

THE ISLAMIC REPUBLIC OF PAKISTAN

FEASIBILITY REPORT

ON

AGRICULTURAL DEVELOPMENT PROJECT

WITH

WIDENING OF PAT FEEDER CANAL

VOLUME I  
(MAIN REPORT)

DECEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY



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## PREFACE

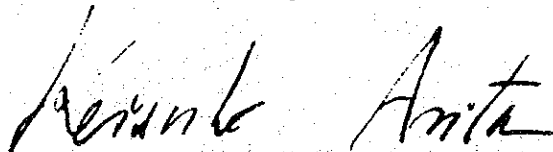
In response to the request of the Government of the Islamic Republic of Pakistan, the Japanese Government decided to conduct a feasibility study on Agricultural Development Project with Widening of Pat Feeder Canal and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Pakistan a survey team headed by Mr. Yoshio Arai from February to April, 1982.

The team exchanged views with the officials concerned of the Government of Pakistan and conducted a field survey in Pat Feeder Canal area, Baluchistan, Pakistan. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the team.

December, 1982



Keisuke Arita  
President  
Japan International Cooperation Agency





Mr. Keisuke Arita  
President  
Japan International Cooperation Agency (JICA)  
Tokyo, Japan

Letter of Transmittal

Dear Sir;

We have a great pleasure to submit herewith the feasibility study report on Agricultural Development Project with Widening of Pat Feeder Canal in the Islamic Republic of Pakistan.

The report, consisting of a volume of Main Report and three volumes of its Appendices, has provided the results of the field works conducted between February 20 and April 30, 1982, and many discussion meeting held among the study team and Pakistan authorities concerned in the same period.

The Project aims at irrigating the objective fields of about 250,000 ha by the water of Indus River to be conveyed from the Guddu Barrage through the widened and improved Pat Feeder Canal and distributaries as well as completing minor canals and on-farm facilities and assuring of the farmers concerned to be benefited from this irrigated agricultural development project.

We are convinced that the successful agricultural development in the area, when realized according to the direction indicated in this report, would greatly contribute to the socio-economic development of the country in the future.

We wish to extend our sincere thanks to the officials of the Government of Pakistan, and the Ministry of Foreign Affairs, the Ministry of Agriculture, Forestry and Fisheries of the Government of Japan and the Japan International Cooperation Agency (JICA), especially for the Japanese Embassy in Islamabad and the advisory group which gave useful advices to the survey team from time to time so as to smoothen the study.

Very truly yours,

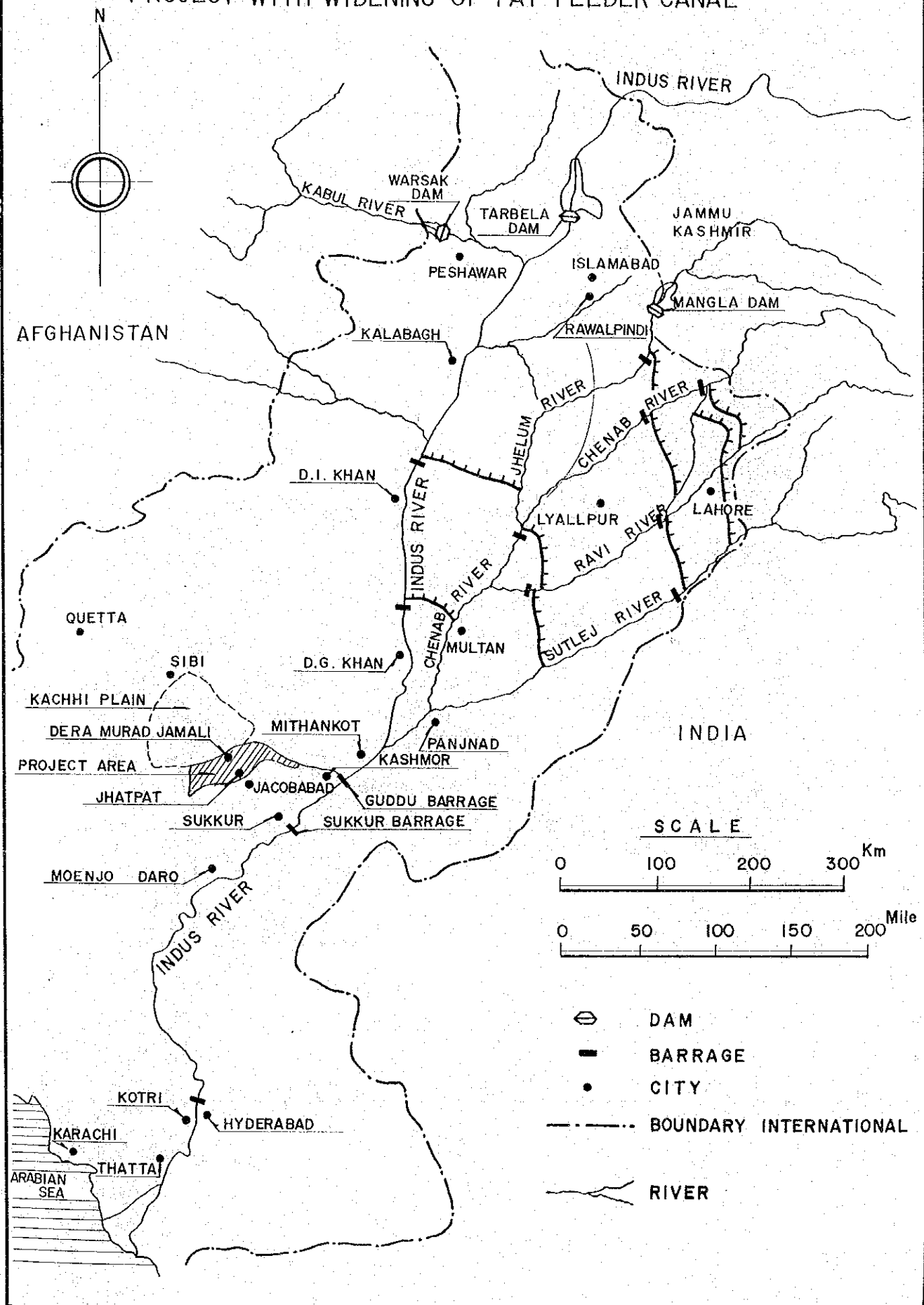
December, 1982



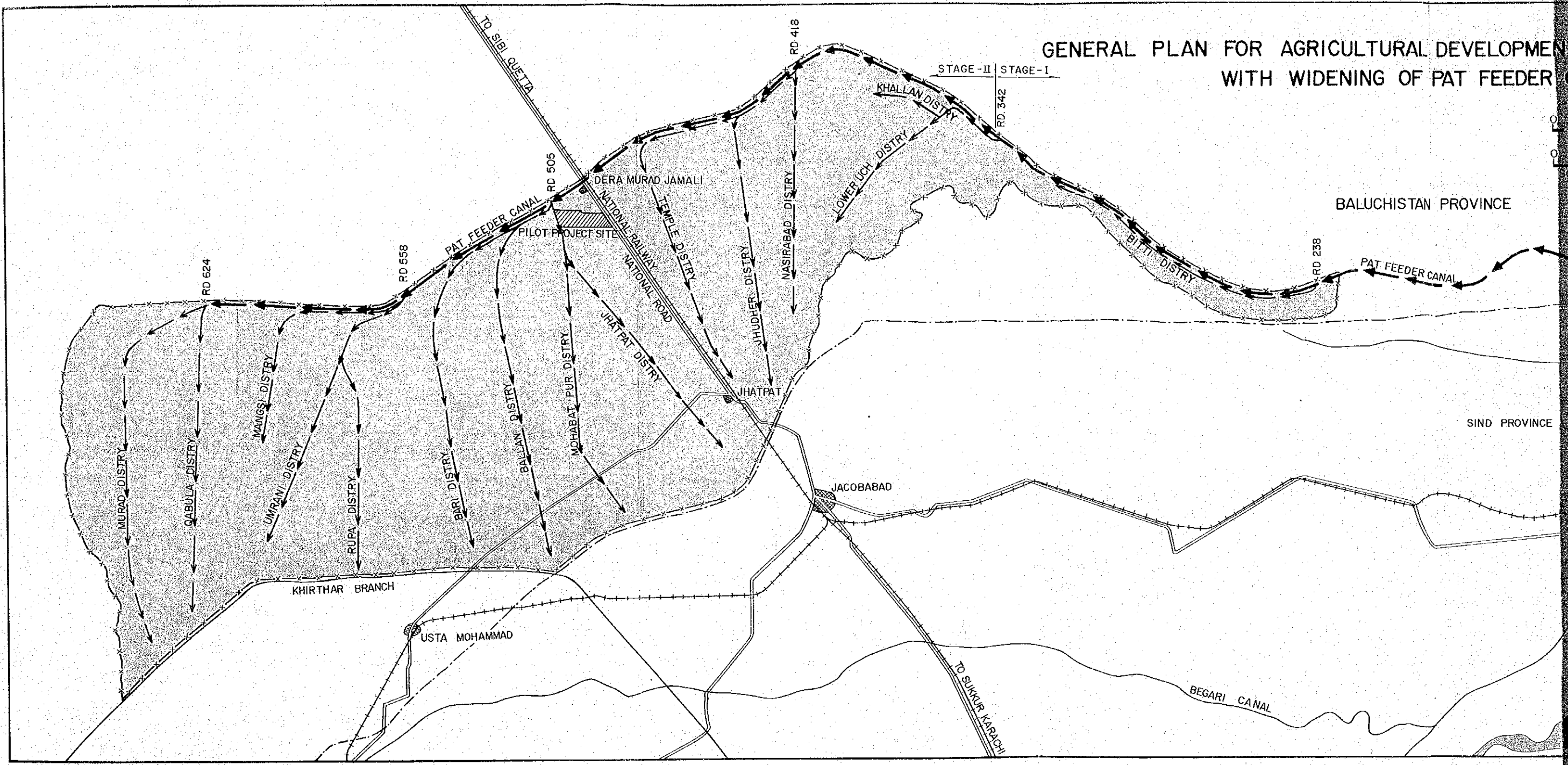
Goshio Arai  
Leader of the Feasibility Study Team  
for Agricultural Development Project  
with Widening of Pat Feeder Canal



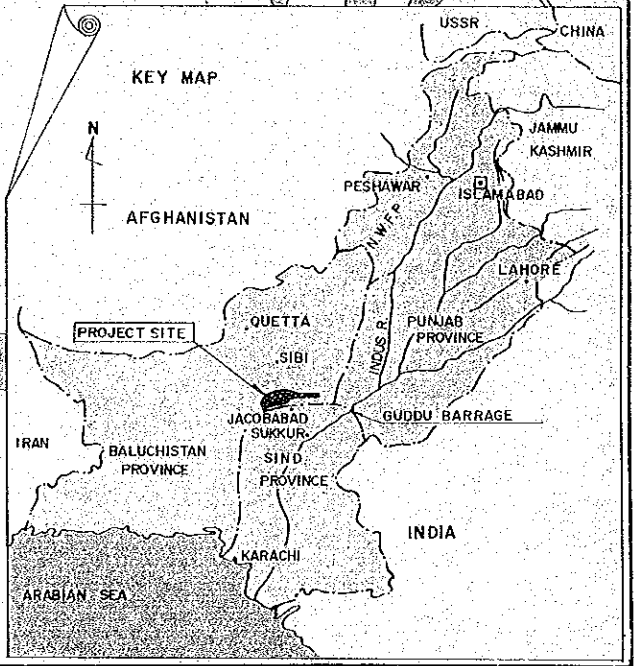
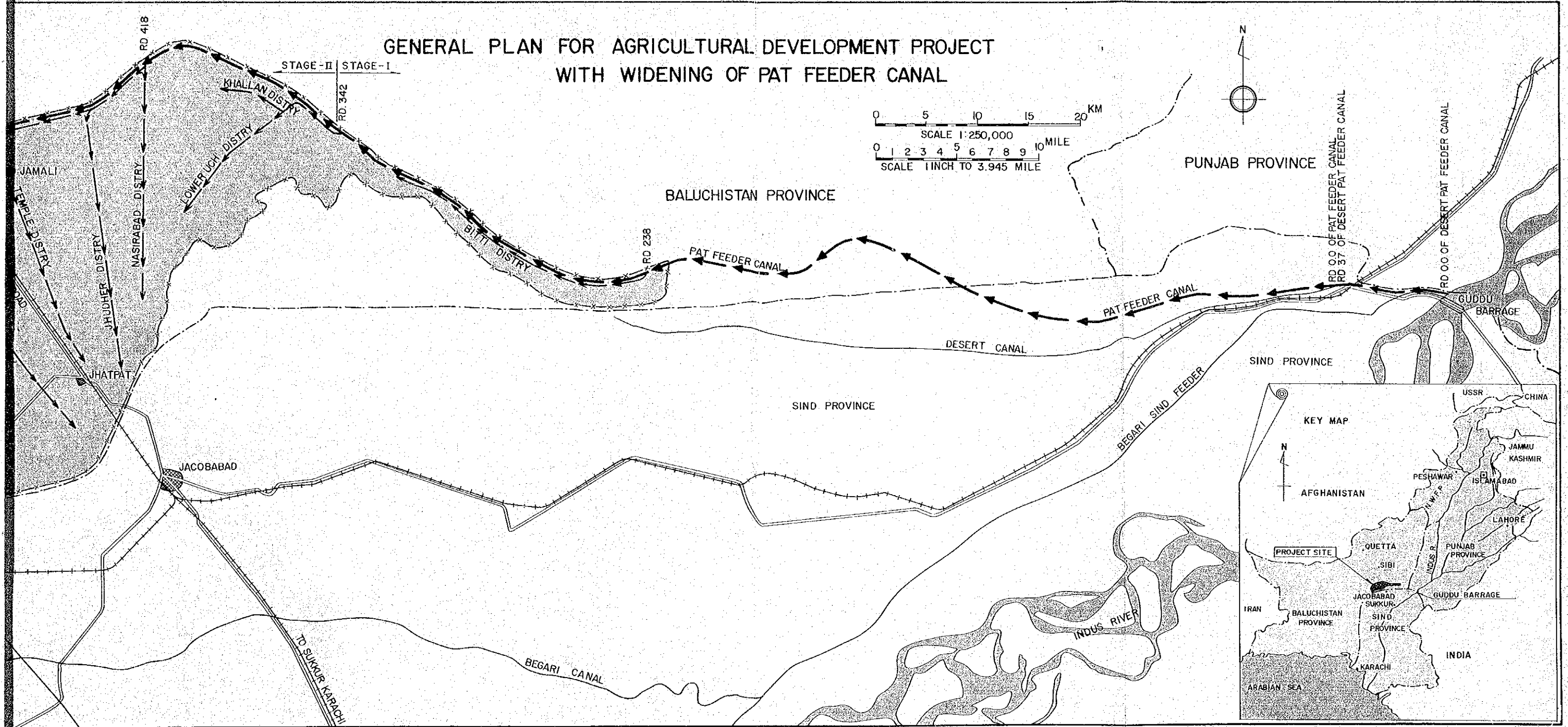
# LOCATION MAP OF AGRICULTURAL DEVELOPMENT PROJECT WITH WIDENING OF PAT FEEDER CANAL



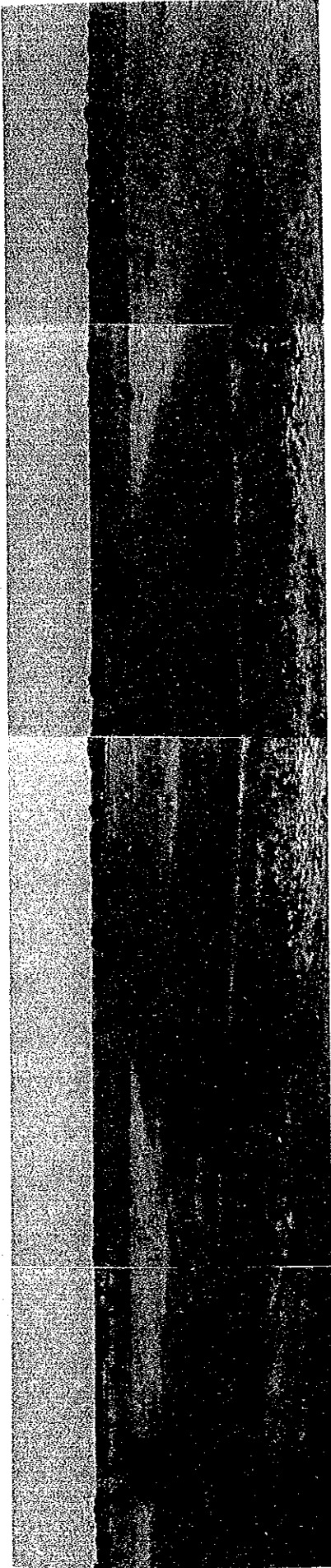
# GENERAL PLAN FOR AGRICULTURAL DEVELOPMENT WITH WIDENING OF PAT FEEDER



# GENERAL PLAN FOR AGRICULTURAL DEVELOPMENT PROJECT WITH WIDENING OF PAT FEEDER CANAL







VIEW OF PRESENT CULTIVATION IN THE PROJECT AREA



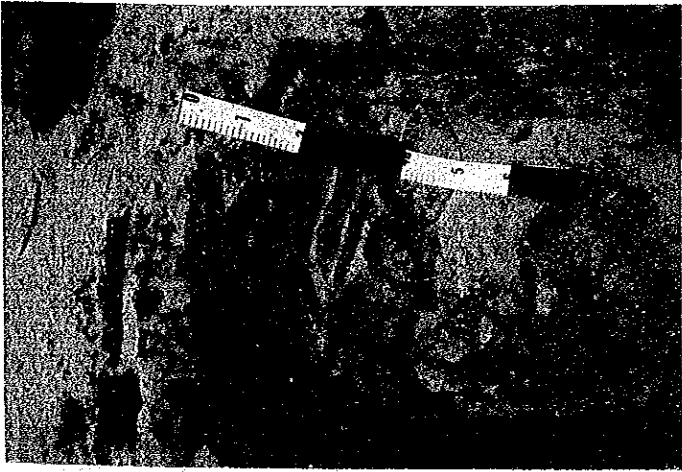
PLOWING BY TRACTOR



PLOWING BY DRAFT CATTLE



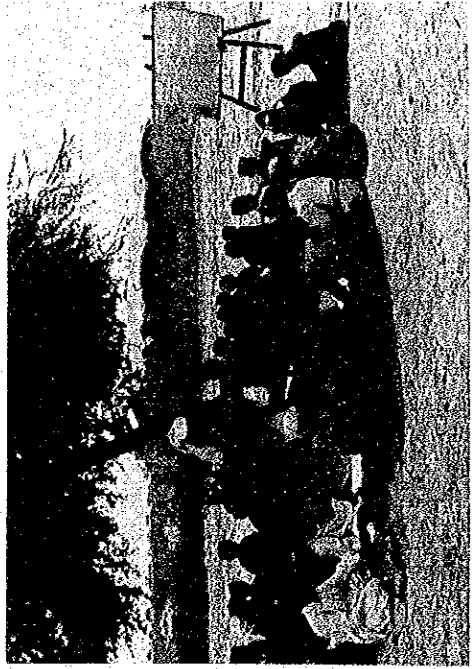




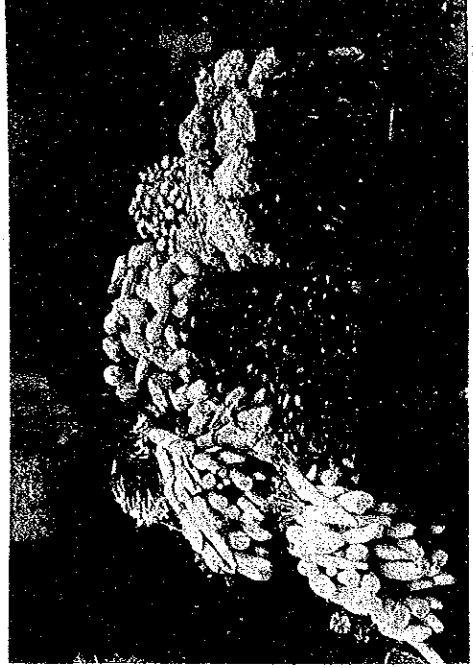
SOIL SURVEY



FARMERS' HOUSE

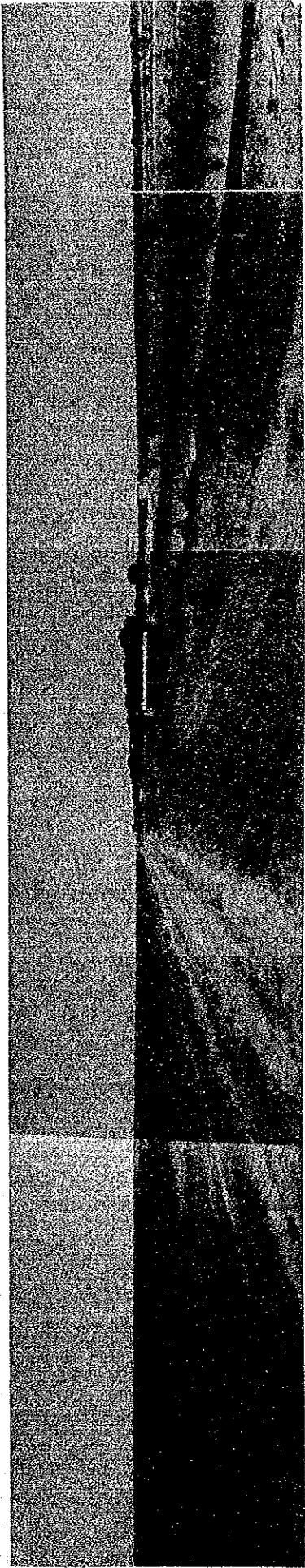


PRIMARY SCHOOL AT THE VILLAGE



VEGETABLES AT VILLAGE MARKET





VIEW OF PAT FEEDER CANAL



DESERT PAT FEEDER CANAL

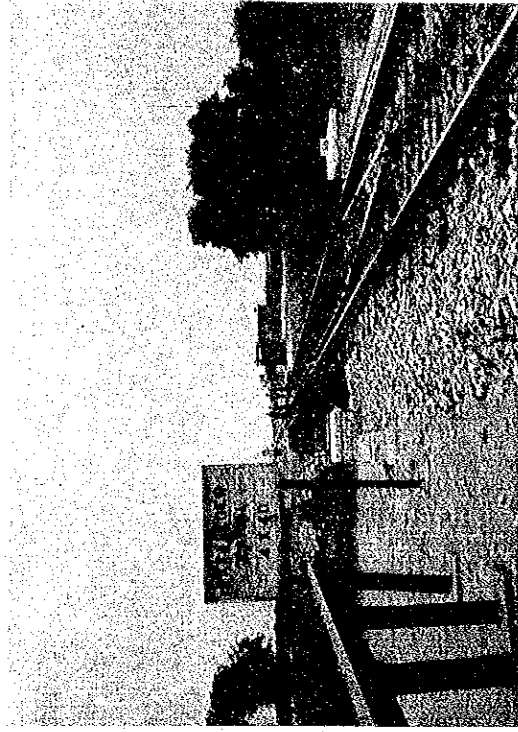


JHUDER DISTRIBUTORY AT RD 20

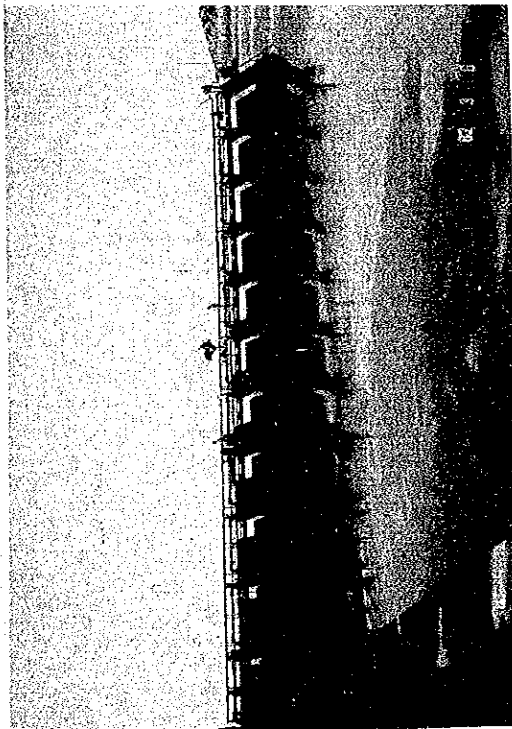




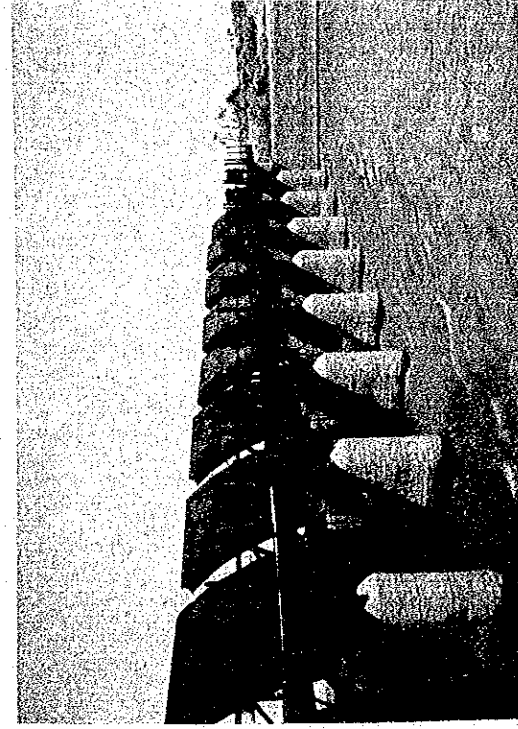
CROSS REGULATOR OF BALI & BALLON DISTRIBUTORIES



RAILWAY BRIDGE AT RD 489 OF PAT FEEDER CANAL



HEAD REGULATOR OF PAT FEEDER CANAL



CROSS REGULATOR OF PAT FEEDER CANAL AT RD 342





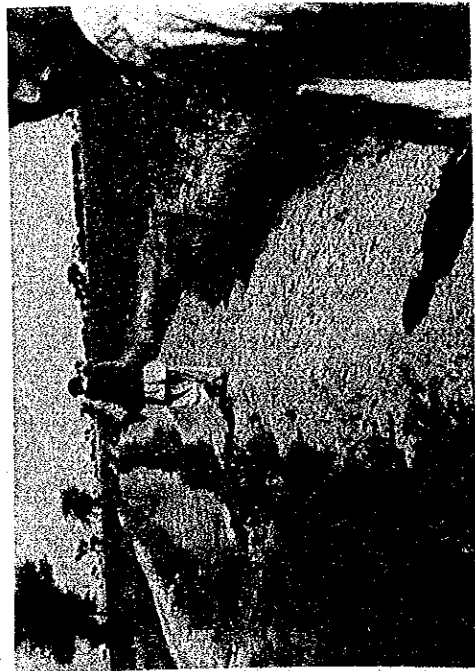
BALLON DISTRIBUTORY



PAT FEEDER CANAL AT RD 565



PLAIN FALL



MAIN WATER COURSE









## C O N T E N T S

	<u>Page</u>
LOCATION MAP	
GENERAL PLAN	
CONTENTS	i
CONVERSION FACTOR AND GLOSSARY	xi
BACKGROUND	xiv
SUMMARY, CONCLUSION AND RECOMMENDATIONS	xvi
A. SUMMARY	xvi
B. CONCLUSION	xxxxi
C. RECOMMENDATION	xxxxiv
CHAPTER I. INTRODUCTION	1
CHAPTER II. ECONOMIC AND SECTORAL BACKGROUND	6
II.1. National Level	6
II.2. Provincial Level	12
CHAPTER III. THE PROJECT AREA	16
III.1. Location and General Features	16
III.1.1. Geographical Location and Road Systems	16
III.1.2. Population and Living Conditions	17
III.2. Physical Conditions	20
III.2.1. Topography	20
III.2.2. Climate	21
III.2.3. Hydrology	26
III.2.4. Geology and Soil	31
III.3. Present Agriculture	54
III.3.1. Present Land Use	54
III.3.2. Farm Management and Land Tenure	55

III.3.3.	Cropping Pattern and Production	57
III.3.4.	Agricultural Credit	63
III.3.5.	Livestock Farming	64
III.3.6.	Input Supply and Farm Mechanization	65
III.3.7.	Agro-Industry	68
III.3.8.	Research and Extension Services	69
III.3.9.	Farmers' Organization	71
III.4.	Irrigation, Drainage and On-farm Conditions	72
III.4.1.	Irrigation Conditions	72
III.4.2.	Drainage Conditions	77
III.4.3.	On-farm Conditions	77
III.5.	Drinking Water Conditions	79
CHAPTER IV.	THE PROJECT	80
IV.1.	Objectives and Component of the Project	80
IV.1.1.	Objectives of the Project	80
IV.1.2.	Components	81
IV.2.	Project Formulation	83
IV.2.1.	Alternatives for Agricultural Development	83
IV.2.2.	Proposed Scheme of Development	86
IV.2.3.	Irrigation Plan	87
IV.2.4.	Canal Plan	95
IV.2.5.	Drainage Plan	100
IV.2.6.	Farm Land Development Plan	107
IV.2.7.	Drinking Water Plan	112
IV.3.	Proposed Agricultural Development	114
IV.3.1.	Proposed Land Use	114
IV.3.2.	Proposed Cropping Pattern	115
IV.3.3.	Forecast of Food Demand and Production	121
IV.3.4.	Production of Crops	124
IV.3.5.	Livestock Farming	126
IV.3.6.	Forecasting of Population and Agricultural Labour Force	128
IV.3.7.	Farm Mechanization and Farm Labour Balance	129
IV.3.8.	Farm Practices and Input Material Requirement	132
IV.3.9.	Farmers' Organization	133
IV.3.10.	Agricultural Supporting Services	134
IV.4.	Proposed Facilities	138

IV.4.1.	Guddu Barrage Head Regulator	138
IV.4.2.	Desert Pat Feeder Canal	138
IV.4.3.	Pat Feeder Canal	139
IV.4.4.	Distributary	146
IV.4.5.	Minor Canal	149
IV.4.6.	Canal Structures	149
IV.4.7.	Road and Bridge	156
IV.4.8.	On-Farm Facilities	161
IV.5.	Pilot Project	164
IV.5.1.	Objectives of the Pilot Project	164
IV.5.2.	Proposed Agricultural Development	166
IV.5.3.	Proposed Facilities	170
IV.6.	Project Cost	176
CHAPTER V.	PROJECT IMPLEMENTATION AND OPERATION	183
V.1.	Executing Agency	183
V.2.	Construction Method and Schedule	185
VI.2.1.	Construction Method	185
VI.2.2.	Construction Schedule	186
V.3.	Operation and Maintenance	188
V.3.1.	Executing Agency and Organization	188
V.3.2.	Operation and Maintenance of Facilities	191
V.3.3.	Operation and Maintenance Cost	193
V.4.	Consulting Services	195
CHAPTER VI.	PROJECT JUSTIFICATION	199
VI.1.	General	199
VI.2.	Economic Evaluation	199
VI.2.1.	Method of Economic Evaluation	199
VI.2.2.	Price Evaluation of Farm Input and Output	200
VI.2.3.	Evaluation of Benefits	202
VI.2.4.	Evaluation of Project Cost	204
VI.2.5.	Internal Economic Rate of Return	205
VI.2.6.	Sensitivity Analysis	206
VI.3.	Financial Analysis	207
VI.3.1.	Farm Budget Analysis	207
VI.4.	Socio-Economic Impact	208

## LIST OF DRAWINGS

<u>DWG. NO.</u>	<u>TITLE</u>
001	TYPICAL CROSS SECTION OF MAIN CANAL
002	TYPICAL CROSS SECTION OF DISTRIBUTARY
003	CROSS REGULATOR OF PAT FEEDER
004	GROUP REGULATOR OF PAT FEEDER AT RD 558
005	GROUP REGULATOR OF PAT FEEDER AT RD 624
006	ROAD BRIDGE OF PAT FEEDER (RD 42, 76 & 92)
007	ROAD BRIDGE OF PAT FEEDER (RD 489.8)
008	VILLAGE ROAD BRIDGE OF PAT FEEDER
009	CROSS DRAINAGE OF PAT FEEDER
010	GROUP REGULATOR OF KHALLAN & LOWER UCH DISTRIBUTARIES
011	PLAIN FALL (CONSTRUCTION)
012	PLAIN FALL (IMPROVEMENT)
013	OFF-TAKE
014	VILLAGE ROAD BRIDGE OF DISTRIBUTARIES (CONSTRUCTION)
015	MINOR CANAL
016	TYPICAL LAYOUT OF ON-FARM FACILITIES
017	TYPICAL STRUCTURE OF ON-FARM FACILITIES
018	LAYOUT OF SAMPLE AREA
019	GENERAL LAYOUT OF PILOT PROJECT
020	DEMONSTRATION OF IRRIGATION FACILITIES (1) OF PILOT PROJECT
021	DEMONSTRATION OF IRRIGATION FACILITIES (2) OF PILOT PROJECT
022	CHECK STRUCTURE OF PILOT PROJECT
023	LAYOUT OF ENGINEERS QUARTERS OF PILOT PROJECT
024	WATER PURIFICATION FACILITIES OF PILOT PROJECT
025	CONSTRUCTION PLANNING

LIST OF TABLE

	<u>Page</u>
Table III.2-1. Soil Series and Area of their Associations Distributing in the Command Area of the Pat Feeder Canal Project .....	39
Table III.2-2. Land Capability Classification of Soils in the Pat Feeder Canal Command Area .....	41
Table III.2-3. New Criteria for Soil Profile Salinity Evaluation	43
Table III.2-4. Area of Soil Profile and Frequency of Surface Sodicity in the Pat Feeder Canal Project Area ....	44
Table III.2-5. Land Capability Classification with Profile Salinity of the Soil in the Pat Feeder Canal Project Area .....	47
Table III.3-1. Land Tenure in Nasirabad .....	56
Table III.3-2. Number of Farm Households by Size of Holding in Nasirabad .....	57
Table III.3-3. Present Crop Yield and Production .....	61
Table III.3-4. Loaning Status of Agriculture in Nasirabad .....	63
Table IV.-1. Water Requirement by Cropping Pattern .....	93
Table IV.3-1. Proposed Cropping Plan .....	119
Table IV.3-2. Cropping Types by Profile Salinity Class(Case-3)..	120
Table IV.3-3. Food Balance at Present and in Future .....	122
Table IV.3-4. Project Yield and Total Production (Target Year)..	125
Table IV-4-1. Hydraulic Section of Desert-Pat and Pat Feeder Canal (Case 1) .....	142
Table IV.4-2. Hydraulic Section of Desert-Pat and Pat Feeder Canal (Case 2) .....	143
Table IV.4-3. Bed Width of and Pat Feeder Canal.....	144
Table IV.4-4. Length, Discharge and Commanded Area of Distributary .....	147
Table IV.4-5. Widening Plan of Head Regulators .....	151
Table IV.4-6. Widening Plan of Cross Regulators .....	152

Table IV.4-7.	List of Plain Falls along Distributaries.....	153 - 155
Table IV.4-8.	List of Bridge .....	157
Table IV.4-9.	List of Bridge Over Plain Falls.....	158 - 160
Table IV.6-1.	Investment Cost of the Project.....	181
Table IV.6-2.	Investment Cost of the Project including interest during the construction.....	182
Table VI.2-1.	List of Farm-gate Prices of Inputs and Outputs....	202
Table VI.2-2.	Beneficial Cultivable Area with Project .....	203
Table VI.2-3.	Net Incremental Crop Production in Target Year 2002 .....	203
Table VI.2-4.	Economic Value of Construction Cost.....	205
Table VI.2-5.	Sensitivity Analysis.....	207



## LIST OF FIGURES

		<u>Page</u>
Fig.III.2-1.	Geological Map around the Pat Feeder Canal Command Area.....	34
Fig.III.2-2.	Location of Pits Examined in the Command Area of the Pat Feeder Canal Project .....	36
Fig.III.2-3.	Soil Map of the Pat Feeder Canal Command Area ....	38
Fig.III.2-4.	Distribution of Soil Profile Salinity in the Pat Feeder Canal Project Area, Based on WAPDA Original Data (1977 - 1979).....	45
Fig.III.2-5.	Land Capability Classes in the Pat Feeder Canal Project Area, Combined with Soil Profile Salinity	48
Fig.III.3-1.	Present Cropping Pattern .....	60
Fig.IV.3-1.	Labour Requirement Balance in the Project Area, with Project .....	129
Fig.IV.4-1.	Irrigation System Diagram Case-1 (8,200 cusecs), Case-3.....	140
Fig.IV.4-2.	Irrigation System Diagram Case-2 (6,700 cusecs).....	141
Fig.V.1-1.	Proposed Organization for Implementation.....	184
Fig.V.2-1.	Implementation Schedule.....	187
Fig.V.3-1.	Proposed Organization Chart of Operation and Maintenance of the Project .....	189
Fig.V.4-1.	Manning Schedule of Consulting Services .....	198

CONTENTS OF APPENDIX - I

VOLUME II

- CHAPTER I. INTRODUCTION
- I.1. Personnel Concerns the Team Contacted
- CHAPTER II. ECONOMIC AND SECTORAL BACKGROUND
- II.1. National Level Background
  - II.2. Statistic Data
  - II.3. Provincial Level
- CHAPTER III. THE PROJECT AREA
- III.1. Location and General Features
    - III.1.1. Geographical Location and Road System
    - III.1.2. Population and Living Conditions
  - III.2. Physical Conditions
    - III.2.1. Topography
    - III.2.2. Climate
    - III.2.3. Hydrology
    - III.2.4. Geology and Soil
    - III.2.5. Descriptions of Representative Soil Profiles
  - III.3. Present Agriculture
    - III.3.1. Present Land Use
    - III.3.2. Farm Household and Land Tenure
    - III.3.3. Present Crop Production
    - III.3.4. Agriculture Credit
    - III.3.5. Livestock Farming
    - III.3.6. Farm Input Materials
    - III.3.7. Farm Mechanization and Labour Balance
    - III.3.8. Organization of Agriculture Extension
    - III.3.9. Farmer's Organization
  - III.4. Irrigation, Drainage & Outfarm Conditions
    - III.4.2. Drainage Conditions

CONTENTS OF APPENDIX - II

VOLUME III

- CHAPTER IV. THE PROJECT
- IV.2. Project Formulation
    - IV.2.1. Crop Water Requirement
    - IV.2.2. Leaching Water Requirement
    - IV.2.3. Intake Rate
    - IV.2.4. Drainage from Hilly Land
  - IV.3. Proposed Agriculture Development
    - IV.3.1. Farmers' Intention Survey and Food Balance Project
    - IV.3.2. Proposed Cropping Patterns
    - IV.3.3. Target Yields of Selected Crops "with Project"
    - IV.3.4. Farm Mechanization and Labour Balance
    - IV.3.5. Farm Practices and Input Materials Requirement
    - IV.3.6. Livestock Farming Plan
  - IV.4. Proposed Facilities
    - IV.4.1. Hydraulic Calculation
    - IV.4.2. Observation and Analysis and Discharge of Pat Feeder
    - IV.4.3. Hydraulic Design of Canal Structure
    - IV.4.4. Constant Head Orifice Turnout
    - IV.4.5. Design of Bridges
    - IV.4.6. On-farm Development
  - IV.5. Pilot Project
  - IV.6. Project Cost
    - IV.6.1. Investment Cost of the Project
    - IV.6.2. Disbursement Schedule
    - IV.6.3. Investment Cost of the Project including Interest During the Construction
- CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION
- V.3. Operation and Maintenance

- CHAPTER VI. PROJECT JUSTIFICATION
  - VI.2. Economic Evaluation
    - VI.2.1. Price Analysis
    - VI.2.2. Analysis of Agricultural Benefits
    - VI.2.3. Gross Production and Production Cost
    - VI.2.4. Revaluation of Project Cost
    - VI.2.5. Internal Economic Rate of Return
  - VI.3. Financial Analysis
    - VI.3.1. Farm Budget Analysis

#### CONTENTS OF SUPPLEMENTARY STUDY

#### VOLUME IV

- I. INTRODUCTION
- II. DEVELOPMENT PLAN
  - II-1. Project Component
  - II-2. Proposed Agricultural Development
  - II-3. Water Requirement
  - II-4. Proposed Facilities
  - II-5. Project Cost
- III. PROJECT IMPLEMENTATION
- IV. PROJECT JUSTIFICATION

## CONVERSION FACTOR AND GLOSSARY

### CONVERSION FACTOR

#### Linear Measures

		<u>English to Metric</u>
One inch (in)	25.4	Millimeters
One foot (ft, 12 inches)	0.3048	Meters
One yard (yd, 3 feet)	0.9144	Meters
One mile (1,760 yards = 5,280 ft)	1.6093	Kilometers

#### Square Measures

One square inch	6.4516	Square Centimeters
One square foot	0.0929	Square Meters
One square yard	0.8361	Square Meters
One acre (ac, 43,560 sq.ft)	0.4047	Hectare
One square mile (640 acres)	259.0 (2.590 Square Kilometers)	Hectare

#### Weights

One pound lb. (16. Oz)	0.4536 (0.4861)	Kilograms Seer
One Hundred Weight (112 Lb)	50.8933 (1.361)	Kilograms Maunds)
One Ton (2,240 Lb)	1.0161 (27.22)	Metric ton Maunds)
	(= 5.60/5.71 Bales of Jute Cotton)	
Cotton Bale (392 Lb)	177.81 (4.7637)	Kilogram Maunds)
	(= 0.175 long ton)	

### Capacity

One acre - feet (ac - ft,AF)	1,233.5	Cubic Meters
One Cusec	0.0283	Cubic meters per second (cms)

### Linear Measures

### Metric to English

One millimeter	0.0394	Inch
One Centimeter	0.3937	Inch
One Meter	1.0936	Yards
One Kilometer	0.6214	Mile

### Square Measures

One square meter	1.1960	Square yards
One Hectare	2.47106	Acres

### Weights

One Kilogram	2.2046	Lbs (1.0716 Seer)
One Quintal (100 Kilograms)	2.679	Maunds
One metric ton (1,000 Kg)	0.98421	Long ton
	(26.79	Maunds)
100 Kg per Hectare	1.4869	Bushels per Acre
	(1.09 Maunds per Acre)	
One Bushel per Hectare	67.253	Kg per Hectare
One Bushel	0.73	Maund
One Imperial Gallon	10.23	Lbs.
(1.2 US Gallon)		
One US Gallon	8.6	Lbs.
One Barrel	36	Imperial Gallon
	(31.5 US Gallon)	

Others

°C	Degree Celsius
°F	Degree Fahrenheit
%	Per Cent
FY	Fiscal Year
EI	Elevation above mean sea level
FSL	Full Supply Level

GLOSSARY

FAO	Food and Agricultural Organization of UN
IBRD	International Bank for Reconstruction & Development
ADB	Asian Development Bank
JICA	Japan International Cooperation Agency
EAD	Economic Affairs Division Ministry of Finance, Planning and Economic Affairs
PDD	Planning & Development Division, Ministry of Planning, Development and Population
MWP	Ministry of Water and Power
IPD	Irrigation and Power Department
WAPDA	Water and Power Development Authority
CCA	Cultivable Commanded Area





**BACKGROUND**

**SUMMARY, CONCLUSION AND RECOMMENDATIONS**



## BACKGROUND

1. Baluchistan is the largest province of Pakistan in area but the smallest in population. The Province has an extremely arid climate and very little rain. The annual average rainfall varies from two inches (50 mm) to eight inches (200 mm) which is too little to support profitable cultivation of agricultural crops.

Although agriculture is the biggest and most important sector in Baluchistan and also the accelerated development effort has been made in the province, the present conditions of agriculture are still unsatisfactory.

The transport and other infrastructural networks are still deficient, and there is very little economic activity except the agricultural sector, which itself is backward. Although firm regional data are not available, some estimates suggest that per capita income in the Province is still between one-half and two-thirds of the national average.

2. The Fifth Five-Year Plan has set an accelerated development of Baluchistan as an objective, and the programmes and the projects are being implemented to reach this goal. Each year, a special allocation for the above implementation is provided to the Province.

As a result, the provincial development programme, which is wholly financed through federal grant and a loan, is projected to increase the amount at the annual rate of 16 per cent, whereas the national average is 12.6 per cent.

In addition, the federal development programme is provided for meeting some more essential requirements in the fields of irrigation, energy, industries and transport.

Pat Feeder Canal Widening Project is planned as a selected development project under the special development plan which aims at securing quick yield of economic and agricultural benefits, and at constructing irrigation facilities considered necessary for irrigated agriculture development.

3. Under the circumstances, the Government of Pakistan has made a request to the Government of Japan for technical cooperation to formulate the Agricultural Development Project with Widening of Pat Feeder Canal (the Project) in the Province. In compliance with the request, the Japan International Cooperation Agency (JICA) dispatched a preliminary survey team to Pakistan for about three weeks from October 27 to November 15, 1981 to make a basic study on the feasibility of the irrigation project. Based on the results of the preliminary survey, the Japanese Mission was dispatched to Pakistan to discuss the Scope of Works (S/W) for the feasibility study of the Project. The above S/W was concluded on January 23, 1982 in Islamabad between the both authorities concerned.
4. In compliance with the S/W, the JICA dispatched the survey team for the feasibility study for about 10 weeks from February 20 to April 30, 1982. After the field survey, the survey team prepared and submitted the Interim Report on the feasibility study. The survey team has prepared the final report which covers three major project components, provision of irrigation and drainage facilities, establishment of the Pilot Project and promotion of the agriculture development.

Aside from the above-mentioned project components, the supplementary study on the Staged Development Plan is made assuming that the existing Rabi crops and the Kharif cropping pattern are so adjusted that the peak water requirements occur in July and August and separating the cost of engineering works from the cost of agricultural development of the area as per the comments of the Government of Pakistan.

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

### A. SUMMARY

#### Geographical Location and Road Systems

1. Pakistan has the total land area of 307,373 sq.miles (796,095 sq.km), comprising four provinces of Baluchistan, North-West Frontier, the Punjab and Sind. Of these, Baluchistan is the largest province with an area of 134,050 sq.miles (347,188 sq.km) followed by the Punjab with an area of 79,634 sq.miles (206,251 sq.km), inclusive of the Federal Capital Area. Sind has an area of 54,406 sq.miles (140,913 sq.km), North-West Frontier 28,773 sq.miles (74,521 sq.km) and the Federally Administered Tribal Areas (FATA) 10,510 sq.miles (27,219 sq.km), respectively.
2. The Project Area is included in Kachhi plain of the Baluchistan plateau, lying between Latitude 28° N to 28°33' N and Longitude 67°30' E to 69°34' E approximately, and is located about 190 miles (300 km) far from Quetta, the capital of Baluchistan, in south-east direction.

The Project Area is of rectangle-like shape with the length of about 60 miles (96 km) from east to west and 15 to 20 miles (24 to 32 km) from north to south.

The land slope varies with gradient in 1 to 2,000 or 1 to 3,000 from north to south gradually, and the area in higher elevation is located along Pat Feeder Canal at about 200 ft to 230 ft (61 to 70 m), and the lower area extends at elevation of about 160 ft to 180 ft (49 to 56 m) in the south of the Project Area.

A national metalled road has been constructed to connect two cities, Quetta and Karachi, with each other. This road runs through the Project Area from north-west to south-east. On the

other hand, there is a national railway running in parallel with the national metalled road to connect the main cities in the country with each other.

In the Project Area, there are some feeder roads and farm roads running along the existing irrigation canals, which are utilized as operation and maintenance roads for the irrigation facilities. However, the density is low and the road crossing facilities are absent in the Area.

### Population and Living Conditions

3. According to the fourth Census in 1981, the population was estimated at 83.8 million in the whole country of Pakistan, and 4.3 million in Baluchistan Province, respectively. On the other hand, there are 244,000 persons living in the Project Area and the population density is computed at about 273 persons per sq.mile (105 persons per sq.km)

In 1980, the socio-economic survey in Nasirabad District, Baluchistan, was carried out by the UNICEF.

According to the survey, the rural electrification covering the main towns in the district and its development plan is made up for extending to village areas.

In the rural area of Nasirabad, the main sources of drinking water are hand-pumped up from canals, ponds and wells, and the major towns hold the reservoirs for the water supply to the people, but their capacities are limited.

### Physical Conditions

4. According to the classification of climate by the World Meteorological Organization, climate of the Baluchistan province belongs to the arid zone type. Generally, a year has two seasons, winter (November to April) and summer (May to October) in Baluchistan.

In the Project Area, there are measurable rainfalls in a year because of being affected by the monsoon, and average annual amount of rainfall has been observed at 3.43 inches (87.1 mm). Throughout the year, 70 per cent of total amount has occurred in summer in concentration to July and August. Concerning the daily rainfall, the maximum daily rainfall has been recorded by about 3.9 inches (99.1 mm) during 10-year observation period.

The mean monthly temperature is 96.9° F (36.1° C) in June, while the minimum is 55.7° F (13.2° C) in January. The maximum air temperature recorded so far is 122° F (50° C) in June and the minimum is 30° F (-0.9° C) in January at Usta Mohammad station.

Concerning the relative humidity, the high humidity has occurred in July to February, and the low one has been recorded in March to June. In a year, the highest mean monthly value occurred in September and the lowest in April, and the former was recorded by 87 per cent and the latter by 16 per cent, respectively.

As for the measurement of the evaporation, the data have been obtained by PAN-A method, and the mean annual amount was estimated at 118.7 inches (2,967 mm).

### Hydrology

5. The Indus River is the most important water resources for the Project Area, and the mean annual run-off was estimated at 168 million acre feet (207,400 MCM), and on the other hand, the mean annual run-off was computed at about 84 million acre-feet (103,614 MCM) at the Guddu Barrage based on daily discharge data observed in 1979 to 1981.

Based on the data collected at the Project site, an attempt was made to roughly examine the balance of the water resources at the Guddu Barrage, in consideration of the demands in the downstream basin from the Guddu Barrage.

As a result of the trials, it is clear that among four case studies of the irrigation plan, Case-3, is the most stable in terms of the water resources.

However, the said trials have included various kinds of unknown factors as for the future development in the Indus River Basin.

6. In the Indus River basin, the WAPDA has investigated and analyzed the sediment since 1960. According to the relevant data, the sediment yield has been estimated in consideration of the effects of the Tarbela Dam to the Guddu Barrage. As a result of the estimation, the sediment yield of the Desert and Pat Feeder Canal will be about 9.18 million cubic feet (260,000 C.Meter) in a year.

#### Geology and Soils

7. Geological features of the Area are characterized by Quaternary alluvial deposits from the Marri-Bugti Hills and the Indus River. Parent materials are both derived from Tertiary sedimentary rocks which are composed mostly of shale, sandstone and limestone. Except the piedmont deposits, these alluvial covers are very thick and fairly finer textured.
8. The soil profile observation and the soil and water analysis were conducted in the Area in March through April, 1982, to check the existing soil classification. A soil map has been made at a scale of 1:250,000 by making rectification of the map by Soil Survey of Pakistan (1972).

Land capability classification was also examined by analysing WAPDA original survey data. As a result, the new classification procedures for evaluating soil profile, salinity and land classes have been proposed.



In view of the inferior characteristics of soils in the Area, a monitoring system on soil salinity and sodicity, and methods of fertilization and field preparation have been recommended by the team.

#### The Project Area

9. The Project covers the total cultivable commanded area (CCA) of 771,300 acres (312,000 ha) in Nasirabad District of Baluchistan Province. Out of this, 612,000 acres (248,000 ha) will be under the command of gravity flow canals (Phase-1) and the balance of 159,300 acres (64,000 ha) of upland will be commanded by pumping cum gravity canals (Phase II) in the later stage. The Project Area is being irrigated by a source of Pat Feeder Canal initiated from the intake structure of Guddu Barrage provided across the Indus River in Sind Province.
10. The Project Area extends over five Tehsils covering part of Nasirabad. The population and number of households in total in the Project Area were estimated at 244,000 and 37,000, respectively. The farm households in the Project Area are 28,000 or 76 per cent of the total, while the farm population was estimated at 184,800, and the average population per farm household is 6.6.

The farm size per farm household in the Project Area ranges at a class from 7.5 to 50 acres, and the area with these farm sizes occupies 85 per cent of the total farm land area.

#### Present Agriculture

11. Although the Project Area is one of the most productive areas in Baluchistan Province, 69 per cent of the total commanded area is left as fallow lands or cultivable waste lands, and a single cropping pattern is practiced exclusively. The cropping intensity in terms of the percentage of the annual cropped area

to the total command area of the Project is as low as 39 per cent. According to the results of survey, considerably large decrease in the cropping area is seen with the sorghum growing for the last ten years, but the areas cropped with rice, wheat and sugarcane have increased rapidly, especially after the year of 1978-79. Other crops like sesamum, Rabi oilseeds and pulses have maintained their cropping level of the area or slightly decreased. This change in cropping pattern denotes farmers' intention to grow more beneficial crops like rice, sugarcane and wheat, while the area with sorghum has been decreased.

12. The present yields of crops in the Project Area are low as compared with the average yields of respective crops in the irrigated areas of the neighbouring provinces. The reason for the low yield is, firstly, shortage in irrigation water, and then several other factors identified during the field survey which are poor water management practices, inadequate supply of farm input materials and farm credits and lack of proper interest on adequate management by tenants. It is difficult to supply irrigation water timely under the present conditions that there are no systematic facilities and organization at on-farm level, and the lands are sometimes not adequately levelled.

#### Irrigation, Drainage and On-farm Conditions

13. Existing irrigation facilities for the commanded area of Pat Feeder Canal consist of Guddu Barrage Head Regulator, Desert-Pat Feeder Canal, Pat Feeder Canal and 13 distributaries. The Guddu Barrage Head Regulator is one of the structures composed with the Guddu Barrage, which was constructed in 1963, and the Head Regulator diverts the water from the Indus River to Desert-Pat Feeder Canal. The intake period of water at the Guddu Barrage was about six months a year before the completion of the Tarbela Dam; however, after the completion of Tarbela Dam the intake of water has been made throughout the year continuously except for about two months from March 15th.

The Head Regulator has been designed with the capacity of 13,139 cusecs (371.8 cu.m/sec) and the maximum recorded intake volume was 12,818 cusecs (362.7 cu.m/sec).

14. The Desert-Pat Feeder Canal is the feeder canal to both Pat Feeder Canal and Desert Canal and unlined earth canal with 37,000 ft (11,278 m) in length. The Pat Feeder Canal is unlined earth canal from the Head Regulator at RD 0 to the end at RD 624, and the total length is 118.2 miles (190.2 km). The maximum discharge at the head of the Pat Feeder Canal was recorded at 3,135 cusecs (88.7 cu.m/sec) in August, 1979. The reasons why the recorded maximum discharge is smaller than the designed capacity are lack of the canal capacity in some parts and the restriction in water right to the Pat Feeder Canal given by the Indus River Apportioning Committee.
15. There are 13 distributaries existing in the Project Area and the total length is 217.07 miles (349.3 km). The cultivable commanded area of Bitti distributaries along the Pat Feeder Canal from RD 238 to RD 342. Other 12 distributaries in total length of about 260,000 ft (79.3 km) are located along the Pat Feeder Canal. The average distance between distributaries is about 21,000 ft (6.4 km). Such alignment seems reasonable for proper water management practice.

The structures of the Pat Feeder Canal and distributaries are composed of cross regulators, head regulators, plain falls, outlets, road bridges, railway bridges, flood inlets and so on.

16. The irrigation canal in on-farm level consists of main water courses, branch water courses, sub-branch water courses, internal water courses, link water courses according to the Canal & Drainage Act, 1981.

The existing water courses for irrigation water supply to the farm lots of about 200,000 acres (80,900 ha) have the peak demand water allowance of 1.0 cusec per 100 acres with 60 per cent of crop intensity.

The intensity of the existing water courses is 15.6 ft per acre (11.7 meters per hectare), which is too low to carry out modern farming practices with proper water management. An extent of a chak which is an irrigation block covered by an outlet is at present 800 acres (324 ha), which is also too large in magnitude to do the modern farming with effective utilization of irrigation water.

17. In the cultivable commanded area (CCA) of Pat Feeder Canal, there is no systematic drainage networks, except those in the CCA of Bitti distributary which is covered by the Hairdin Drainage Project. The work started in December 1974 and completed on June 30, 1980, and the Project has been in full operation since July 1, 1980 under the Right Bank Outfall Drainage Project by the WAPDA. The feasibility study on drainage project for the CCA of Judher, Nasirabad and Lower Uch Distributaries is on-going by the WAPDA.

#### Objectives of the Project

18. The Project aims to increase agricultural production in the Project Area by more effective use of the Indus River flows available at the existing Guddu Barrage, create the employment opportunities throughout the year, and improve the living environment from the viewpoint of the rural development through the provision of assured irrigation water with improved agricultural supporting services and road system.

In order to achieve the above-mentioned objectives and to get quick yield of benefit in the whole Project Area, the following should be envisaged by staging manner in accordance with the proposed Implementation Schedule.

- i) Establishment of an irrigation system with widening Desert-Pat Feeder Canal, Pat Feeder Canal, distributaries and minor canals for perennial irrigation for growing of profitable crops,
- ii) On-farm development for irrigated agriculture as well as for modernized agricultural practice,
- iii) Provision of road networks by improving service roads along main canals and distributaries and existing roads located in the Project Area.
- iv) Establishment of a pilot project in the Project Area to carry out the trial farm (applied research) programme, demonstration of irrigation facilities, advanced farming practice and training programme, and
- v) Institutional arrangement and strengthening of agricultural supporting services for full development of the Project Area.

#### Components of the Project

19. The Project includes the following components:

##### Civil Works

- i) **Irrigation Facilities**  
Widening and upgrading of main canal, distributaries and minor canals as well as related structures.

- ii) On-farm Development  
Construction of on-farm facilities
- iii) Roads  
Construction of road networks including the improvement of service roads and the rehabilitation of existing roads.

Pilot Project

- iv) Pilot Facilities  
Construction of Pilot facilities such as irrigation facilities for demonstration, laboratory facilities, training accommodation and administrative facilities.
- v) Agricultural Development Programme  
Promotion of applied research, demonstration farm and modern farming practice.
- vi) Training Programme  
Training of the officials concerned with agricultural development and water management, the leaders and promoters of villages and farmers in the Area.

Agricultural Development

- vii) Irrigated Agriculture  
Introduction of modernized agricultural techniques under the well-controlled water management.
- viii) Supporting Services  
Provision of necessary extension and training, and strengthening of input supply, credit, marketing and agricultural processing.