There are enough groundwater resources available in this area to meet the drought year. For emergency groundwater development the total water resources development plan recommended in the capital area should be considered for this area, too.

606. Further Investigation

The groundwater investigations performed in this study only delineate an outline of the hydrogeological conditions of the study area. Further studies should proceed for more accurate estimation of the area's groundwater development potential based on more detailed and reliable data. Such data would include long-term hydrographs of the groundwater tables.

The Landsat imagery interpretation is one of the effective methods for analysing groundwater resources. This method is best suited for groundwater analysis on the vast and undeveloped area such as desert. However, in such highly developed area as the study area, this method does not necessarily give more detailed information/data than those obtained from the field investigation; hence, Landsat data in this study is not very useful.

Major investigation items for further studies are listed below:

a. Investigations for the Aquifer

1. Simultaneous well observation covering the entire study area (twice a year, using the existing wells).
2. Study of the aquifer with drilling surveys and geo-electric soundings.
3. Study of permeability and storage coefficient of the aquifers with aquifer tests.
4. Chemical analysis of groundwater.

b. Investigation for the Groundwater Flow

1. Long-term observation of groundwater table (observation wells and existing wells).

2. Observation of precipitation.

3. Current measurement of the rivers.

4. Precise measurement of discharge amount of groundwater.

5. Assumption of recharge amount of groundwater.

6. Study of groundwater balance.

c. Planning of the Groundwater Utilization

1. Prospect of groundwater balance of the each groundwater basin

2. Consideration of the possibility of urgent groundwater utilization for the each groundwater basin.

3. Comparison and examination of the measures for water shortage of the rivers

4. Planning of groundwater utilization

7. WATER RESOURCES DEVELOPMENT PLAN

7. WATER RESOURCES DEVELOPMENT PLAN

701. Target Year

The target year of the study is 2010. And it is also requested to the study team to make recommendation for water resources development potential beyond 2010 up to 2030.

702. Optimum Dam Sizing

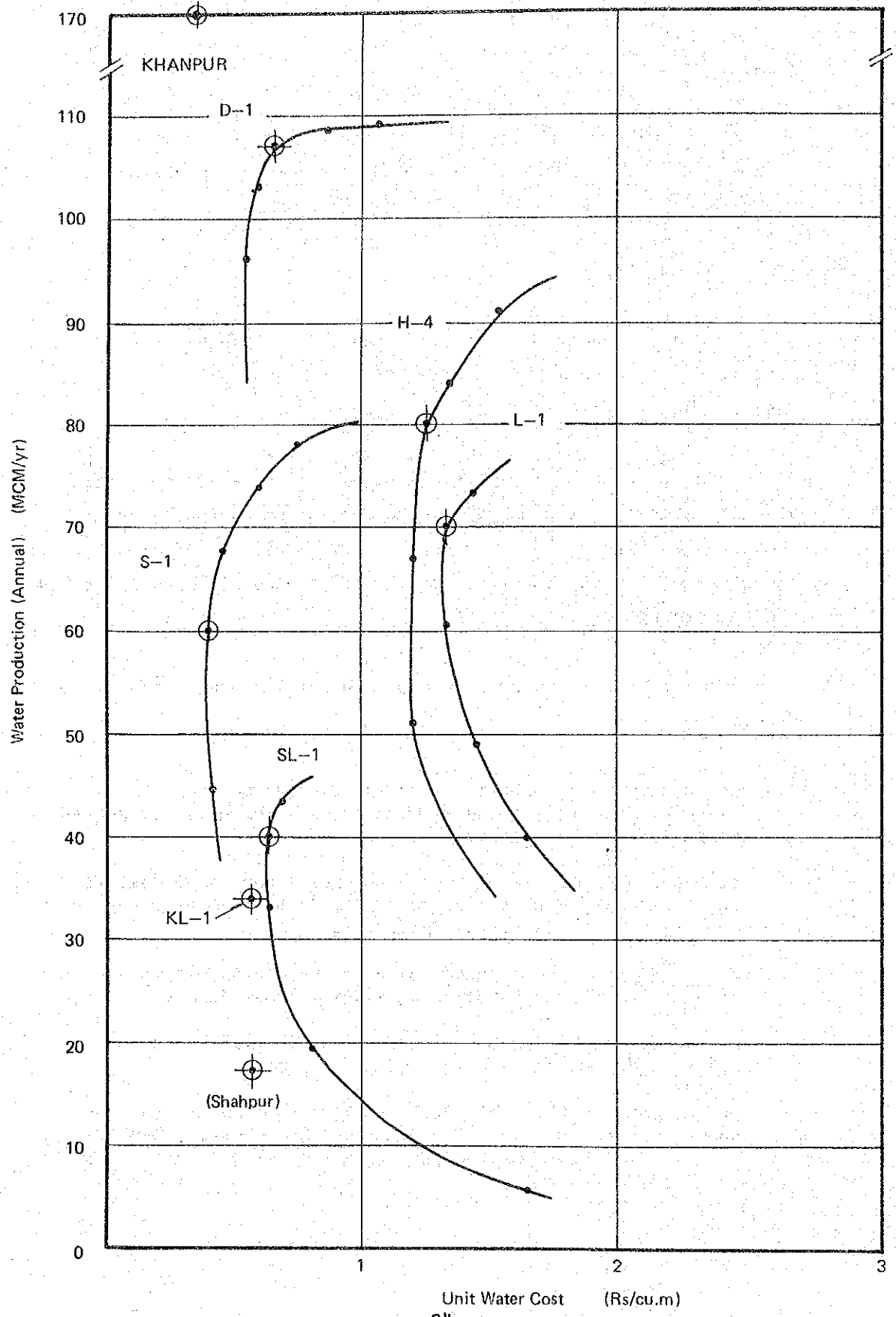
From a viewpoint of effective use of water resources on a stream, dam size shall be as large as possible within the engineering limits.

An appropriate dam size shall be close to the minimum point of unit water cost and large in capacity as much as possible as indicated in Figure VII-1. When the maximum size is limited by technical circumstances of dam construction, the sizing will follow them accordingly.

Following is the manner to approach optimum dam sizing in this study:

- On each proposed damsite, a relation curve between "investments" and "effects" will be made which is designated as "unit water cost curve".
- At the stage of selection of a damsite among those nominated on a stream, "live storage capacities" of a dam will represent above-mentioned factor of "effects".
- At the next stage of selected a damsite, "probable water productions" of the a dam will represent the "effects".
- As factors of "investments", "dam construction costs and operation/maintenance costs" will be adopted.
- On the "unit water cost curve" made by the manner mentioned above, appropriate dam size will be pointed out. Shape of curve describes a parabola having the minimum point of unit water cost of the dam.

Figure VII-1. Unit Water Cost and Water Production



703. Specifications of Selected Dams

General features of selected dams are shown in Table VII-1. Selection was made on the basis of preliminary design, unit water cost comparison and comprehensive technical consideration.

704. Accumulated Unit Water Cost

From the cost data of proposed facilities selected finally, water costs and their compositions for respective systems are calculated and listed up in Table VII-2.

705. Water Demand and Supply Balance in Target Years

Water resources development to meet water demands for the target years of 2010 and 2030 in accordance with the basic concept is programmed and described in Tables VII-3 and VII-4 respectively.

Table VII-1. General Features of Selected Dams

Number of Dam	D - 1	H - 4	S - 1	L - 1	SL - 1	KL - 1	Shahpur
Name of River	Dor River	Haro River	Soan River	Soan River	Soan River	Soan River	Haro River
Name of Tributary	-	-	-	Ling River	Sil River	Kurang River	Nandna Kas
Name of Dam	Rajoia	Pina	Cherah	Dadhochai	Dhok Shaban	Lohi Bher	Shahpur
Catchment Area * (sq.km)	292.3	498.5	341.1 (188.3)	285.0	237.6	558.8 (283.7)	203.9
Reservoir Area (sq.km)	2.9	4.2	6.1	8.4	6.5	4.7	8.6
Gross Storage (m.c.m)	74.62	144.94	82.95	116.65	83.38	41.80	47.28
Live Storage (m.c.m)	60.00	125.00	66.00	91.00	62.00	16.30	40.00
Dead Storage (m.c.m)	14.62	19.94	16.95	25.65	21.38	25.50	7.28
High Water Level (El.m)	1,017.0	869.0	591.5	554.5	473.0	480.0	449.58
Normal Water Level (do)	1,012.0	864.0	586.0	549.5	469.0	480.0	449.58
Low Water Level (do)	981.5	815.0	570.0	529.0	453.0	475.5	440.40
Type of Dam **	E	E	C&F	E	E	E	G (Heightening)
Dam Top Elevation (El.m)	1,020.0	872.5	594.0	557.5	475.5	482.0	450.8
Dam Height (m)	85.0	132.5	C;65.0 F;14.0	92.5	55.5	42.0, 18.0	30.59 32.61
Dam Length (m)	1,590	510	C;260 F;1750	1,570	420	300 + 910 = 1,210	256.0
Dam Volume (m.c.m)	5.469	7.477	C;0.236 F;0.453	7.360	1.943	0.797 + 0.506 = 1.306	-
Initial Cost (10^6Rs)	1,172.65	1,689.31	381.52	1,575.89	415.50	303.44	60.00
Annual O/M Cost (10^6Rs/Yr)	5.5	7.1	2.5	6.7	2.5	2.5	2.5
Water Production (m.c.m/yr)	107.0	80.0	60.0	70.0	40.0	34.0	17.25
Unit Water Cost (Rs/cu.m)	0.65	1.25	0.39	1.33	0.63	0.56	0.34

* ( ) .... Direct Catchment Area ** Type of Dam G; Concrete Gravity, E; Embankment, F; Embankment Flank

Table VII-2. Compositions of Unit Water Costs of Potential Resources

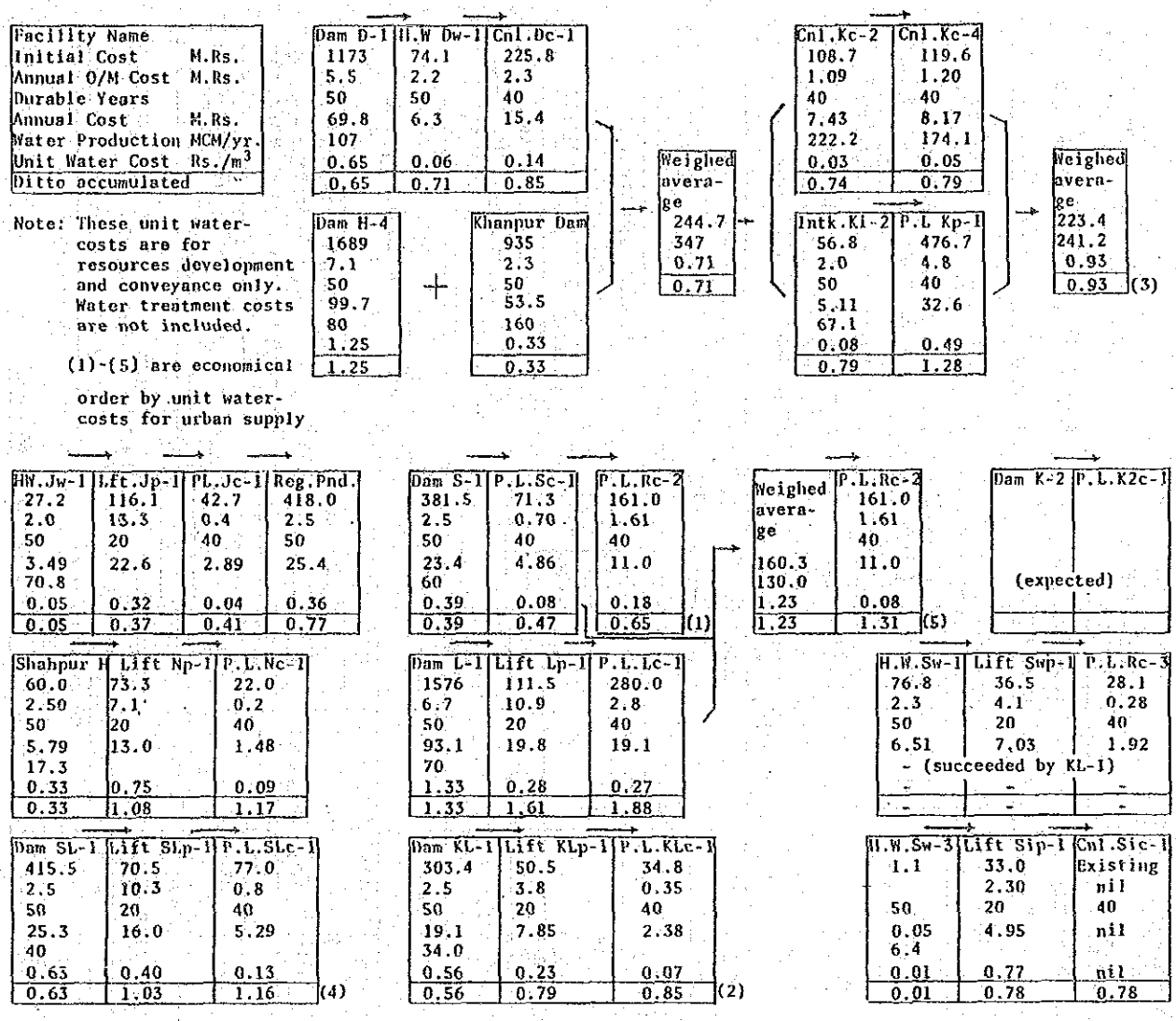


Table VII-3. A Trial of Water Balance

(Target Year = 2010)

Water Resources		Presented Production as of 2000	Additional Production	Notes	Total Production as of 2010
1. Dor Basin	1.1. Storage Dam D-1	-	-		-
	1.2. Diversion Dam Dw-1	-	-		-
	Total	-	-		-
2. Haro Basin	2.1. Storage Dam H-4	-	-		-
	2.2. Storage Dam Khanpur	160.0	-		160.0
	2.3. Tube Wells & Springs	47.3	-		47.3
	2.4. Diversion Dam Jw-1	70.8	-		70.8
	2.5. Storage Dam Shahpur	-	17.3	Heightening	17.3
	Total	278.1	17.3		295.4
3. Soan Basin for Islamabad	3.1. Storage Dam Simly	52.8	-		52.8
	3.2. Storage Dam K-2	?	?	Expected	?
	3.3.1. Head Works N.P.-1	?	?	Expected	?
	3.3.2. Ditto Kurang	5.3	-		5.3
	3.3.3. Ditto Six Others	16.2	-		16.2
	3.4. Tube Wells Islamabad	29.5	6.0	12.0/2	35.5
	Total	103.8	6.0		109.8
4. Soan Basin for Rawalpindi	4.1. Storage Dam Rawal	37.2	-		37.2
	4.2. Tube Wells Rawalpindi	42.6	7.0	14.0/2	49.6
	4.3. Diversion Dam Sw-1	-	-		-
	4.4. Storage Dam S-1	60.0	Succeeded by KL-1		60.0
	4.5. Storage Dam L-1	-	-		-
	4.6. Storage Dam KL-1	-	34.0	M-i→KL-1	34.0
	4.7. Storage Dam SL-1	-	40.0		40.0
	Total	139.8	81.0		220.8
5. Head Works (Pump) at Soan river		6.4	-		6.4
6. Tube Wells for New Int. Air port		0.8	0.9		1.7
Grand Total		528.3	105.2		634.1
Total of Storage Dams's Resources		310.0	91.3		401.3
Ditto of Diversion Dams (incl.Head W.)		98.7	-		98.7
Ditto of Tube Wells		120.2	13.9		134.1

MCM/Year

Demand	(Users and their Dimentions)
	1. Khanpur Dam project
57.7	1.1. Right Bank Irrigation
33.9	1.2. Left Bank Irrig. (exist.)
24.8[1]	1.3. POF Wah (refer to Appe-
22.5[2]	1.4. PIDC Taxila ndix D.1.-)
138.9	Sub Total
88.1	2. Haro Left Area Irrigation 16,100hax7,077m³/ha/yr.x77.3%[3]
165.9	3. Urban Water Islamabad 433,000 m³/day x 365 x 1.05
217.7	4. Urban Water Rawalpindi 568,100 m³/day x 365 x 1.05
xx.x	5. Rural Irrigation Islamabad (Under individual study by JICA)
6.4	6. Rawalpindi South Irrigation 900ha x 7,077m³/ha/yr.x 100%
1.7	7. New International Air Port 1.0 MGD

←Dor Conduction

←Khanpur Conduction

Note; 1) from Wah Spring, 2) from Tube Wells
3) Remains are by Small S. Lift Irrig.

The Allowance;
Resources(634.1)- Demand(618.7)=15.4 MCM

Table VII-4. A Trial of Water Balance

(Target Year = 2030)

MCM/Year

Water Resources		Presented Production as of 2010	Additional Production	Notes	Total Production as of
1. Dor Basin	1.1. Storage Dam D-1	-	107.0	incl. Dw-1	107.0
	1.2. Diversion Dam Dw-1	-	-		-
	Total	-	107.0		107.0
2. Haro Basin	2.1. Storage Dam H-4	-	80.0		80.0
	2.2. Storage Dam Khanpur	160.0	-		160.0
	2.3. Tube Wells & Springs	47.3	-		47.3
	2.4. Diversion Dam Jw-1	70.8	-		70.8
	2.5. Storage Dam Shahpur	17.3	-	Heightening	17.3
	Total	295.4	80.0		375.4
3. Soan Basin for Islamabad	3.1. Storage Dam Simly	52.8	-		52.8
	3.2. Storage Dam K-2	?	-	expected	?
	3.3.1. Head Works N.P.-1	?	-	expected	?
	3.3.2. Ditto Kurang	5.3	-		5.3
	3.3.3. Ditto Six Others	16.2	-		16.2
	3.4. Tube Wells Islamabad	35.5	-		35.5
	Total	107.8	-		107.8
4. Soan Basin for Rawalpindi	4.1. Storage Dam Rawal	37.2	-		37.2
	4.2. Tube Wells Rawalpindi	49.6	-		49.6
	4.3. Diversion Dam Sw-1	-	succeeded by KL-1		-
	4.4. Storage Dam S-1	60.0	-		60.0
	4.5. Storage Dam L-1	-	70.0		70.0
	4.6. Storage Dam KL-1	34.0	-	M-1→KL-1	34.0
	4.7. Storage Dam SL-1	40.0	-		40.0
	Total	220.8	70.0		290.8
5. Head Works (Pump) at Soan river		6.4	-		6.4
6. Tube Wells for New Int. Air port		1.7	0.8		2.5
Grand Total		634.1	257.8		871.9
Total of Storage Dams's Resources		401.3	257.0		658.3
Ditto of Diversion Dams (incl.Head W.)		98.7	-		98.7
Ditto of Tube Wells		134.1	0.8		134.9

Demand	(Users and their Dimentions)
	1. Khanpur Dam project
57.7	1.1. Right Bank Irrigation
33.9	1.2. Left Bank Irrig. (exist.)
24.8[1)]	1.3. Wah
22.5[2)]	1.4. Taxila
138.9	Sub Total
102.3	2. Haro Left Area Irrigation 15,100hax7,077m³/ha/yr.x89.8%[3)]
215.8	3. Urban Water Islamabad 563,000m³/day x 365 x 1.05
379.1	4. Urban Water Rawalpindi 989,100m³/day x 365 x 1.05
xxx.x	5. Rural Irrigation Islamabad (Under individual study by JICA)
6.4	6. Rawalpindi South Irrigation 900ha x 7,077m³/ha/yr.x100%
2.5	7. New International Air Port 1.5 MGD

←Dor Conduction

←Khanpur Conduction

Note; 1) from Wah Spring, 2) from Tube Wells.
3) Remains are by Small S. Lift Irrig.

The Allowance:
Resources(891.9) - Demand(845.0) = 46.9 MCM

8. IMPLÉMENTATION PROGRAMMES

8. IMPLEMENTATION PROGRAMMES

801. Staged Development Plan of the Water Resources

Staged development plan of the water resources in the metropolitan area should be established taking into account the water demand of respective sectors, economic standpoint of facility construction and other social infrastructures related. The project would be implemented over a 43-year period, starting in 1988 with implementation of the first phase being followed by the second phase in 2001 and the third phase in 2011 to end in 2030. The phase-wise plans of water resources development can be summarized as follows:

(Unit: MCM)

Target Year	Storage Dam	Diversion Dam	Tubewell	Total
1987 (Present)	136.5	15.1	99.3	250.9
2000 (1st Phase)	173.5	83.6	29.4	286.5
2010 (2nd Phase)	91.3	-	5.4	96.7
2030 (3rd Phase)	257.0	-	0.8	257.8
Total	658.3	98.7	134.9	891.9
Percentage	(78.8%)	(11.1%)	(15.1%)	(100.0%)

Construction of facilities for the project will be completed as shown schematically in Figure VIII-1 in the third phase.

Chronological growth of water demands and supplies is illustrated in Figure VIII-2.

Figure VIII-1. Schematic Flow of Proposed Water Supply

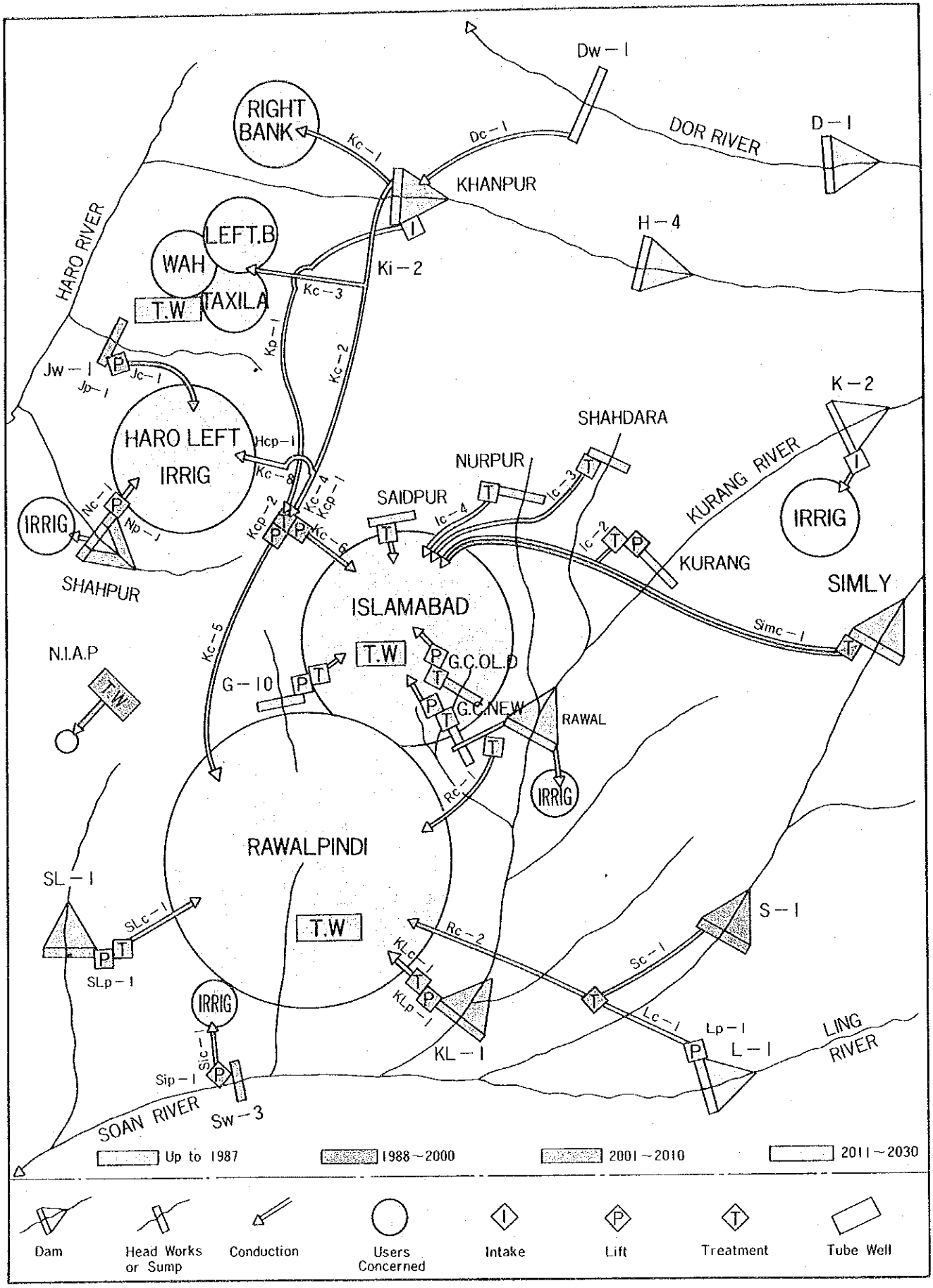
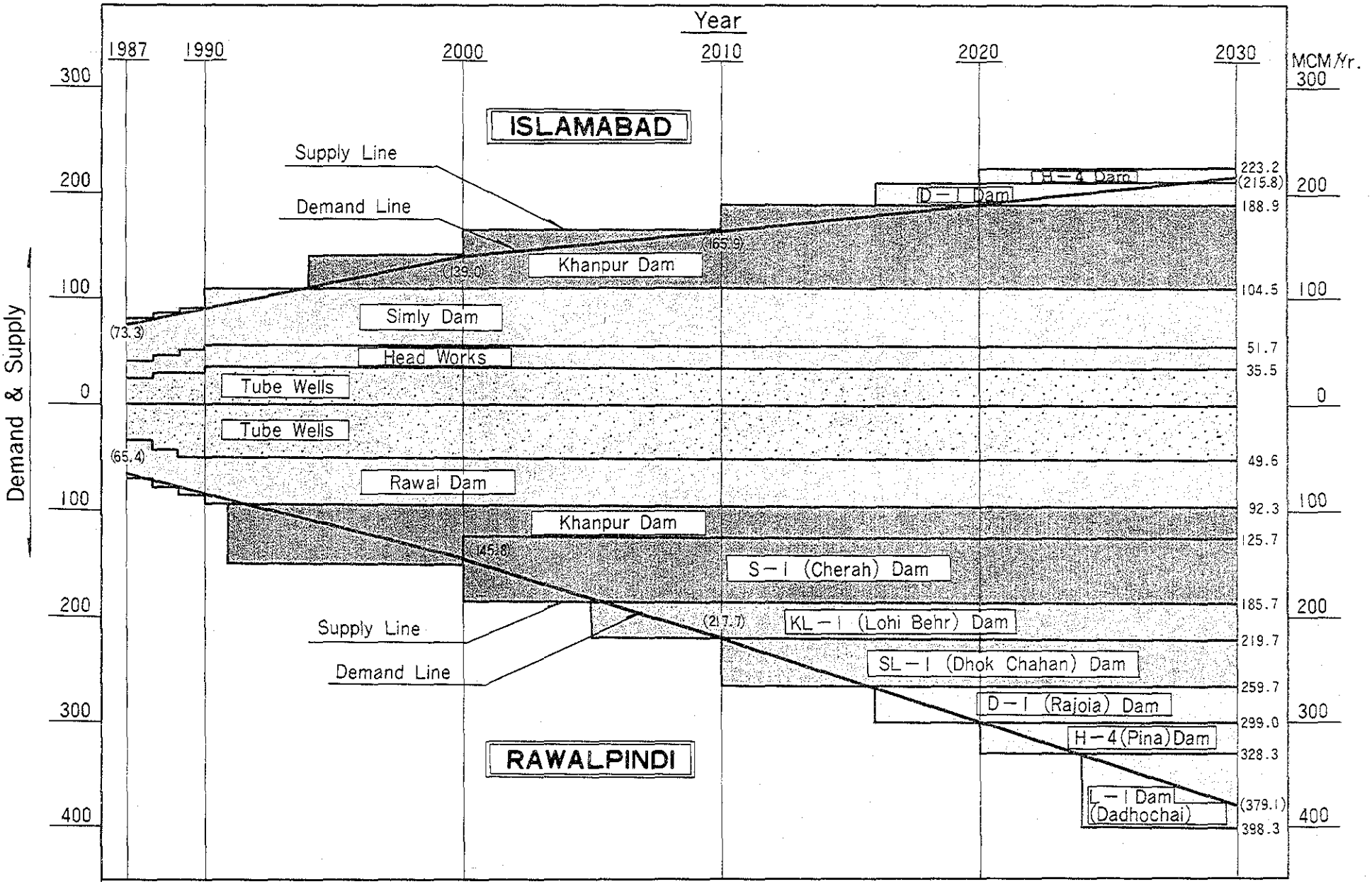


Figure VIII-2. Chronological Growth of Water Demands and Supplies



802. Investment Cost

The total investment costs which consist of construction cost, land acquisition, office facility, administration/engineering, physical contingencies and the cost of terminal facility are estimated at Rs. 16,500 million, of which Rs. 5,340 million is for the first phase, Rs. 2,200 million for the second phase, Rs. 8,960 million for the third phase. The summary of required investment costs is tabulated as follows:

Summary of Cost

(Unit: Rs. million)

Item	First Phase	Second Phase	Third Phase	Total
A. Major Facility	2,926.2	1,107.8	5,618.6	9,652.6
B. Land Acquisition	63.3	19.3	75.8	158.4
C. Office Facility	15.0	4.7	28.3	48.0
D. Engineering/Adminis.	295.2	91.2	538.2	924.6
E. Physical Contingency	329.3	122.0	625.1	1,076.4
Total	3,629.0	1,345.0	6,886.0	11,860.0
F. Terminal Facility				
- Urban Water	1,378.2	726.9	2,009.6	4,114.7
- Irrigation	328.7	123.6	60.3	512.6
- Airport Water	4.1	4.5	4.1	12.7
Total	1,711.0	855.0	2,074.0	4,640.0
Grand Total (A to F)	5,340.0	2,200.0	8,960.0	16,500.0

803. Organizational Set-up for Project Implementation

Implementation programmes of water resources development in the Metropolitan area are based upon a super long-term concept with intermediate and ultimate target years set at 2010 and 2030, respectively. The development of the Metropolitan areas is expected to be increasingly stepped up in line with such a concept.

At the same time, the administrative functions of Islamabad will necessarily be broadened and enhanced in parallel with such a development, including utilization and management of developed facilities.

In this connection, it will not be long before the need arises to consider the adjoining city of Rawalpindi functionally a part of the Metropolis or the Metropolis itself.

The water resources development for urban beneficiaries of the twin cities will center on the construction of dam for the storage of surface water. Such development is, at the same time, inseparably interconnected with other kinds and purposes of water utilization and it is thus considered to be imperative that an integrated implementation organ for the coordination and adjustment of various conflicting factors will be established.

In this light the expected urban functions of Islamabad and Rawalpindi in the said target years will be studied on the premise that the twin cities will be merged into a single city in accordance with the request of the Pakistan Government.

The said reorganization will be executed stage by stage (up to 1990, 2000, 2010) taking into consideration the federal policies and urban development plan and its development progress for the Metropolitan area.

9. EVALUATION OF THE WATER RESOURCES DEVELOPMENT PLAN

9. EVALUATION OF THE WATER RESOURCES DEVELOPMENT PLAN

This is the master plan study of a multi-project consisting of seven major components which is estimated to require the initial cost of Rs. 16,500 million and spans the implementation period of over forty years.

Financial analysis will be necessary as well as useful to grasp the overall picture on the viability of the Master Plan from the standpoint of actual project implementation as related to the executing organization.

Assessing the viability of the Plan piece by piece by separating each component will lead one to an erroneous conclusion that some components are viable, while others are not, thereby disrupting the notion of the Plan as one entity.

Furthermore, the Study Team deems it most important for water authorities which will directly get in touch with the implementation and operation/maintenance of the Project to place themselves financially on a sound basis in light of a problematic financial status of the existing Metropolitan water supply authorities. The fact that the Project is a water supply project and as such involves basic human needs does not justify a lack of financial discipline on the part of the authorities concerned. Especially, it is estimated that over forty percent of the initial cost will be met through external loans and it is essential that the authorities concerned will have clear-cut basic policies and eventually set their houses in order in pursuance of them to induce or convince international or foreign lenders into loan agreements in a smooth, favorable manner.

In line with the above concept, the Study Team tried to provide basic guidelines on such financial matters as water tariffs, ability to pay of households as percentage of their income, the standard

FIRR and relending terms on which the Government will provide capital to the water authorities.

901. Project Benefits

The benefits to be brought forth by the realization of the Project can be divided into urban water benefits and irrigation benefits in accordance with the ultimate usages of developed water resources. These two kinds of benefits are further divided into financial benefits and economic benefits.

a) Urban Water

Financial benefits of urban water depend on the water rates water supply authorities will impose on beneficiaries per unit quantity of consumption. Such water rates must be determined in the most appropriate manner by assessing both beneficiaries' paying ability and financial position of water supply authorities.

It is decided that financial benefits of urban water to be supplied under the Project will be Rs. 2.53 per 1,000 lit. (Rs. 11.50 per 1,000 gallons) as of 1987. Unit benefits will grow in future in parallel with the growth of beneficiaries' income.

Economic benefits of urban water are not calculated on the basis of unit cost of production. They are basically determined by beneficiaries' willingness to pay for unit quantity of consumption.

According to socio-economic surveys conducted by the Study Team, the beneficiaries in the Metropolitan areas are on average willing to pay Rs. 1.77 per 1,000 lit. (Rs. 8.05 per 1,000 gallons). It is assumed that their willingness to pay will grow in future in parallel with the growth of their income.

b) Irrigation Water

It is expected that agriculture in the beneficiary areas will witness a remarkable growth of income through the elevation of cropping intensity, improvement of cropping pattern, increase of production per unit cropped area, etc. when irrigation water is supplied to those areas under the Project.

The annual financial benefits of irrigation under the Project are estimated at Rs. 180.27 million. It means that financial benefits per 1,000 lit. (1,000 gallons) of irrigation water will be Rs. 1.50 (Rs. 6.82).

So far as irrigation is concerned, economic benefits are considered to be equal to financial benefits.

c) Airport Water

The New International Airport, the user of the urban water to be supplied belongs to public institutions and accordingly in accordance with the custom in the country financial benefits of the urban water for the user are assumed to be the same with those for the domestic user, i.e. Rs. 2.09 per 1,000 lit. (Rs. 9.50 per 1,000 gallons). Unit financial benefits are assumed to grow in future in parallel with the growth of the user's income.

Economic benefits of the airport water are assumed to be equal to the willingness to pay of Metropolitan public beneficiaries, i.e. Rs. 1.77 per 1,000 lit. (Rs. 8.05 per 1,000 gallons). Unit economic benefits are assumed to grow in future in parallel with the growth of the user's income.

902. Water Tariff

a) Water Tariff for Urban Water

The total average unit rate of urban water will be RS. 2.53 per 1,000 lit. (Rs. 11.50 per 1,000 gallons) as of 1987. User wise, on domestic/public users Rs. 2.09 per 1,000 lit (Rs. 9.50 per 1,000 gallons) and on commercial/industrial users Rs. 4.18 per 1,000 lit. (Rs. 19.0 per 1,000 gallons) will be imposed. Household income is estimated to grow at an average annual rate of around 3 percent in future in parallel with the growth of the economy. Water rate for domestic users, i.e. households will grow at an average annual rate of around 2 percent in parallel with the growth of household income on the premise that water payment is 2.5 percent of household income. Water rates for other users are assumed to grow in a similar way as the growth of domestic water rate.

b) Water Tariff for Irrigation Water

As already described, the irrigation water to be developed under the Project will bring forth the benefits of Rs. 1.50 per 1,000 lit. (Rs. 6.82 per 1,000 gallons). There arises a problem that out of that amount how much the authorities should collect from farmers. Analysis reveals that out of Rs. 1.50, Rs. 0.37 is made up of operation and maintenance cost. And the rest is consisted of investment cost and profit. The Study Team proposes that farmers bear the cost corresponding to 80 percent of O/M cost, i.e., they pay Rs. 0.30 per 1,000 lit (Rs. 1.36 per 1,000 gallons) and the remaining Rs. 1.20 per 1,000 lit. (Rs. 5.46 per 1,000 gallons) be shouldered by the Federal Government in the form of subsidy.

903. Project Evaluation

a) Project Cost and Preconditions

It is estimated that under the Project annual end demand for water amounting to 551.0 MCM will newly arise during the period 1988 to 2030, and to cope with it initial and O/M costs related to water resources development facilities amounting to Rs. 11,860.0 million and Rs. 189.0 million, respectively will be required.

Furthermore, it is preliminarily estimated that initial and O/M costs related to distribution and other facilities amounting to Rs. 4,640.0 million and Rs. 162.6 million, respectively, will be required.

Project life is assumed to be 50 years, ranging from 1988 to 2037. Project implementation period is assumed to be 43 years, starting in 1988 and ending in 2030.

When initial costs for water resources development facilities and the same costs for distribution and other facilities are converted into economic values by subtracting transfer payment such as customs duty and taxes from them, one gets Rs. 8,865.8 million and Rs. 3,859.6 million (preliminary estimate), respectively. Their respective conversion factors are 74.75 percent and 83.18 percent. Conversion operations were not performed on O/M cost.

The Study Team proposes the value of 5 percent as the standard FIRR for a water supply project. As the economic opportunity cost of capital the Team adopts the value of 12 percent which Planning Commission in the country recommends.

b) Financial Evaluation

Financial analysis reveals that the Project has the FIRR of 5.4 percent. It is higher than the standard FIRR of 5 percent by

0.4 percent and shows that the Project, incorporating water supply sector as a major component has a sufficient viability upon the above-mentioned premises on benefits.

b) Economic Evaluation

Economic analysis reveals that the Project has the EIRR of 4.2 percent. It is lower than the opportunity cost of capital of 12 percent by 7.8 percent. However, as already described, it is rare that a water supply project has an internal rate of return equal to or more than 6 percent.

Also, it is difficult to directly quantify economic benefits and when beneficiaries' willingness to pay is substituted for them, it tends to be lower than the real level. Furthermore, a water supply project involves basic human need and can not be left undone if people are to lead hygienic, healthy and modern lives. For these reasons, the Project, incorporating water supply sector as a major component, is judged to be economically feasible.

904. Financial Support

a) Development Budget of Water Sector and Initial Cost

The gross domestic product (GDP) of Pakistan in 1985-86 was Rs. 527,792 million at market prices. The Annual Development Programme (ADP), which is the development budget of Pakistan was Rs. 39,398 million in the same year. Consequently, ADP as percent of GDP comes to 7.5 percent. Out of the total amount of ADP, Rs. 5,197 million or 13.2 percent was appropriated for water sector. At Federal level, the appropriation for the same sector was Rs. 4,001 million.

On conditions that the above relationships continue in the future and the average annual growth rate of GDP during the project

implementation period 1988 to 2030 is 4.88 percent the cumulative amount of water sector development budget for the same period works out at Rs. 715,289 million. At Federal level it is roughly estimated at Rs. 550,678 million. On the other hand, total initial cost for water resources development, distribution and others under the Project adds up to Rs. 16,500 million. Thus, the share of the total initial cost in the corresponding water sector development budget works out at 3.0%.

Population and GDP of the Project Region as the administrative region encompassing beneficiary areas in 1981 occupied 4.3 percent and 4.5 percent of national population and GDP, respectively. The above share is, therefore, considered to be reasonable and realistic. Thus, the Project is judged to be an undertaking the country can sufficiently cater for in budgetary/financial terms.

b) Financing Terms for Executing Agency

Analysis reveals that when the urban water supply project under the Project has the FIRR of 5.2 percent, water payment as percentage of household income will be 2.5 percent. Practically, the maximum limit of the ability to pay for water of a household is considered to be 3 percent of its income. Therefore, under the above FIRR households can reasonably and realistically bear water cost.

The Study Team thus proposes that the Federal Government will provide the executing agency of the Project with the development funds at the annual interest rate of 5 percent or less.

10. CONCLUSION AND RECOMMENDATION

10. CONCLUSION AND RECOMMENDATION

1. The water resources development plans proposed in this report are based on the projected population and water demand at the target year of 2010 and 2030. Islamabad metropolis is expanding as a new capital of Pakistan in accordance with the federal government policy and CDA's development plan, so that the water resources development plans should be implemented following the revision of national policy or urban development plan as well as that of urban water supply scheme.

2. The urban water supply area covers both Islamabad area where a new capital is under construction and Rawalpindi area which is an old city. The both areas have different development history, but will develop their administrative functions complementary to each other in future.

   As development progresses, the urban development plan covering two cities will be comprehensively formulated and revised as required. Consequently, urban water supply scheme should adjust itself to the revision.

3. The irrigation development plan on the proposed area should be undertaken in due consideration of farmer's needs, prospect of suburban agriculture, its profitability and economics.

   On implementing the plan, elaborate study on the existing water rights and prior intake methods should be made with the authorities concerned.

4. For surface water resources development, hydrological data should be regularly observed at the proposed dam sites and intake points.

   For groundwater development, on the other hand, water level and yield in the existing wells should be continuously gauged in order

to evaluate available yield and influence of new wells on the existing wells.

5. Judging from such natural features as topography, meteorology and geology, and expected function and scale of the capital, water resources for urban water will be developed mainly by dams reserving surface water. Groundwater, spring and lifting schemes (especially for irrigation purpose) are other potential water resources for alternatives.

   Groundwater, especially, should be utilized as provisional water resources or water resource alternative for extraordinary drought year appearing once in more than 10 years.

   In wet year, therefore, surface water should be efficiently utilized for saving the groundwater resources.

6. The groundwater investigations performed in this study only delineate an outline of the hydrogeological conditions of the study area. It has not been made clear in this study that even the present groundwater abstraction amount is optimum or not because of the lack of data. For the reasons mentioned above, further studies should proceed for more accurate estimation of the area's groundwater development potential based on more detailed and reliable data. Such data would include long-term hydrographs of the groundwater tables.

7. Basic approach to water resources development is to undertake higher priority schemes which have less disadvantages from technical and economic points of view.

   Detailed water resources development plan should be formulated within the framework allowable, examining compensation for the existing water rights, evaluating effects on the rights and coordination various development plans in the same basin.

8. D-1 and H-4 dams related to the Khanpur dam are multi-purpose dams, requiring not only large sum of investment, but also understandings and consensus from various consumers.

Water allocation of the Khanpur dam should be revised when necessary by evaluating present water use, potential of other water resources and their economics.

9. As for water use plan of the Kurang river basin, optimum water allocation should be formulated by elaborately examining present urban water supply and the on-going irrigation development project (covering 6,600 ha).

10. Technically and economically appropriate watershed management schemes should be formulated by evaluating the characteristics of river basin.

Intensive administrative guidance should be exerted to implement the schemes, examining countermeasures and regulations on water pollution.

11. It will not be far away before the urban development plan can not function without uniting two cities into one administration.

Expansion of the development will increase administrative tasks in CDA. Taking it into consideration that the Khanpur conduction project is needed to be implemented by joint venture by the both cities, the construction and O/M of water supply facilities should be administered by the united organization in future.

Intricate urban water system in the both cities should be phased out into a single organization. The reformed organization will promote engineers who can deal with construction of large-scale dams and urban water system.

12. As water resource development progresses and urban water supply system expands, operation and maintenance works will extend to wide area and become intricate.

Since the multi-purpose dam and single-purpose dam co-exist having different water use patterns in various consumers, water utilization and operation plan of dams should be formulated on a long-term basis in due consideration of technical innovation and coordination with medium-term plan.

13. The Metropolitan population to be served with urban water in the ultimate target year of 2030 is estimated at 3,267,000. And per capita demand in the same year is forecast to be 475 lit. Consequently, the annual total demand for urban water works out at 566.4 MCM. Furthermore, irrigation water of 120.3 MCM to serve the farming areas of 17,000 ha lying adjacent to the Metropolis and urban water of 2.5 MCM to serve the New International Airport will be required under the Project.

14. The construction cost for the development of water resources to meet the above demands is estimated at Rs. 9,652.6 million. Out of it, Rs. 4,218.7 million or 43.7% will be catered for by foreign exchange component, and the remaining Rs. 5,433.9 million or 56.3% will be met by local currency.

Along with it, the cost for land acquisition, office facilities, engineering/administration and physical contingencies is preliminarily estimated at Rs. 2,207.4 million. Furthermore, the cost for terminal facilities is preliminarily calculated at Rs. 4,640.0 million. Thus, the total investment cost necessary to meet water requirements under the Project works out at Rs. 16,500.0 million.

15. The project has the EIRR of 4.2%. It is by 7.8% lower than the opportunity cost of capital at 12% in the country. However, the Project will provide urban water to the ever-growing Metropolitan population and also irrigation water to the adjacent areas for the period of half a century.

The urban water is essential and indispensable for the future Metropolitan citizens to enjoy hygienic, healthy and modern lives, and irrigated farmlands will supply them with ample fresh vegetables and fruits, thereby promoting and maintaining their nutritional balance and health. that is to say, the Project is a fundamentally social undertaking, concerning itself with basic human needs. The project is thus judged to be economically feasible.

16. Under the FIRR of 5.4% water supply authorities can formulate a water tariff under which metropolitan households will spend 2.5% of their income on water. The percentage is within the maximum limit of ability to pay at 5% and also within the practical limit at 3%.

A higher FIRR is likely to put undue stresses on beneficiaries' home economy. While the long-term interest rate in the country is 14%, it is not reasonable, nor realistic to apply such a value in assessing the financial feasibility of a project with a highly social meaning and importance. Because of its crucial implications in the welfare of the future Metropolitan households, the Project is judged to be feasible at the FIRR of 5.4%.

17. It is preliminarily estimated that the Federal Government will have enough budgetary means to finance the Project, judging from the budgetary scale yearly growing in parallel with the national economy and a fair share water sector enjoys in budgetary allocations.

The Federal Government is strongly recommended to provide the executing agency of the Project with the necessary development funds at the annual interest rate of 5% or less on the above mentioned ground.

18. Urban water is an economic commodity, and it is at the same time one of basic human needs. The accommodation of these two sides can be attained through a water tariff structure where charges will be nominal up to the limit of a basic consumption, but beyond it they will progressively go up. Formulation and adoption of such a structure is highly recommended to reconcile Islamic teaching with modern economics.

19. For proper management of the urban water supply system, self-financing basis should be set up by introducing optimum water tariff system as well as levying the tariff compatible with Islamic belief.

The water tariff system will be set up by coordinating such programs as raising of consumers' consciousness, provision of service facilities and prevention of water leakage.

Increase of the consumers' income will improve their living condition as well as their payable amount for water, but a sufficient financial support from the federal government is indispensable at the same time.

20. These recommended projects should be phased on long-term basis. In order to meet acute urban water demand at the present moment, construction of water treatment plants and distribution facilities connected to the Khanpur dam and expansion of both Simly and Rawal water treatment plants should be commenced as early as possible.