CHAPTER 5 BASIC DESIGN

5.1 Principles of Design

Major principles of the basic design of the project facilities are set as follows

- Design standards utilized in Pakistan are principally adopted for the basic design.

- Materials and machinery available in Pakistan will be utilized as much as possible for construction to minimize the supply of these from Japan.

- Operation of the project facilities is designed to be as simple as possible. For example, the dam will be designed without spillway gates.

- Automatic control and remote control of project facilities will be minimized considering the difficulties of operation and of making repairs and obtaining spare parts for such control devices. Manual and on-site operation will be used.

- Alignment of road is so designed as to avoid bridges and tunnels in order to minimize the construction cost. The resulting decrease in straight portions of the road alignment is accepted because of the above consideration.

- Considering the large scale of project cost, the project implementation period of 2 years is divided into 2 phases.

5.2 Design Conditions

5.2.1 Dam Facilities

(1) Design flood

The flood probability of a 5 to 10 years return period is adopted as the design flood of the dam. The rational formula below is adopted for calculations.

$$Q = \frac{1}{3.6} \cdot f \cdot r \cdot A$$

Q	:	Design flood discharge	(m^3/sec)
f	:	runoff coefficient	0.8
r	:	rainfall intensity	(mm/hr)

$$r = \frac{R_{24}}{24} \left(\frac{24}{T}\right)^{2/3} \text{ ... Mononobe formula}$$

R_{24}	:	daily rainfall	(mm/day)
T	:	time of concentration	(hr)

$$T = \left(\frac{11.9 \times L^3}{H}\right)^{0.385} \times \frac{1}{3600}$$

L	:	length of water course	(m)
H	:	height	(m)
A	:	catchment area	(km^2)

Name of Dam	M - 1		M - 2	
A:Catchment area	10 km^2		57 km^2	
f:Run off coefficient	0.8		0.8	
R24:Daily rainfall 1/10=143mm/day	1/5=123mm/day	1/10=143mm/day	1/5=123mm/day	
T:time of concentration	$T=\left(\frac{11.9 \times 7100^3}{140}\right)^{0.385} \times \frac{1}{3600} = 3.0^{hr}$		$T=\left(\frac{11.9 \times 17700^3}{240}\right)^{0.385} \times \frac{1}{3600} = 7.0^{hr}$	
r:Rainfall intensity	$r = \frac{123}{24}\left(\frac{24}{3}\right)^{2/3}$ = 20.5mm/hr	$r = \frac{143}{24}\left(\frac{24}{3}\right)^{2/3}$ = 23.8mm/hr	$r = \frac{123}{24}\left(\frac{24}{7}\right)^{2/3}$ = 11.7mm/hr	$r = \frac{143}{24}\left(\frac{24}{7}\right)^{2/3}$ 13.5mm/hr
Q:Discharge	45.6m3/sec	52.9m3/sec	148.2m3/sec	171.0m3/sec
Design flood discharge	50 m3/sec		150 m3/sec	

Maximum flood spill out capacity utilizing the dam freeboard is calculated as follows:

Name of dam	M - 1 dam	M - 2 dam
Effective length of weir	23 m	45 m
Discharge coefficient	2.0	2.0
Overflow depth	2.0 m	2.5 m
Emergency discharge	130 m^3/s	356 m^3/s

In this case, the flood discharge is about the same as the maximum flow capacity of the existing river section at both dam sites.

(2) Freeboard

The freeboard of the dam is to be calculated from the following formula.

Fb = 0.03H + 2

Fb : Freeboard (ft)

H : Dam height (ft)

H = Dam crest EL - Foundation excavation EL

2.0 : Constant (ft)

Name of dam	M - 1 dam	M - 2 dam
Dam crest elevation	1962 feet	1640 feet
Cut line elevation	1921 feet	1604 feet
Height of dam	41 feet	36 feet
Freeboard	3.23feet = 0.98 = 1.0m	3.08feet = 0.94=1.0m

(3) Sedimentation

Within the catchment area of the Malal River, on which M-1 and M-2 dams are to be constructed, there are no high mountains or steep valleys; the maximum hill height is about 300 m. Large-scale landslides are not found in the catchment area. During the rainy season, deposit inflow to the reservoir is in the form of suspended load. The reservoir scale is small and

two to three months of river inflow is sufficient to fill it to its full water level. Therefore, the river inflow passes through the reservoir downstream most of the time. Excessive rapid deposit inflow to the reservoir is not expected. For design purposes, the specific deposit inflow to the reservoir is calculated as follows:

$$q = (1000 - 1500)\ m3/yr/km2 \times 0.25 = 250 - 375 = 300\ m3/yr/km2$$

However, deposit does progress from the upstream portion of the reservoir. The excavation of deposits will be necessary every year.

Name of dam	M - 1 dam	M - 2 dam
Catchment area	10 km^2	57 - 10 = 47 km^2
Specific sediment volume	300 m^3/year/km^2	300 m^3/year/km^2
Period	1 year	1 year
Design sediment volume	3,000 m^3	14,100 m^3
Annual work day	15 days	71 days

5.2.2 Water Supply Scheme

(1) Unit consumption rate

ICTA adopts 20 lit./day/capita for the planning of its water supply scheme. For this Project, 40 lit./day/capita is accepted according to the planning standards of Punjab Province for water supply schemes. In the standard, the planning period is taken as 10 years for rural areas, assuming a 30% population increase over 10 years. The unit consumption is given as 36 lit./day/capita for areas with a population less than 2,000 and 45 lit./day/capita for a population of 2,000 - 5,000. For the planning of the Project, 40 lit./day/capita is adopted regardless of the beneficiary population.

It should be noted, however, that as the living conditions improve and income increases, the unit consumption rate is sure to increase. It is recommended that when it reaches such a stage, the water supply scheme possibly with a dam to cover the whole rural area should be considered. The MIRAD project is planned to serve until the living conditions are improved.

(2) Pump type

Based on the field survey on the existing pump facilities, submersible motor pumps are seldom used and turbine pumps (Borehole pump) are mostly used, even for deep wells of nearly 100 m. Turbine pumps in the case of high head with small capacity are usually inefficient compared with submersible motor pumps due to the high electricity consumption per unit water pumped up. The reasons for not utilizing submersible motor pumps are considered as follows:

1. Submersible motor pumps of domestic production are limited in kind and in numbers, and prices are very high for imported ones.

2. Comparatively poor performance of large diameter drilling often causes problems such as when the drilled hole is not vertical or the inside wall of the drilled hole has slipped or been damaged, or when installation of casing and/or strainer is not done as designed. The design capacity and actual yield sometimes differ greatly which results in frequent on-off operations for submersible pumps.

3. Operation staff and mechanics are familiar with turbine pumps and their operation.

Based on the facts noted above, submersible motor pumps are designed only for deep wells in the Project and motor pumps will be supplied from Japan. All other pumps will be obtained as domestic products.

5.2.3 Rural Roads

(1) Standard cross section

Existing rural roads have several problems as follows:

1. The total road width of 7.3 m is wide enough for vehicles but the pavement width of 3.6 m is too narrow and the wheels of vehicles run off of the pavement onto the shoulder when two small vehicles pass each other.

2. Asphalt pavement quality is not always uniform.

3. Cross drainage and side ditches are sometime not sufficient in number as well as in capacity.

4. Common vehicles such as sedan and trucks (4 t) are often over loaded and the road pavements are damaged soon

Items 2 to 4 are considered due to budget limitations.

After completion, traffic will certainly increase not only in number but also heavy vehicles and machinery that are overloaded would pass.

Based on the above considerations, careful attention should be paid to the quality and width of pavement and a solid foundation. The design standards are set as follows:

1. Total road width is 7.3 m
2. Pavement width is 4.5 m with 2-layers asphalt pavement bearable for traffic of heavy vehicles of 20 ton class
3. Shoulder portion of 0.5 m at each side is paved with one asphalt layer

5.3 Basic Design

5.3.1 Irrigation plan

(1) M-1 Dam

(a) Dam type

The dam type of M-1 dam is designed as a concrete gravity type based on the following considerations.

- Geological features of foundation rocks are good enough for the concrete gravity type

- Earth materials suitable for dam embankments are not found near the dam site
- As the dam body is small and ready-mixed concrete is available, the concrete type is more economical.
- Concrete dams are safer against over-topping

(b) Reservoir capacity

- H - Q curve
  The curve, elevation vs. reservoir capacity is given in Fig. 5-1, which was obtained from 1/2000 topography.
- Reservoir capacity
  Topographical maximum capacity was selected, i.e., Q=93,000 m^3 with reservoir water of EL 596.0 m
- Effective capacity 90,000 m^3
  Effective capacity = Total capacity - Deposits
  = 93,000 - 3,000 = 90,000 m^3
- Available water for irrigation
  Taking seepage and evaporation losses into account, the available water for irrigation is 86,000 m^3

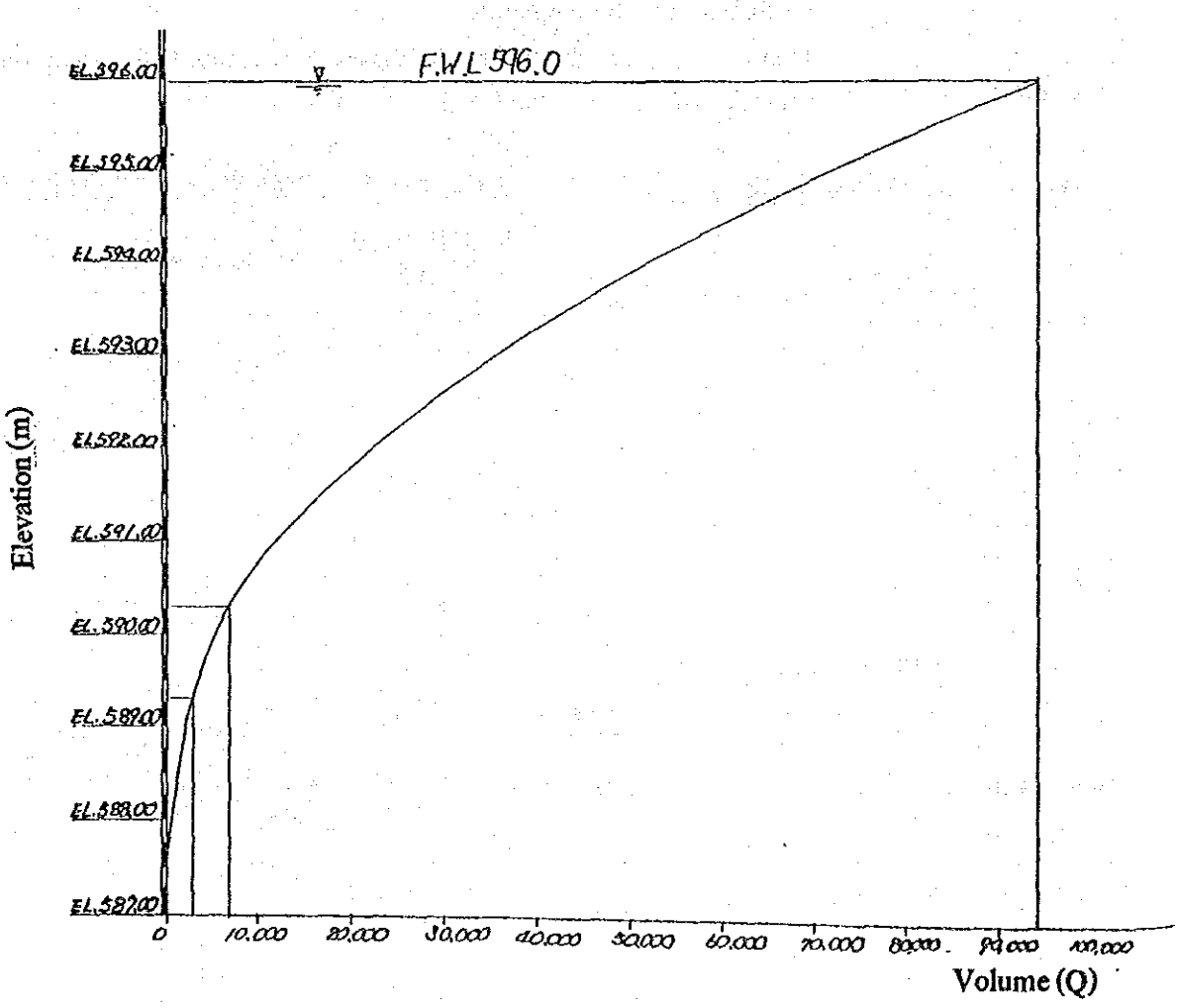
$$\text{Available Water} = \frac{\text{Total reservoir capacity - Sand deposits}}{1.05}$$

$$= \frac{93000 - 3000}{1.05} = 86{,}000\ m^3$$

Fig.5-1 M - 1 Dam H - Q Curve

M - 1

Elevation (A) m	Interval (ΔH) m	Area (A) m^3	Average area m^3	Volume Volume m^3	Accumulated m^3
El 586.54	0.46	0	0	0	0
587.00	1.00	210.4	105.2	48.4	0
588.00	1.00	897.6	554.0	554.0	602.4
589.00	1.00	2,138.7	1,518.15	1,518.2	2,120.6
590.00	1.00	4,772.9	3,455.8	3,455.8	5,576.4
591.00	1.00	8,372.8	6,572.85	6,572.9	12,149.3
592.00	1.00	11,895.0	10,133.9	10,133.9	22,283.2
593.00	1.00	15,258.4	13,576.3	13,576.3	35,859.9
594.00	1.00	17,351.1	16,304.75	16,304.8	52,164.7
595.00	1.00	20,347.6	18,849.3	18,849.3	71,014.0
596.00	1.00	24,896.4	22,622.0	22,622.0	93,636.0



(c) Standard cross section

- Crest elevation EL. 598.0 m

  Crest EL.= Full water level + Overflow depth + Freeboard at spillway

  = 596.0 + 1.057 + 1.0 = 598.057 = 598 m

  Full water level : EL. 596.0 m

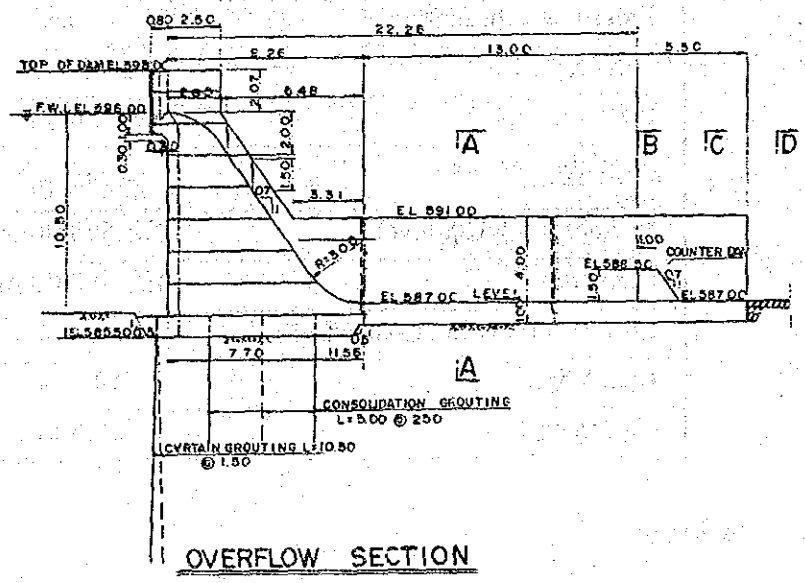
  Overflow depth of spillway : $H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{50}{2.0 \times 23m}\right)^{2/3} = 1.057$ m

  Freeboard : 1.0 m

- Foundation excavation elevation EL. 585.5 m
- Dam height 12.5 m

  H = EL. 598.0 - EL. 585.5 = 12.5 m
- Standard cross section

  Considering the stability against sliding on its foundation, the standard cross section is designed as follows:



OVERFLOW SECTION

(d) Foundation treatment

Foundation rocks are considered less permeable having Lu of less than 2.5; however, alternate layers of sandstone and shale run from the upstream to downstream direction and seepage may occur through

these layers. Curtain grouting together with consolidation grouting will be required as foundation treatment.

Depth of curtain grouting is set at about 10.5 m, the same as the maximum reservoir water depth. Grout holes are designed to incline 30° to the left bank.

(e) Major features of M-1 dam

Name of Dam	M - 1 Dam
Name of river	Malal kas
Catchment area	10 km^2
Foundation rock	Sandstone. Shale
Dam type	Concrete gravity dam
Design flood discharge	50 m^3/s
Emergency discharge	130 m^3/s
Total capacity	93,000 m^3
Effective capacity	90,000 m^3
Available storage	86,000 m^3
Normal full water level	EL.596.00 m
Dam crest	EL.598.00 m
Lowest foundation excavation	EL.585.50 m
Dam height	12.5 m
Crest length	66.5 m

(2) M-2 Dam

(a) Dam type

The dam type of M-2 dam is designed as a concrete gravity type based on the following considerations.

- Geological features of foundation rocks are good enough for the concrete gravity type

- Earth materials suitable for dam embankments are not found near the dam site
- As the dam body is small and ready-mixed the concrete is available, the concrete gravity type is more economical.
- Concrete dams are safer against over-topping

(b) Reservoir capacity

- H - Q curve
  The curve, elevation vs. reservoir capacity is given in Fig. 5-1, which was obtained from 1/2000 topography.
- Reservoir capacity
  Topographical maximum capacity was selected, i.e., Q=165,000 m^3 with reservoir water of EL 497.5 m
- Effective capacity 150,900 m^3
  Effective capacity = Total capacity - Deposits
  = 165,000 - 14,100 = 150,900 m^3
- Available water for irrigation
  Taking seepage and evaporation losses into account, the available water for irrigation is 144,000 m^3

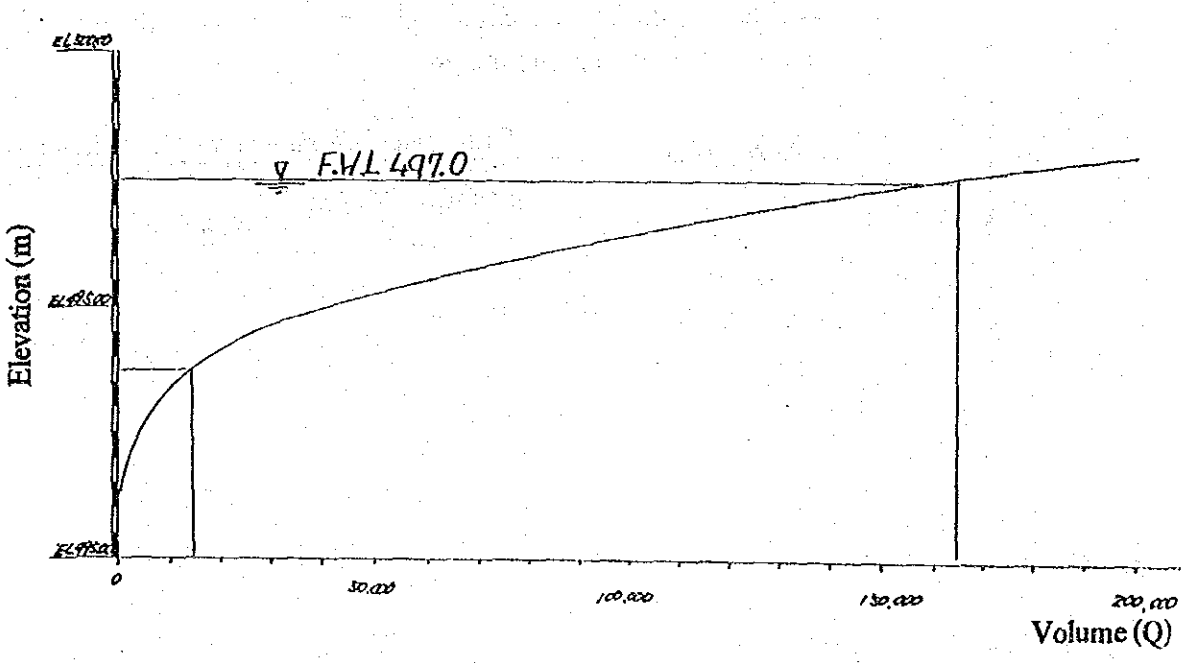
$$\text{Available Water} = \frac{\text{Total reservoir capacity - Sand deposits}}{1.05}$$

$$= \frac{165000 - 14100}{1.05} = 144{,}000\ m^3$$

Fig.5-2 M - 2 Dam H - Q Curve

M - 2

Elevation (A) m	Interval (ΔH) m	Area (A) m^3	Average area m^3	Volume Volume m^3	Accumulated m^3
EL 490.36	0.64	0	0	0	0
491.00	1.00	778	389	249	0
492.00	1.00	3,662	2,220	2,220	2,469
493.00	1.00	5,988	4,825	4,825	7,294
494.00	1.00	15,238	10,613	10,613	17,907
495.00	1.00	33,399	24,318.5	24,318.5	42,225.5
496.00	1.00	47,968	40,683.5	40,683.5	82,909
497.00	1.00	62,354.7	55,161.35	55,161.4	138,070.4
498.00	1.00	76,912.0	69,633.4	69,633.4	207,703.8



(c) Standard cross section

- Crest elevation EL. 500.0 m

  Crest EL.= Full water level + Overflow depth + Freeboard at spillway

  = 497.5 + 1.400 + 1.0 = 499.9 = 500.0 m

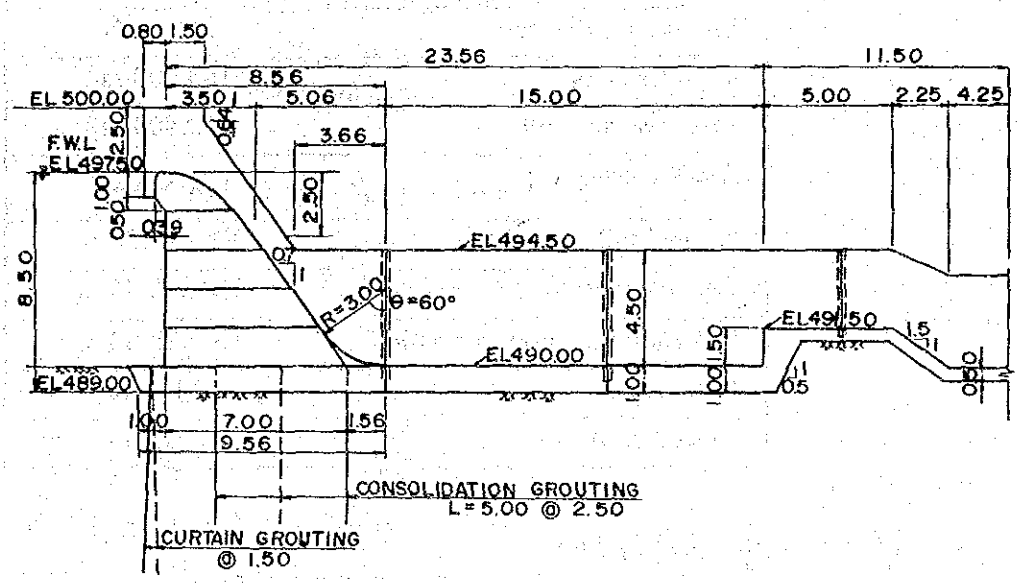
  Full water level : EL. 497.50 m

  Overflow depth of spillway : $H = (\frac{Q}{CL})^{2/3} = (\frac{150}{2.0 \times 45m})^{2/3} = 1.400$ m

  Freeboard : 1.0 m
- Foundation excavation elevation EL. 489.0 m
- Dam height 11.0 m

  H = EL. 500.0 - EL. 489.0 = 11.0 m
- Standard cross section

  Considering the stability against sliding on its foundation, the standard cross section is designed as follows:



OVERFLOW SECTION (TYPE I)

(d) Foundation treatment

Foundation rocks are less permeable, the same as at the M-1 dam site, and have sufficient bearing capacity for a gravity dam. Curtain grouting is designed to minimize uplift and to improve permeability on both abutments. A small-scale fault found at the left abutment can be improved by grouting as no clayey formation exists in the fault. Depth of curtain grouting is designed at 8.5 m, the same as the maximum reservoir water depth.

(e) Major features of M-2 dam

Name of Dam	M - 2 Dam
Name of river	Malal kas
Catchment area	57 km^2
Foundation rock	Sandstone. Shale
Dam type	Concrete gravity dam
Design flood discharge	150 m^3/s
Emergency discharge	355 m^3/s
Total capacity	165,000 m^3
Effective capacity	150,900 m^3
Available storage	144,000 m^3
Normal full water level	EL.497.50 m
Dam crest	EL.500.00 m
Lowest foundation excavation	EL.489.00 m
Dam height	11.0 m
Crest length	130.0 m

(3) Irrigation plan by dam

(a) Irrigation area

The irrigation areas of M-1 and M-2 dams are located at higher elevations than the water elevation of the reservoirs so that pumping up of irrigation water is necessary. Due to this situation, the irrigation areas were selected at places near to the reservoirs and at as low an elevation as possible.

The net irrigation area was decided from the water balance calculation with 1/5 to 1/10 probability of a dry year. The locations of irrigation areas are shown in the attached drawings.

	M-1 Dam	M-2 Dam			
		A block	B block	C block	Total
Irrigation Area (ha)	40	46	70	44	160

(b) Maximum intake capacity

The maximum capacity of the intake structure was calculated from the water balance and is summarized as follows:

Condition of calculation

- TRAM Value : 35 mm
- Irrigation efficiency : 0.6
- Irrigation interval : 7 days
- Rainfall data : daily rainfall for 37 years

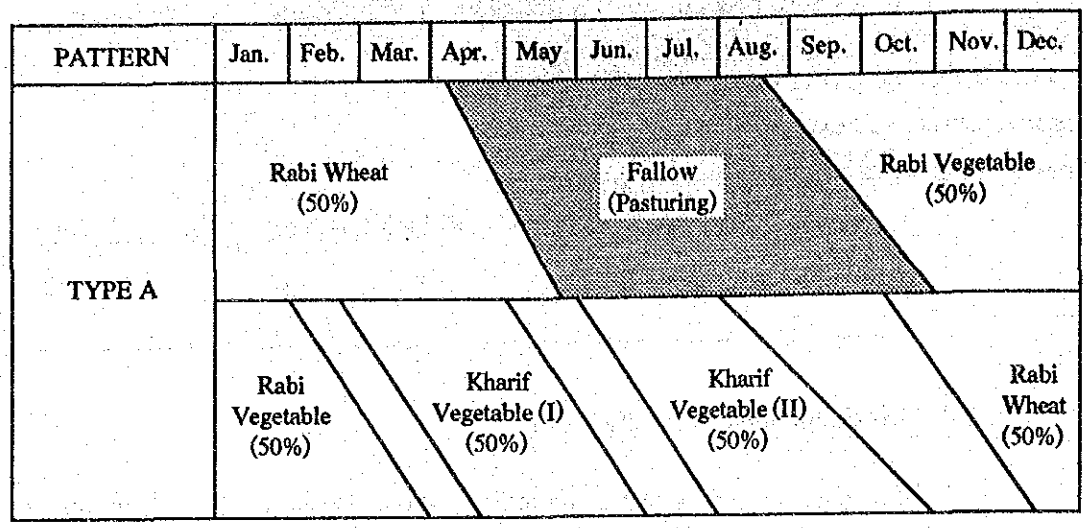
Crop water consumption per month

Monthly Crop Consumption Use

(unit : mm)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Rabi wheat	42	70	98	61	5	-	-	-	-	3	17	26	322
Rabi fodders	47	77	100	60	0	-	-	-	5	36	36	33	394
Annual vegetable	48	37	12	-	-	-	-	3	25	48	53	44	270
Annual fruit	48	68	96	141	189	213	171	144	129	96	60	42	1,397
Kharif vegetable (I)	-	2	31	110	141	61	-	-	-	-	-	-	345
Kharif vegetable (II)	-	-	-	-	-	44	108	110	69	19	-	-	350

Cropping Pattern



	M-1 Dam	M-2 Dam
Maximum intake Capacity	0.022 m^3/sec	0.086 m^3/sec

(c) Pump facilities

The irrigation water distribution system is to pump up water from the reservoir to farm ponds from which the water will be distributed by gravity through open channels combined with pipelines. Major dimensions of pump facilities are summarized in the table below.

Name of dam	M-1 dam facilities	M-2 dam facilities	
		Reservoir pump	Booster pump
Maximum intake capacity	0.022 m^3/sec	0.086 m^3/sec	0.063 m^3/sec
Number of pumps	2	2	2
Design pumping discharge	0.011m^3/sec (0.660 m^3/min)	0.043 m^3/sec (2.580 m^3/sec)	0.0315 m^3/sec 1.890 m^3/sec)
Actual pump head	31.5 m	21.0 m	26.0 m

Length of canal	500 m	250 m	1,500 m
Diameter of pipe	ø150 mm	ø250 mm	ø250 mm
Total pump head	45 m	30 m	40 m
Pump type	Axial flow pump (11 kW)	Axial flow pump (30 kW)	Axial flow pump (30 kW)

(d) Farm ponds

The function of farm ponds situated in this irrigation system is to regulate the difference between intake capacity and crop requirement/consumption of irrigation water. The capacity of farm ponds is then derived from the conditions where the maximum pump operation hours are set at 24 hrs for the irrigation period and 16 hrs for distribution. Wet masonry is designed for slope protection of farm ponds.

Name of dam		Farm pond capacity
M-1 dam		$5.2 \times \frac{10}{24} \times (24 - 16) \times 40 = 693 = 700\ m^3$
M-2 dam	A	$5.2 \times \frac{10}{24} \times (24 - 16) \times 46 = 797 = 800\ m^3$
	B	$5.2 \times \frac{10}{24} \times (24 - 16) \times 70 = 1213 = 1200\ m^3$
	C	$5.2 \times \frac{10}{24} \times (24 - 16) \times 44 = 762 = 800\ m^3$

(4) Deep well for irrigation

(a) Groundwater

Major dimensions of deep wells are summarized below. Maximum operation hours are set at 6 hr/day.

Name of well	TWI-1	TWI-2	TWI-3
UC	Kirpa	Sihala	Sihala
Depth	130 m	130 m	130 m
Diameter	500 mm	500 mm	500 mm
Diameter of casing	350 mm	350 mm	350 mm
Pumping discharge	5 lit/sec	14 lit/sec	14 lit/sec
Design yield	108 m^3	302 m^3	302 m^3

(b) Irrigation area

Irrigation area depends on maximum yield from well and crop requirements.

Name of well	TWI-1	TWI-2	TWI-3
Max. pump output	5 lit./sec	14 lit./sec	14 lit./sec
Design yield	108 m^3	302.4 m^3	302.4 m^3
Water requirement	0.144 lit./sec/ha	0.144 lit./sec/ha	0.144 lit./sec/ha
Irrigation area	9 ha	24 ha	24 ha

(c) Farm ponds

Capacity of farm ponds for a deep well irrigation system is set at the capacity to store one day's yield from a deep well. Farm ponds are made of a concrete structure.

Name of well	TWI-1	TWI-2	TWI-3
Farm pond capacity	130 m^3	324 m^3	324 m^3

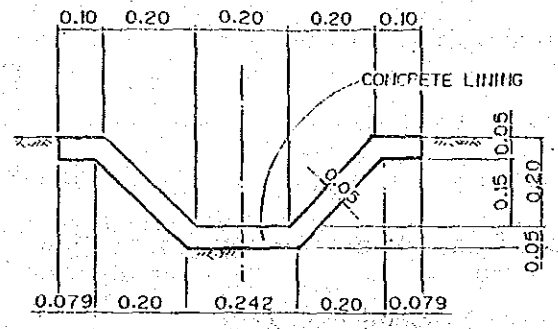
(d) Pump facilities

Submersible motor pumps are selected for deep wells. Major dimensions of such pumps are summarized below.

Name of well	TWI-1	TWI-2	TWI-3
Pump type	Submersible motor pump	-do-	-do-
Max. pumping discharge	5 lit./sec	14 lit./sec	14 lit./sec
Total pump head	45 m	40 m	40 m
Diameter	ø65	ø100	ø100
Output	5.5 kW	11 kW	11 kW

(e) Main canal

Canals from farm ponds are designed with concrete lining considering the relatively steep slopes of the irrigation area.



STANDARD SECTION OF CANAL

(5) Estimated benefit with irrigation

After the implementation of the irrigation facilities, the gross benefit from the irrigated agriculture is estimated as follows:

Development Stage	Net Benefit (Rs)	Net Benefit per Farm (Rs)
Without Irrigation	815,000	4,940
With Irrigation	2,504,000	15,200
Full Development with Irrigation	11,963,000	72,600

In this table, "With irrigation stage" means the stage after the implementation of the irrigation facilities with the existing cropping pattern. "Full development stage" means the stage in the future with irrigation and with the improved cropping pattern and farming practices. The net benefit per ha of the estimated cropping pattern according to the development stage is calculated and shown in the following table.

Net Benefit of Each Crop (Rs/ha)

Without Irrigation		With Irrigation		Full Development	
Wheat	1,230 Rs	Wheat	3,890 Rs	Wheat	4,870 Rs
Maize	1,930	Maize	4,630	Cabbage	18,890
Beans	2,970	Beans	19,000	Raddish	9,890
				Beans	23,760
				Tomato	45,900
					32,070
				Cucumber	17,100

5.3.2 Multi-purpose Groundwater Development Plan

(1) Water supply system by deep wells

(a) Water resource

Groundwater resources for deep wells are those aquifers of the Quaternary alluvial and diluvial layers and the Tertiary sandstone layers located along the Soan River.

Major dimensions of deep wells are as follows:

- Drilling depth : 110 - 130 m
- Drilling diameter : 500 mm
- Design static water level : 5 - 10 m below ground level
- Design dynamic water level : 25 - 30 m below ground level
- Casing pipe : Stainless steel pipe 350 mm dia.

-	Strainer	:	Stainless steel pipe 350 mm dia. slit 0.5 - 2 mm
-	Pump	:	Submersible motor pump
-	Max. pump output	:	0.014 lit./s ($50m^3/hr$)
-	Design yield	:	50 m^3/hr x 6 hr = 300 m^3/day
-	Operation hour	:	Continuous operation 2hr Waiting 6hr 8 hr/cycle 3 cycles/day
-	Operation method	:	The pump will be stopped automatically as the water table is lowered and will be started manually as the water table is recovered.

(b) Water tank and pipeline

Pumped water from a deep well will be distributed through the following facilities.

-	Reservoir	:	Reinforced concrete reservoir
-	Reservoir capacity	:	2/3 of design yield = 200 m^3
-	Booster pump	:	Pump up water from the reservoir to water tank
-	Pipeline	:	ø 150mm GI pipe
-	Water tank	:	Reinforced concrete
-	Distribution line	:	GI pipe Public tap is the terminal

(c) Major features of water supply scheme

Name of well	L-27	L-28	L-30	L-31
Site	Sihala	Sihala	Sihala	Rewat
Supply area	Sihala	Sihala	Sihala	Rewat
Drilling depth	110-130 m	110-130 m	110-130 m	110-130 m
Design discharge	14 lit./sec	14 lit./sec	14 lit./sec	14 lit./sec
Length of pipeline	3.5 km	3.9 km	6.5 km	2.9 km
Drilling diameter	500 mm	500 mm	500 mm	500 mm
Diameter of casing	350 mm	350 mm	350 mm	350 mm
Water tank	3	4	1	1
Reservoir (capacity)	1 (200 m^3)	1 (200 m^3)	1 (200 m^3)	1 (200 m^3)
Submersible motor pump output	11 kW	11 kW	11 kW	11 kW
Submersible motor pump diameter	ø100	ø100	ø100	ø100
Booster pump output	18.5 kW	15kW,11kW	37kW	18.5kW
Booster pump diameter	ø80	ø65, ø65	ø80	ø80
Beneficiaries	1,880	1,450	4,990	4,945

(2) Water supply system by shallow wells

In this plan, the water resources are existing shallow wells. Rehabilitation of the wells is necessary to increase and stabilize their yield.

(a) Additional excavation/drilling

Drilling depth	:	10 m from the bottom of the existing well
Drilling diameter	:	500 mm
Casing pipe diameter	:	350 mm
Casing pipe	:	Stainless pipe
Strainer	:	Slit type, 0.5-2.0 mm

(b) Pumping plan

- Maximum pump yield : 0.002 m^3/s (7.2 m^3/hr)
- Designed pump up operation : 1hr pump up } 4 hr/cycle

3hr waiting 6 cycles/day

- Operation method : Manual operation for start
  Automatic operation for stop
- Designed pump up capacity : 7.2 m^3/hr = 43.2 m^3/day
- Overhead water tank : Reinforced concrete
- Capacity of water tank : 2 days pump up capacity
  85 m^3/tank
- Distribution line : GI pipe to public taps

(3) Hand pump installation plan

Number of hand pumps installed is decided from the diameter of the existing well and the number of users.

UC	Name of well	Number	Diameter of existing well (m)	Service population
Tamair	WTA-1	1	1.66	300
	WTA-5	1	1.84	1,800
	WTA-6	2	2.04	500
	WTA-8	1	1.74	300
	WTA-10	1	1.56	400
Kirpa	WKI-1	1	1.92	500
	WKI-2	2	2.50	1,800
	WKI-3	2	2.26	1,200
	WKI-4	1	1.70	300
	WKI-5	1	1.90	400
	WKI-6	2	1.96	700
	WKI-7	2	2.10	2,000
	WKI-9	1	1.10	150
	WKI-11	1	1.74	400
	WKI-12	1	1.65	350
Cherah	WCH-1	2	2.15	900
	WCH-2	1	1.50	1,200
	WCH-8	2	2.75	1,500
	WCH-12	2	2.20	1,000
	WCH-14	1	1.80	1,000
Total		28	-	16,700

5.3.3 Multi-purpose Farm Pond Development Plan

(1) Possible development capacity

By means of excavation, the existing farm pond capacity is increased. Rock excavation is excluded from the scope of work. Rehabilitation of embankments is included if necessary, such as filling, embanking, earth lining or stonemasonry lining, etc. Storage capacity rehabilitation is summarized below.

No.	UC	Storage Capacity	Nos of Users
F. P2	Koral	3,700 m^3	920
F. P3	Kirpa	4,100 m^3	
F. P4	Kirpa	3,300 m^3	} 6,110
F. P5	Kirpa	1,600 m^3	
F. P6	Kirpa	1,800 m^3	480
F. P8	Cherah	3,200 m^3	10,000
F. P12	Rewat	1,800 m^3	-
F. P15	Koral	3,500 m^3	1,850
F. P17	Sihala	2,100 m^3	570
F. P18	Rewat	59,700 m^3	4,990
F. P19	Kuri	18,700 m^3	-
F. P20	Shah Allah Ditta	11,700 m^3	2,820
F. P21	Kirpa	1,800 m^3	6,110
Total		117,000 m^3	

(2) Spillway

A spillway shall be provided at every farm pond. The design flood for the spillway will be a 5 year flood scale. Spillways are to be made of concrete structure.

5.3.4 Rural Road Development

(1) Basic conditions for design

Utilizing the road design standard of LG&RD as a reference, traffic volume, vehicle type and design speed are set as follows:

Traffic volume	Type II (15 - 60)
Vehicle	Bus, Truck (20 t load)
Design speed	30 km/hr

(2) Road alignment and length

Road length is designed as follows including rehabilitation/repair length.

Name	Alignment	New construction	Rehabilitation	Total
R-1	Darwala - Cherach	5.7 km	3.0 km	8.7 km
R-2	Gagri - Lahdiot	7.4 km	2.0 km	9.4 km

(3) Standard cross section

(a) Road width

Standard of LG&RD is adopted.

	Width	Remarks
Total width	7.3 m	
Pavement width	4.5 m	Asphalt 2 layers
Shoulder width	2.8 m (one side 1.4 m)	Asphalt 1 layer 0.5 pavement width

(b) Pavement

Asphalt pavement is designed. It is classified into 3 types according to the foundation conditions.

Type A	Rock foundation
Type B	Normal soil foundation
Type C	Sandy foundation

(4) Cross section slope

In accordance with the "Civil Engineer's Hand Book" and Japanese standard, the cross sectional slope of roads is set at 2 % from the center of the road to both sides.

(5) Longitudinal slope

Adopting the same standards as noted above, the maximum slope is set at 8 % and in an exceptional case the maximum slope is set at 10 %.

(6) Road alignment

Basic principles for selection of road alignment are:

- To avoid houses, wells, graveyard and electric poles
- To minimize embankment/excavation work
- To detour farm bridge portions
- Minimum radius for curves 100 m
- Exceptional cases 50 m

(7) Related structures (river and valley crossings)

To cross rivers and valleys, slab type bridge and culvert structures are designed.

(8) Drainage

In the project area, rainfall is concentrated in July, August and September. The substantial provisions and structures for drainage are not always provided with the existing rural roads and erosion develops along the roads, especially at the abutment portion of bridges. In the basic design, drainage canals along the road are designed as follows:

River/valley crossing	concrete canal
Sandy foundation	- do -
Other ordinary soil foundation	earth canal
Rock foundation	no canal

5.3.5 Rural Development Station

Rural development stations are located at Kirpa and Gokina villages. The facilities of rural development stations are as follows:

Hall -----	utilized for meeting room	100 m^2
Office -----	office for Technicians	15 m^2
- do - -----	data storage	15 m^2
Others-----	toilet, sink, etc.	20 m^2

Total floor area is about 150 m^2

Expected users of rural development station are:

Kirpa station	8,460 people,	1,392 houses
Gokina station	2,805 people,	495 houses

5.3.6 Provision of Machinery and Equipment

(1)	Backhoe shovel	(0.4 m^3)	1 no.
	Dump truck	(8 ton)	3 nos.
	Bulldozer	(11 ton)	1 no.

- These machineries are necessary to remove silt deposits in the reservoirs of M-1 and M-2 dams. Although a sand sluice valve is installed at the dam body, the development of sand deposits upstream of the reservoir cannot be stopped. Removal of these deposits is required to maintain the reservoir's functions. The place from which to haul out the deposits is the upstream right side area in the case of both dams.
- These machineries are required for the maintenance of farm ponds, and can be utilized to excavate or rehabilitate other ponds excluded from the scope of this Project.
- The required number of working days in a year for the removal of deposits is calculated below. Among the 0.4 m^3 backhoe shovel, 8 ton dump truck and 11 ton bulldozer, the critical machine capacity is that of the backhoe shovel.

The work capacity of 0.4 m^3 backhoe shovel is:

$$Q = \frac{3600 \times q \times f \times E}{cm} \times 6.1 \text{ (hr/day)}$$

where Q : Work capacity per day (m^3/day)
q : Work capacity per cycle
f : Bulk factor of soil
E : Work efficiency (0.7)
Cm : Cycle time (28 sec)

The required number of each type of machinery is calculated from the daily work capacity of each.

Machinery	Work capacity per day	No.
0.4.m^3 Backhoe shovel	32.4 m^3/hr x 6.1 hr = 197.6 = 200 m^3/day	1
8 ton Dump truck	12 m^3/hr x 7 hr = 84 m^3/day 200 / 84 = 2.4	3
11 ton Bulldozer	51.9 m^3/hr x 6.1 hr = 316.6 = 320 m^3/day 200 / 320 = 0.63	1

(2) Water tank lorry (5,000 lit) 3

Three water tank lorries are provided based on the following reasons.

(a) Supply drinking water 2

In order to supply drinking water during rehabilitation work on the existing shallow wells, to the people who are using the water from this well, two water tank lorries are necessary based on the following calculation.

- Water requirement per well $Q_1 = 43.2\ m^3/day$

  $Q_1 = 0.002\ m^3/sec \times 60\ sec \times 2\ hr \times 3 = 43.2\ m^3/day$

- Required time to supply 1 m^3

  $0.097\ hr/0.5\ m^3 = 0.19\ hr$

  $T_1 = (Cm \times Q, 60 \times q)\ (hr/0.5\ m^3)$

  $T_2 = (58 \times 0.5\ m^3, 60 \times 5) = 0.097\ (hr/0.5\ m^3)$

  $Cm = (2 \times d, V) + t_1 + t_2 + t_3 + t_4$

  $= (2 \times 5000, 500) + 5 + 18 + 5 + 10 = 58$ min.

where

T_1	:	Work hour per 0.5 m^3
q	:	Tank capacity (5,000 lit.)
d	:	Length (10,000 m)
V	:	Speed (500 m/min)
t_1	:	5 min
t_2	:	Supply time (18 min)
t_3	:	Waiting time (5 min)
t_4	:	Sprinkling time (10 min)

$$N = \frac{43.2\ m^3/day}{5.2\ hr/day \div 0.19\ hr/m^3} = 2$$

(b) Supply water during rehabilitation of farm pond 1

(3) Four wheel drive jeep 3

- Operation and maintenance

  Markaz 2 (Sihala & Tarlai)

  LG & RD 1

(4) Tractor 25

- Rural development station 5 /station x 3 = 15

  (Cherah, Kirpa and Shah Allah Ditta)

- Markaz 5 /Markaz x 2 = 10

  (Sihala and Tarlai)

(5) Portable water quality test set

- For observation of water quality

Number of wells requiring tests

Rehabilitation well	13
Hand pump installed well	20
Deep well for drinking	4
Total	37 wells

- Test will be conducted once per month for one year after completion of construction.

Necessary number of test sets are:

12 months x 37 wells = 444 wells

444 wells ÷ 50 wells/set = 9 sets

Adding one set as a spare, a total of 10 sets are necessary.

5.4 Implementation Plan

5.4.1. General

After signing of the Exchange of Notes (E/N) for the Project by both governments, an agreement between the government of Pakistan and an authorized Japanese foreign exchange bank is to be concluded on the Authorization to Pay in accordance with the Notes. The government of Pakistan will implement the Project using a Japanese consulting firm and Japanese contractor firm.

5.4.2 Construction Plan

(1) Number of Workable Days

a. Temperature

- Monthly mean temperatures

(unit : °c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
10.0	12.3	17.2	22.7	27.7	31.6	29.9	28.8	27.3	22.6	16.5	11.6	21.5

Chaklala 1954 - 1986

- Monthly maximum temperatures

(unit : °c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
11.5	15.7	19.8	25.3	32.2	33.4	32.2	30.9	29.4	24.1	23.6	15.5	33.4

Chaklala 1954 - 1986

- Monthly minimum temperatures

(unit : °c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
7.5	9.7	14.4	19.4	25.1	29.2	27.7	27.2	25.5	20.5	14.3	9.9	7.5

Chaklala 1954 - 1986

Monthly mean temperatures vary between 10.0°C (January) and 31.6 °C (June), and the maximum difference of temperature is 25.5°C. Temperatures from May to September generally exceed the upper range of suitable temperatures (25°C) for the placing of concrete. The work, however, of concrete placing shall be executed during early morning or night time in this season.

b. Rainfall

- Average annual rainfall — 1,130 mm (Chaklala 1952-1988)
- Maximum annual rainfall — 2,225 mm (- ditto -)
- Monthly mean rainfall

(unit : °c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
59.8	69.0	83.6	56.8	38.2	55.0	276.3	301.9	104.2	32.2	18.8	34.6	1,130.4

Chaklala 1952 - 1986

- Monthly mean rainy days

(unit : °c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
5	6	8	6	5	5	12	13	7	3	2	3	75

Chaklala 1952 - 1988

- Maximum daily rainfall

(Unit : mm)

	Maximum Daily Rainfall	Year
1.	181.3	1982
2.	173.5	1983
3.	153.1	1985
4.	143.3	1987
5.	143.3	1988

Annual rainfall in the project area ranges from 710 mm to 2,200 mm, of which 60% occurs in the wet season from July to September. It is generally considered that rainfall will not have adverse affects on the construction progress. Large-scale earthworks, the progress of which is highly affected by rainfall, are not included in the Project.

Based on the above data, the number of workable days in a month is set at 20 days for planning of a construction schedule considering national holidays and weekly holidays on Friday and Saturday.

PAKISTAN PUBLIC HOLIDAYS

1988

Pakistan Day	Wednesday, 23rd March
May Day	Sunday 1st May
Eid-ul-Fitr (3 days)	Tuesday, 17 May
	Wednesday, 18 May
	Thursday, 19 May
Eid-ul-Azha (3 days)	Sunday, 24th July
	Monday, 25th July
	Tuesday, 26th July
Independence Day	Sunday 14th August
Muharram (Ashura) 2 days	Monday 22nd August
	Tuesday, 23rd August
Defence Day	Tuesday 6th September
Death Anniversary of Quaid-I-Azam	Sunday 11th September
Eid-Milad-un-Nabi	Monday 24th October
Iqbal Day	Wednesday 9th November
Birthday of Quaid-I-Azam	25th December

16 ✓

Subject to appearance of the Moon

Number of annual holidays

Friday & Saturday	52 weeks x 2 days = 104 days
National holidays	16 days
Custom holidays	5 days
Total	125 days/year
Holidays/month	10.4 days/month

Workable days/month

$$\frac{365 - 125}{12} =$$

20 days

(2) Construction Materials and Machinery

Most of the major construction materials and machinery are available in (Islamabad) and Karachi. Coarse and fine aggregates for concrete are taken from quarry sites along the Soan River and the Kurang River. Construction machinery is available in the Islamabad area but may not be sufficient in number. It may be necessary to obtain some machinery from Karachi and Lahore. A concrete plant for ready-mixed concrete is located near National Park Road in the project area and has ability to produce about 150 m^3/day. The distance from Islamabad to major towns is shown below.

Length		Required time	
		By land	By airplane
Islamabad - Karachi	1,580 km	30 hours	2 hours
Islamabad - Lahore	290 km	5 hours	45 minutes
Islamabad - Rawalpindi	30 km	30 minutes	-

(3) Necessary Engineers

In addition to the ordinary engineers for construction and supervision, engineers for specific field of construction work should be summoned from Japan. These engineers are (1) well engineer (2) electrical engineer for control equipment (3) supervisor for pump installation, and (4) supervisor for gate & valve installation.

(a) Well engineer

Hydro-geological formations related to the Project are very complicated and aquifers are distributed in narrow and thin layers. Particularly, the groundwater source for shallow wells exists in weathered sandstone layers. The supervisor of drilling work should have sufficient experience and knowledge on hydro-geology.

(b) Electrical engineer

Electrical equipment for the project includes communication and control equipment between pump house and water tank and control devices of

pump facilities. A Japanese engineer is required for the installational and operational testing the equipment which will be provided from Japan.

(c) Supervisor for pump installation

Submersible motor pumps for deep wells are provided from Japan. Technical assistance is required for pump installation and test operations.

(d) Supervisor for gate & valve installation

The gate and valve for the sand sluice to be installed at the dams are newly developed for sand sluice use. The same as in the case of electrical equipment and pump facilities, a supervisor for installation shall be summoned from Japan.

5.4.3 Plan of Construction Supervision

In accordance with the system of the Japanese grant aid programme, the consultant contract is concluded between the Pakistani government and a Japanese consulting firm for the detailed design and supervision of construction. The major scope of work of the consultant is to implement and supervise the construction work on behalf of the Pakistani government. This includes:

1) Assistance for construction contract

Preparation of tender documents, prequalification of applicants, soliciting and evaluation of tender, preparation of contract documents, witnessing of the contract,etc.

2) Inspection and approval of construction drawings and samples submitted by the contractor, interpreting design drawings and specifications, etc.

3) Supervision of construction works

The consultant will supervise the contractor in regard to the construction plan and schedule, give necessary instructions and report on the progress of work to the Pakistani government.

4) Assistance for payment procedures

The consultant will assist the Pakistani government in procedures for payment to the contractor through evaluation of invoices, etc.

5) Inspection

The consultant will inspect the results of the works and give necessary instructions to the contractor.

After confirming the completion of all the construction work in accordance with the contract and the specifications, the consultant will witness the delivery of the Project to the Pakistani government, and then the consultant will terminate its services upon the approval of the Pakistani government,

5.4.4 Supply of Construction Materials

The construction works of the project are generally classified into (1) Earth work, (2) Concrete work, (3) Well work, and (4) Pipeline work. Major materials necessary for the various types of work are summarized as follows:

		Materials	Construction Machinery
(1)	Civil Works	Gravel for pavement	Bulldozer, Backhoe shovel, Dump truck, Stake truck, Tractor shovel, Tamping roller, Asphalt finisher, Air compressor, Pump, Tamper, Generator
(2)	Concrete Works	Cement, Aggregates, Reinforced iron bar, Forms, Scaffolds	Concrete pump, Portable mixer, Truck crane, Concrete vibrator, Tank lorry, Generator, Cooling plant
(3)	Deep Well Work	Pump, Casing, Cable, Scaffold	Boring machine, Generator, Pump, Tank lorry
(4)	Pipe Works	Steel pipe, Valve, Coupling for pipe, Paint	Truck, Backhoe shovel, Compactor

These construction materials are principally procured and supplied in Pakistan, except for the following materials for the construction of wells.

- Submersible motor pump for deep well
  Submersible motor pumps available in Pakistan do not meet the requirements of technical specifications.

- Casing pipe
  Casing pipe of stainless steel are not available in Pakistan.

- Hand pump
  Hand pumps of above 10 m length are not produced in Pakistan

a. Major materials procured in Pakistan

Cement, Aggregate (sand, crushed stone),
Ready mixed concrete, Concrete products, (RC pipe), Brick, Stone, etc.
Wood and wooden made materials
Pipes and accessories
Pumps and accessories (except submersible pumps)
Wire and cables

Machinery for construction (Bulldozer, Backhoe, Dump truck, Vibrator, Roadroller, Truck crane, Motor grader, Tamping roller, Tire roller, etc.)
Others (Form, Scaffoldings, Drainage pumps, Generator, Compressor, Crane, Folklift, Trailer, etc.)

b. Construction materials supplied from Japan

Submersible motor pump, Casing, Hand pump, and accessories (valve, meter pressure tank, etc.), Automatic control devices, Drilling machine for well

5.4.5 Construction Schedule

The total construction period is 24 months and is divided into 2 phases. (12 months/phase)

		First Phase	Second Phase
1. Multi-purpose Groundwater Development			
- Deep Well Water Supply Scheme		TW-30,31,28 (3 sites)	TW-27 (1 site)
- Shallow Well Water Supply Scheme		WKI-8,10 WCH-11,13 WSI-1,WSH-1 (6 sites)	WCH-3,6,7,9 WTA-2 WKO-1,WGO-1 (7 sites)
- Hand Pump Installation		7 sites (2 pumps/site) 8 sites (1 pumps/site)	1 site (2 pumps/site) 4 sites (1 pumps/site)
	Total	15 sites (22 pumps)	5 sites (6 pumps)

	First Phase	Second Phase
2. Irrigation Development		
- Dam and Reservoir and Irrigation Facilities	M-2 dam	M-1 dam
- Deep Well and Irrigation Facilities	TW-1	TW-2,3

3.	Multi-purpose Farm Pond Rehabilitation	FP-2,3,4 5,6,8,21 (7 sites)	RP-12,15,17 18,19,20 (6 sites)
4.	Road	R-1	R-2
	New construction	5.4 km	7.4 km
	Rehabilitation and Repair	3.0 km	2.0 km
5.	Rural Development Station	Kirpa	Gokina

Implementation schedule of the Project is shown in Fig. 5-3.

Preparation for Tender

Based on the Detailed Design Report, tender documents will be prepared. The scheduled period for the preparation is 3 months in the First Phase and 2 months in the Second Phase.

Tender Schedule

The scheduled period for the tendering procedure (tender notice, preliminary evaluation, bid evaluation and contract agreement) is 1.5 months in the First Phase and 1.0 month in the Second Phase.

Construction Schedule

After signing of the construction contract upon approval of the Japanese government, the construction work shall be started. The construction schedule is shown in Fig. 5-4.

Fig. 5-3 Implementation Schedule

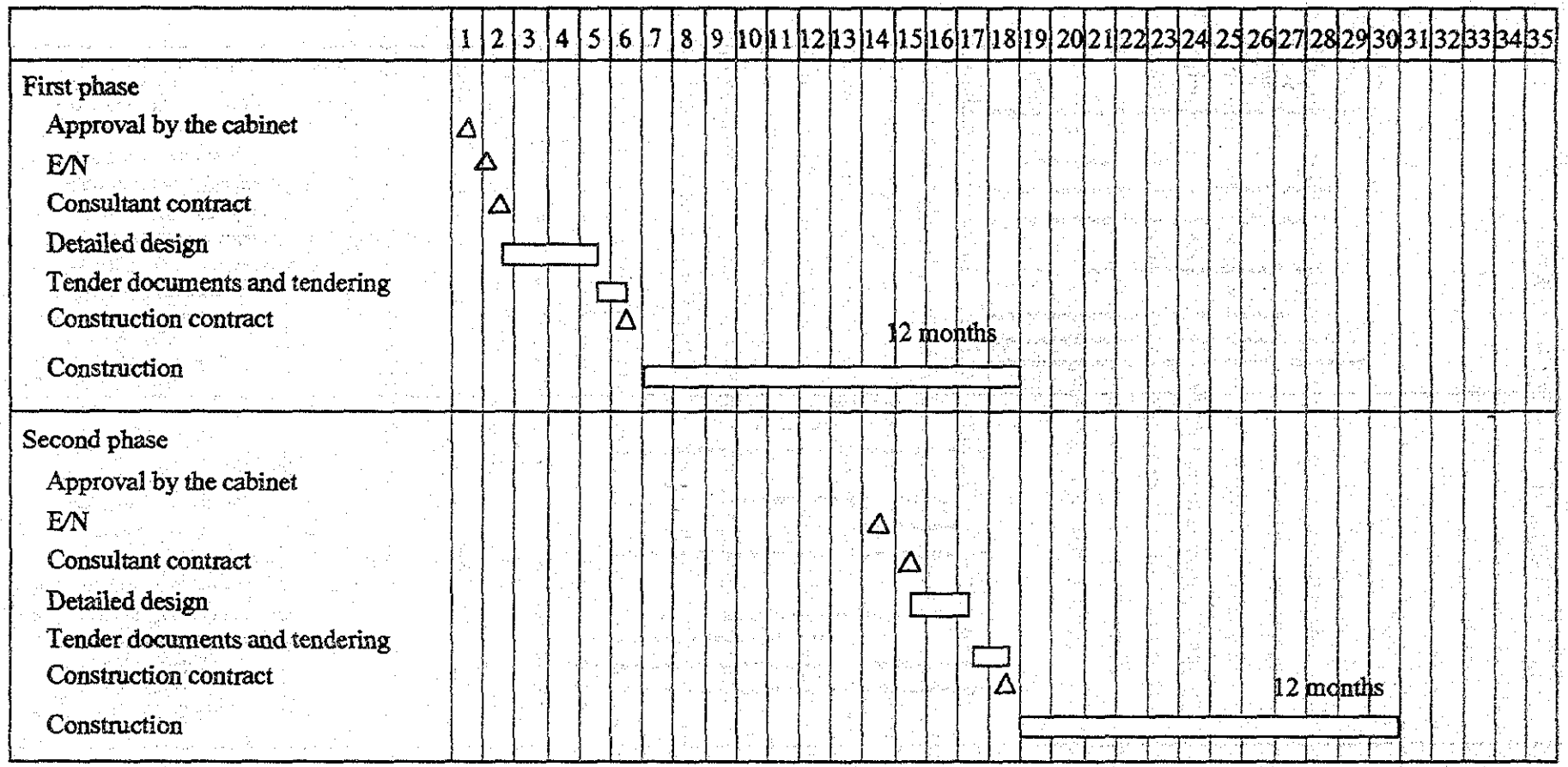
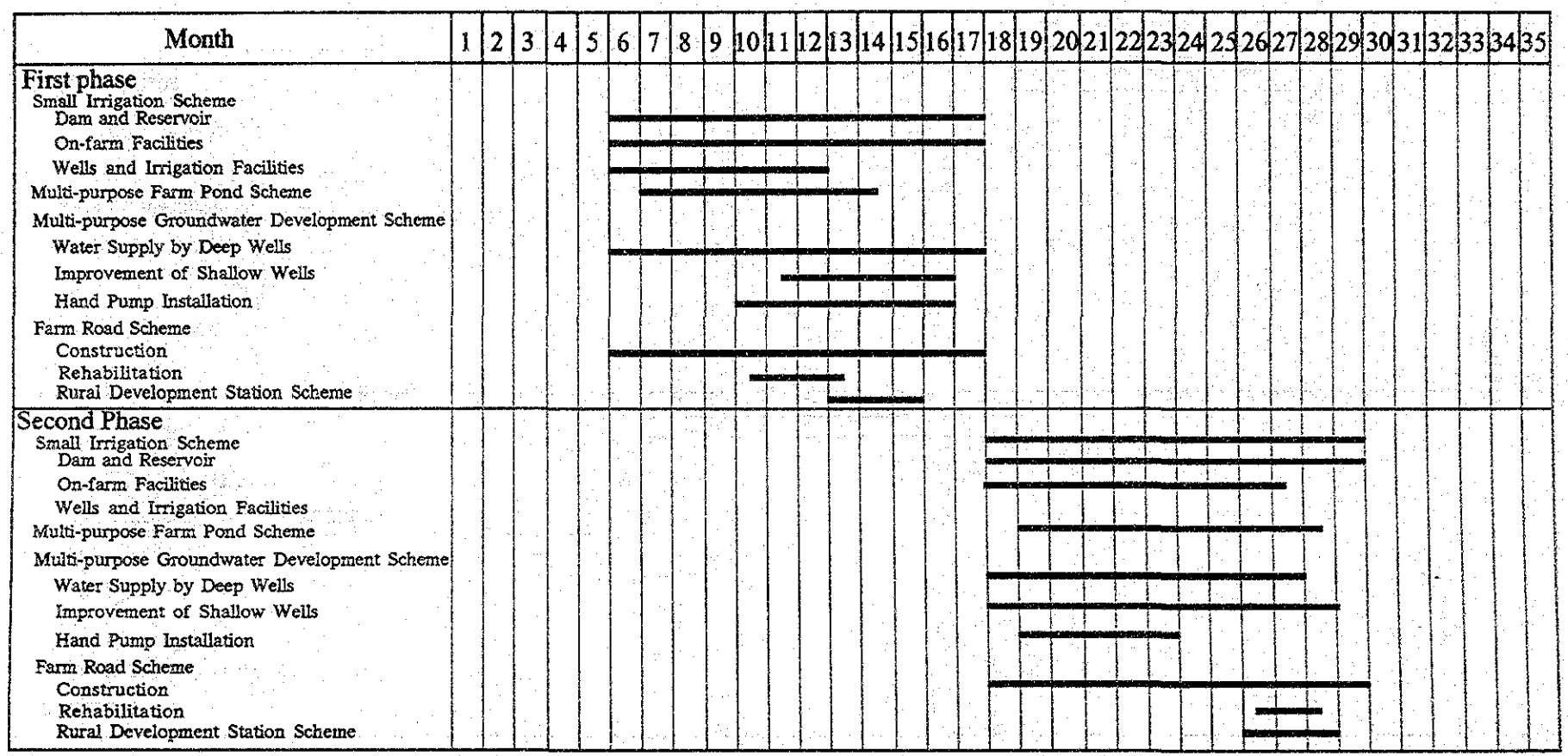


Fig. 5-4 Construction Schedule



CHAPTER 6 PROJECT EVALUATION

6.1 General

Objectives of the Project are the integrated social and economic development of the Islamabad rural area and improvement of the living conditions of people who have been left behind the prosperity of urban areas. These will be achieved through implementation of an irrigation development scheme, water supply scheme, rural road scheme, multi-purpose farm pond rehabilitation scheme, and rural development station scheme which were selected from among those schemes identified by the Master Plan Study on "Integrated Rural Area Development in Pakistan."

The Islamabad rural area has high potential and many advantages for agricultural development, being located near the great agricultural market of Islamabad. The rural area is, however, still practicing rainfed agriculture with low incomes and less employment opportunities than with other form of agriculture. Irrigation is the key to changing the existing form of agriculture into a suburban type with high and stable income with vegetables as the main target of production. The Project will contribute to economic viability. Its achievements will serve as a model of development for small scale irrigation and spread to adjacent areas.

Important and real motives of this integrated rural development project are that the implementation of a single component aiming at economic development will not bring about a substantial improvement to the living conditions of the people in the rural area. Achievements obtained from an implemented single scheme will be absorbed by many other social deficits and problems existing in the rural area.

Social conditions and living environments should be improved together with an economic development scheme.

A water supply scheme is one of the great needs of the rural area. Almost a full day's heavy labour of drawing water from wells by hand and transporting it over a long distance to home are burdening women and children. The water supply scheme will free these people from such heavy labour, create opportunities to go to

school and to engage in more productive work and improve the sanitary environment. Various and substantial effects can be expected.

The rural road development scheme will also contribute to the improvement of many social conditions in the rural area. Transportation of agricultural products to the market and of the materials from the market becomes easy and quick. With public transportation, many effects are promised such as better access to hospital, commuting to urban areas instead of lodging there, etc.

The rehabilitation of multi-purpose farm ponds aims at efficient use of rainfall and drainage water and to supplement the water supply scheme and irrigation scheme during the dry season.

Rural development stations will serve as key stations and extension stations through coordination with other rural development schemes and operation and maintenance of project facilities.

6.2 Project Benefits

The Project is a model project for the integrated development of the Islamabad rural area. The Project will benefit about 65,000 people in 25 villages, about 46% of the total population of 140,000 in the Islamabad rural area (1981 census). The total irrigation area developed by the Project is 257 ha. Annual net benefit obtained from the present rainfed agriculture in the corresponding area is only Rs. 1.04 million. After implementation of the irrigation scheme, annual net benefit will be Rs. 3.04 million and up to Rs.16.64 million at the full development stage of suburban type agriculture.

After the completion of road construction under the Project, the annual benefit is calculated at Rs. 2.2 million from cost savings for the transportation of agricultural materials and products, benefits from less damage to agricultural products, and cost saving from shifting to commuting to work instead of lodging in town.

As for the farmers included in the irrigation benefit area of the Project, their present average annual income per household is about Rs. 4,940 (410 Rs/month), which is much lower than the average income of the Islamabad rural area, about Rs. 9,700 (810 Rs/month, 1984). With the irrigation project, incremental annual income per household will be Rs. 10,260, or a total income of Rs. 15,200, which

is about 1.56 times the average annual income of Islamabad rural area households. In addition, with the development of farming techniques, suburban type agriculture will promise an annual income of up to 72,600 Rs/household, which is the highest rank in Pakistan.

The backgrounds to support the above calculations are related to the facts that the irrigation area is located near a great market, the production of higher benefit crops becomes possible due to irrigation of an area that is non-productive at present ,and family labour can be fully devoted to agriculture.

The water supply scheme, farm pond rehabilitation and rural development stations will result in many indirect social benefits which will enable direct returns. The water supply system will free up family labour hours and contribute to the decrease of illiteracy. Advanced farming techniques for suburban agriculture will be introduced through rural development stations.

6.3 Evaluation and Conclusion

It is concluded that the Project is appropriate to be executed under the Japanese grant aid programme as it will create great benefits to the local economy and will contribute to social development and improvement of the depressed living conditions at present in the Islamabad rural area. It is considered that there will be no problems in budgetary arrangements and staff preparation of ICTA, the project executing agency of the Pakistani side, for implementation, operation and maintenance of the Project.

Appendix

1. Team Member

1-1 Basic Design Study

Name	Speciality	Organization
Mr. Takayuki HAZAMA	Team Leader	Deputy Director Investigation & Research Dept. Japanese Institute of Irrigation and Drainage
Mr. Yoji SEKIGUCHI	Project Coordinator	First Recruitment Div. Japan Overseas Cooperation Volunteers
Mr. Tadashi OHORI	Chief Engineer (Irrigation and Drainage)	Nippon Giken Consultants
Mr. Hiroshi MIZUNO	Dam & Foundation Engineer	Nippon Giken Inc.
Mr. Shigemi KIMURA	Hydro-Geologist	Nippon Giken Inc.
Mr. Motoo TAKI	Road Engineer	Nippon Giken Inc.
Mr. Yasunori MATSUKAWA	Structure & Design Engineer	Nippon Giken Inc.
Mr. Hiroshi YASUDA	Agronomist	Nippon Giken Inc.

1-2. Explanation for Draft Final Report

Name	Speciality	Organization
Mr. Tetsuya UMEZAKI	Team Leader	Deputy Director, Construction Department, Kyshu Regional Agricultural Office, Ministry of Agriculture, Forestry and Fisheries
Mr. Tadashi OHORI	Chief Engineer (Irrigation and Drainage)	Nippon Giken Inc.
Mr. Shigemi KIMURA	Hydro-Geologist	Nippon Giken Inc.

2. Survey Schedule

2-1 Basic Design study

No.	Date	Day	Work Schedule
1	1 /20	Fri.	Departure from Japan and arrival at Islamabad
2	1 /21	Sat.	Preliminary discussion meeting with JICA (6 members) Field Survey
3	1 /22	Sun.	Discussion meeting with JICA and EAD
4	1 /23	Mon.	Dam site survey Leader and coordinator arrive Islamabad Road survey Discussion meeting with ICTA (2 members)
5	1 /24	Tue.	Discussion meeting with ICTA Field survey Road route Irrigation sites Well sites
6	1 /25	Wed.	Field survey Road route Irrigation area Well sites (Water quality test)
7	1 /26	Thu.	- do -
8	1 /27	Fri.	Field survey (Dam sites and Irrigation area, Water quality test)
9	1 /28	Sat.	Field survey (Road route, Water quality test)

No.	Date	Day	Work Schedule
10	1 / 29	Sun.	- do -
11	1 / 30	Mon.	Discussion meeting with ICTA, Signing of Minutes of Discussions Data collection
12	1 / 31	Tue.	Discussion meeting with JICA and Embassy of Japan, Leader & coordinator leave for Japan Data collection
13	2 / 1	Wed.	Discussion meeting with ICTA (6 members) Data collection
14	2 / 2	Thu.	R-1 Road alignment Water quality test Discussion meeting with UC (Tamair, Cherah) and Field survey
15	2 / 3	Fri.	Analyzing data
16	2 / 4	Sat.	Field survey (Dam sites, R-2 road) Discussion meeting with UC (Koral, Sihala, Rewat) and Field survey
17	2 / 5	Sun.	Discussion meeting with UC (Kirpa, Gokina) and Field survey Meeting with NESPAK
18	2 / 6	Mon.	R-2 Road alignment Analyzing data
19	2 / 7	Tue.	Discussion meeting with ICTA Analyzing data

No.	Date	Day	Work Schedule
20	2 / 8	Wed.	Indication of pipeline and well sites Analyzing data
21	2 / 9	Thu.	Field survey (farm ponds and Gokina Village)
22	2 / 10	Fri.	Analyzing data
23	2 / 11	Sat.	Indication of (pipeline) Analyzing data
24	2 / 12	Mon.	Field survey (farm ponds) Date collection at NARC
25	2 / 13	Mon.	Pumping test Data collection at NARC
26	2 / 14	Tue.	Pumping test Analyzing data
27	2 / 15	Wed.	- do -
28	2 / 16	Thu.	Progress reporting to Embassy of Japan and JICA (chief engineer and 3 members) Pumping test
29	2 / 17	Fri.	Three members leave for Japan
30	2 / 18	Sat.	Data collection at survey of Pakistan Three members leave for Japan
31	2 / 19	Sun.	Electric prospective survey Topographic survey (farm ponds)
32	2 / 20	Mon.	- do -

No.	Date	Day	Work Schedule
33	2 / 21	Tue.	Aerial photographs survey Geological data collection
34	2 / 22	Wed.	Topographic survey (farm ponds) Electric prospective survey
35	2 / 23	Thu.	- do -
36	2 / 24	Fri.	Analyzing data
37	2 / 25	Sat.	Electric prospective survey Pre-basic designing (M-1 and M-2 dam)
38	2 / 26	Sun.	Markaz investigation Topographic survey (farm ponds)
39	2 / 27	Mon.	Topographic survey (farm ponds) Data collection (pump and well)
40	2 / 28	Tue.	Data collection (Meteorological survey and Geological survey in Lahore)
41	3 / 1	Wed.	Final meeting with Embassy of Japan and ICTA Data collection
42	3 / 2	Thu.	Discussion meeting with the chairman of UC
43	3 / 3	Fri.	Analyzing data
44	3 / 4	Sat.	Reporting the results of survey to JICA Pakistan office
45	3 / 5	Sun.	Leaving Islamabad for Japan

2-2 Explanation for Draft Final Report

No	Date	Day	Work Schedule
1	5/21	Sun	Departure from Japan
2	5/22	Mon	Arrival at Islamabad
3	5/23	Tue	Courtesy call (JICA, Embassy of Japan, and ICTA)
4	5/24	Wed	Discussion meeting with ICTA
5	5/25	Thu	Discussion meeting with ICTA
6	5/26	Fri	Field survey
7	5/27	Sat	Discussion meeting with EAD
8	5/28	Sun	Reporting the results to JICA and Embassy of Japan
9	5/29	Mon	Leaving Islamabad for Japan
10	5/30	Tue	Arrival at Japan

3. Member List of Persons Concerned

Japanese persons concerned

- Embassy of Japan in Pakistani

Mr. Shigeo Karimata	First Secretary
Mr. Yutaka Sumita	First Secretary

- JICA Pakistani Office

Mr Kazuo Tanigawa	Resident Representative
Mr. Masato Togawa	Assistant Resident Representative

- Pakistani Persons concerned

Mr. Jamshed Burki	Administrator, ICTA
Mr. Sang-e-Marjan	Director Development and Finance, ICTA
Mr. Naguibullah Malik	Deputy Commissioner, ICTA
Mr. Wagar Malik	Director, AES, ICTA
Mr. Azmat Taimur Osman	Deputy Director (Dev), ICTA
Mr. Shaigan Sharif Malik	Deputy Director (Dev), ICTA
Mr. Javed Chishti	Deputy Director Planning Ministry of LG & RD, ICTA
Mr. Raja Abdul Hameed	Assistant Director of LG & RD, ICTA
Mr. Ch. Saifullah	Assistant Engineer of LG & RD, ICTA
Mr. Arshed khan	Assistant Agriculture Engineer, ICTA
Mr. Abbas Hussain shah	Assistant Director, ICTA
Mr. Nayyer Bokhari	Administrator, PWP

MINUTES OF DISCUSSIONS
FOR
THE BASIC DESIGN STUDY
ON
ISLAMABAD MODEL INTEGRATED RURAL AREA DEVELOPMENT PROJECT
IN
ISLAMIC REPUBLIC OF PAKISTAN

In response to the request of the Government of the Islamic Republic of Pakistan (hereinafter referred to as "the Government of Pakistan"), the Government of Japan decided to conduct a basic design study on the Islamabad Model Integrated Rural Area Development Project (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to the Government of Pakistan the Basic Design Study Team (hereinafter referred to as "the Team") headed by Mr.Takayuki HAZAMA, the Deputy Director of the Investigation and Research Department of the Japanese Institute of Irrigation and Drainage.

The Team had a meeting on the Project with the officials concerned of the Government of Pakistan headed by Mr. Sang-e-MARJAN, the Director of Development and Finance, Islamabad Capital Territory Administration (ICTA) on 24th January, 1989 at the conference room of ICTA.

As a result of the discussions, both parties agreed to recommend to their respective Governments that the major points of understandings reached between them, attached herewith, should be examined towards the realization of the Project.

Islamabad,30th January,1989

Takayuki Hazama

Mr.Takayuki HAZAMA
Leader of the
Basic Design Study Team
JICA

Mr.Sang-e-MARJAN
Director of Development
and Finance, ICTA,
The Government of Pakistan

ATTACHMENT

1. The Japanese side explained the inception report of the Basic Design Study and the Pakistani side understood it.

2. Both parties confirmed the objectives of the Project and the executing body of the Project as agreed upon in the minutes of discussions of the Preliminary Study Team signed on 30th January, 1988

3. The Project area is shown in ANNEX-I. The Project area of the Upper Krang River Irrigation Development Project shall be excluded from the study area of the Basic Design Study.

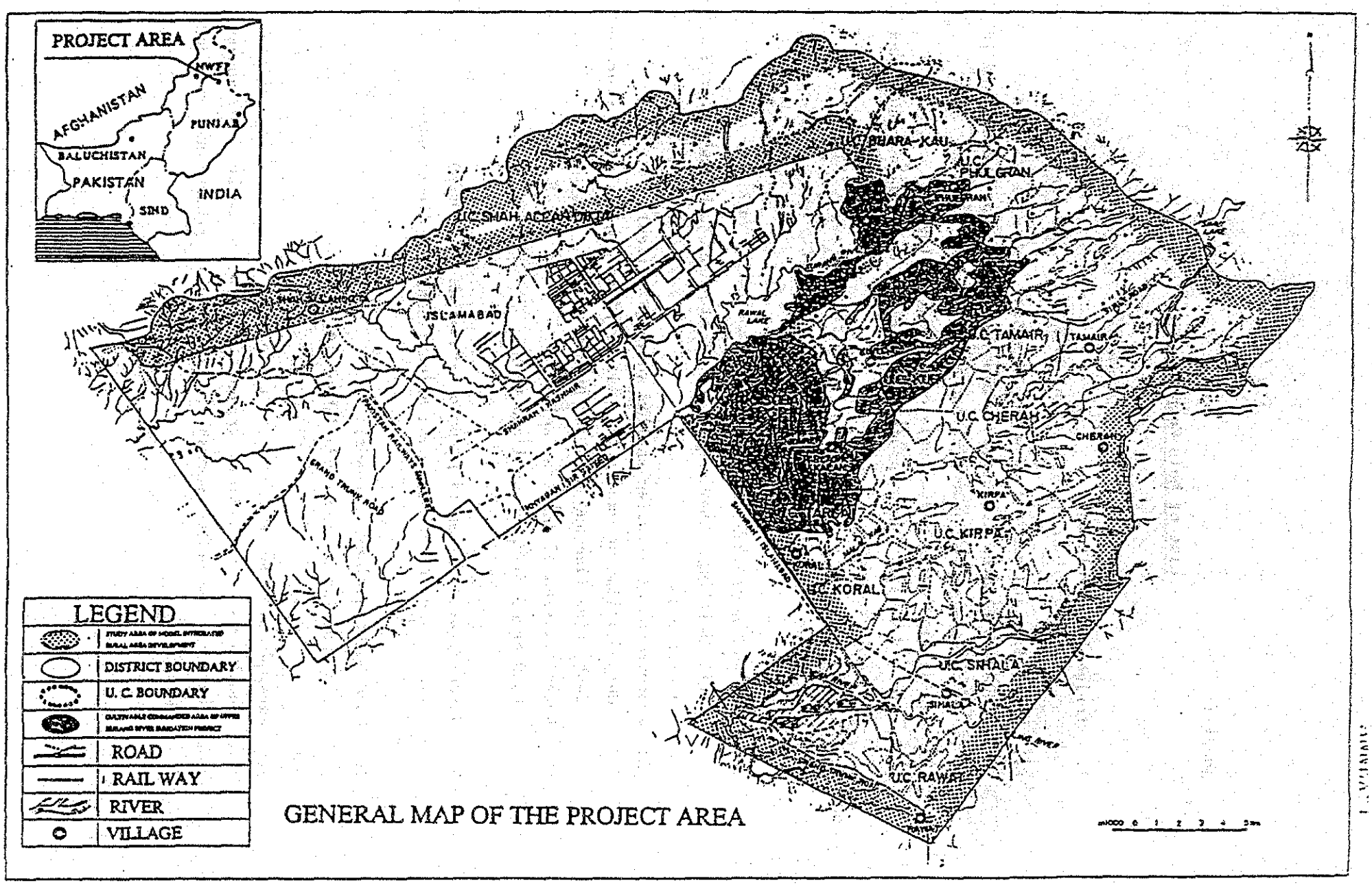
4. The Team will convey to the Government of Japan the request of the Government of Pakistan that the former takes necessary measures to cooperate by implementing the Project within the scope of Japanese grant aid program. (List of main components requested by the Government of Pakistan for Japan's grant aid is attached as ANNEX-II.)

5. The Pakistani side understood Japan's grant aid system explained by the Team.

6. The Government of Pakistan will take necessary measures listed in ANNEX-III on condition that the grant aid is executed to the Project.

7. The Team will finalize the report by the end of April and submit to the Government of Japan. The Government of Japan will review the report and evaluate the conclusion on the execution of this project as grant aid.

8. List of participants on the meeting is attached in ANNEX-IV.


PROJECT AREA
NWFP
AFGHANISTAN
PUNJAB
BALUCHISTAN
PAKISTAN
INDIA
SIND
U.C. BHARA-KAU
U.C. PHULGRAN
U.C. SHAH ACCAR DARA
ISLAMABAD
RAWAL LAKE
U.C. TAMAIR
TAMAIR
U.C. CHERAH
CHERAH
KIRPA
U.C. KIRPA
U.C. KORAL
U.C. SIHALA
SIHALA
U.C. RAWAT
RAWAT
GRAND TRUNK ROAD
LEGEND
DISTRICT BOUNDARY
U. C. BOUNDARY
ROAD
RAIL WAY
RIVER
VILLAGE
GENERAL MAP OF THE PROJECT AREA

ANNEX-II

List of Main Components

1. Irrigation development

(1) Small dams and associated works (2 sites)
dam and related structures, main canal, secondary canal, and if necessary, pump, pipe line and storage tank

(2) New shallow wells and associated works (3 sites)
well drilling, pump, pipe line, storage tank, main canal, and secondary canal

2. Ground water multi-purpose development

(1) New tube wells (4 sites)
well drilling, pump, pipe line, storage tank and taps for public use

(2) Improvement of existing shallow wells (12 sites)
deep drilling or excavation, linear plate lining, pump, storage tank, pipe line and taps for public use

(3) Rehabilitation of existing wells
hand pump, cover of well and tank

3. Rehabilitation of multi-purpose farm ponds (17 ponds)
excavation, embankment with brick lining and diesel pump

4. Road constructions (2 roads)
construction of new roads (about 18.5 km)

5. Rural development stations (4 stations)
buildings (U.C. office, garage, cooperative market, storeroom nursery for baby, workshop, hall), play ground and washing place

ANNEX-III

Necessary Measures

The Pakistani side will ensure the following measures.

(1) Acquisition of land necessary for the execution of the Project (dam sites, reservoir area, pipe lines, roads, etc)

(2) Power supply for the facilities

(3) Organizing of water users association (like those in Punjab Province)

(4) Construction of farm ditches (sponsored by land owner)

ANNEX-IV

List of Attendants

Mr. Shigeo Karimata
First Secretary
Embassy of Japan

Mr. Takayuki Hazama
Team Leader
Japanese Institute of
Irrigation & Drainage

Mr. Yoji Sekiguchi
Coordinator
JICA

Mr. Tadashi Ohori
Chief Engineer
Nippon Giken Inc.

Mr. Hiroshi Mizuno
Dam&Foundation Engineer
Nippon Giken Inc.

Mr. Shgemi Kimura
Hydro-Geologist
Nippon Giken Inc.

Mr. Motoo Taki
Road Engineer
Nippon Giken Inc.

Mr. Hiroshi Yasuda
Agronomist
Hokkaido Engineering
Consultants

Mr. Yasunori Matsukawa
Structure & Design Engineer
Nippon Giken Inc.

Mr. Sang-e-Marjan
Director Development
and Finance ICTA

Mr. Naguibullah Malik
Deputy Commissioner
ICTA

Mr. Shaigan Sharif Malik
Deputy Director
Development ICTA

Mr. Javed Chishti
Deputy Director Planning
Ministry of LG & RD

Mr. Raja Abdul Hameed
Assistant Director
LG & RD ICTA

Mr. S.Abbas Hussain
Extra Asstt.
Director Agriculture

Mr. Saif Ullah
Engineer
ICTA

Minutes of Discussion
on
Draft Report of the Basic Design Study
for
The Islamabad Model Integrated Rural Area Development Project
in
The Islamic Republic of Pakistan

In responce to the request of Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Islamabad Model Integrated Rural Area Development Project (hereinafter referred to as "the Project") and entrusted the study to Japan International Cooperation Agency (JICA). JICA sent to Pakistan the Basic Design Study team headed by Mr. Takayuki HAZAMA, the Deputy Director of the Investigation and Research Department of the Japanese Institute of Irrigation and Drainage, from January 20th through March 5th, 1989. The Basic Design Study Team carried out a field survey and had a series of discussions on the Project with the officials concerned of the Islamabad Capital Territory Administration headed by Mr. Sang-e-MARJAN, Director of Development and Finance, ICTA.

As a result of the survey and discussions, JICA prepared a Draft Report of the Study and dispatched a mission to the Islamic Republic of Pakistan for explanation of a Draft Report headed by Mr. Tetsuya UMEZAKI, Deputy Director, Construction Department, Kyushu Regional Agricultural office, Minnistry of Agriculture, Forestry and Fisheries from May 21st through 30th, 1989.

Both parties had a series of discussions on the Report and have agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Islamabad May 27, 1989

梅崎哲哉

Mr. Tetsuya UMEZAKI
Leader,
Mission for Explanation
of Draft Report, JICA.

27-5-89

Mr. Taimur Azmat Osman
Director of Development,
ICTA,
The Government of Pakistan.

ATTACHMENT

1. The Pakistani side agreed in priniciple to the basic design proposed in the Draft Final Report.

2. The Pakistani side underestood the system of Japan's Grant Aid Programme and confirmed the arrangements to be taken by the Government of Pakistan for realization of the Project as agreed upon in the "Minutes of Discussions "dated January 30th, 1989.

3. The Government of Pakistan shall release the necessary budget at the proper time according to the construction schedule.

4. The Government of Pakistan shall construct the garages and repair-shops for Tractors at locations proposed for rural development stations.

5. Final Reports(10 copies in English)on the Project will be submitted to the Pakistani side in June 1989.

List of Participants

1. Mr. Tetsuya UMESAKI,
   Leader,
   Deputy Director,
   Kyushu Regional Agriculture
   Office,
   Ministry of Agriculture,
   Forestry & Fisheries.

2. Mr. Tadashi OHORI,
   Irrigation Planning,
   Nippon Giken Inc.

3. Mr. Shigemi KIMURA,
   Ground Water Development,
   Nippon Giken Inc.

4. Mr. Y. SUMITA,
   First Secretary,
   Embassy of Japan,
   Islamabad.

1. Mr. Jamshed Burki,
   Administrator,
   ICTA

2. Mr. Naguibullah,
   Deputy Commissioner,
   ICTA

3. Mr. Waqar Malik,
   Director, AES
   (Agricultural Extension Services)
   ICTA

4. Mr. Azmat Taimur Osman,
   Deputy Director (Dev),
   ICTA

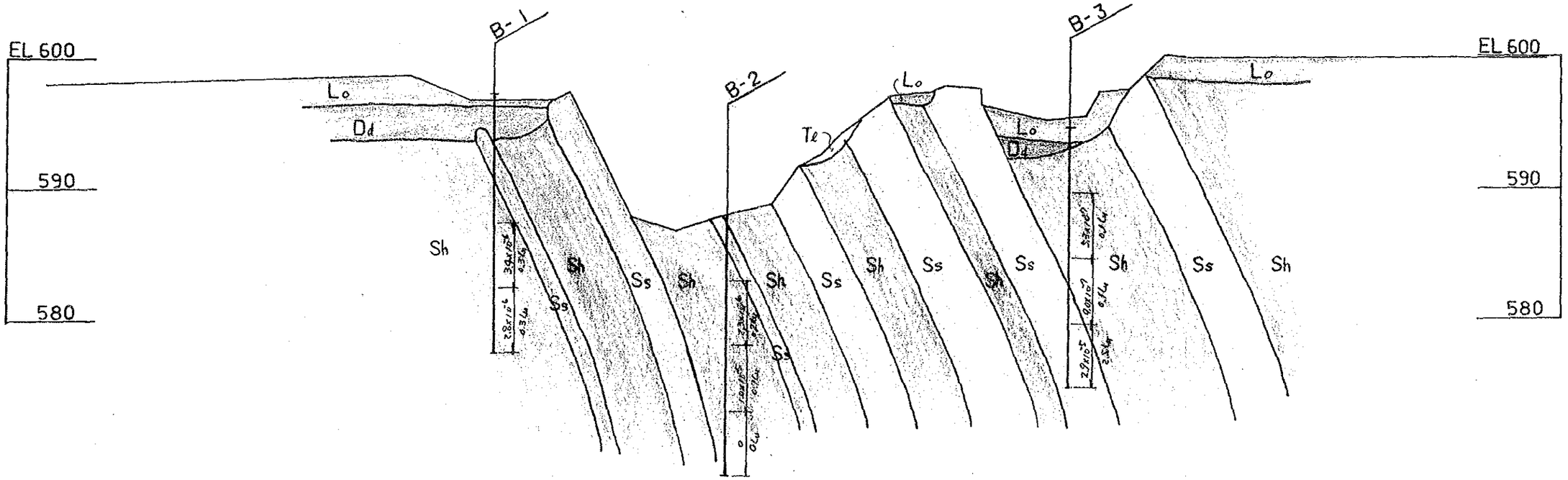
5. Mr. Raja Abdul Hameed,
   Assistant Director (LG&RD),
   ICTA

6. Mr. Ch. Saifullah,
   Assistant Engineer (LG&RD),
   ICTA

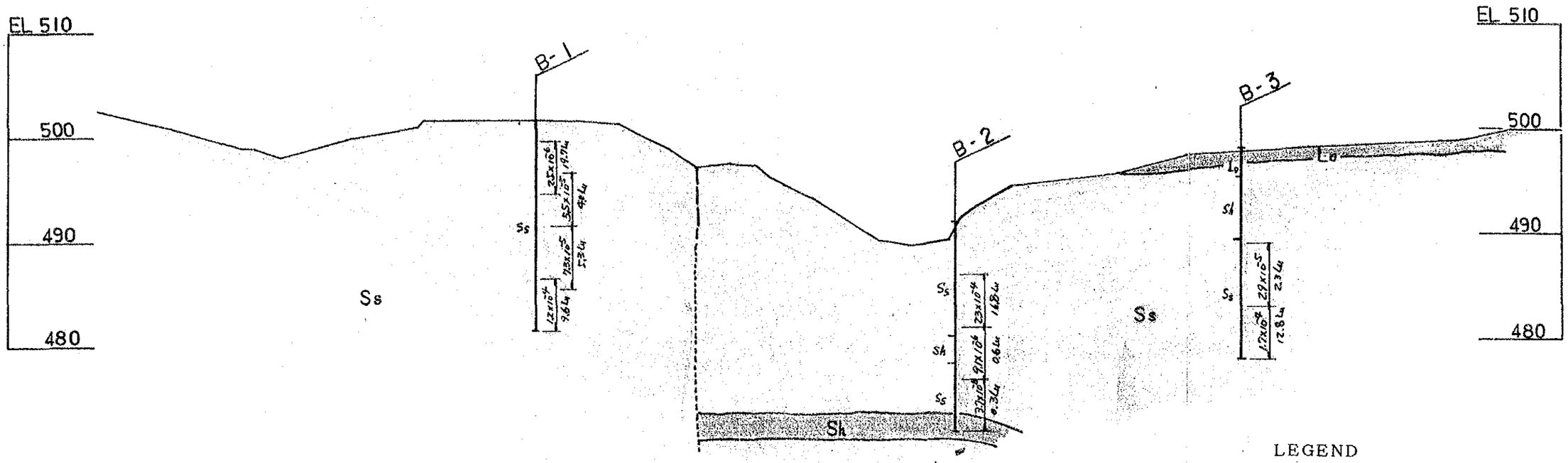
7. Mr. Arshad Khan,
   Assistant Agriculture Engineer,
   ICTA

8. Mr. Abbas Hussain Shah,
   Assistant Director,
   ICTA

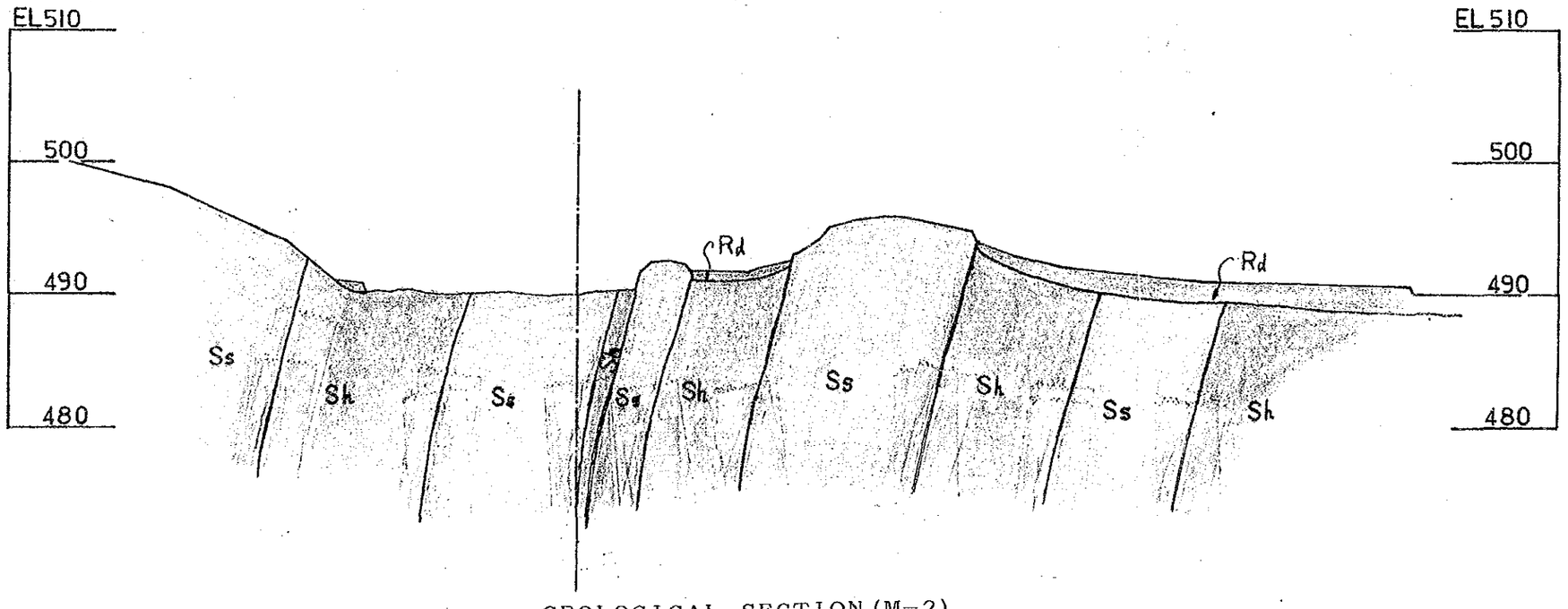
9. Mr. Nayyer Bokhari,
   Administrator,
   People Works Programme



GEOLOGICAL PROFILE (M-1)

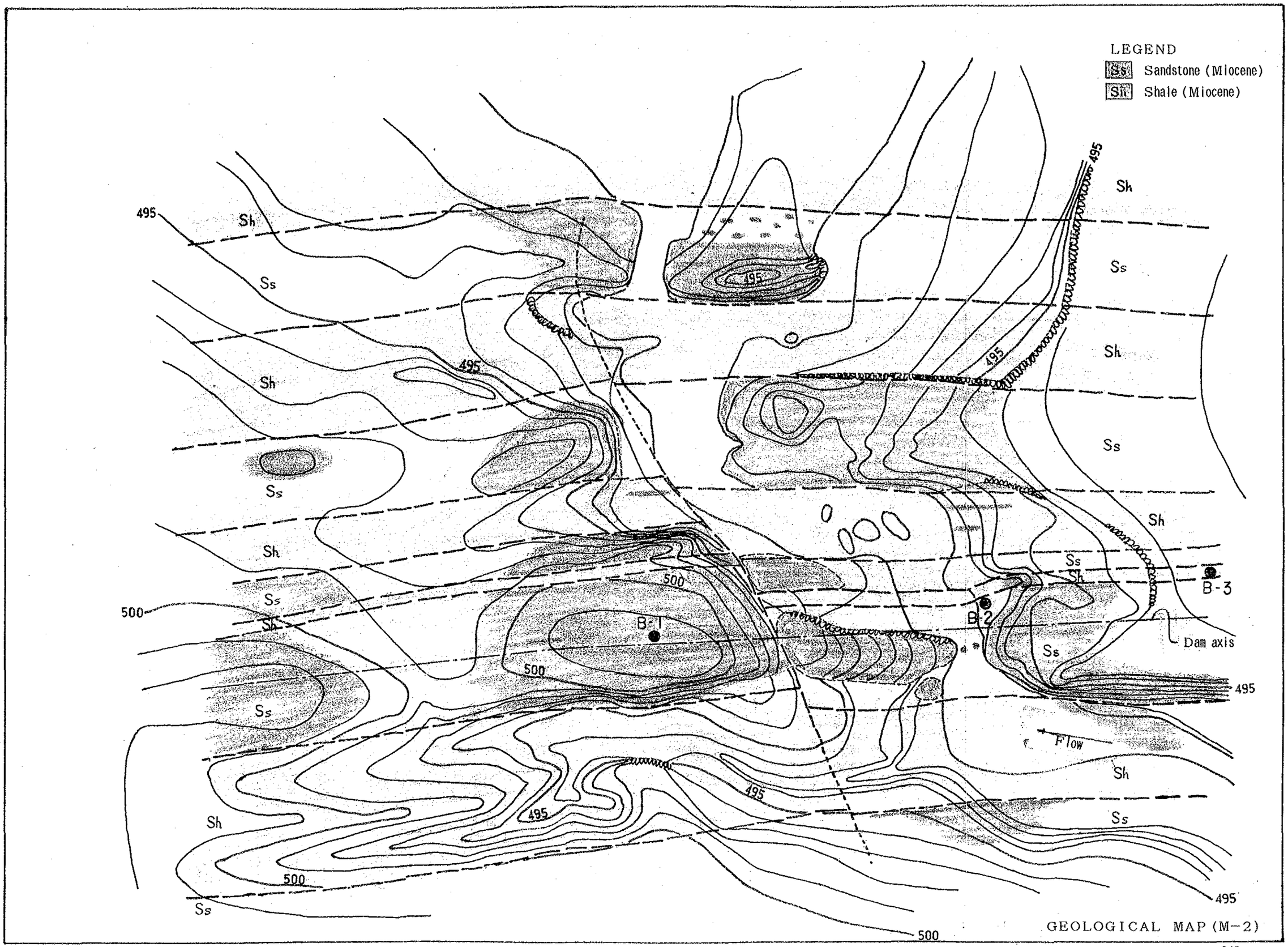


GEOLOGICAL PROFILE (M-2)



GEOLOGICAL SECTION (M-2)

GEOLOGICAL MAP (M-1)



GEOLOGICAL MAP (M-2)

7. Basic Statistical Data of Village

	R E W A T			S I N A L A						
	Rewat	Niazian	Humak	Gagri	Hardo Ghar	Jandala	Kangota Sayedan	Ladhiot	Hoon Dhamial	Sihala
POPULATION & HOUSEHOLD										
Population	4,998	575	4,945	1,450	1,300	500	550	575	2,500	6,000
Household	830	95	824	240	220	85	90	96	180	1,200
Farmer's Population	2,250	335	3,250	900	900	290	335	380	1,690	3,000
Farmer's Household	450	60	650	220	180	70	60	65	110	800
Farmer's Population(Age 14-50)	1,412	200	1,505	505	525	265	225	120	1,110	1,450
AREA & LAND OWNERS										
Total area (ha)	1,037	276	1,372	521	401	274	361	452	244	1,605
Under cultivation (ha)	600	130	752	340	160	104	240	196	64	814
No. of land owners										
0 to 2	645	55	700	370	120	140	45	155	120	600
2 to 4	200	35	100	120	35	15	25	20	41	400
4 to 6	20	5	40	15		5	20	2	6	50
6 to 10	5		10	5		2	3		10	20
over 10							2			10
Total	870	95	850	510	155	170	90	177	180	1,100
AREA UNDER CROPS (ha)										
Wheat	400	72	360	140	80	36	80	72	32	236
Ground Nut	32	20	16		4					
Vegetable			2		1					20
Bajra										
Maize	230	12	160	120	52	20	72	60	16	100
Pulses	4	20	20	20	20	6		12	12	120
Fodder					3		24			
Jawar					12					
Total	716	124	550	280	152	70	184	152	60	500
ANIMAL (Nos.)										
Bull	20	8			50		1	2	2	15
Buffalow	374	29	150	80	100	15	20	40	25	800
Donkey	60	5	12	30	5	20		35	10	600
Sheep	10	9	50							
Poultry Farm	8		5		3					15
Cow	324	70	500	120	80	35	40	90	40	2,500
Camel				9	2	2				4
Horse										
Goat	250	50	250		100		50	30	150	
Bird	26,000	300	17,000		2,000	200	150	150	150	45,000
TOTAL INCOME (YEARLY)										
Gross income by agriculture										
Agriculture	2,266,300	400,270	1,900,600	730,850	490,920	215,340	404,040	470,310	214,000	2,700,270
Livestock	2,700,550	204,425	1,620,750	620,000	747,500	130,500	191,500	350,250	271,075	7,670,500
Total	5,002,850	770,795	3,510,350	1,300,850	1,247,420	345,040	675,540	020,560	400,755	10,404,070
Expenditure by agriculture										
Agriculture	1,405,730	204,100	1,230,400	450,255	200,350	137,220	320,610	290,070	120,100	1,040,014
Livestock	1,200,040	140,700	000,110	300,200	330,570	00,000	00,000	100,000	120,010	4,240,000
Total	2,740,570	420,000	2,100,500	700,510	020,020	200,000	410,070	400,000	240,200	5,000,414
Net income by agriculture										
Agriculture	700,570	200,200	050,120	200,700	210,570	70,110	100,400	100,440	00,000	1,140,550
Livestock	1,500,710	140,000	750,000	310,740	410,020	00,400	100,400	170,270	150,050	3,420,000
Total	2,200,200	340,000	1,410,750	500,500	020,400	130,750	200,000	350,710	240,550	4,570,450
Total gross income per household										
Agriculture	5,030	0,140	2,010	3,350	2,770	2,070	0,000	7,350	1,000	3,400
Livestock	0,140	4,740	2,400	2,020	4,150	1,000	3,100	5,520	2,470	0,500
Total	11,100	12,000	5,410	0,100	0,020	4,040	11,200	12,000	4,420	13,000
Total net income per household										
Agriculture	1,730	3,400	1,010	1,200	1,170	1,110	2,000	2,770	010	1,430
Livestock	3,340	2,340	1,160	1,420	2,200	000	1,040	2,000	1,300	4,200
Total ...	5,000	5,740	2,170	2,720	3,400	1,990	4,000	5,450	2,190	5,720

	KORAL					KIRPA				CHERAH		
	Lohi Bher	Pind Dia	Darwala	Bhimber Trar	Pind Malkan	Kirpa	Panjoran	Partal	Jhang Sayedan	Cherah	Ara	Darkala
POPULATION & HOUSEHOLD												
Population	1,938	635	928	2,850	1,858	6,112	1,183	485	760	15,023	982	1,508
Household	270	88	153	458	198	988	288	84	118	1,144	158	212
Farmer's Population	1,188	478	725	1,488	1,218	4,158	958	318	488	7,185	675	1,187
Farmer's Household	228	88	113	358	118	838	288	48	78	948	128	188
Farmer's Population(Age 14-58)	735	168	298	885	658	3,188	332	135	568	4,893	211	938
AREA & LAND OWNERS												
Total area (ha)	975	188	571	838	532	1,479	152	136	219	2,998	328	398
Under cultivation (ha)	353	86	338	628	488	1,284	111	72	126	2,238	226	338
No. of land owners												
0 to 2	386	127	278	388	138	678	173	68	111	448	25	225
2 to 4	4	11	28	48	28	163	14	15	38	288	28	61
4 to 6	4	1		28	28	63	13	8	21	138	18	28
6 to 18	4		4	15	4	8	13	13	5	148	3	16
over 18				5		2			8	38	6	14
Total	318	139	294	388	174	906	213	97	178	948	88	344
AREA UNDER CROPS (ha)												
Wheat	128	58	132	488	288	392	92	47	85	1,288	148	192
Ground Nut	28	8	28	12	32							
Vegetable						38	21					
Bajra												
Maize	88	28	148	248	48	338	78	28	72	948	78	144
Pulses	28	12	8	8	8	48		18	36	258	18	74
Fodder												
Jawar				8	4	36	15	12	9	58	12	36
Total	228	188	388	668	292	836	284	186	282	2,452	244	446
ANIMAL (Nos.)												
Bull	8		48	18	18	158	33	37	24	274	38	58
Buffalow	48	58	138	228	188	2			37	478	45	98
Donkey	2	12	18	25	12	87	17		17	187	44	47
Sheep				288	28	47	18	17	15	178	48	34
Poultry Farm	4			8	2	11	3		4	12	2	1
Cow	188	38	118	288	158	298	39	43	35	438	98	115
Camel		1	5	5	5	7				12	2	4
Horse		1		5	3	3	4		4	2		
Goat	57	58	148	458	158	278	29	4	98	535	278	127
Bird	15,543	258	388	16,888	6,378	3,888	838	488	888	12,788	788	2,188
TOTAL INCOME (YEARLY)												
Gross income by agriculture												
Agriculture	772,858	384,388	934,348	2,118,368	1,852,848	2,518,884	568,158	357,481	678,398	7,947,678	791,988	1,484,688
Livestock	436,675	382,588	983,588	1,886,588	861,258	395,658	63,375	58,875	316,658	3,741,588	528,625	756,625
Total	1,218,725	726,388	1,917,848	4,885,868	1,914,888	2,914,454	631,525	416,278	998,843	11,689,178	1,321,685	2,241,285
Expenditure by agriculture												
Agriculture	471,878	221,275	588,883	1,388,884	881,314	1,598,424	373,764	284,456	398,226	4,864,381	582,896	857,568
Livestock	228,312	158,787	443,897	822,215	488,725	238,946	48,755	41,745	138,883	1,674,377	238,934	351,812
Total	692,182	388,862	1,032,180	2,222,199	1,388,238	1,329,378	414,519	246,281	529,189	6,538,758	748,938	1,288,588
Net income by agriculture												
Agriculture	388,188	143,825	345,257	718,376	371,528	928,388	194,388	152,945	288,187	3,883,288	288,884	627,892
Livestock	218,363	283,713	548,483	1,884,285	452,525	164,784	22,628	17,138	177,787	2,867,123	291,581	485,613
Total	518,543	348,738	885,668	1,788,661	824,851	1,885,884	217,888	178,875	488,834	5,158,412	588,875	1,832,785
Total gross income per household												
Agriculture	3,588	8,872	8,288	8,855	9,571	3,835	2,731	7,284	8,888	8,384	5,888	8,248
Livestock	1,884	5,842	8,784	5,388	7,838	477	385	1,282	4,888	3,847	4,414	4,288
Total	5,583	12,114	16,872	11,445	17,481	3,512	3,838	8,488	12,688	12,331	11,814	12,451
Total net income per household												
Agriculture	1,384	2,384	3,855	2,855	3,378	1,188	935	3,121	3,888	3,252	2,488	3,484
Livestock	883	3,385	4,782	3,841	4,114	188	188	358	2,258	2,181	2,438	2,253
Total	2,357	5,778	7,837	5,888	7,482	1,387	1,844	2,471	5,918	5,423	4,838	5,737

	TUMAIR Tumair	SHAH ALLAH DITTA Shah Allah Ditta	Gokina Kalan	T O T A L
POPULATION & HOUSEHOLD				
Population	7.243	2.825	2,985	64,986
Household	889	565	495	9,389
Farmer's Population	5,432	2,820	2,746	43,844
Farmer's Household	687	524	458	7,593
Farmer's Population(Age 14-58)	1,884	438	1,254	23,634
AREA & LAND OWNERS				
Total area (ha)	3,484	433	433	19,335
Under cultivation (ha)	1,378	374	82	11,312
No. of land owners				
0 to 2	2,556	196	176	8,727
2 to 4	98	184		1,884
4 to 6	13	105		618
6 to 10	12			292
over 10	12			84
Total	2,682	484	176	11,605
AREA UNDER CROPS (ha)				
Wheat	1,188	42	42	5,938
Ground Nut		4		164
Vegetable				26
Bajra	17			68
Maize	847	48	48	4,889
Pulses	391	4		1,126
Fodder				27
Jawar	25			235
Total	2,478	98	62	11,681
ANIMAL (Nos.)				
Bull	297	98	148	1,296
Buffalow	538	288	285	3,861
Donkey	278			1,513
Sheep	137	25	15	799
Poultry Farm	18			94
Cow	398	188	178	6,881
Camel	18			68
Horse	4			26
Goat	1,848	458	515	5,957
Bird	8,795			158,818
TOTAL INCOME (YEARLY)				
Gross income by agriculture				
Agriculture	8,284,237	337,352	242,252	38,887,488
Livestock	5,254,580	1,655,880	1,701,525	33,674,780
Total	13,618,737	1,992,852	1,943,877	72,282,169
Expenditure by agriculture				
Agriculture	4,943,766	212,778	168,566	23,745,967
Livestock	2,286,886	729,925	748,454	16,868,272
Total	7,158,572	941,881	901,820	39,915,299
Net income by agriculture				
Agriculture	3,428,471	125,876	81,886	14,861,582
Livestock	3,847,694	925,975	961,171	17,685,428
Total	6,468,165	1,851,851	1,842,857	32,486,338
Total gross income per household				
Agriculture	12,175	645	538	5,516
Livestock	7,648	3,158	3,781	4,244
Total	19,823	3,883	4,319	9,768
Total net income per household				
Agriculture	4,979	239	182	2,123
Livestock	4,436	1,767	2,136	2,235
Total	9,415	2,886	2,318	4,357

8. **Data List of Existing Wells**

c : clay
g : gravel
s : sand
sh : shale
ss : sand stone

No._____

Inventory of existing wells in Tirich

Well No.	U.C	Village	Well Depth (m)	Well Diameter (m)	G.W.L (m)	Water Depth (m)	G.W.L in Dry Season	Aquifer	Beneficiaries	
WTA-1	Tamair	Fatahal	5.20	1.66	4.50	1.20	△	s.s	300	ハンドポンプ
2	"	Dhoke Chaudrian	11.30	1.05	3.14	3.25	◎	c-ss	1140	灌漑井戸 2/3
3	"	Mahra	7.31	2.30	1.42	5.73	◎	c	347	
4	"	Karak	15.70	1.10	13.09	2.61	×	c-g-sh	100	
5	"	Tamair	13.00	1.24	8.07	4.93	◎	c+s	1200	ハンドポンプ
6	"	Dhoke Seeri	7.10	3.04	3.12	4.07	◎	ss	500	ハンドポンプ
7	"	Ara	8.04	1.36	4.60	4.34	×	sh	160	
8	"	Dhadi	14.22	1.74	3.57	10.65	◎	ss	300	ハンドポンプ
9	"	Mujara	11.70	1.25	4.24	6.86	△	g-sh	120	
10	"	Talibar	3.26	1.56	1.42	2.38	◎	ss	400-1500	ハンドポンプ
11	"	Dhoke Aslam	10.24	1.44	3.32	7.02	×	c	200	
12	"	Langra	12.17	1.72	8.50	3.17	△	c+g	500	
13	"	Dhoke Fullah	10.88	1.32	6.24	4.71	△	c	150	
14	"	Tamair (Middle School)	4.24	1.10	1.15	3.09	◎	sh	200	
WKT-1	Kirpa	Punj Gran	11.65	1.92	4.33	7.02	◎	ss	500	ハンドポンプ
2	"	Thang Saveian	14.62	2.50	6.56	3.13	◎	old well unknown	1500	ハンドポンプ
3	"	Kirpa	22.30	2.26	16.24	6.46	◎	ss	200	ハンドポンプ
4	"	Monillah Fujiran	15.24	1.52×1.20	2.25	2.99	△	s.s	300	ハンドポンプ
5	"	Bagh Wala	3.30	1.00	2.00	1.30	×	c	400	ハンドポンプ
6	"	Tahliwala	6.23	1.04	2.97	3.03	×	c	700	ハンドポンプ
7	"	Muhalla Jang Khani	10.11	2.10	3.40	6.71	△	ss	1000-2000	ハンドポンプ
8	"	Parri Fujiran	10.20	2.00	2.22	6.67	◎	s.s	300	灌漑井戸 2/3
9	"	Dhoke Baxu Ali Zaman	14.30	1.12	10.27	3.43	◎	c	150	ハンドポンプ
10	"	Punj Gran	11.45	1.92	1.22	10.27	◎	ss	150	灌漑井戸 2/3
11	"	Saeeyan Wala	4.27	1.74	1.33	2.94	◎	s.s	400	ハンドポンプ
12	"	Kale Wala	7.27	1.65	1.65	6.12	◎	c-s	250	ハンドポンプ
13	"	Kirpa	15.37	1.54	14.75	2.62	△	g-s	350	

Inventory of existing wells & springs

Well No.	W. C.	Village	Well Depth (m)	Well Diameter (m)	S.W.L (m)	Water Depth (m)	S.Wi in Dry Season	Number	Beneficiaries	
W/CH-1	Cheruh	Cheruh	8.00	2.15	1.15	6.85	◎	1~2	900	ハンドポンプ
〃 2	〃	Cheruh	10.08	1.56×1.52	2.26	7.82	◎	50	1200	ハンドポンプ
〃 3	〃	Mahra	7.70	2.35	2.26	5.14	◎	9~10	2000	改良井戸 2ヶ所
〃 4	〃	Cheruh	6.20	2.30	1.70	4.50	△	0	—	
〃 5	〃	Cheruh	5.08	2.10	1.40	3.68	△	0	—	
〃 6	〃	Cheruh	10.00	2.30	2.93	7.07	◎	1~2	400	改良井戸 2ヶ所
〃 7	〃	Dhoke Mahri	11.10	2.58	3.60	7.50	◎	50	5000~6000	改良井戸 2ヶ所
〃 8	〃	Kaliah	12.60	2.75	7.30	5.30	△	9~36	1500	ハンドポンプ
〃 9	〃	Kaliah	9.48	1.77	7.27	2.21	△	9~10	300	改良井戸 2ヶ所
〃 10	〃	Kaliah	2.62	1.00	0.92	1.72	◎	7~8	1300~2500	(洪水の影響) 改良井戸 2ヶ所
〃 11	〃	Darkala	11.60	(1.60×1.70) 2.30	4.23	7.37	◎	6		ハンドポンプ
〃 12	〃	Thanda Pani	10.40	2.20	6.26	3.67	◎	5~10	1000	改良井戸 2ヶ所
〃 13	〃	Herno	15.00	1.0×2.12	5.73	9.27	◎	old well unknown	2000	ハンドポンプ
〃 14	〃	Thanda Pani	9.35	1.20	6.88	2.47	◎	6	1000	
WSI-1	Sihala	Hun Diamial	20.21	1.44	10.38	1.43	◎	5~6	300	改良井戸 — 定期的に涸れる 2ヶ所
〃 2	〃	〃	21.02	1.22	21.00	0.02	◎	9~10	400	
SKD-1	KORAL	Bhambar Thar (Rain Sayedian	3.23	2.45×1.93	2.90	2.33	⊙	5.5	400~6000	改良 2ヶ所
SKD-2	〃	〃	3.25	2.20×2.0	0.48	2.77	⊙	5.5	—	
WKD-1	〃	Channi Musu Khan	2.20	1.27	2.27	0.43	×	0~9	150	改良井戸 2ヶ所