic efficiency.

#### Fruit and Vegetables

Research on apricot, plum, pears, persimmon, grapes, almond, phalsa, mangoes, figs and other fruits with the following activities:

- a. Introduce and select high yielding superior quality of varieties of the above mentioned fruits, and standardize their propagation and production techniques.
- b. Develop techniques for effective control of major pests.

Emphasis will be placed on development of disease-resistance and insect control of vegetables such as tomatoes, peas, brassica, chillies and beans, with the following activities:

- i). Control of aphids in collaboration with similar programs on oilseeds.

- (ii). Introduce and test high yielding, short, medium and long-term varieties of peas, resistant to diseases, particularly root-rot and powdery mildew.

#### Pest Management Program

##### Objectives:

To determine the biology, ecology and significance of pests on barani conditions and devise methods of appropriate control.

##### Examples of Activities:

- a. Survey and identify economically important insect pests; mites and other organisms causing fungal, bacterial and viral diseases; nematodes; weeds and their natural enemies (predators and parasites) found in association with vegetable field crops (wheat, maize, oil-seeds, etc.) and fruit trees of barani areas located around NARC.
- b. Develop reference collections of insects, mites, diseased materials, weeds and their natural enemies during these studies.
- c. Study biology and ecology of major insect pests and etiology and epidemiology of diseases on the crops and fruit trees under study.
- d. Quantify the significance and importance of different elements in an integrated control scheme, that is, the relative control role of natural, cultural and chemical components, etc.
- e. Determine the level of economic injury in respect to important pests, diseases and weeds for the development of effective pest management system.
- f. Work towards the development of integrated control program for the major pests, diseases and weeds of the important crops and fruit trees.

- g. Develop facilities for mass rearing of parasites and predators for their releases in the fields and study the factors favourable for their establishment in natural conditions.
- h. Study the mode of action and efficacy of selective insecticides, fungicides, nematocides and weedicides against insects, fungi, nematodes and weeds for their possible timely use in the integrated pest control system.

#### Soil and Water Management Program

##### Objectives:

To determine the inter-relationship between crop production and water stress and develop cultural practices for efficient land and water use.

##### Examples of Activities:

- a. Study the response of crops to different fertilizer applications in barani conditions and measure their residual effects.
- b. Develop methods to improve soil productivity through micro-biological fixation of nitrogen.
- c. Develop methods of water conservation considering both crop production and soil erosion.
- d. Develop and test alternative methods for soil management to increase water infiltration and root penetration.
- e. Determine economic combinations of rainfall and supplemental irrigation in barani areas.

### Socio-Economic Studies Program

#### Objectives:

To determine and describe the problems arising out of adopting technological changes in the production functions, resource allocation and land utilization, and to develop criteria for the socio-economic uplift of the farming community in barani areas.

#### Examples of Activities:

- a. Identify the socio-economic problems of farmers of barani areas and discover solutions through research, particularly in the spheres of crop and livestock production, resource use, systems of farming, post-harvest technology, land tenure, land utilization, labour employment and productivity.
- b. Assist in designing biological research at NARC to ensure that economic considerations are included, and that variables are measured.
- c. Estimate socio-economic impact of agricultural research conducted at NARC.
- d. Conduct research and recommend measures for the reduction of socio-economic disparity and rural poverty in rainfed areas.
- e. Develop and evaluate economic systems for utilization of NARC land not currently required for field experimentation.
- f. Apprise the transfer the PARC research results to farmers of barani areas.

### Forage, Fodder and Range Management Program

#### Objectives:

To determine methods of increasing the nutritive value of livestock feed and increase the productivity of forage and fodder crops through proper management of ranges and pastures.

#### Examples of Activities:

- a. Maintain and evaluate a nursery of forage and fodder crops under local conditions and supply material to provincial research units.
- b. Develop agronomic systems for maximum production of forage grasses and legumes for barani areas and determine their places in the cropping pattern and evaluate grazing and harvesting systems.
- c. Develop efficient methods of reseedling and management of range areas with different species.
- d. Establish, in cooperation with extension services, demonstration plots under an out-research program.
- e. Evaluate nutritive quality of forage and fodder species through bio-chemical analysis and digestion trials in collaboration with livestock improvement research program.
- f. In cooperation with the germplasm centre, multiply breeder's seeds and develop seed production techniques for selected species.

### Livestock Health and Production Program

#### Objective:

To improve the growth and management of livestock on barani lands.

#### Examples of Activities:

- a. Prepare a livestock feed inventory and its chemical composition.
- b. Work out nutritive standards of livestock and poultry under local conditions.
- c. Develop formulas for balanced rations for livestock and poultry, based primarily on indigenous by-products of industries.
- d. Study the use of protein substitutes and growth promoters.
- e. Develop efficient and economical methods for grazing and silage and hay making in collaboration with forage and fodder program.
- f. Collaborate with fodder and forage Program in developing methods of increasing the nutritive value of fodder and forage crops.
- g. Provide specialized diagnostic laboratory facilities as a service for other research centres, particularly emphasizing etiology of diseases of obscure origin.
- h. Cooperate with livestock germplasm program including research on reproductive problems with artificial insemination.
- i. Cooperate with goat and buffalo and other national research programs.
- j. Develop foundation stock for producing superior dairy goats.
- k. Evolve a management system including stocking rates.
- l. Improve goats for milk production both by selection and cross-breeding.

- m. Select goats for mutton production alone and in combination with milk.
- n. Find out nutritional requirements.
- o. Investigate problems of reproductive and environmental physiology.
- p. Study methods of management for improved production.
- q. Evolve more productive poultry strains for rural areas.

#### Agricultural Machinery Program

##### Objectives:

To facilitate the mechanization of small farms by providing appropriate agricultural machinery designs which could be produced and marketed through local manufacturing and commercial channels.

##### Examples of Activities:

- a. Introduce, evaluate and adapt potentially useful machines from similar agro-climatic regions.
- b. Design and develop appropriate agricultural machines for small scale farming operations.
- c. Provide assistance to the manufacturers for local production of suitable agricultural machines.
- d. Assist in coordinating agricultural machinery research and developmental activities among the provincial, central and industrial organizations.
- e. Train engineers from agricultural engineering institutions, universities and machinery manufacturers in the design, development and production of agricultural machines.

### Germplasm Centre and National Herbarium

#### Objective:

A germplasm centre will facilitate the introduction, documentation, evaluation and preservation of valuable germplasm of both plants and animals from other countries and different areas of Pakistan. A Herbarium, a permanent and accurate record of cultivated plants, will serve the needs of taxonomists primarily - and will be a useful resource to many disciplines in agriculture.

#### Examples of Activities:

##### Germplasm Centre

- a. Accept requests for introduction, and transmit them to the appropriate country or area.
- b. Introduce seeds, plant material, pollen, micro-flora, semen and new breeds.
- c. Identify and catalogue all introductions.
- d. Eliminate diseases and insects from introduced materials through inspection, fumigation, seed treatment and plant quarantine.
- e. Store introduced materials. This will include temporary storage of vegetative and seed materials and semen as well as long-term storage of seed and semen of introduced and locally produced improved varieties of germplasm.
- f. Distribute introduced stocks, immediately or after being increased, to other research workers in Pakistan and, on request, to researchers in other countries.

- g. Evaluate and characterize introductions in cooperation with other stations.
- h. Develop and maintain records of performance on all introductions.
- i. Dispatch and support plant exploration teams to other countries.
- j. Propagate or increase, in cooperation with the provinces, species that would not grow in Islamabad.
- k. Undertake seed and semen storage.

Pakistan National Herbarium

- a. Preserve collections, including those of the past, present and future.
- b. Continue to make collections of the domesticated flora and their relatives of Pakistan and, where feasible, the flora of other countries.
- c. Provide facilities for taxonomical research by both the staff of the herbarium and other scientists in Pakistan.
- d. Give or loan, on request, specimens to recognized institutions both inside and outside the country, for taxonomic study.
- e. Help scientists, both at NARC and at other institutions, in the identifications of plants.
- f. Prepare publications of studies which will serve taxonomists, agriculturists, and the general public.

Communication, Documentation and Training Centre

## Objective:

To collect, identify and disseminate research information and integrate national research information systems with international agricultural information networks like AGRIS, CARIS, etc.; organize conferences and seminars and impart practical training to administrators, research and extension workers.

## Examples of Activities:

- a. Provide documentation and service for procuring, identifying, storing, retrieving and disseminating scientific information generated in Pakistan or elsewhere and to develop a close liaison with national and international agencies.
- b. Maintain an up-to-date record of current research personnel and research projects in the country.
- c. Collect and publish research material in suitable forms like professional journals, technical bulletins, research reports, monographs, etc.
- d. Establish and maintain a well organized agricultural research reference library.
- e. Evaluate the effectiveness of alternative communication techniques.
- f. Provide logistical support and help arrange conferences, seminars, short courses and practical training.
- g. Provide administrative and logistical support and help arrange training of post-graduates and researchers.

### Research Services Centre

#### Objectives:

To determine appropriate physical, chemical and biochemical test requirements for barani projects and perform them as needed.

#### Examples of Activities:

- a. Assist other soil laboratories in establishing appropriate standards and procedures.
- b. Determine, in coordination with principal investigators, equipments and needs for Projects.
- c. Assist in laboratory design and fabrication of equipment.
- d. Provide maintenance of laboratory equipments and maintain central storage of laboratory equipment and supplies.

### ESTABLISHMENT OF REGIONAL AGRICULTURAL RESEARCH CENTRES

The agricultural area in Pakistan could be classified into the following 5 broad agro-ecological zones:

- a. Very low rainfall arid zone and desert areas.
- b. Rainfed agricultural zones (medium rainfall).
- c. Hill zone (in the northern Himalayan areas).
- d. Irrigated Agriculture Zone.
- e. Coastal areas.

Regional centres would be established for each zone. Each centre would be inter-disciplinary in character and would primarily aim at improving the productivity of the total farming system in its zone and have strong research groups for socio-economic research. They would be closely linked with the national commodity research institutes and other related organizations to develop site-specific appropriate farming systems

for the different categories of the farmers in the area. They will also serve as the main linkage of agricultural research for the provincial extension agencies in cooperation with the provincial agricultural research stations.

#### ESTABLISHMENT OF NATIONAL COMMODITY RESEARCH INSTITUTES

Because of severe limitations of trained scientific manpower, financial and other resources, it is proposed to concentrate on establishment of research institutes for important agricultural commodities at the national level and to intensify research efforts (both basic and applied) on these commodities in the national institutes. These institutes will be multi-disciplinary in character and will have sub-stations in different ecological zones to adapt the technology to local conditions in cooperation with the regional and provincial research institutes.

#### PROVINCIAL RESEARCH INSTITUTES

The provincial agricultural research institutes would play an important role in the revised set-up and will be responsible for conducting all the field-oriented experimentation and for adapting the latest technology developed by the national commodity research institutes and the area farming system recommended by the regional research institutes. They would work closely with agricultural extension and get the valuable feed-back of field problems for further research. Intricate and complex problems, the solution of which requires highly specialized staff and sophisticated laboratory facilities and which cannot be tackled in the provincial institutes, would be passed on to the appropriate regional/national research institutes where the requisite facilities would be available. The PARC would strengthen the provincial research institutes by supplying scientific expertise, equipments,

scientific informations and training facilities to augment their research capability for field-oriented, applied research.

## Chapter 6

STRENGTHENING OF AGRICULTURAL RESEARCH CAPABILITY

PARC has planned several measures to strengthen the agricultural research system in the country. Some of these already have been implemented, while the details of the others are being worked out. These are discussed in the following sections:

NATIONAL COORDINATED COMMODITY RESEARCH PROGRAMS (NACREP)

PARC has developed a number of commodity-oriented research programs in cooperation with provincial institutes, agricultural universities and federal research institutes. The philosophy behind such programs lies in a coordinated attack on national problems through cooperative planning and coordinated resource allocation. The coordinator provides the necessary leadership in the planning and execution of research programs and in provision of requisite facilities. The projects are exclusively financed by PARC.

Each coordinated program consists of a number of research projects whose objectives directly support the coordinated program. The principal investigators of each project constitute a technical committee for the program, which provides the technical and administrative guidance to the PARC coordinator and determines the technical contents of the program. The evaluation of the projects and the program is accomplished by the coordinator. The Coordinated research programs currently in operation relate to wheat, barley and triticale, maize, millet and sorghum, oilseeds, potato, rice, fodder and forage, vegetables, animal nutrition and livestock cross breeding. National Coordinated Research Programs on other important commodities/subjects are being developed as additional funds and trained manpower become available.

## COORDINATED AGRICULTURAL RESEARCH PLANNING SYSTEM (CAREPLANS)

The CAREPLANS involves both the users of research and the doers of research in the identification of problems that represent research opportunities and in the formulation of research projects designed to solve the identified problems. The main functions of CAREPLANS are given below:

### Identification of Problems

The first essential pre-requisite is to identify problems hampering progress of agricultural production. The best way to accomplish this is to bring together representatives from a broadbase of interests in agriculture (progressive farmers, suppliers, industrialists, extension workers, working scientists, etc.) and charge them with the responsibility of reviewing the current status of various agricultural commodities/resources/technologies and identifying principal constraints/bottlenecks limiting production. This would result in the formulation of a list of potential researchable opportunities. Research efforts could then be concentrated in areas where need is greatest.

### According of Priorities

The following criteria may be kept in view in according priorities to problems identified.

- a) urgency of the problem, (threat of disease, etc.)
- b) economic importance.
- c) scope and size of the problem considering:-
  - i) people, land units affected.
  - ii) benefits of research in relation to cost.
  - iii) likelihood of extensive and immediate adoption of results of research.

- d) availability of adequate facilities.
- e) feasibility of completion of proposed research within the stipulated time and;
- f) avoidance of wasteful duplication of research efforts.

The task of identifying problems and according priorities may be assigned to an ad-hoc committee designated as "Status Review Committee".

#### Formulation of Projects

Priorities having been determined, research projects should be formulated in high priority areas of research by an ad-hoc committee designated as a "Technical Planning Committee" comprising scientists of PARC, potential performing organizations of the provinces and the federal establishments. In doing this exercise, the committee should take advantage of Current Research Information System of Pakistan (CRISP), data organized by PARC and Current Awareness Literature Sources, to gain a perspective of the problem and thus formulate technically sound research projects. Each independent or coordinated project must clearly state (a) Title, (b) Objectives, (c) Present and previous work, (d) Methodology/approach, (e) Resources needed, (f) Personnel, (g) Cooperator(s), (h) Institutional units involved, (i) Any other information needed to evaluate the project.

#### Evaluation of Research Projects

Projects prepared by the Technical Planning Committee should be critically reviewed by two specialists in the subject with particular reference to the following:-

1. The actual scientific research problem proposed to be investigated by the researchers.
2. Whether literature review of the proposed research is adequate and up to date? If not, important references should be consulted.

3. Whether the research proposal involves any wasteful duplication or unnecessary overlapping? If so, how it can be avoided?
4. Whether the work plan of the proposed research is technically sound and is likely to produce meaningful results? If not, how can it be improved.
5. Whether the Principal Investigator is competent to undertake the proposed research work?
6. Whether the research institution is adequately equipped to implement the project efficiently?
7. Whether the staff requested for the proposed research is essential and compatible with the tasks involved?
8. Whether equipments asked for, are essential and cost involved is reasonable? If not, to what extent can it be modified?
9. Whether the project is likely to be completed within the stipulated time? If not, probable time justified?
10. Whether the project covers high priority areas of research?
11. Whether the project would increase the institutional/national sciences capabilities?
12. Significance of the proposed project. Its socio-economic aspect towards development of the country and contribution to man's knowledge (give brief narrative).
13. Whether any modification/alteration is needed in the scope of work, methodology or approach proposed to be adopted?
14. Assessment of the project as a whole.

#### Approval of Research Projects

The research projects together with comments of the reviewers should be carefully examined by the technical committee concerned consisting of

specialists in the respective field and the Executive Board/Chairman advised as to whether the project should be:

- i) approved as such,
- ii) approved with modifications considered necessary,
- iii) deferred, or
- iv) dropped.

Unless there are strong reasons to the contrary the recommendations of the technical committee should be accepted by the Executive Board/Chairman of the Council.

#### Assigning of Research Projects to Various Institutes/Organizations

The Council should maintain a complete central record of all research institutes/experiment stations/centres/universities/departments and other organizations engaged in agricultural research in respect of facilities in the form of scientific manpower, their qualifications and experience, buildings, equipments, land, laboratory and other facilities. To start with, creative scientists in research institutes where optimum facilities already exist for the implementation of the projects in an efficient manner should be invited to prepare projects. Simultaneously, the research capabilities of less developed provinces should be gradually strengthened to undertake site-specific studies and research on problems of special interest to them.

#### IMPLEMENTATION OF RESEARCH PROJECTS

##### Delegation of Powers

To conduct research along profitable lines, it is imperative that planning should be centralized, but execution must be decentralized. The performing scientists/organizations should be delegated adequate financial and administrative powers to implement the approved projects as smoothly as scheduled.

### Provision of Facilities

Facilities needed in the form of personnel, space, equipments, supplies and services should be provided without undue delay so that the project becomes fully operational within three months of the date of approval.

### Formulation of Work Plans

Year-wise work plans to implement the project should be prepared in detail and a strategy for implementation developed. Every subsequent year-wise work-plans and implementation strategies should be revised on basis of performance during the previous year.

### Accomplishment Reporting

Two annual accomplishment reports, one on research progress and another on expenditure incurred, should be submitted on prescribed proformas. Forms CRISP 3 and 4 are provided for the purpose.

Accomplishments should be reported against each objective included in the approved project.

### Accomplishment Evaluation

Annual accomplishment and expenditure reports should be critically evaluated against expected accomplishments and expenditure by two subject-matter specialists with particular reference to the following:-

- i) work accomplished against objectives;
- ii) soundness of methodology/approach adopted;
- iii) reliability of data collected;
- iv) statistical analysis of data; and
- v) interpretation of results and drawing of conclusions.

### PARC'S RESEARCH PROJECT MANAGEMENT SYSTEM

The research management system at PARC will have as its principal tool the approved research project. The research project should be prepared by appropriate coordinators/principal investigators on the following proforma.

Title: A brief, clear, specific designation of the subject of the research. The title used itself should give a good indication of what the project is about.

Justifications: Should present (1) the importance of the problem to the rainfed farming production system of the nation, (2) reasons for doing the work, such as the needs the project will fill and the importance of doing the work now, and (3) ways in which public welfare or scientific knowledge will be advanced.

Previous Work and Present Outlook: A brief summary covering pertinent previous research work on the problem (citing the more important and recent publications from other stations and workers, as well as your own); the status of current research; and the additional information needed, which the project is expected to contribute. (Literature citations may be listed at the end of the Project outline).

Objectives: A clear, complete, and logically arranged statement of the specific objectives of the project. These objectives should be attainable within the time frame of the project.

Procedure: A statement of the essential working plans and methods to be used in attaining each of the stated objectives. The procedures should correspond to the objectives and follow the same order. Phases of the work to be undertaken concurrently should be designated. The location of the work and the facilities and equipment needed and available should be indicated. Wherever appropriate, the procedure should provide data suitable for statis-

tical analysis. The statement on procedure should indicate that the research has been carefully planned and should provide for changes when they are necessary to improve the work.

Technology Transfer Plan: A clear and concise statement of how the information obtained by the attainment of the objectives will be transferred to other scientists/farmers.

Probable Duration: An estimate of the maximum time likely to be required to complete the research originally planned and to accomplish the technology transfer plan. Whenever any material change in the objectives for the project is advisable, a new or revised project outline should be prepared. A major change in procedure might also necessitate a revision of the project outline.

Financial Support: Estimated annual allotments (by dollars and rupees) to (i) salaries and (ii) support; based on analysis of requirements for labour, equipment, supplies, travel and other operating expenses.

Personnel: The leader, or leaders and other technical workers assigned, their responsibility and time committed to the project.

Institutional Units Involved: Each subject matter and service unit in PARC and other units of the ARC in Provinces contributing essential services or facilities. The responsibilities of each should be indicated.

Cooperation: A statement as to cooperation with the international centres, other donors, the U.S.D.A., or other agencies cooperating formally on the project.

The proposed project should be submitted to the PARC for approval. The executive Board shall review the proposals for scientific merit, programmatic appropriations, multi-disciplinary composition, realism in objectives/procedure/resources. The Board can approve or disapprove.

### REVIEW OF AGRICULTURAL RESEARCH SYSTEM (PARS)

Periodic review of research system in the country is essential to ensure that the various components of the system function at the maximum level of efficiency.

At present no review procedure exists in the country to evaluate critically the research work done either by various organizations or individual scientists, with the result that the administrators, the economists, the politicians and the people do not know precisely what is being done for the welfare of the country. Critical evaluation of research is necessary to determine:

- i) whether funds allocated for research are producing economic benefits to justify their use, as compared to other economic activities of the Government,
- ii) which scientists are doing productive/creative work and deserve accelerated promotion to encourage their creativity and which others, whose performance is below standard, should be adjusted elsewhere,
- iii) if there are deficiencies in manpower, equipments, funds and other facilities and how best these could be made up,
- iv) whether the quality of research at an Institute is improving or is going down,
- v) what changes are necessary in the approved research program due to changed economic conditions and overall agricultural production in the country and elsewhere in the world, and
- vi) whether practical use is being made of useful findings made under various research projects. If not, suggest remedies therefore.

It is necessary that review of research should be started immediately and thereafter should form a regular feature of all research organizations, just like audits of accounts.

In respect to each institution, research review should be both internal and external. Internal review should be organized by the head of the organization himself with the help of appropriate committees including specialists from outside. External review should be organized by PARC, which should set up ad-hoc review committees for this purpose. The committees should have powers to "co-opt" specialists and economists keeping in view the type and nature of research work to be evaluated. The report of the Internal Review Committee should be made available to the External Review Committee.

Review Committees should evaluate:-

- i) the total program of an agricultural research institution to determine the extent to which it contributes to the welfare of the people and to the solution of national problems,
- ii) the proposals of the Internal Review Committee, suggesting major areas of research, deficiencies and strengths which forms the basis for setting up priorities and allocating resources,
- iii) work of research teams and organizational units (coordinated research programs),
- iv) work of individual scientists to assess and encourage their creativity,
- v) other constraints that limit productivity.

The members of Review Committees should, inter alia, find out from individual scientists their personal difficulties and try to ensure that they enjoy a suitable environment for research. Remedies, if any, required

in this regard should form an integral part of the report. The report of the evaluation committee should be sent to the head of the institute concerned directly in respect of federal institutes and in respect of provincial institutes through the provincial government concerned for information, necessary action and future guidance.

When a research institute is visited subsequently, the Review Committee should first see to what extent the recommendations made by them previously have been followed.

Some of the important criteria which should be kept in view in evaluating research programs of an institute are:-

- i) the extent to which the research meets the national/provincial goals;
- ii) contribution to man's knowledge;
- iii) cost-benefit ratio;
- iv) urgency of research (threat of disease, etc.);
- v) number of people likely to benefit;
- vi) feasibility of implementation and completion of proposed research within the stipulated time;
- vii) assurance that research on the same subject was not being conducted on the same lines and under the same set of conditions by another organization; and
- viii) likelihood that extensive and immediate use would be made of research findings.

Particular attention should be given to the evaluation of individual scientists to assess their productivity and the standard of performance, keeping in view:-

- a) nature and description of assignment,

- b supervision required or leadership exercised,
- c education background,
- d publications written,
- e research accomplishments, and
- f honours and awards held.

The Review Committees may develop their own criteria for evaluating the work of individual scientists. A suggested method is that the scientists should at first be given a score by each member of the committee independently. This should be discussed point by point until the committee reaches a consensus score, which would determine the grade of the scientist, the lowest being zero, the average 50 and the top quality 100. The entire organization can thus be classified as above average, average and below average. Yearly evaluation would indicate whether the quality of staff is improving or declining. In addition, the evaluation reports of the coordinators and their appraisal of individual projects in the national coordinated programs should be made available to the review committees as well as appropriate CRISP outputs.

In pursuance of the directive of the Government, PARC has recently initiated a comprehensive review of agricultural research in the country. The assignment is expected to be completed within about three months time. The review is likely to reveal serious weaknesses, deficiencies and imbalances in the agricultural research system and recommend suitable remedial measures to improve matters.

#### CURRENT RESEARCH INFORMATION SYSTEM OF PAKISTAN (CRISP)

In order to provide a basis for national coordinated agricultural research planning and effective management of research resources, the Pakistan Agricultural Research Council has instituted an automated system for storing

and retrieving information on research projects in Pakistan. All the organizations, whether provincial, federal, autonomous or private, doing research on any aspect of agriculture will be required to send information on CRISP proforma to make the information comprehensive and complete.

The system known as the Current Research Information System of Pakistan (CRISP) stores, in the computer, descriptive information on each research project such as title, principal investigator, organization, objectives, methodology, progress reports, and expenditure. In addition, it describes each project in terms of research problem area, field of science, commodity, research activity, location and subject, etc.

This automated system of storing and retrieving information on research projects in Pakistan is being developed with the help of USDA. The "CRISP" system currently in operation in Washington is being scaled down for the specific needs of Pakistan. The basic function of the system is to accept information on research projects and to display that information in accomplishment and summary report formats. Computer descriptive information on each research project is to be collected and stored, i.e., a data bank will be organized and different types of summary reports can then be produced and sent to organizations concerned. Each project involves the filling up of information on three specific types of forms. (Annex. VII).

'CRISP' Form I. This form is used to report the project status, financial data code, responsible organization, performing organization, its province, project title, names of project scientists, objectives, plan of work, keywords, award data, start date and termination date.

In addition, it consists of the dates of approval and signature awarding and implementing the research project. It is completed at the beginning of the research project.

'CRISP' Form 2. This form is used to classify a research project by research problem area or activity. Whether it is basic, applied or developmental.

'CRISP' Form 3. This form is used to report annual progress on active research projects and summary reports for completed research projects. Funding level and manpower level is to be mentioned on this form.

#### Output Summary Reports

With the help of "CRISP" the following inventories can be obtained in printed form.

1. Summary of Investigators. A listing of all investigators reported on projects showing their names, project code, termination date, total amount and total scientific man years required for the project.

2. Summary of Organizations. A listing by performing organization showing project code, funding amount of each project and also total amount, scientific man years and total scientific man years required for all projects in the same organization and names of scientists conducting these projects.

3. Commodity Series. A consolidated summary of funds and scientific man years required for each commodity code.

A listing by commodity code showing research problem area, project code, funding amount and scientific man years.

4. Research Problem Area Series - Funds - A Summary of funding by RPA Code. Staff support and a summary of scientific man years support by RPA Code.

#### Project inventory

A listing by RPA, code showing project code, commodity code, funding amount and scientific man years required for each project.

### CURRENT AWARENESS LITERATURE SYSTEM (CALIS)

The working scientists are enrolled with USDA. They make request for research information in their area of interest. USDA makes computer search of World literature and sends bibliographic print-outs to cooperating scientists. They identify titles of interest and the USDA supplies hard copies of titles identified on request. PARC acts as the Coordinating Agency.

### MODIFICATION OF PROCEDURE FOR PROCESSING PL-480 PROJECTS

It has been observed that the existing procedure of processing PL-480 projects is rather cumbersome, lengthy and leaves much to be desired to process these projects expeditiously and in an effective manner. In order to simplify the existing procedure and to make it more effective it is proposed that henceforth these projects should be processed in the following manner:-

a) Research project should be prepared by the Sponsoring Agencies on the standard format prescribed by the USDA. These should be accompanied by the following certificates duly signed by the Head of the Organization concerned so that:

- i) 50 percent of the non-recurring expenditure involved would be met by the sponsoring agency and
- ii) foreign exchange, if required, would be provided by the organization concerned out of its own allocation.

Fifty copies of the project should be sent to the Directorate of Research (Coordination), PARC, through the Provincial Research Coordination Board (PRCB) and two copies to the Director of Research (Coordination), directly in advance.

b) The PRCB concerned shall forward the research projects to the Director of Research(Coord.), PARC, with such amendments/alterations as are considered necessary by them within two months time. In case no information is received from the PRCB within the specified period (two months), it will be assumed that the project has the approval of the PRCB and will be further processed by PARC in the normal manner.

c) The PARC will maintain a list of experts in the various fields/ disciplines of agriculture. This list will be modified from time to time as and when necessary. The Research Projects when received from the PRCB will be sent to two experts on the subject for critical evaluation in accordance with the prescribed proforma.

The projects will also be evaluated by the Director concerned in PARC.

The Director concerned will submit the projects to the Member concerned along with his own observations and the comments of the reviewers.

The Chairman shall endorse the projects to USDA/FERRO on the advice of the Member concerned for further necessary action.

Urgent projects of exceptional merit may be endorsed to USDA/FERRO directly by the Chairman.

The projects endorsed to USDA/FERRO will be placed before the Technical Committees, Planning, Priorities and Finance Committee and the Council for information.

The annual final technical reports of the projects will be considered by the concerned technical committee with a view to improving the working of the project, and their comments will be communicated to USDA/FERRO and the Executing Agency

The final report of the project shall be submitted by the executing agency within six months of the completion of the project.

### LIBRARY SERVICE

It was most unfortunate that, at the time of independence in 1947, almost all the important national agricultural libraries (libraries of Indian Veterinary Research Institute, Mukteswar; Indian Dairy Research Institute, Bangalore; Indian Council of Agricultural Research, New Delhi, etc.) were located in areas which, after partition of the sub-continent, constituted parts of India. Furthermore, these libraries were declared unique and were not partitioned. Even the duplicate copies of most of the publications available in the libraries were not given to Pakistan.

The only worthwhile libraries in the field of agriculture in Pakistan were those of the Agricultural College, Lyallpur (now The Agricultural University, Faisalabad) and the College of Animal Husbandry (now Veterinary Sciences), Lahore. The Lyallpur Library was partially burnt at the time of partition and the Lahore Library was deprived of important publications by the migrating non-muslims. There was a small library in the Agriculture Division which was first transferred to PARC and then re-transferred to the Agriculture Division. Concerted efforts have been made, and are still being made, by the Agricultural Universities, Agricultural, Animal Husbandry and Forestry Colleges and Research Institutes in the country to build up their libraries as quickly as possible, but this will take time.

The Library of the Indian Council of Agricultural Research is, perhaps, the best library in the whole of Asia, covering all fields of Agriculture. PARC, which is a counterpart of ICAR, has a small library unit. Most of the referrals made to PARC to supply background information on the schemes to be financed by them or by the United Nations agencies, etc. cannot be attended properly for want of up to date literature with the Council. There is no national library in the country covering all

fields of agriculture to serve as a reference library. The establishment of an up-to-date reference and service library by PARC, embracing all fields of agriculture, is a matter of great urgency and its importance in agricultural research can hardly be over-emphasized. PARC is making concerted efforts to make up the deficiency as speedily as possible within its limited resources. There is need to further intensify efforts in this regard.

In addition, there is also need to improve the library facilities of agricultural universities and at least major agricultural research institutes in the provinces. They have to be provided adequate funds, including foreign exchange, to modernize the existing libraries.

PARC may also establish a Research Information Cell as an integral part of the library. The objectives of the cell should be to:-

- i) Prepare a World Directory of Agricultural Research, including therein the following information in respect of important research institutes engaged in research in the various fields of agriculture in different countries;
  - a) name and location of the institute;
  - b) qualifications and experience of the staff;
  - c) major equipments available;
  - d) publications issued (regular and periodicals);
  - e) training facilities available (post-graduate, doctorate and post-doctorate); and
  - f) facilities, if any, available in the form of scholarships, fellowships and post-doctorate studies. Full advantage should be taken of the facilities available with the U.N. agencies like FAO, WHO, UNESCO, UNICEF, etc., in compiling the proposed Directory of World Agricultural Research.

- ii) Collect, classify and supply the right kind of information needed by any agricultural research institute/individual scientist on problems under investigations.
- iii) Establish contacts and working arrangements with all important agricultural research institutes for the regular exchange of information which would be properly classified and made readily available as and when needed by our scientists.

The Research Information Cell should be well staffed/equipped with modern machinery and equipments and should serve as "PASTIC" for agricultural research.

The Cell should periodically prepare a bibliography on important subjects for the benefit of the scientists engaged in research in those subjects.

#### DEVELOPMENT OF MANPOWER FOR AGRICULTURAL RESEARCH

There is an overall acute shortage of trained manpower for agricultural research in the country. In some cases, there is not a single trained specialist for research on certain important aspects of even the major agricultural commodities. In order to develop a meaningful agricultural research and development program, it is most urgent that PARC develop a corps of well-trained research scientists in all the disciplines of agriculture, with particular emphasis on major commodities. A beginning has already been made in this direction.

A number of young scientists have been recruited recently, after a nation-wide search for talent. These young scientists are being sent abroad for specialized training in different universities and at the International Agricultural Research Centres. They will be available for posting at the National Agricultural Research Centre and other commodity

institutes, which are expected to start functioning within the next 2-3 years.

In addition to training abroad, PARC has also started a program to train selected young scientists in the universities in Pakistan, especially in those disciplines where the local universities have high quality faculty capabilities. In this way, it is hoped to build up sufficient trained manpower to meet the requirements of agricultural research, not only at the national level for PARC, but also for the provinces as well as the agricultural universities:

#### Recruitment of Scientists

Selection of the right type of scientists for research in the various disciplines of agriculture is far more important than any other single factor to achieve the desired goals in agricultural production and development. It has been observed that where a competent scientist, with the requisite qualification and experience for the job, was appointed as principal investigator, he/she invariably produced the desired results within the stipulated time, but where due care was not exercised in this regard, there was almost complete wastage of time, money and energy spent on the research projects. The need for the selection of scientists on merit and merit alone can, therefore, be hardly over-emphasized.

PARC's selection procedure consists of:

- i) prescribing well considered academic and other qualifications for each post;
- ii) inviting applications through wide publicity in the press;
- iii) strict scrutiny of applications received in the light of prescribed qualifications;
- iv) giving written tests to eligible candidates;

- v) holding personal interviews of candidates who obtain 90% or above marks in the written test;
- vi) rating of candidates on the basis of weighted criteria fixed for academic/other qualifications, written tests and personal interviews (Annex.VIII).
- vii) recruitment of candidates strictly in the order of merit within the framework of overall government policy and directives issued from time to time.

The scientists recruited are placed on probation for one year with 15 days notice on either side or salary in lieu thereof.

#### Merit Promotion

One of the major reasons for the poor performance of agricultural research in Pakistan is the outmoded career structure for the scientists, where promotions to higher cadres are made essentially on the basis of seniority in service with little regard for achievements. PARC proposes to introduce a system of 'Merit Promotion' for the research scientists. Under this system promotions will be based on rigorous periodic assessment of scientists of an expert panel. Promotions to higher grades would be made by upgrading of the incumbent posts, irrespective of the availability of vacancies, to avoid rivalry and bickering among professional colleagues. This system will provide better opportunities for career advancement, facilitate optimum use of scientific manpower and ensure desired mobility.

Recognition of merit in one or the other form is essential to provide the necessary incentive for scientists with outstanding performance to improve upon their achievements still further. A separate form has been prescribed for this purpose (Annex. IX)

### Personnel Management

The management procedure involves objective assessment of the performance of the staff in accordance with forms specially prescribed for this purpose. These relate to:

- i) Placement follow-up (Annex. X).
- ii) Appraisal of Performance (Annex.XI)
- iii) Performance Rating and Certification of position (Annex. XII)

This would enable PARC to determine as to whether or not the scientists recruited should be retained in the organization.

### SUPPLY, MAINTENANCE AND REPAIR OF LABORATORY EQUIPMENTS

At present, adequate arrangements do not exist for the supply, maintenance and repairs of laboratory equipments of standard quality, especially sophisticated equipments. A preliminary survey carried out in the recent past revealed that equipments worth millions of rupees were lying unused for want of petty repairs or replacement of minor parts. Moreover, the technicians were also not well trained in the handling and maintenance of complicated equipments. Besides strengthening the research capability of various agricultural research institutes, PARC will maintain a well equipped staff unit for the maintenance and repairs of laboratory equipments and the training of laboratory technicians.

### IMPROVEMENT OF EXTENSION SERVICES

Agricultural extension is a provincial subject and the provinces are carrying out this activity according to their resources, which are extremely limited. PARC will, however, supplement the efforts of the provincial governments in this regard. Its activities will be chiefly confined to:

- i) Coordination, streamlining and accelerating information transfer and communication support of extension services;

- ii) Holding national/international conferences/workshops in respect to selected topics and important crops before sowing - to finalize the recommendations which would be published and widely disseminated.
- iii) Providing maximum communication media support through the Ministry of Information and Broadcasting, putting selective spot announcements and slogans on all the radio and television stations, regularly publishing the popular journal "Progressive Farming", crops and livestock manuals, etc.
- iv) Undertaking research in agricultural extension techniques currently in operation to identify weaknesses/deficiencies, wherever they exist, and suggest remedial measures therefore.
- v) Preparation and supply of extension materials such as slides, flip charts, wall newspapers, pamphlets, leaflets, etc., to provincial extension workers.
- vi) Acquiring information of benefit to the farmers from all sources and its dissemination to all concerned.

## Chapter 7

NEGLECTED AREAS OF AGRICULTURAL DEVELOPMENTLIVESTOCK

Agricultural research has not developed in a balanced manner. Major emphasis during the past many years has been on cereal production, which was considered synonymous with food production. In fact, self-sufficiency in food must aim at a balanced development of agriculture, providing adequate quantities of carbohydrates, fats and proteins (both of plant and animal origin), vitamins and minerals for the majority of the population. Unfortunately, this has not been done. The most neglected area has been the livestock sector. This is not surprising because very few people in Pakistan are well aware of the following facts:-

- i) The contribution of animal agriculture to GDP is as great as that of plant agriculture, if not more.
- ii) If the contribution of livestock, in the form of animal manure and draft power, is deducted from plant agriculture and added to animal agriculture, it becomes the single biggest contributor to GDP. Even in the U.S.A., where agriculture is completely mechanized, contribution of livestock to GNP is, on the whole, more than that of crops.
- iii) Livestock and their products are the second most important earners of foreign exchange.
- iv) Studies conducted under the auspices of the National Science Council clearly indicated that there is an acute shortage of proteins of animal origin in the country. The available supplies are hardly 33% of the desirable level, which is highly detrimental

for the national health - especially for young children and expectant and nursing mothers. If concerted efforts are not made to increase production of proteins of animal origin, the existing protein gap will widen further with the fast increase in population and, later on, it may be extremely difficult to avert the impending protein crisis.

- v) Production per animal unit in Pakistan is highly variable, which provides tremendous scope for quick development both by intensive selection and crossing with suitably improved exotic stock. This potential, if judiciously exploited, could result in the production of superior animals well adapted to climatic and soil conditions in other countries located in tropical and sub-tropical areas, thus creating tremendous demand for the export of live animals.
- vi) Agriculture is not likely to be completely mechanized for a long time to come because of several limiting factors. Mechanization will not exceed 20-30% during the next 25-30 years. Thereafter, Pakistan will have to adopt a cautious and flexible approach to mechanized agriculture, concentrating efforts only in those areas where increased production is possible by bringing more area under cultivation, growing crops which are labour consuming, growing 3 or more crops in a year, and releasing labour from agriculture for use in more profitable occupations in industries and other sectors of the economy.
- vii) The demand for livestock products is bound to increase with the development of industries based on livestock products and with rising standards of living.

- viii) The loss sustained by the country due to late age at first calving (48 months instead of 28 months) and longer calving interval (18 months instead of 12 months) in buffaloes alone comes to over Rs. 1.6 billion per annum. If 10% of this loss could be prevented in 5 years time, it would not only make a substantial contribution to GDP, but would also materially improve the plane of nutrition of the people, reduce medical expenditures and result in accelerated economic development of the country by improving the productive capacity of the people.
- ix) The annual per capita consumption of meat is about 9 lbs. as against 20-25 lbs. in the Middle Eastern countries and more than 60 lbs. in the developed countries. However, little or no attention has been given to meat production in the past. The result is that the prices of meat have increased by more than 12 times during the past 25 years and the upward trend continues unchecked despite two meatless days a week. Some attention has been paid to poultry production in the principal cities with the result that poultry meat, which used to be about 25% more costly than mutton, is now being sold at about 30% less within the short period of about 10 years, indicating clearly the tremendous scope for further development of poultry.
- x) The size of funds allocated to a sector of agriculture is a very reliable indicator of the importance attached to its development by the Government. The following table shows the funds allocated to crop production, livestock production, forestry and fisheries during the First Five Year Plan periods.

Table 41. Allpccation made by the Planning Commission

Sector	First Plan	Second Plan	Third Plan	Fourth Plan	Fifth Plan	% increase in Fifth plan over 1st plan
	(million rupees)					
Crops	403.41	303.00	2839.54	4016.45	10416.40	2484
Livestock	113.82	124.00	147.77	175.00	1201.00	953
Forestry	90.10	134.00	257.61	230.90	953.10	958
Fisheries	34.92	46.00	169.94	133.47	411.00	1074

It is seen from the above that funds allocated to the livestock sector are proportionately far less compared to the size of the industry and the scope for its development. The discrepancy is too great to be easily reconciled.

In spite of the great importance of the livestock industry in the economy of the country, it has not received the attention it deserved in planning for research and development. For example, the total value of pure milk at Rs. 110/-per standard maund almost equals the total combined value of wheat, rice, sugarcane and cotton, as per details given below:

Table 42. Annual Value of Major Agricultural Commodities vis-a-vis Milk

Commodity	Production ('000' tons)	Average price per 37.324 kg	Value (million rupees)
Wheat	10,870	Rs. 45.00	13,105
Rice Paddy	3,204	Rs. 50.00	4,292
Cottonseed (1000 bales)	4,200	Rs. 140.00	2,793
Sugarcane	27,200	Rs. 9.00	6,558
Total			26,748
Milk	9,000	Rs. 110.00	26,524

Leaving aside a few exceptions, highly talented scientists are not attracted to the animal husbandry sector because of lack of opportunities for promotion to higher position, low prestige of the profession in the public eye and the undeveloped state of the industry.

Whereas a number of steps have been taken by the Government to increase production of wheat, rice, sugarcane and cotton, viz.. provision of numerous financial and other incentives, establishment of research institutes, accelerated research programs and liberal allocation of funds for research, not a single institute has been established for dairy research in the country and, until recently, there has not been a single worthwhile national research project in operation on any major aspect of the dairy industry.

Some of the main reasons which appear to be responsible for the slow development of the livestock sector are as follows:-

- i) The role of livestock in the agricultural economy of the country and its scope for further development has not been properly appreciated by the administrators at the highest level
- ii) The level of human nutrition was below the minimum requirements to maintain health. Efforts were, therefore, concentrated on utilizing the limited resources of land for providing food for direct human consumption rather than producing crops for livestock production.
- iii) Not even a Class-II animal husbandry officer has been appointed in the Planning Division for the past 20 years to plan livestock development - an industry for which creation of an independent section was fully justified.
- iv) There is a general impression that development of livestock is

a very slow, tedious and long range process and as such it has always been given a low priority in developmental efforts and allocation of funds.

Intensification of livestock R&D efforts is imperative to ensure balanced development of agriculture in Pakistan.

### PEST MANAGEMENT

Accurate estimates of losses caused by insect pests, non-insect pests and other pathogens to plant agriculture for the country as a whole have not so far been made on the basis of carefully conducted national surveys. However, estimates of losses made by various workers range between 6,000-11,000 million rupees annually. Efforts made so far to reduce such losses are not commensurate with the obvious magnitude of the problem. Furthermore, there are several inherent weaknesses in the current state of research and methods of control of these pests. Some of these are as follows:

- i) No country-wide survey of major pests of economic importance has been carried out on an adequately planned basis.
- ii) Complete information on important pests, host plants, biology, ecology, distribution, magnitude of damage is lacking.
- iii) No machinery exists to forecast pest incidence in the country.
- iv) There is no legislation in the country regarding the use of insecticides.
- v) Spraying of crops is mostly indiscriminate, which creates more problems (air pollution, water pollution, mammalian, avian toxicity and surge resistance) than it solves.
- vi) No national institute exists in the country to deal effectively with research on all aspects of pest management.

## RANGE LANDS

One of the most valuable resources is the pastoral range, which constitutes 2/3 of the land area of Pakistan. Large areas of land in Quetta, Kalat, D.I. Khan, Bahawalpur, Khairpur, Hyderabad and Rawalpindi receive so little rainfall that cultivation of agronomic crops is not an economical proposition. However, most of these tracts, if properly developed and judiciously exploited, could support a livestock industry of substantial size.

Many of the range lands have been so overgrazed that the grasses and shrubs had no chance to restore themselves to their full potential. Under heavy grazing pressure, the palatable species perished, while the non-palatable species, left untouched, seeded freely and flourished. This damage, built up through years of over-exploitation, is conspicuous by an almost absence of nutritious forage, especially in the east, has caused serious soil and water-erosion problems.

At present, the grazing capacity of these lands is much below their inherent capacity but most of them can still restore themselves, although in some cases many years would be required to do so.

Very little progress was made in the proper development of range lands during the first three Five year Plan Periods. Pakistan, with its rapidly increasing population, can ill-afford to neglect this important resource, especially when further devastation continues unchecked.

The research effort in range problems would have to be broad-based, involving specialists in range management, soil and water conservation, animal husbandry, animal health, rural sociology, agricultural economics and marketing. Range research should be a global enterprise. Local research programs need to be profitably linked with international endeavours and

undertaken at a scale compatible with the magnitude of the task involved.

A project for the establishment of The Arid Zone Research Institute by PARC has been approved. Its headquarters will be in Quetta with substations in the Sind, Punjab and NWFP. At present its scope of activities is rather limited for want of trained staff and other physical facilities. PARC, however, has plans for intensification of research efforts in this area.

#### FOOD TECHNOLOGY (Handling, Storing and Processing of Agric. Products)

Most of the modern techniques and facilities for handling, storing and processing of agricultural products are derived from countries located in temperate zones and as such have limited application under the climatic conditions of tropical countries. The problems of bad storage and processing are often underrated. At a conservative estimate, they account for about 15% of the losses. The damage caused by too high temperature and moisture leads to biological/chemical changes, microbiological spoilage by molds and bacteria and still more complicated processes like spontaneous heating and, at times, even combustion. Determination of proper harvesting time, proper handling during collection, transportation and storage and establishment of rural processing industries would go a long way in improving the quality and nutritive value of agricultural products and in providing better opportunities for marketing them at higher prices.

Creation of adequate facilities for research on handling food crops of all kinds, from the field through well controlled storage, transportation, processing and packaging procedures, is needed to provide the people living in urban areas with reasonably priced, hygienic and nutritious food. This has to be closely linked with general agricultural planning, scientific and technical education and research. There is an urgent need of training in food

technology at the university level to produce graduate nutritionists/dieticians to go into the food industry.

At present, there is no single institute in the country to deal with research on various aspects of a food industry, viz., composition, storage, transportation, preservation, packaging of food products and training of food technologists. The need for the establishment of a modern full-fledged institute of food technology as a constituent unit of each of the agricultural universities is strongly indicated.

### FISHERIES

There is an acute shortage of protein of animal origin in our diet. Fish is an important source of animal protein. It has assumed considerable importance because of its substantial contribution to foreign exchange earnings, which increased from Rs. 83.3 million in 1969-70 to Rs. 461.9 million in 1978-79 - an increase of 455% in 10 years time.

The country has vast inland and marine fisheries resources which are not being exploited fully and judiciously. There has been considerable increase in fish production from the marine waters during the last ten year period, which indicates tremendous potential for further development.

The main problems in fisheries development requiring immediate attention are:-

- i) Reclamation of derelict water areas for fish culture.
- ii) Establishment of fish seed farms and nurseries.
- iii) Judicious exploitation of tanks, ponds and impounded waters.
- iv) Biological management of fisheries for optimum sustained yield.
- v) Stocking dams, lakes and canals with fast growing species.
- vi) Improvement of fish ladders in barrages.

- vii) Improvement in fish landing, berthing, storage and marketing facilities.
- viii) Training of drivers, mechanics and fisherman to handle mechanized crafts and gears.
- ix) Expansion of mechanized fishing fleet.
- x) Establishment of industries for processing of fish and their by-products.
- xi) Detailed surveys of off-shore and deep waters of the sea.
- xii) Control of weeds in lakes, canals, impounded waters and dams.
- xiii) Improvement in biological and technological studies on fisheries.

Research is necessary to solve the various problems outlined above affecting fisheries development and exploitation. At present, there is no full-fledged research institute in the country to adequately deal with these problems. Establishment of a modern well-equipped and staffed fisheries research institute to conduct research on various aspects of both inland and marine fisheries and provides training facilities at all levels is strongly indicated.

AREAS IN WHICH EARLY RESULTS CAN BE ANTICIPATED

Some of the important research areas with early and high potential payoff are:

- i) Identification of evolving germplasm that possess complete resistance against some and at least partial resistance against most of the pathogens - major thrust may be directed against wheat rusts and chickpea blight in food crops and Mareks' Disease in Poultry.
- ii) Development and introduction of site-specific packages of technologies for at least major agricultural commodities in various agro-ecological zones duly backed by an effective extension and communication service and supply of essential inputs.
- iii) Development of an integrated pest surveillance and management system for major crops in different agro-ecological zones.
- iv) Biological nitrogen fixation - selection of more efficient strains of bacteria for the various legumes.
- v) Development of pesticide toxicology capabilities to enable judicious use of various pesticides.
- vi) Farming Systems research to improve the farmers' overall efficiency of production rather than individual commodities.
- vii) Salinization and sâdification.
- viii) Expansion of cross breeding program in cattle in a well planned and a systematic manner.
- ix) Reproductive inefficiency - higher age at first calving and longer calving interval.
- x) Formation of balanced economic nations based primarily in by-products of industries for various species of livestock including poultry.
- xi) Development of more productive strains/breeds of small ruminants (sheep and goats) for mutton, wool/hair and milk production.

## Chapter 8

THE RECOMMENDATIONS FOR CONSIDERATION1. PRIORITY FOR AGRICULTURAL RESEARCH

Agricultural research should be accorded the highest priority in allocation of resources to optimize agricultural production to meet the needs of the fast growing population, ensure welfare of the vast majority of the population, and overall economic and political stability of the country.

2. PLANNING

A national plan (both short and long-term) of agricultural research should be prepared by PARC - say for a period of five or ten years establishing requirements, priorities and areas of cooperative activity with the provincial governments, the universities and other autonomous bodies. Within this frame-work each research institution should prepare research programs personalized to its own resources and capabilities (page 113).

3. FUNDS

A gradually increasing allocation of funds (up to 2% of the agricultural GDP) should be made to agricultural research during the next 10 years to produce worthwhile results in responding to complex problems of agricultural production (page 107).

4. IMBALANCES IN ALLOCATION OF FUNDS

Agriculture (crops, livestock, forestry and fisheries) should be regarded as a single, integrated industry necessitating balanced development. The serious imbalances now existing in allocations of funds for research to various sub-sectors of agriculture should be removed and

future allocations made on the basis of size of each sub-sector, its contribution to GDP, its importance in the economy of the country and its scope for further development.

The tendency to use major portions of funds for capital outlay, salaries, allowances and charges other than operational expenses for research should be avoided to produce meaningful results.

Separate specific allocations should be made for research in the agricultural universities (page 112).

5. PROFORMA FOR RESEARCH

Uniform proforma should be developed for the country regarding (1) formulation of research projects; (2) extension proposals; (3) appraisal of research projects; (4) appraisal of extension proposals; (5) monitoring of research projects; (6) critical evaluation of half yearly, annual and final progress reports (page 149).

6. MANPOWER

Total requirements of trained manpower at various levels to implement the national program should be carefully worked out for a period of 5-10 years and matched with an up-to-date catalogue of personnel currently available. The shortfall should be made up as early as possible, according immediate priority to shortfalls in critical areas and locations (page 120).

7. RESEARCH ESTABLISHMENTS

A critical evaluation of the performance of all research establishments in the country should be made by PARC. Those with zero or negative return, incapable of being made viable, should be closed and the resulting savings utilized to enhance the capabilities of the others (page 96).

## 8. FEDERAL-STATE COOPERATION

PARC's activities should be mainly confined to planning, coordination, evaluation, promotion and strengthening of agricultural research on a country-wide basis. It should undertake in-house research in those areas where provincial research is non-existent or seriously inadequate and basic research which can be best accomplished at a well-equipped/staffed national research institute (page 97).

## 9. APPLIED VERSUS BASIC RESEARCH

Major emphasis should be on applied research (problem/mission-oriented) which is economically worthwhile. Nevertheless, a small percentage of investment in basic research, the only source on which practical advances for the future can be based, should also be made. It should, however, be conducted only in those divisions of the National Research Institute and departments of agricultural universities which are adequately equipped and have high quality manpower to undertake such research (page 74).

## 10. COORDINATION

Coordination at the provincial level should be ensured by the Agricultural Research Coordination Boards, while PARC should do so at the national and international levels, and for this purpose establish a Central Project Cell where, inter alia, all necessary records of past, present, and projected research should be maintained (page 117).

## 11. PRIORITIES OF RESEARCH

Research priorities should be determined on the basis of urgency, the extent to which they meet the national goals, the number of people likely to benefit, benefit-cost ratios, etc. Research efforts should be intensified where need is greatest.

12. REVIEW OF RESEARCH

Regular evaluation of researchers and their research programs should be carried out to ensure maximum cost-effectiveness by a Standing External Evaluation Committee of PARC, with the help of specialists (page 156).

13. LINKAGE BETWEEN EDUCATION, RESEARCH & EXTENSION

Effective linkage between education, research and extension should be established at both the provincial and federal levels to develop a stable and efficient agricultural research and development system in the country (page 119).

14. MANAGEMENT OF SCIENTIFIC PERSONNEL

Standard proformas should be developed for recruitment, placement and objective assessment of the performance of research workers to ensure that retention in service and promotion is based on merit, quality and quantity of research accomplished (page 169).

15. CAREER ADVANCEMENT & MERIT PROMOTION

The service structure of the scientists should be reconstituted to permit the promotion of deserving cases to the highest grade in due course of time and allow accelerated promotion to those with outstanding performance regardless of existence of vacancies in the higher grades (page 168).

16. BRAIN DRAIN & MALADJUSTMENTS

Permanent brain drain should be arrested by persuasive, attractive conditions of service and a congenial scientific environment, rather than through legislative or coercive measures.

A specialist should not be shifted to a higher post for which he is not qualified, merely by virtue of his seniority. He should, however, be promoted to the higher grade in his own post (page 124).

17. RESEARCH INFORMATION FROM ABROAD

PARC should arrange for the acquisition of research information on topics of interest to Pakistan from all available sources abroad, particularly USDA, classify it and supply the information needed by a scientist currently undertaking or proposing to undertake research in a particular area (page 125).

18. EXTENSION SERVICE

A comprehensive review of extension techniques currently in operation should be undertaken by PARC on a country-wide basis to identify weakness/deficiencies, wherever they exist, and make realistic and practicable recommendations to make the system really work in an effective manner under different socio-economic conditions in the various agro-ecological regions (page 126).

19. LIBRARY SERVICE

PARC should not only develop an up-to-date modern service library on agricultural and allied subjects, but also assist in strengthening the libraries of the main agricultural research institutes (page 164).

20. MAINTENANCE AND REPAIRS OF LABORATORY EQUIPMENTS

PARC should maintain a well-equipped/staffed unit for the maintenance and repairs of sophisticated laboratory equipments with provision for the training of laboratory technicians to serve all the agricultural research and educational organizations in the country (page 169).

21. NATIONAL COMMODITY AND REGIONAL INSTITUTES

Well-equipped, adequately funded and well-staffed national research institutes on major agricultural commodities should be established to undertake applied research on complex and intricate problems of agricultural production as well as basic research in important areas.

Also, regional research institutes to cater for the specific needs of the various regions should be considered seriously to optimize utilization of scarce resources for agricultural research and development. (page 146).

ORDINANCE NO. XXXVIII OF 1981

An  
ORDINANCE

to provide for constituting and re-organizing the Pakistan Agricultural  
Research Council

WHEREAS it is expedient to provide for constituting and reorganising  
the Pakistan Agricultural Research Council and for matters connected therein  
or ancillary thereto;

AND WHEREAS the President is satisfied that circumstances exist which  
render it necessary to take immediate action;

NOW, THEREFORE, in pursuance of the Proclamation of the fifth day of  
July, 1977, read with the Provisional Constitution Order, 1981 (C.M.L.A.  
Order No. 1 of 1981), and in exercise of all powers enabling him in that  
behalf, the President is pleased to make and promulgate the following  
Ordinance:

CHAPTER I

PRELIMINARY

1. Short Title, Extent and Commencement.

- 1) This Ordinance may be called the Pakistan Agricultural Research  
Council Ordinance, 1981.
- 2) It extends to the whole of Pakistan.
- 3) It shall come into force at once.

2. Definitions

In this Ordinance, unless there is anything repugnant in the  
subject or context:

- a) "agriculture" means crops, livestock including poultry, fisheries, forestry, range management, soil science, socio-economic institutional and engineering aspects connected therewith and such other activities and subjects as the Federal Government may, by notification in the official Gazette, declare to be agriculture within the meaning of this clause;
- b) "Board" means the Board of Governors of the Council;
- c) "Chairman" means the Chairman of the Council;
- d) "Council" means the Pakistan Agricultural Research Council established under section 3;
- e) "Executive Committee" means the Executive Committee of the Board.
- f) "Prescribed" means prescribed by rules or regulations;
- g) "President" means the President of the Board;
- h) "research establishment" includes agricultural experiment stations, field stations, institutes, centres, sub-centres, laboratories and other units of the Council howsoever designated;
- i) "rules" means rules made under this Ordinance.
- j) "regulations" means regulations made under this Ordinance; and

#### ESTABLISHMENT OF THE COUNCIL

### 3. Establishment of the Council

- 1) There shall be established a Council to be called the Pakistan Agricultural Research Council.
- 2) The Council shall be a body corporate having perpetual succession and a common seal with powers, subject to the provisions of this

Ordinance, to acquire, hold and dispose of property, both movable and immovable; and shall by the said name sue and be sued.

- 3) Unless the Federal Government, by notification in the official Gazette, otherwise directs, the headquarters of the Council shall be at Islamabad.
- 4) The Council may from time to time establish regional offices, local offices, sub-offices and research establishments at such places as it may deem fit.

### CHAPTER III

#### FUNCTIONS AND POWERS OF THE COUNCIL

##### 4. Functions and Powers of the Council

The functions of the Council shall be:

- a) to undertake, aid, promote and coordinate agricultural research;
- b) to arrange the expeditious utilization of the research results;
- c) to establish research establishments mainly to fill in the gaps in existing programme of agricultural research;
- d) to arrange the training of high-level scientific manpower in agricultural sciences;
- e) to generate, acquire and disseminate information relating to agricultural;
- f) to establish and maintain a reference and research library; and
- g) to perform any other functions related to the matters aforesaid.

##### 5. Directions from the Government

In discharging its functions, the Council shall be bound by such directives and orders, if any, as may be given to it on any questions of

policy by the Federal Government which shall be the sole judge as to whether a question is a question of policy.

#### CHAPTER IV MANAGEMENT

##### 6. Board of Governors

1) The overall control, direction and superintendence of the affairs of the Council shall vest in a Board of Governors consisting of the following members, namely:

- i) the President;
- ii) the Chairman;
- iii) not more than five whole-time members; and
- iv) such other members as the Federal Government may appoint on the recommendations of the Chairman from time to time.

2) The appointment of the Chairman and other members shall be made by notification in the official Gazette.

##### 7) President

The Federal Minister incharge of the Ministry dealing with Agriculture shall be the President of the Board.

##### 8) Executive Committee

1) There shall be an Executive Committee consisting of the Chairman and the whole-time members of the Board.

2) Subject to the provisions of this Ordinance and the rules and regulations and the general or special directions of the Board, the Executive Committee shall be the principal administrative body of the Council

responsible for executing all policies and discharging all functions of the Council under this Ordinance.

3) Notwithstanding anything contained in sub-section(2), the Executive Committee shall:

- i) undertake regular review of the evaluation of the accomplishments and progress of the research projects and the programs of the research organizations; and
- ii) exercise control over the research activities of the Council

9) Chairman

1) The Chairman shall be the chief executive of the Council.

2) The President of Pakistan shall appoint an eminent scientist connected with agriculture to be the Chairman on such terms and conditions as he may determine.

3) The Chairman shall hold office during the pleasure of the President of Pakistan.

4) The Chairman shall have such powers and perform such functions as are assigned to him by or under this Ordinance.

5) The Chairman may, from time to time, for the purpose of ensuring efficient functioning of the Council and facilitating its day to day functions, delegate to members, officers and employees of the Council such of his functions, powers or duties as may be considered necessary by him.

10) Whole-time members

The whole-time members shall be appointed by the President of Pakistan for a period of three years and shall perform such functions and exercise such powers as are assigned to them by or under this Ordinance and shall be eligible for re-appointment.

11) Term of office of non-official members

1) The members of the Board who are not officials of the Federal Government, hereinafter referred to as non-official members, shall, unless otherwise directed by the Federal Government, hold office for a term of three year and shall be eligible for re-appointment.

2) A non-official member may, be writing under his hand addressed to the Federal Government, resign his office.

3) A casual vacancy in the office of a non-official member shall be filled by the appointment of another member for the residue of the term of his predecessor.

12) Meetings

1) The meetings of the Board shall be held at least twice a year and shall be presided over by the President or, in his absence, by a member nominated by him for the purpose.

2) Subject to the provisions of sub-section (I), the meetings of the Board and of the Executive Committee or of other committees shall be held at such times and at such places and in such manner as may be prescribed by regulations:

Provided that, until regulations are made in this behalf, such meetings shall be convened by the Chairman.

3) Unless otherwise prescribed, one-third of the total members in the case of the Board and one-half of the total members in the case of the Executive Committee shall form a quorum at any meeting of the Board or the Executive Committee, as the case may be:

Provided that no quorum shall be necessary for an adjourned meeting.

13) Delegation of powers by the Board

The Board may from time to time delegate to the Executive Committee such of its functions and powers as it may consider necessary:

Provided that the Executive Committee may, in an emergency which in its opinion requires immediate action, take such action as it considers necessary and shall report it for approval to the Board in the next meeting.

14) Validity of proceedings

No act, proceeding, decision or order of the Council, Board or Executive Committee shall be invalid by reason only of the existence of a vacancy in or any defect in the constitution of the Council, Board or Executive Committee.

## CHAPTER V

## ESTABLISHMENT

15) Appointment of officers, etc.

1) The Council may appoint such officers and staff as it may consider necessary for the efficient performance of its functions on such terms and conditions as may be prescribed.

2) The Council may engage on contract experts and consultants for a period not exceeding two years at a time on such terms and conditions as it may determine and subject to such directions as the Board may from time to time give in this behalf.

3) Notwithstanding anything contained in any contract or agreement or in the conditions of service, every person serving in or under the Agricultural Research Council constituted under the Agricultural Produce

Cess Act, 1940 (XXVII of 1940), immediately before the commencement of this Ordinance, including persons on deputation to other organizations or abroad, shall stand transferred to the Council and become an employee of the Council on the same terms and conditions, including remuneration, tenure of service, rights and privileges as to pension and gratuity and other matters, as were applicable to him immediately before the commencement of this Ordinance, until his employment in the Council is terminated in accordance with his conditions of service or his terms and conditions are altered by regulations, which shall not be less favourable than those by which he was governed immediately before his transfer to the Council.

16) Transfer of existing civil servants to the Council

1) Notwithstanding anything contained in any law, contract or agreement or in the conditions of service, every civil servant employed in the Attached Department portion of the Directorate-General of the Pakistan Agricultural Research Council and serving in or under the Council immediately before the commencement of this Ordinance, including persons on deputation to other organizations or abroad, shall, save as hereinafter provided, cease to be a civil servant and stand transferred to, and become an employee of, the Council on the same terms and conditions, including remuneration, tenure of service, rights and privileges as to pension and gratuity and other matters, as were applicable to him immediately before the commencement of this Ordinance, until his employment in the Council is terminated in accordance with his conditions of service or his terms and conditions are altered by regulations, which shall not be less favourable than those by which he was governed immediately before his transfer to the Council.

2) Any person referred to in sub-section (1) who is on deputation with the attached Department portion of the Directorate-General of the Pakistan Agricultural Research Council shall continue in the employment of the Council on deputation in accordance with the terms of his deputation.

3) Any person referred to in sub-section (1) may, within three months from the commencement of this Ordinance, opt not to be transferred to the service of the Council and the option so exercised shall be final.

4) An employee who opts under sub-section (3) not to be transferred to the service of the Council may, as far as possible, be provided a suitable posting elsewhere by the Federal Government.

5) If an employee does not accept the appointment offered to him under sub-section (4), within the time allowed to him, or if it is not possible for the Federal Government to provide a suitable posting to him under that sub-section, his service shall stand terminated on the date on which he declines the offer or the time allowed to him expires or, as the case may be, on which the Federal Government informs him that it is not possible to provide a suitable posting to him, and he shall be entitled to be paid by the Federal Government compensation equivalent to three months remuneration.

Explanation: The compensation payable to an employee under this sub-section shall be in addition to and not in derogation of his rights as to pension, gratuity, provident fund money or other benefits to which he may be entitled under his conditions of service.

6) The termination of service of an employee under sub-section (5) shall be deemed to be discharge from service owing to abolition of a permanent post for the purpose of admissibility of compensation pension.

7) The Federal Government shall pay pension charges and gratuity in respect of, and provident fund accumulations of, each employee transferred

to the Council under sub-section (I), in such manner and to such extent as may be prescribed by rules.

8) No person referred to in sub-section (I) who stands transferred to the Council shall, notwithstanding anything contained in any law for the time being in force, be entitled to any compensation because of his transfer

## CHAPTER VI

### FINANCE

#### 17) Grants, etc.

The Federal Government may, from time to time, place annual grants at the disposal of the Council for the smooth discharge of its functions and the efficient conduct of its affairs.

#### 18) Funds

1) There shall be constituted for the Council a fund to which shall be credited all the sums received by the Council and out of which shall be defrayed all the expenditure incurred by the Council.

2) The funds of the Council shall consist of:

- a) grants made by the Federal Government and the Provincial Governments;
- b) grants, donations, endowments, contributions, aid and assistance given by other organisations;
- c) foreign aid and loans obtained or raised with the approval of the Federal Government; and
- d) receipts from other sources.

#### 19) Budget and accounts

1) The Council shall, in respect of each financial year, submit for the approval of the Federal Government, by such date and in such form

as may be prescribed by rules, a statement showing the estimated receipts and expenditure and the sums which are likely to be required from the Federal Government during the financial year.

2) The Council may open accounts in any scheduled bank in Pakistan.

3) The accounts of the Council shall be maintained in such form and manner as the Federal Government may determine in consultation with the Auditor-General of Pakistan.

4) The accounts of the Council shall be audit by one or more auditors who are chartered accountants within the meaning of the Chartered Accountants Ordinance, 1961 (X of 1961), and are appointed by the Federal Government in consultation with the Auditor-General of Pakistan on such remuneration, to be paid by the Council, as the Federal Government may fix.

#### 20) Exemption from taxes

Notwithstanding anything contained in the Business Profits Tax Act, 1947 (XXI of 1947), the Gift-tax Act, 1963 (XIV of 1963), the Wealth-tax Act, 1963 (XV of 1963), the Income Tax Ordinance, 1979 (XXXI of 1979), or any other law for the time being in force relating to income-tax, super-tax, wealth-tax, gift-tax, capital gains tax or business profits tax, the Council shall not be liable to pay any such tax on its income, capital, profits, wealth, gifts or gains.

#### 21) Investment of funds

Subject to such instructions as the Federal Government may, from time to time, issue, the Council may invest its funds, in any security of the Federal Government or a Provincial Government or in any of the securities enumerated in section 20 of the Trusts Act, 1882 (II of 1882).

22). Borrowing Power

The Council may, with the previous sanction of the Federal Government, and on such terms and conditions as may be approved by the Federal Government, borrow in Pakistan currency or foreign currency.

23). Financial assistance to Council

The Council may, with the approval of the Federal Government accept financial or any other assistance and grants of any kind in furtherance of its objects and in order to discharge its functions.

24). Annual Report

The Council shall furnish to the Federal Government, as soon as possible after the end of each financial year, but not later than the last day of December next following, a report on the conduct of its affairs for that year, and shall publish the same alongwith a Summary of the accounts for that year.

## CHAPTER VII

### GENERAL AND MISCELLANEOUS PROVISIONS

25). Power to make rules

1) The Federal Government may, by notification in the official Gazette, make rules for carrying out the purposes of this Ordinance.

2) In particular and without prejudice to the generality of the foregoing provision, such rules may provide for:

- i) The functions and powers of the Chairman;
- ii) The appointment and terms and conditions of service of the whole-time members of the Council, including disciplinary matters; and

- iii) the conditions under which the Council may enter into arrangements with other institutions and individual organisations, whether public, private or autonomous bodies.

26). Power to make regulations

1). The Council may, with the previous sanction of the Federal Government, by notification in the official Gazette, make regulations not inconsistent with this Ordinance and the rules providing for all matters for which provision is necessary or expedient for the purpose of giving effect to the provisions of this Ordinance and the efficient conduct of the affairs of the Council.

2). In particular and without prejudice to the generality of the foregoing provision, the regulations may provide for:

- i) the appointment of the officers and employees of the Council;
- ii) the terms and conditions of service of the officers and employees of the Council including pension and disciplinary matters;
- iii). the conduct of business at the meetings of the Board and the Executive Committee;
- iv): the duties, functions and conduct of the officers and employees of the Council;
- v). preparation of annual estimates of income and expenditure and supplementary estimates;
- vi). the forms of returns and statements for various purposes;
- vii). the constitution of benevolent fund, group insurance, gratuity, provident fund and welfare fund for the Council employees;

viii). the manner in which payments are to be made by or on behalf of the Council and the officers by whom orders for making deposits or investments or for withdrawals or any other disposal of the income or funds of the Council shall be authenticated, made or signed; and

ix). the custody and use of common seal of the Council.

27). Officers, staff, etc. deemed to be public servants

Every official member of the Council or Board and every officer and employee of the Council shall be deemed to be a public servant within the meaning of section 21 of the Pakistan Penal Code (Act XLV of 1860).

28). Ordinance XXIII of 1969 not to apply to Council

Nothing contained in the Industrial Relations Ordinance, 1969 (XXIII of 1969), shall apply to or in relation to the Council or its establishments or any of the officers or employees of the Council.

29). Indemnity of Council, etc.

1). No suit, prosecution or other legal proceedings shall lie against the Council or any member or any other officer or staff of the Council for anything in good faith done or intended or purported to be done under this Ordinance or rule, regulation or order made thereunder.

2). The Council shall not be responsible for any misfeasance, malfeasance or non-feasance of any officer or employee, for the time being of the Council.

30). Notice of suit against Council, etc.

1). No suit shall be instituted against the Council or any member or any person associated with the Council or against any officer or employee of the Council or against any person acting under the direction or authority of the Council, the Chairman or of any officer or employee

of the Council in respect of any act purporting to be done under this Ordinance or the rules or regulations until the expiration of one month from the delivery of a written notice at the head office of the Council or the place of abode of such member, officer, employee or person stating the cause of action, the name and address of the intending plaintiff and the nature of the relief sought.

2). In every such suit the plaint shall contain a statement that such notice has been so delivered.

3). Notwithstanding anything contained in the Limitation Act, 1908 (IX of 1908), no such suit as is described in sub-section (1) shall, unless it is a suit for the recovery of immovable property or for a declaration of title thereto, commence otherwise than within six months next after the accrual of the cause of action.

31). Certain claims for compensation to be barred

No person shall have any right, whether in contract, tort or otherwise, to any compensation for any loss incurred by reason of the operation of any of the provisions of this Ordinance or by reason of the compliance by any other organisation with any policy guidelines or directions given to it under this Ordinance or under any rules or regulations.

32). Winding up

No provision of law relating to the winding up of bodies corporate shall apply to the Council and the Council shall not be wound up except by the orders of the Federal Government in such manner as the Federal Government may direct.

- 33). Savings \_ Upon the Commencement of this Ordinance -
- a). all funds, properties, rights and interests of whatsoever kind issued, used, enjoyed, possessed, owned or vested in the Agricultural Research Council in existence immediately before such commencement and all liabilities legally subsisting against the said Council shall pass to the Council as established under this Ordinance;
  - b). everything done, action taken, obligations or liabilities incurred, rights and assets acquired, persons appointed or authorised, jurisdiction or powers conferred, endowments, bequests, funds or trusts created, donations or grants made, orders issued under any of the provisions of the Acts, rules or regulations, applicable to the said Council shall remain in force and be continued and, having regard to the various matters which by this Ordinance have to be regulated or prescribed by rules or regulations, be deemed to have been respectively done, taken, incurred, acquired, appointed, authorised, conferred, created, made, or issued under this Ordinance and reference in any document to any of the provisions of the said Acts or the rules or regulations made thereunder shall, so far as may be, be deemed to be reference to the corresponding provisions of this Ordinance or the rules or regulations made or deemed to have been made thereunder; and
  - c) any rules or regulations made under the said Acts shall, in so far as they are not inconsistent with the provisions of this Ordinance or the rules and regulations made under this Ordinance having regard to the various matters which by this Ordinance

have to be regulated or prescribed by rules or regulations respectively shall continue to be in force, until they are repealed, replaced, rescinded or modified in accordance with the provisions of this Ordinance.

34). Removal of difficulties

If any difficulty arises in giving effect to any provisions of this Ordinance, the Federal Government may make such order, not inconsistent with the express provisions of this Ordinance, as may appear to it to be necessary or expedient for the purpose of removing the difficulty.

GENERAL  
M. ZIA-UL-HAQ,  
President

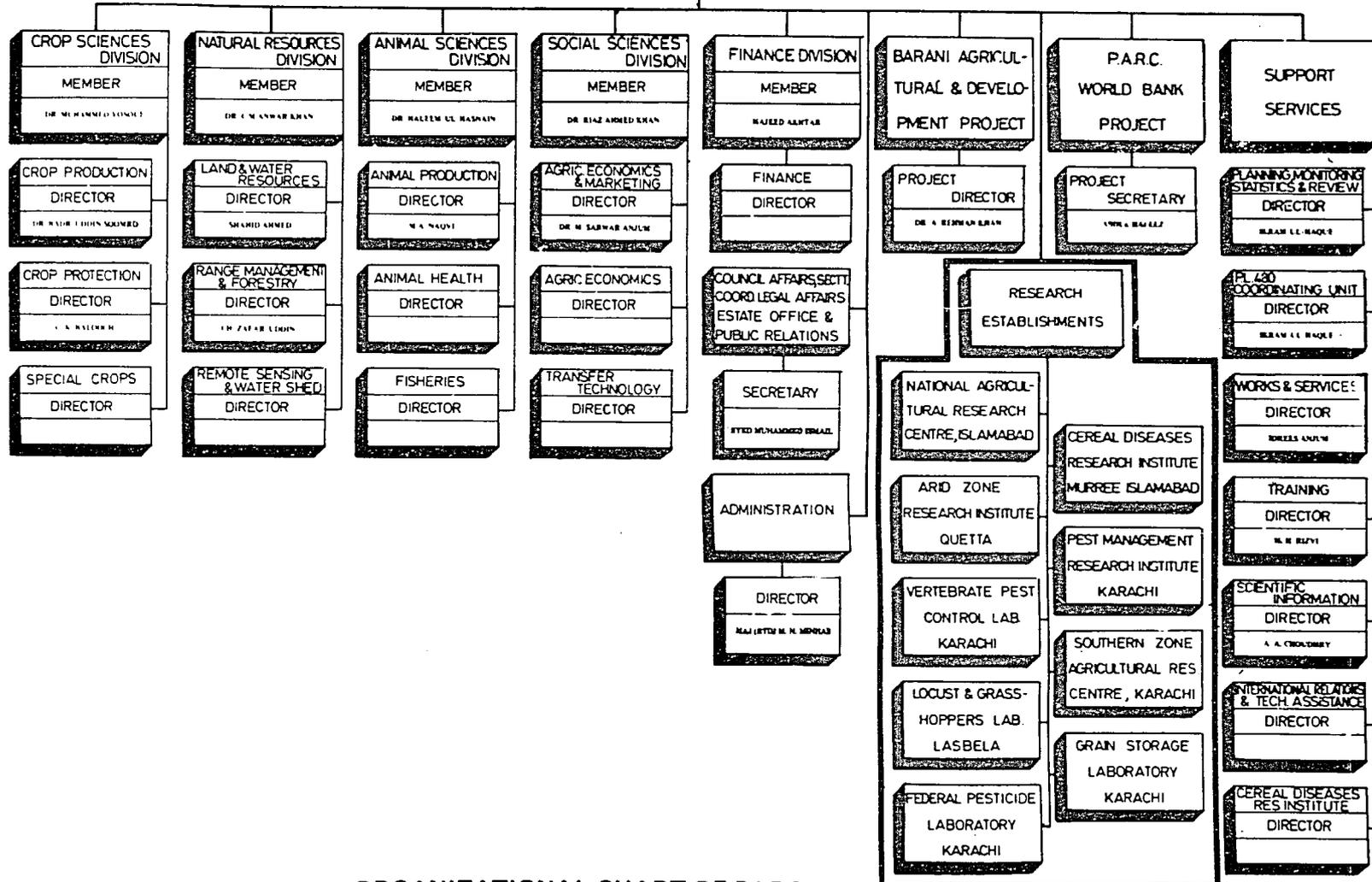
S. A. NUSRAT,  
Principal Secretary

*Board of Governors*

**PRESIDENT, PARC**  
 MINISTER FOR FOOD, AGRIC. & COOPERATIVE'S  
 VICE ADMIRAL MUHAMMED FAZIL JANULLA, PN

**CHAIRMAN, PARC**  
 DR. AMIR MUHAMMED

*Executive Committee*



ORGANIZATIONAL CHART OF PARC

Annexure -1 (B)

## Annexure-II

BUDGET AND STAFF OF PROVINCIAL RESEARCH  
ESTABLISHMENTS IN AGRICULTURE SECTOR IN  
PAKISTAN

Sr. No.	Name of the Institute	Budget(Rupees) (1977-1978)	Staff			Total
			Ph.D.	M.Sc.	B.Sc.	
1.	Agricultural Research Institute, Sariab, Quetta.	3,610,000	3	29	34	66
2.	Agricultural Research Institute, Tandojam.	5,600,000	1	86	44	131
3.	Agricultural Research Institute, Tarnab, Peshawar.	11,670,000	5	75	178	258
4.	Animal Husbandry Laboratory, Karachi.	40,000	-	-	2	2
5.	College of Veterinary Sciences, Lahore.	4,070,000	2	30	11	43
6.	Directorate of Land Reclamation Punjab, Lahore.	4,850,000	-	15	82	97
7.	Directorate of Soil Conservation Punjab, Rawalpindi.	16,470,000	-	9	32	41
8.	Directorate of Wool/Hair & Mutton Production, Punjab, Multan.	1,290,000	-	1	22	23
9.	Faculty of Agriculture, University of Peshawar.	3,320,000	7	13	46	66
10.	Fine Wool Sheep Farm, Sarai Karishna, Mianwali.	420,000	-	1	2	3
11.	Fisheries Research Institute, Qadirabad, Gujranwala.	400,000	1	4	9	14
12.	Irrigation Research Institute, Lahore.	5,230,000	1	11	21	33
13.	Komori Goat Farm, Khudabad, Dadu Sind.	230,000	-	-	2	2
14.	Livestock Development Research Farm for Kundi Buffaloes, Robri, Sind.	350,000	-	-	1	1
15.	Livestock Experiment Station, Angora Goat, Muzaffargarh.	560,000	-	2	3	5

16. Livestock Experiment Station, Fazilpur, Dera Ghazi Khan.	560,000	-	2	3	5
17. Livestock Experiment Station, Hasilpur	650,000	-	2	4	6
18. Livestock Experiment Station, Jaba, Mansehra, Hazara.	80,000	-	-	2	2
19. Livestock Experiment Station, Karachi.	340,000	-	-	3	3
20. Livestock Experiment Station, Khairimurat, Atoock.	240,000	-	2	1	3
21. Livestock Experiment Station, Khushab.	1,380,000	-	-	2	2
22. Livestock Experiment Station, Nabisar Road, Tharparkar.	430,000	-	-	5	5
23. Livestock Experiment Station, Qadirabad, Sahiwal.	860,000	-	-	5	5
24. Livestock Production Research Institute, Bahadurnagar, Okara.	7,030,000	3	12	26	41
25. Maize & Millet Research Institute, Pirsabak, Nowshera.	2,340,000	2	7	19	28
26. Maize & Millet Research Institute, Yousafwala, Sahiwal.	1,940,000	2	11	12	25
27. Oilseeds Research Institute, Faisalabad.	1,410,000	2	23	6	31
28. Plant Protection Institute, Faisalabad.	1,600,000	1	42	1	44
29. Poultry Research Institute, Karachi.	2,140,000	-	12	4	16
30. Poultry Research Institute, Rawalpindi.	1,750,000	-	7	39	46
31. Ayub Agricultural Research Institute, Faisalabad.	29,347,448	18	299	187	504
32. Rapid Soil Fertility Survey and Soil Testing Institute, Lahore.	4,800,000	1	30	19	50
33. Red Sindhi Cattle Breeding Farm, Tando Mohammad Khan.	470,000	-	-	3	3
34. Rice Research Institute, Dokri, Sind.	4,200,000	1	23	10	34
35. Rice Research Institute, Kala Shah Kaku.	1,750,000	4	21	11	36

36. Sericulture Research Laboratory, Lahore.	50,000	-	2	3	5
37. Silvicultural Research Division, Hyderabad.	180,000	-	1	4	5
38. Silvicultural Research Forest Division Lahore.	740,000	-	1	4	5
39. Sind Agriculture University, Tandojam, Sind.	11,500,000	16	123	23	162
40. Sind Horticulture Institute, Mirpur Khas, Sind.	1,000,000	1	9	13	23
41. Soil Mechanics and Hydraulics Laboratory, Karachi.	1,000,000	-	1	4	5
42. University of Agriculture, Faisalabad. (Multi-disciplinary).	28,200,000	95	219	47	361
43. Vegetable Research Institute, Faisalabad.	3,750,000	-	33	1	34
44. Veterinary Research Institute, Lahore.	5,220,000	1	16	45	62
45. Veterinary Research Institute, Peshawar.	1,850,000	1	7	16	24
46. Wheat Research Institute, Faisalabad.	1,200,000	2	31	3	36
	<u>176,117,448</u>	<u>170</u>	<u>1212</u>	<u>1014</u>	<u>230</u>

**BUDGET AND STAFF OF FEDERAL RESEARCH  
ESTABLISHMENTS IN AGRICULTURE SECTOR IN  
PAKISTAN**

Sr. No.	Name of the Institute	Budget (Rupees)		Staff		Total
		1977-1978	Ph.D.	M.Sc.	B.Sc.	
1.	Arid Zone Research Institute, Quetta, Baluchistan.	1,750,000	-	8	3	11
2.	Atomic Energy Agricultural Research Centre, Tandojam.	4,290,000	15	25	3	43
3.	Cereal Diseases Research Institute, Islamabad.	1,390,000	3	13	6	22
4.	Commonwealth Institute of Biological Control, Rawalpindi.	2,240,000	4	19	2	25

5. Cotton Research Institute, Multan.	1,750,000	4	19	15	38
6. Cotton Research Institute, Sakrand.	6,090,000	1	17	6	24
7. Directorate of Marine Fisheries, Karachi.	3,040,000	-	9	11	20
8. Drainage & Reclamation Institute of Pakistan, Latifabad, Hyderabad.	6,500,000	-	8	5	13
9. Institute of Cotton Research and Technology, Karachi.	1,900,000	1	10	24	35
10. Irrigation, Drainage & Food Control Research Council, Rawalpindi.	9,000,000	1	19	4	24
11. National Agricultural Research Centre, Islamabad.	1,450,000	1	2	1	4
12. Nuclear Institute for Agriculture & Biology, Faisalabad.	4,990,000	20	55	17	92
13. Nuclear Institute for Food and Agriculture, Tarnab.	2,200,000	3	14	8	25
14. Pakistan Agricultural Research Council, Islamabad.	62,460,000	17	75	52	144
15. Pakistan Central Cotton Committee, Karachi.	10,500,000	-	2	-	2
16. Pakistan Forest Institute, Peshawar.	4,900,000	5	34	25	64
17. Pakistan Tobacco Board, Peshawar.	6,060,000	1	16	23	40
18. Soil Survey of Pakistan, Lahore.	4,880,000	3	42	26	71
19. Water Quality and Soils Monitoring Directorate, Lahore.	4,400,000	1	38	39	78
	<u>139,790,000</u>	<u>80</u>	<u>425</u>	<u>270</u>	<u>775</u>

**BUDGET AND STAFF OF RESEARCH ESTABLISHMENTS BY SUB-SECTORS OF  
AGRICULTURE IN PAKISTAN**

Sr. No.	Name of the Institute	Budget (Rupees) (1977-1978)	Staff			
			Ph.D.	M.Sc.	B.Sc.	Total
<b>MULTI-DISCIPLINE WITH EMPHASIS ON FIELD CROPS</b>						
1.	Agricultural Research Institute, Sariab, Quetta.	3,610,000	3	29	34	66
2.	Agricultural Research Institute, Tandojam, Sind.	5,600,000	1	86	44	131
3.	Agricultural Research Institute, Tarnab, Peshawar.	11,670,000	5	75	178	258
4.	Arid Zone Research Institute, Quetta, Baluchistan.	1,750,000	-	8	3	11
5.	Atomic Energy Agricultural Research Centre, Tandojam.	4,290,000	15	26	3	44
6.	Cereal Diseases Research Institute, Islamabad.	1,390,000	3	13	6	22
7.	Commonwealth Institute of Biological Control, Rawalpindi.	2,240,000	4	19	2	25
8.	Cotton Research Institute, Multan.	1,750,000	4	19	15	38
9.	Cotton Research Institute, Sakrand.	6,090,000	1	17	6	24
10.	Directorate of Land Reclamation, Lahore,	4,850,000	-	15	82	97
11.	Directorate of Soil Conservation, Punjab, Rawalpindi.	16,470,000	-	9	32	41
12.	Drainage and Reclamation Institute of Pakistan, Latifabad, Hyderabad.	6,500,000	-	8	5	13
13.	Faculty of Agriculture, University of Peshawar.	3,320,000	7	13	46	66
14.	Institute of Cotton Research and Technology, Karachi.	1,900,000	1	10	24	35
15.	Irrigation, Drainage and Flood Control Research Council Rawalpindi.	9,000,000	1	19	4	24

16.	Irrigation Research Institute, Lahore.	5,230,000	1	11	21	33
17.	Maize & Millet Research Institute, Pirsabak, Nowshera.	2,340,000	2	7	19	28
18.	Maize & Millet Research Institute, Yousafwala, Sahiwal.	1,940,000	2	11	12	25
19.	National Agricultural Research Centre, Islamabad.	1,450,000	1	2	1	4
20.	Nuclear Institute for Agriculture and Biology, Faisalabad.	4,990,000	20	55	17	92
21.	Nuclear Institute for Food & Agri- culture, Tarnab, Peshawar.	2,200,000	3	14	8	25
22.	Oilseeds Research Institute, Faisalabad.	1,410,000	2	23	6	31
23.	Pakistan Agricultural Research Council, Islamabad.	62,460,000	17	75	52	144
24.	Pakistan Central Cotton Committee Karachi.	10,500,000	-	2	-	2
25.	Pakistan Tobacco Board, Peshawar.	6,060,000	1	16	23	40
26.	Plant Protection Institute, Faisalabad.	1,600,000	1	42	1	44
27.	Ayub Agricultural Research Institute Faisalabad.	29,347,448	18	299	187	504
		<hr/>				
		209,957,448		923		4867
		<hr/>				
<u>CROPS</u>						
28.	Rapid Soil Fertility Survey & Soil Testing Institute, Lahore.	4,800,000	1	30	19	50
29.	Rice Research Institute, Dokri, Sind.	4,200,000	1	23	10	34
30.	Rice Research Institute, Kala Shah Kaku,	1,750,000	4	21	11	36
31.	Sind Agriculture University, Tandojam.	11,500,000	16	123	23	162
32.	Sind Horticulture Institute, Mirpur Khas.	1,000,000	1	9	13	23

33.	Soil Mechanics & Hydraulics Laboratory, Karachi.	1,100,000	-	1	4	5
34.	Soil Survey of Pakistan, Lahore.	4,880,000	3	42	26	71
35.	University of Agriculture, Faisalabad.	28,200,000	95	219	47	361
36.	Vegetable Research Institute, Faisalabad.	3,750,000	-	33	1	34
37.	Water Quality and Soils Monitoring Directorate, Lahore.	4,400,000	1	38	39	78
38.	Wheat Research Institute, Faisalabad.	1,200,000	2	31	3	36

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66,780,000	124	570	196	890
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ANIMAL HUSBANDRY

39.	Animal Husbandry Laboratory, Karachi.	40,000	-	-	2	2
40.	College of Veterinary Science, Lahore.	4,070,000	2	30	11	43
41.	Directorate of Wool/Hair & Mutton Production, Punjab Multan.	1,290,000	-	1	22	23
42.	Fine Wool Sheep Farm, Sarai Karishna, Mianwali.	420,000	-	1	2	3
43.	Kamoni Goat Farm, Khudabad, Dadu, Sind.	230,000	-	-	2	2
44.	Livestock Development Research Farm for Kundi Buffaloes, Rohri, Sind.	350,000	-	-	1	1
45.	Livestock Experiment Station, Angora Goat, Muzaffargarh.	560,000	-	2	3	5
46.	Livestock Experiment Station, Fazilpur, Dera Ghazi Khan.	650,000	-	2	4	6
47.	Livestock Experiment Station, Hasilpur.	650,000	-	1	1	2
48.	Livestock Experiment Station, Jaba, Mansehra, Hazara.	80,000	-	-	2	2

49.	Livestock Experiment Station, Karachi.	340,000	-	-	3	3
50.	Livestock Experiment Station, Khairimurat, Attock.	240,000	-	2	1	3
51.	Livestock Experiment Station, Khushab.	1,380,000	-	-	2	2
52.	Livestock Experiment Station, Nabisar Road, Tharparkar.	430,000	-	-	5	5
53.	Livestock Experiment Station, Qadirabad, Sahiwal.	860,000	-	-	5	5
54.	Livestock Production Research Institute, Bahadurnagar, Okara.	7,030,000	3	12	26	41
55.	Poultry Research Institute, Karachi.	2,140,000	-	12	4	16
56.	Poultry Research Institute, Rawalpindi.	1,750,000	-	7	39	46
57.	Red Sindhi Cattle Breeding Farm, Tando Mohammad Khan.	470,000	-	-	3	3
58.	Veterinary Research Institute, Lahore.	5,220,000	1	16	45	62
59.	Veterinary Research Institute, Peshawar.	1,850,000	1	7	16	24
		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
		30,050,000	7	93	199	299
		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
<u>FORESTRY</u>						
60.	Pakistan Forest Institute, Peshawar.	4,900,000	5	34	25	64
61.	Sericulture Research Laboratory, Lahore.	500,000	-	2	3	5
62.	Silvicultural Research Division, Hyderabad,	180,000	-	1	4	5
63.	Silvicultural Research Forest Division, Lahore.	740,000	-	1	4	5
		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
		6,320,000	5	38	36	79
		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>

FISHERIES

64.	Directorate of Marine Fisheries, Karachi	3,040,000	-	9	11	20
65.	Fisheries Research Institute Qadirabad, Gujranwala	400,000	1	4	9	14
Total:		3,440,000	1	13	20	34
Grand Total:		316,547,448	250	1637	1282	3169

BUDGET AND STAFF OF THE ESTABLISHMENTS OF  
PAKISTAN ATOMIC ENERGY COMMISSION CONDUCTING  
RESEARCH IN AGRICULTURE IN PAKISTAN

Sr. No.	Name of the Institute	Budget(Rs.) (1977-1978)	Staff			
			Ph.D.	M.Sc.	B.Sc.	Total
1.	Atomic Energy Agricultural Research Centre, Tandojam, Sind	4,290,000	15	25	3	43
2.	Nuclear Institute for Agriculture and Biology, Faisalabad	4,990,000	20	55	17	92
3.	Nuclear Institute for Food and Agriculture, Peshawar, N.W.F.P.	2,200,000	3	14	8	25
		11,480,000	38	94	28	160

BUDGET AND STAFF OF THE UNIVERSITIES AND  
COLLEGES IN AGRICULTURE IN PAKISTAN.

Sr. No.	Name of the Institute	Budget(Rs.) (1977-1978)	Staff			
			Ph.D.	M.Sc.	B.Sc.	Total
1.	College of Veterinary Sciences, Lahore.	4,070,000	2	30	11	43
2.	Faculty of Agriculture, University of Peshawar, Peshawar.	3,320,000	7	13	46	66
3.	Sind Agriculture University, Tandojam.	11,500,000	16	123	23	162
4.	University of Agriculture, Faisalabad.	28,200,000	95	219	47	361
		47,090,000	120	385	127	632

**BUDGET AND STAFF OF THE WAPDA RESEARCH  
ESTABLISHMENTS IN PAKISTAN.**

Sr. No.	Name of the Institute	Budget(Rs.) (1977-1978)	Staff			Total
			Ph.D.	M.Sc.	B.Sc.	
1.	Water Quality and Soil Monitoring Directorate, Lahore.	4,400,000	1	38	39	78
	Total:	4,400,000	1	38	39	78

LIST OF RESEARCH STATIONS & SUB-STATIONS UNDER  
FEDERAL & PROVINCIAL RESEARCH INSTITUTES

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Name of Institute

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FEDERAL

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|--|--|
| 1. Arid Zone Research Institute, Quetta.                     | 1. Arid Zone Research Station, Bahawalpur.<br>2. Arid Zone Research Station, Dera Ismail Khan<br>3. Arid Zone Research Station, Umarnkot, Sind.  |
| 2. Cereal Diseases Research Institute, Islamabad.            | 1. Research Sub-Station, Murree.<br>2. Research Sub-Station, Karachi.  |
| 3. Commonwealth Institute of Biological Control, Rawalpindi. | 1. Research Sub-Station, Multan.<br>2. Research Sub-Station, Murree.   |
| 4. Pakistan Agricultural Research Council, Islamabad.        | 1. National Agricultural Research Centre, Islamabad.<br>2. National Herbarium and Museum, Islamabad.<br>3. Desert Locust Research Station, Malir Halt, Karachi.<br>4. Food Storage Division, Malir Halt, Karachi.<br>5. Federal Pesticides Laboratory, Karachi.<br>6. National Mycological Herbarium & National Insect Museum, Karachi.<br>7. Plant Pathology Division, Karachi.<br>8. Radio Isotope & Radiation Laboratory, Karachi.<br>9. Vertebrate Pest Control Centre, Karachi. |
| 5. Pakistan Tobacco Board, Peshawar.                         | 1. Tobacco Research Station, Okara.<br>2. Tobacco Research Station, Kalpani, Mardan.<br>3. Tobacco Research Station, Khan Garhi, Mardan.<br>4. Tobacco Research Station, Peshawar.<br>5. Tobacco Research Station, Mansehra.   |
| 6. Pakistan Forest Institute, Peshawar.                      | 1. Forestry Research Field Station, Hyderabad.   |

PUNJAB

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|---|---|
| 1. Directorate of Land Reclamation, Punjab. | 1. Experimental Research Station, Chakanwali, Gujranwala.<br>2. Experimental Research Station, Mohavangala, Faisalabad.<br>3. Experimental Research Station, Jagattan, Faisalabad.<br><br>4. Experimental Research Station, Nianthanna, Multan. |
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|  | 5. Experimental Research Station, Kundian, Miawali          |
|  | 6. Experimental Research Station, Bhakkar, Miawali          |
|  | 7. Experimental Research Station, Leiah, Multan             |
|  | 8. Experimental Research Station, 7/3-1, Jhang              |
|  | 9. Experimental Research Station, Sialkot.                  |
| 2. Irrigation Research Institute, Lahore                   | 1. Hydraulics Research Station, Naddipur                    |
|  | 2. Experimental Research Station, Niazbeg                   |
| 3. Oilseeds Research Institute, Faisalabad.                | 1. Groundnut Research Sub-Station, Rawalpindi               |
|  | 2. Rape-seed Research Sub-Station, Khanpur                  |
| 4. Maize & Millet Research Institute, Yousafwala, Sahiwal. | 1. Maize & Millet Research Sub-Station, Yousafwala, Sahiwal |
|  | 2. Maize & Millet Research Sub-Station, Iqbal Nagar         |
|  | 3. Maize & Millet Research Sub-Station, Chak No. 86/9-L.    |
|  | 4. Maize & Millet Research Sub-Station, Rawalpindi          |
| 5. Plant Protection Institute, Faisalabad                  | 1. Plant Protection Research Sub-Station (PPRS), Gujranwala |
|  | 2. PPRS, Sheikhpura   |
|  | 3. PPRS, Lahore   |
|  | 4. PPRS, Gujrat   |
|  | 5. PPRS, Qasur  |
|  | 6. PPRS, Sialkot  |
|  | 7. PPRS, Rawalpindi   |
|  | 8. PPRS, Mianwali   |
|  | 9. PPRS, Sargodha   |
|  | 10. PPRS, Jhang   |
|  | 11. PPRS, Sahiwal   |
|  | 12. PPRS, Vehari  |
|  | 13. PPRS, Multan  |
|  | 14. PPRS, Bahawalpur  |
|  | 15. PPRS, Bahawalnagar                                      |
|  | 16. PPRS, Rahimyar Khan                                     |
| 6. Punjab Agricultural Research Institute, Faisalabad.     | 1. Horticulture Research Station, Sahiwal                   |
|  | 2. Mango Research Station, Shujabad                         |
|  | 3. Sugarcane Research Station, Murree                       |
|  | 4. Cotton Research Station, Multan                          |
|  | 5. Cotton Research Station, Sahiwal                         |
|  | 6. Agricultural Research Station, Bahawalpur.               |
|  | 7. Fodder Research Station, Sargodha                        |
|  | 8. Tobacco Research Station, Sahiwal                        |
|  | 9. Agronomy Sub-Station, Rawalpindi                         |
|  | 10. Cotton Research Sub-Station, Khanpur                    |
|  | 11. Cotton Research Sub-Station, Jhang                      |
|  | 12. Cotton Research Sub-Station, Pialan.                    |
|  | 13. Cotton Research Sub-Station, Sahiwal.                   |
|  | 14. Cotton Research Sub-Station, Sargodha.                  |

15. Cotton Research Sub-Station, Raiwind.
  16. Sugarcane Research Sub-Station, Bahawalpur.
  17. Cotton Research Sub-Station, Rawalpindi.
  18. Sugarcane Research Sub-Station, Khanpur.
  19. Entomology Sub-Station, Rawalpindi.
  20. Entomology Sub-Station, Pasrur.
  21. Entomology Sub-Station, Hasanabad.
  22. Entomology Sub-Station, Sialkot.
  23. Fodder Research Sub-Station, Bahawalpur.
  24. Fodder Research Sub-Station, D.G. Khan.
  25. Horticulture Sub-Station, Sargodha.
  26. Horticulture Sub-Station, Charrapani.
  27. Horticulture Sub-Station, Jhang.
  28. Horticulture Sub-Station, Soan Valley.
  29. Horticulture Sub-Station, Sunny Bank, Murree.
  30. Jute Research Sub-Station, Dhakkar Farm.
  31. Pulses Research Sub-Station, Attock.
  32. Pulses Research Sub-Station, Kallarkot.
  33. Pulses Research Sub-Station, Rakh Ultra.
  34. Tobacco Research Sub-Station, Bahawalpur.
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- |  |  |
|--|--|
| 7. Rapid Soil Fertility Survey & Soil Testing Institute, Lahore. | <ol style="list-style-type: none"> <li>1. Soil &amp; Water Testing Laboratory, Bahawalpur.</li> <li>2. Soil &amp; Water Testing Laboratory, Lahore.</li> <li>3. Soil &amp; Water Testing Laboratory, Multan.</li> <li>4. Soil &amp; Water Testing Laboratory, Rawalpindi.</li> <li>5. Soil &amp; Water Testing Laboratory, Sargodha.</li> <li>6. Soil Fertility Centre, Bahawalpur.</li> <li>7. Soil Fertility Centre, Lahore.</li> <li>8. Soil Fertility Centre, Multan.</li> <li>9. Soil Fertility Centre, Rawalpindi.</li> <li>10. Soil Fertility Centre Sargodha.</li> </ol> |
|--|--|
- 
- SOIL FERTILITY SUB-CENTRES, in 21 districts
- |   |  |
|---|--|
| 8. Vegetable Research Institute, Faisalabad | <ol style="list-style-type: none"> <li>1. Potato Research Station, Sialkot.</li> <li>2. Vegetable Research Sub-Station, Bahawalpur.</li> <li>3. Vegetable Research Sub-Station, Gujranwala.</li> <li>4. Vegetable Research Sub-Station, Jhang.</li> <li>5. Vegetable Research Sub-Station, Mianwali.</li> <li>6. Vegetable Research Sub-Station, Multan.</li> <li>7. Vegetable Research Sub-Station, Ochali.</li> <li>8. Vegetable Research Sub-Station, Rawalpindi.</li> <li>9. Vegetable Research Sub-Station, Sahiwal.</li> <li>10. Vegetable Research Sub-Station, Sheikhpura.</li> <li>11. Vegetable Research Sub-Station, Sialkot.</li> <li>12. Vegetable Research Sub-Station, Murree.</li> </ol> |
|---|--|
- 
- |   |  |
|---|--|
| 9. Wheat Research Institute, Faisalabad | <ol style="list-style-type: none"> <li>1. Wheat Research Station, Rawalpindi.</li> </ol> |
|---|--|
- 
- |  |   |
|--|---|
| 10. Livestock Production Research Institute, Bahadurnagar, Okara | <ol style="list-style-type: none"> <li>1. Livestock Experiment Station, Bahadurnagar, Okara.</li> <li>2. Livestock Experiment Station, Qadirabad, Sahiwal.</li> </ol> |
|--|---|

1]. Poultry Research  
Institute, Rawalpindi.

1. Poultry Production Sub-Station, Lahore.
2. Poultry Production Sub-Station, Rawalpindi.
3. Poultry Production Sub-Station, Faisalabad.
4. Poultry Production Sub-Station, Multan.
5. Poultry Production Sub-Station, Sahiwal.
6. Poultry Production Sub-Station, Bahawalpur.
7. Divisional Govt. Poultry Farm, Lahore.
8. Divisional Govt. Poultry Farm, Dina.
9. Divisional Govt. Poultry Farm, Rawalpindi.
10. Divisional Govt. Poultry Farm, Sargodha.
11. Divisional Govt. Poultry Farm, Multan.
12. Divisional Govt. Poultry Farm, Bahawalpur.
13. District Poultry Farm, Gujrat
14. District Poultry Farm, Bahawalnagar.
15. District Poultry Farm, Mianwali.
16. District Poultry Farm, Attock.

SIND

1. Agricultural Research  
Institute, Tandojam.

1. Maize & Millets Research Station, Dadu.
2. Sugarcane Research Station, Naudero.
3. Sugarcane Research Station, Thatta.
4. Agricultural Research Sub-Station, Dadu.
5. Agricultural Research Sub-Station, Sakrand.
6. Agricultural Research Sub-Station, Kotdiji.
7. Agricultural Research Sub-Station, Shikarpur.
8. Cotton Research Sub-Station, Mirpurkhas.

2. Sind Horticulture  
Institute, Mirpurkhas.

1. Vegetable Research Station, Mirpurkhas.
2. Fruit Research Sub-Station, Mirpurkhas.
3. Vegetable Research Sub-Station, Sarhand.
4. Vegetable Research Sub-Station, Husri.
5. Horticulture Research Sub-Station, Jamesabad.

N.W.F.P.

1. Agricultural Research  
Institute, Tarnab,  
Peshawar.

1. Agricultural Research Station, D.I. Khan.
2. Agricultural Research Station, Mardan.
3. Agricultural Research Sub-Station, Abbottabad.
4. Agricultural Research Sub-Station, Karak.
5. Agricultural Research Sub-Station, Mangora.
6. Agricultural Research Sub-Station, Mansehra.
7. Agricultural Research Sub-Station, Sarai Naurang.

2. Maize & Millet Research  
Institute, Pirsabak,  
Peshawar.

1. Maize & Millet Research Sub-Station, Mansehra.
2. Maize & Millet Research Sub-Station, Mangora.  
Swat
3. Maize & Millet Research Sub-Station, Ratta.  
Kilachi, D.I.Khan.

BALUCHISTAN

1. Agricultural Research Institute, Sariab, Quetta.
1. Fruit Research Station, Quetta.
2. Regional Livestock Diagnostic Laboratories, Quetta.
3. Wool Research Laboratories, Mustung, Baluchistan.
4. Multipurpose Sheep Research Station, Yetabad, Baluchistan.
5. Beef Production Research Station, Sibi, Baluchistan.

Annexure IVTASKS TO BE ACCOMPLISHED BY PARC UPTO JULY, 1980

1. The concept of projectizing programs, complete
2. Project statements for Maize and Wheat programs, near completion
3. Development of Pakistan CRISP system, underway
4. Proformas and instrumental material for accomplishment, reporting complete
5. Accounting system of ARC, audited
6. Technical Assistance fiscal management advisor on board establishing new accounting system.
7. A new ARC function manual/directive system, prepared
8. Commodity procurement, established
9. System of commodity procurement, established
10. Current duties at ARC defined with job description
11. ARC committees, reorganized
12. Technical assistance plans for future year, prepared
13. Participants training selection plan developed for incountry and abroad and selected trainees, put in position
14. PARC architect, selected
15. All villages vacated on PARC land
16. Project statements for rice, oilseeds and forage coordinated program/completed.
17. Training sessions with coordinators for CRISP system underway
18. New accounting system for ARC initiated and staff needs determined
19. Budgets allocated to coordinators for new system
20. Appropriate administrative authority delegated to coordinators
21. Redefined staff duties in ARC approved and being implemented
22. Five year technical assistance program prepared for annual review

23. Improved training plan approved and being implemented
24. Construction at PARC underway according to revised schedules
25. Oilseeds coordinator/research team leader approved
26. Coordinated program approved for pest management and cropping systems
27. Project descriptions for CRISP system initiated
28. Annual accomplishment reports for all approved projects submitted
29. New accounting system under implementation
30. Commodity procurement, maintenance, and distribution underway according to schedule
31. Technical Assistance and Training schedules being carried out according to plan
32. Satisfactory construction progress at PARC

Annexure-V

GOVERNMENT OF PAKISTAN  
MINISTRY OF FOOD, AGRICULTURE AND COOPERATIVES  
(FOOD AND AGRICULTURE DIVISION)

Islamabad, the 17th September, 1978.

NOTIFICATION

No. F. 2-1/78-E-III(ARC): In exercise of the powers conferred by Section 5A and sub-section (2) of section 5C of the Agricultural Produce Cess Act, 1940 (XXVII of 1940), and in supersession of all previous Notifications on the subject, the Federal Government is pleased to set up the following Agricultural Research Council, namely:-

1. Composition of the Agricultural Research Council. The Agricultural Research Council shall consist of -

- |  |                   |
|--|-------------------|
| 1. Chairman, who shall be an eminent scientist connected with agriculture, to be appointed by the President of Pakistan. | Whole-time member |
| 2. Member, Plant Sciences, to be nominated by the President.   | - do -            |
| 3. Member, Animal Sciences, to be nominated by the President.  | - do -            |
| 4. Member, Social Sciences, to be nominated by the President.  | - do -            |
| 5. Member, Finance, to be nominated by the President.  | - do -            |

- |     |   |                  |
|-----|---|------------------|
| 6.  | Four scientists, one from each Province to be nominated by the President.   | Part-time Member |
| 7.  | Four heads of principal institutions and research laboratories of the Council.  | - do -           |
| 8.  | Four prominent and progressive farmers - one from each Province - to be nominated by the provincial governments.  | - do -           |
| 9.  | Four scientists, including two Vice-chancellors of agricultural universities, representing the provincial governments, two from the Punjab and two from Sind. | - do -           |
| 10. | Four persons with interest in agriculture or industry connected with agriculture, to be nominated by the Federal Government.                                  | - do -           |
| 11. | One representative of the Agriculture Division,   | - do -           |
| 12. | Chief, Food and Agriculture Section,<br>Planning Division.  | - do -           |
2. Management of the Council The general direction, conduct and management of the affairs of the Agricultural Research Council, including administration of its funds, shall vest in the Council.
3. Executive Board
- (1) There shall be a sub-committee to be known as the executive Board of the Council, which shall consist of all the whole-time members of the Council, to assist the Council in the management of its affairs.
  - (2) The Executive Board shall be a whole-time Sub-Committee.
  - (3) The Executive Board shall undertake regular review evaluation of the accomplishments and progress of the research projects, the programs and the constituent units of the Council.

- 4) The Executive Board shall exercise control over the research activities of the Council and shall, with the concurrence of the Chairman, approve, expand, diminish, redirect or relocate the research projects of the Council.
- 5) The Executive Board may appoint ad-hoc Committees and expert panels for specific scientific work.

#### 4. President

- 1) The Federal Minister for Food, Agriculture and Cooperatives Shall be the President of the Council.
- 2) The President shall, when present, preside at the meetings of the Council.
- 3) The President shall have power to issue policy directives to the Council in respect of the performance of its functions, in accordance with national policies and plans.

#### 5. Chairman

- 1) The term of the Chairman of the Council will be five years.
- 2) The Chairman shall be the chief scientific and executive officer of the Council and shall coordinate the work of the Council and exercise general supervision and control over all the employees of the Council.
- 3) The Chairman shall preside at all the meetings of the Committees and Sub-Committees of the Council and shall be responsible for the orderly conduct of business thereat.
- 4) The Chairman in an emergency, which in his opinion requires immediate action, may take such action as he considers necessary and shall, as soon as possible, report this to the Council.

- 5) The Chairman shall have the power to create temporary posts and to make appointments against those for a period not exceeding six months and to engage on contract experts and consultants for a period not exceeding two years at a time.
- 6) The Chairman may direct any employee of the Council to take up such assignments in connection with the work of the Council as he may consider necessary.

#### 6. Funds of the Council

- 1) The annual budgetary allocation of the Council shall be transferred to the Council as a Government grant-in-aid, which shall be operated by the Council in accordance with the procedure approved by the Federal Government for the operation of the cess fund.
- 2) The accounts of the Council shall be audited by not less than two auditors who are chartered accountants within the meaning of the Chartered Accountants Ordinance, 1961 (X of 1961) to be appointed by the Council in consultation with the Auditor-General of Pakistan.

#### 7. Officers, staff and experts

- 1) The Council shall appoint a Selection Board comprising the Chairman, a representative of the Federal Public Service Commission and three eminent scientists to be nominated by the Council on the recommendations of the Chairman to recommend to the Council appointment of suitable candidates against posts equivalent to Grade-17 and above.
- 2) The Council may appoint such officers and servants and engage such consultants or experts as are considered necessary for the efficient performance of its functions.

Sd/-  
( A. Sami Qureshi )  
Secretary to the  
Government of Pakistan

## Annexure - VI

RULES AND PROCEDURE RELATING TO THE FOREIGN AGRICULTURAL RESEARCH GRANT PROGRAM OF THE UNITED STATES DEPARTMENT OF AGRICULTURE UNDER PUBLIC LAW-480

INTRODUCTION: The United States Department of Agriculture (USDA) introduced a new program in October, 1958, under the authority of the States Public Law No. 480 known as the Foreign Agricultural Research Grant Program. The object of the program is to help other countries to undertake research of mutual interest in agricultural sciences, e.g., utilization, marketing, plant and animal husbandry, forestry and human nutrition.

The US grant covers all the recurring expenditure; that is, salaries, supplies and material and local travel for the research personnel to be employed under the Schemes. Non-recurring expenditure on items on non-expendable equipments having anticipated usefulness beyond the fixed duration of each Scheme will be shared by the USDA with the Government of Pakistan. Thus the Government of Pakistan will be responsible for providing some foreign exchange involved to cover the subsistence and cost of travel abroad and equipments.

2. Coordination. The Agricultural Research Council shall be the coordinating agency for the PL-480 projects relating to agriculture and its allied subjects drawn up by the provincial governments, central government, departments, universities and private institutions.
3. Mode of Submission. The scheme will be prepared on the proforma prescribed by the USDA with fullest details and will be sent to the Agricultural Research Council, Pakistan. No Department/Institution shall submit any scheme or correspond directly with USDA. Any reference received from USDA directly by the Department, etc. shall be replied through the Agricultural Research Council.

#### 4. Processing of the Projects.

- (i) On receipt of the project it will be examined in the Agricultural Research Council, Pakistan, from the technical and financial points of view.
- (ii) The project will be revised/modified as the case may be, by the authors as advised by the Agricultural Research Council, Pakistan.
- (iii) If and when a project is found suitable by the Council Secretariat, it will be placed before the concerned Technical Committee of the Council which shall further examine its technical soundness.
- (iv) The Department concerned shall revise/modify or shall submit such additional information concerning the project as shall be required by the Technical Committee. On receipt of the revised/modified project, or of the additional information, the project will be reconsidered by the Technical Committee concerned.
- (v) The project, when found technically sound and of mutual interest and usefulness to Pakistan and the U.S.A., will be placed before the Policy, Liaison and Finance Committee of the Council, which shall examine the financial and economic aspects of the project.
- (vi) The financial side of the project shall be revised by the department concerned in the light of the recommendations of the Policy, Liaison and Finance Committee, if the Council so recommends.
- (vii) When the project is finally recommended by the Policy, Liaison and Finance Committee it shall be considered by the Council for final approval at its annual meeting, which is generally held twice a year.

#### 5. Submission to USDA.

- (i) On final approval, the project shall be submitted by the Council Secretariat to the Agricultural Attache, American Embassy, for transmission to the USDA.
- (ii) The USDA shall correspond on such matters as they deem fit, with the Council Secretariat and not with the authors or the department which has drawn up the project.
- (iii) The project shall be revised/modified by the sponsoring department in the light of the observations made by the USDA.

#### 6. Grant Letters.

- (i) When a project is finally accepted by the USDA for financial assistance, its acceptance shall be communicated to the Council Secretariat by them.
- (ii) The grant letter which shall constitute a regular agreement between the Government of Pakistan and the U.S.A. shall be signed on behalf of the Pakistan Government by the Secretary/ Joint Secretary, Ministry of Agriculture and Works, Government of Pakistan, under his seal.
- (iii) The USDA will ensure remittance of the cost for one year of the project within one month of the signing of the grant letter.
- (iv) The money shall be remitted through crossed cheques drawn in favour of the Secretary, Agricultural Research Council.
- (v) On receipt of the installment, the Council Secretariat shall ask the sponsoring department to implement the scheme immediately but not later than 30 days, except in special

circumstances which shall be communicated promptly to this Council Secretariat which shall in turn advise the USDA.

(vi) The general provisions applicable to PL-480 projects as set out by the USDA will be strictly adhered to by the officer in charge of the project and the department concerned where the project is being implemented.

7. Commencement of the Scheme. The date of commencement of the project will be intimated to the Council Secretariat for onward transmission to the USDA.

8. Reports and Returns.

(i) The Officer-in-charge of the department concerned where the PL-480 project will be implemented shall ensure timely and regular submission to the Council Secretariat of periodical/annual Progress Reports on the prescribed proformas by the USDA for onward transmission to the USDA.

(ii) Half yearly progress reports and estimates for the next six months shall also be submitted by the department concerned to the Council Secretariat in good time for transmission to the USDA, as required by them.

(iii) The financial assistance received shall be exhibited by the Council Secretariat in the budget of the Agricultural Research Council, Pakistan.

(iv) The liability of the Government of Pakistan shall be confined to the payment of the depreciated value of the equipments under the project. Such liability shall also be reflected in the budget of the Council.

9. Delegation of powers: The Chairman of the Agricultural Research Council, Pakistan, shall delegate such financial and administrative powers to the departments concerned as will ensure smooth implementation of the Scheme.
10. Accounting formalities: The following financial accounting procedure shall generally apply:-
- (i) The principles enunciated in the General Financial and other relevant rules in respect to financial control shall apply to the funds under these projects.
  - (ii) The amount placed at the disposal of the head of the department will be jointly operated upon by him and officer in-charge of the project
  - (iii) Statement of actual expenditure for each shall be furnished to the Council Secretariat by 7th of every following month.
  - (iv) Estimates for the six months shall be submitted to Pakistan Agricultural Research Council, in good time to enable them to place funds for that period.
  - (v) Contingent and T.A. bills, etc., will be submitted to Pakistan Agricultural Research Council, for post audit.
  - (vi) Funds allocated under one head of expenditure shall not be diverted to another head of expenditure without prior approval of the Pakistan Agricultural Research Council.
  - (vii) Expenditure sanctions in respect to all items of work exceeding the limit prescribed in the General Financial Rules will be issued by the Council Secretariat with the approval of the Chairman.

(viii) Indents for the procurement of the equipments may be placed on D.G.S. & D. directly by the executing department concerned under intimation to Pakistan Agricultural Research Council

11. Recruitment in the Projects: appointments, promotions, etc., shall be made under the projects in the following manner:-

(i) Class I Posts: appointment to Class I posts shall be made by the Chairman on the recommendations of a selection committee, appointed by the Chairman, for the purpose.

(ii) Class II Posts: (Gazetted & non-Gazetted): appointments shall be made by the head of the departments in which the project will be implemented, on the recommendations of the selection committee, which shall include a representative of the Council Secretariat.

(iii) Class III & IV Posts: appointments shall be made by the head of departments by whom the scheme is executed on the recommendations of the departmental selection committee. The gazetted appointment shall be notified by the Council Secretariat in the Gazette.

12. Higher salary and special pay:

(i) No higher salary shall be given to any of the Officers of the scheme except with the approval of the Government.

(ii) No honorarium or special pay will be given to any of the officers of the scheme except with the approval of the Government for which a proper proposal shall be submitted to the council Secretariat by the Officer-in-charge of the scheme.

14. Equipments: Non-perishable equipments and other assets, shall be regulated to the general provisions applicable to the project as set out by the USDA.

ACCESSION NO. . . . . PAKISTAN AGRICULTURAL RESEARCH COUNCIL

1 7 : RESEARCH WORK UNIT/PROJECT DESCRIPTION-RESEARCH RESULT : . . . . . WORK UNIT NO. . . . .

PROJECT STATUS - : FINANCIAL DATA CODE : WORK UNIT NO.
00 N-New, R-Revised, T-Terminated - : : . . . . .14 . . . . .21, . . . . .
-- 10 11-13

PERFORMING ORGANIZATION : RESPONSIBLE ORGANIZATION
----- : -----
22 41 : 42 61

RESPONSIBLE INDIVIDUAL : PROVINCE-RESPONSIBLE ORGANIZATION : UNIVERSITY RESEARCH
01 ----- : ----- : Y-Yes, N-No
-- 10 29 : 30 40 : 41

PROJECT INFORMATION

Type : Contract/Grant/Agreement Disposition of Equipments
A - Contract C - Coop, Agmt. : A - None purchased
B - Grant D - In-House : With A - ARC, B - Other B - To ARC
- : - D - To D.O
42 43 - 44

FINANCIAL/MANPOWER INFORMATION : FACILITIES
Face Amount : Total SMY : A - Federally Owned D - Provincial
----- : ----- : B - Federally Leased E - other
45 52 : 53 56 : C - Combined -
57

PROJECT TITLE

02 -----
03 -----
04 -----
10 69

PROJECT SCIENTIST - 1 : PROJECT SCIENTIST - 2 : PROJECT SCIENTIST - 3
05 ----- : ----- : -----
-- 10 29 : 30 49 : 50 69

OBJECTIVE (06-28)

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APPROACH ( 16-28)

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10 69

KEYWORD DESCRIPTORS

Keyword - 1 Keyword -2 Keyword - 3 Keyword - 4 Keyword - 5 Keyword - 6
29 ----- : ----- : ----- : ----- : ----- : -----
-- 10 19 20 29 30 39 40 49 50 59 60 69

RECOMMENDED

Signature Title Date
----- : ----- : -----
----- : ----- : -----

APPROVED

AWARD DATE

START DATE

TERMINATION DATE

30 -- -- -- : -- -- -- : -- -- --
-- 10 15 16 21 22 27

BASIC RESEARCH		APPLIED RESEARCH		DEVELOPMENTAL REPORT	
31	%		%		%
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10	12	13	15	16	18

CLASSIFICATION BY ACTIVITY, COMMODITY, SCIENCE, AND RESEARCH PROBLEM AREA

ACTIVITY		COMMODITY		SCIENCE		RESEARCH PROBLEM AREA		PRODUCT OF PERCENTS							
Code	%	Code	%	Code	%	Code			%						
32	---	---	---	---	---	---	---	---	---						
33	---	---	---	---	---	---	---	---	---						
34	---	---	---	---	---	---	---	---	---						
35	---	---	---	---	---	---	---	---	---						
36	---	---	---	---	---	---	---	---	---						
37	---	---	---	---	---	---	---	---	---						
38	---	---	---	---	---	---	---	---	---						
39	---	---	---	---	---	---	---	---	---						
40	---	---	---	---	---	---	---	---	---						
10	13	14	16	17	20	21	23	24	27	28	30	31	33	34	35

SPECIAL CLASSIFICATION

Rows 41 to 43 are used to identify special areas of research, sub-activities, or special research programs.

Code	%	Code	%	Code	%	Code	%								
41	---	---	---	---	---	---	---								
42	---	---	---	---	---	---	---								
43	---	---	---	---	---	---	---								
10	13	14	16	17	20	21	23	24	27	28	30	31	34	35	37

COOPERATORS

Any	Other Federal Agencies	Industry and Others	Province
44 Y. Yes, N-No	Y. Yes, N.No.	Y. Yes, N.No	Y. Yes, N-No
10	11	12	13

COOPERATING DEPARTMENTS WITH THE RESPONSIBLE ORGANIZATION

Cooperator 1	Cooperator 2	Cooperator 3
14	34	54
23	53	71

PAKISTAN AGRICULTURAL RESEARCH COUNCIL

RESEARCH WORK UNIT/PROJECT DESCRIPTION - PROGRESS REPORT

ACCESSION NO.

WORK UNIT NO.

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1 7

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PROGRESS REPORT: (45-74)

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PUBLICATIONS: (75-94)

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FUNDING LEVEL (RUPEES)

Federal	Province	Total
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95

10 17	18 25	26 33
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MANPOWER LEVEL (MAN-YEARS)

SCEIENTIFIC OFFICERS

ESTABLISHMENT

Federal	Province	Total	Federal	Province	Total
34 36	37 39	40 42	43 45	46 48	49 51

PERIOD COVERED BY THIS REPORT

From  
yr. mo. da.  
--/ --/ --

To  
yr. mo. da.  
--/ --/ --



EVALUATION REPORT FOR MERIT PROMOTION

FOR THE PERIOD \_\_\_\_\_ TO \_\_\_\_\_

1. Name
2. Designation of Post
3. Scale of pay
4. Present pay
5. Date of appointment on present post

	Below Min.	Mar- ginal Meets Min.	Aver- age	Above Aver- age	Out stan- ding	Not appli- cable	
	1	2	3	4	5	6	7
1. <u>Maintaining Quality of Work</u> (Works rapidly; carries out assignments promptly, achieves high output.							
2. <u>Maintaining Quality of Work</u> (Performs tasks accurately; carries tasks through to completion; produces acceptable work.							
3. <u>Following Policies and Procedures</u> (Follows instruction; adheres to established forms, policies and practices; applies appropriate procedures, rules and regulations.							
4. <u>Exercising Technical or Special Skills.</u> (Applies technical or professional knowledge; draws upon special experience to handle task of situation; uses clerical, stenographic, mechanical or other skills.							

	1	2	3	4	5	6	7
5.	<u>Communication Orally</u> (Arouses and holds interest; reports observations and experiences effectively; expresses information and instructions clearly; presents ideas and facts in meetings and conferences).						
6.	<u>Communication in Writing</u> (Composes correspondence or other written materials; follows rules of grammar and punctuations prepares and transmits technical or scientific reports; composed directives, proposals, and other documental reviews correspondence).						
7.	<u>Accepting Responsibility and Initiating Action</u> (Completes job with minimum of supervision; acts independently when situation requires it; takes steps to improve self, observes safety precautions).						
8.	<u>Responding to Need for Extra Effort</u> (Prepares thoroughly for assignment; voluntarily helps with tasks outside of regular duties; makes special effort to do effective job; contributes extra effort to complete task on time).						
9.	<u>Adapting to New or Different Situations</u> (Turns readily from one assignment or task to another; obtains assistance where and when needed; recognizes potential problem and takes necessary action)						
10.	<u>Showing Creativity</u> (Contributes original ideas; develops new procedures, techniques, or inventions; suggests novel approach to task or situation).						
11.	<u>Evaluating Facts and Making Decisions</u> (Draws appropriate conclusions from data or situation; makes decisions when necessary; makes sound decisions; uses good judgement).						
12.	<u>Planning and Organizing Own Work</u> (Anticipates requirements of job; organizes and schedules for efficient use of time and effort; provides in advance for contingencies coordinates with other individuals or groups).						

	1	2	3	4	5	6	7
13. <u>Assuming Leadership</u> (Provides leadership for fellow workers; provides leadership to other individuals or groups).							
14. <u>Getting Along with Co-Workers</u> (Cooperates with other individuals and groups; assists others when needed; cultivates friendly co-operative relationships; remains faithful under stress or provocation).							
15. <u>Dealing with Persons or Groups outside own Agency.</u> (Works effectively; gains cooperation; obtains information or acceptance; responds effectively to requests for information or assistance; projects favourable image of Agency).							
16. <u>Supervising Others</u> (Schedules and assigns tasks for effective production; motivates subordinates; makes effective use of employees' skills trains and develops subordinates; maintains communication with subordinates.							

### CAREER POTENTIAL

Item	No. Report	Same Report	Very Progressive
Attitude towards career growth and development			
Competence for technical assignment the next higher level	Not adequate	Adequate	Outstanding
Competence Supervisory or Managerial assignment at the next higher level.	Not adequate	Adequate	Outstanding
Ability and potential for continued growth future performance at two levels higher(in next 3-5 years).	Questionable	Probable	Very Promising

AWARDS REVIEWWhether

1. the employee performed outstandingly in his total job during the past year.
2. the employee performed outstandingly outside his job.
3. the employee accomplished any unusual task in comparison with other employees.
4. the employee received any Award in the past year.
5. the employee received any awards or recognition outside his department.

ADDITIONAL TRAINING NEEDED

Indicate if the employee needs additional training for more effective performance, and continued growth and development technical, scientific, management, etc.

Conduct and Personal Habits

Maintains neat and clean appearance, dresses appropriately.

Safety Program

In aware of and observes safe working practices, maintains secrecy and is trustworthy.

Physical Fitness

Adequate for all job requirements. If restricted explain.

Signature of Supervisor

Dated: \_\_\_\_\_

EVALUATION GUIDES

**OUTSTANDING** - Superior; far above average on the element performs unusually well under any circumstances he may face.

**ABOVE AVERAGE**- Above the average or above "run of the mill" on the element - performs well under condition more than average difficulty.

**AVERAGE** - Satisfactory on the element; neither strong nor weak, but definitely acceptable.

**MARGINAL MEETS MINIMUM** - Barely meets the requirement - poor enough that he needs improvement to be average.

**BELOW MINIMUM** - Less than marginal on the element - does not meet the requirements for the element.

## Annexure-X

PLACEMENT FOLLOW-UP

FOR THE PERIOD \_\_\_\_\_ TO \_\_\_\_\_

1. Name
2. Designation of Post
3. Scale of Pay
4. Present Pay
5. Date of Appointment  
on present post.

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	Yes	No
1. Has the employee been explained in detail in writing/orally his duties and responsibilities?		
2. Does the employee understand and fully realise his duties and responsibilities?		
3. Has the employee been informed as to how his supervisor expects him to perform his duties?		
4. Is the employee making satisfactory progress towards assuming full responsibility of his duties?		
5. Are the employee's conduct, attitude & ability to get along with others satisfactory?		
6. Are the employee's work performance compare favourably with that normally expected of an average employee in a similar position?		

General Remarks

Signature of Supervisor

Dated: \_\_\_\_\_

APPRAISAL OF PERFORMANCE

FOR THE PERIOD \_\_\_\_\_ TO \_\_\_\_\_

1. Name
2. Designation of Post
3. Scale of Pay
4. Present Pay
5. Date of appointment  
on present post.

1. Work Performance Consider interest, initiative, attention to and ability to understand instructions, understanding his work and its purpose, skill in performing assigned duties productively, etc.
2. Response to Training Indicate the manner in which the employee responded to training during the probationary period state kind of training given. Is employee's attitude, towards training given conducive to growth and increased competence?
3. Conduct (Consider sobriety, attendance, attitude, general behaviour, etc.)
4. Character and General Suitability Consider apparent honesty, integrity, neatness, cleanliness, cooperativeness, ability to get along with others, aggressiveness, self-confidence.
5. Potential for Advancement Indicate if he is potential material for advancement as an individual worker, as a supervisor of other employees or not at all.
6. Other Comments, if any.
7. Recommendations with respect to further retention  
Indicate whether employee be recommended for further retention in service. If not, give reasons.

Signature of Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

Annexure - XII

PERFORMANCE RATING AND CERTIFICATE  
OF POSITION DESCRIPTION

FOR THE PERIOD \_\_\_\_\_ TO \_\_\_\_\_

1. Name
2. Designation of Post
3. Scale of Pay
4. Present Pay
5. Date of Appointment on present post

Yes    No

1. Have you reviewed a copy of your position Description?
2. Is this position description an accurate and complete statement of your major duties and responsibilities?
3. Has your supervisor explained to you the standards of performance of your post?
4. Has your supervisor discussed with you (orally or writing) how your work meets these standards?

Signature of Employee \_\_\_\_\_ Date \_\_\_\_\_

Certification and Rating by Supervisor.

Performance Rating recommended by Supervisor:

- a) Below minimum.
- b) Marginal - meets minimum
- c) Average
- d) Above Average
- e) Outstanding

Action by Head of Division (Description & Rating)

- a) Accurate
- b) Inaccurate - minor changes attached
- c) Inaccurate - needs major revision
- d) Should be abolished.

Signature \_\_\_\_\_ Date \_\_\_\_\_

Action by Head of Organization

Performance Rating approved - Additional Remarks, if any.

## Annexure-XIII

PROGRESS OF BUDGET POSITION OF PARC FROM 1973-74 TO 1982-83

Year	Non-Development	Development	PL-480	Cess Fund	USAID	Ford Foundation	Seed Certificate	Total
1	2	3	4	5	6	7	8	9
1973-74	841,900	1,280,000	5,100,000	3,282,000	266,400	-	350,000	11,120,300
1974-75	2,794,900	21,447,000	10,255,000	4,275,300	3,429,400	450,000	423,400	43,075,000
1975-76	4,276,400	47,300,000	12,034,000	5,356,700	3,287,300	867,900	624,600	73,746,900
1976-77	4,669,400	24,450,000	12,150,000	5,751,000	3,012,800	450,000	-	124,230,100
1977-78	4,772,900	31,100,000	17,750,000	4,352,300	3,156,500	581,000	-	61,712,700
1978-79	5,083,600	33,925,000	20,263,200	3,973,000	3,447,900	494,000	-	67,186,700
1979-80	5,147,800	41,804,000	27,506,000	16,745,300	730,000	124,000	-	92,057,100
1980-81	12,289,000	78,850,000	20,000,000	14,151,000	-	-	-	125,290,000
1981-82	47,000,000	175,144,000	24,375,000	-	-	-	-	246,519,000
1982-83	46,706,000	140,459,000	15,000,000	-	-	-	-	202,165,000
<b>Total</b>	<b>133,581,900</b>	<b>595,759,000</b>	<b>164,433,200</b>	<b>57,886,600</b>	<b>17,330,300</b>	<b>2,966,900</b>	<b>1,398,000</b>	

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