5. THE SECOND PRIORITY PROJECT

Among the three basins situated in the south-east slope of Mt. Semeru, the Sediment control facility project in K. Mujur basin was selected as the second priority project.

In K. Mujur basin, the Urgent Rehabilitation Project is already financed by OECF loan and now being under construction. This project is composed of long dikes and the rehabilitation of a check dam aiming to prevent disasters of the comparable magnitude of the one which occurred in May, 1981. After completion of the dikes, the sediment disaster in the left hand of K. Mujur almost will be ceased.

5.1 ALTERNATIVE PLANS

The facilities which have such functions as sediment yield suppression, sediment runoff regulation and sediment runoff storage are selected as proposed facilities for the second priority project among the Revised Master Plan. Refer to Fig.-5.1

As the construction order of sediment control facilities has great influence upon its function, it is decided from a technical standpoint. The construction order of the proposed facilities for the second priority project are decided on the basis of the following consideration, and shown in Table-5.1.

① Sediment control facilities function effectively as a whole system of them including the all facilities completed upon to then. Therefore all the existing facilities are included in each alternative.

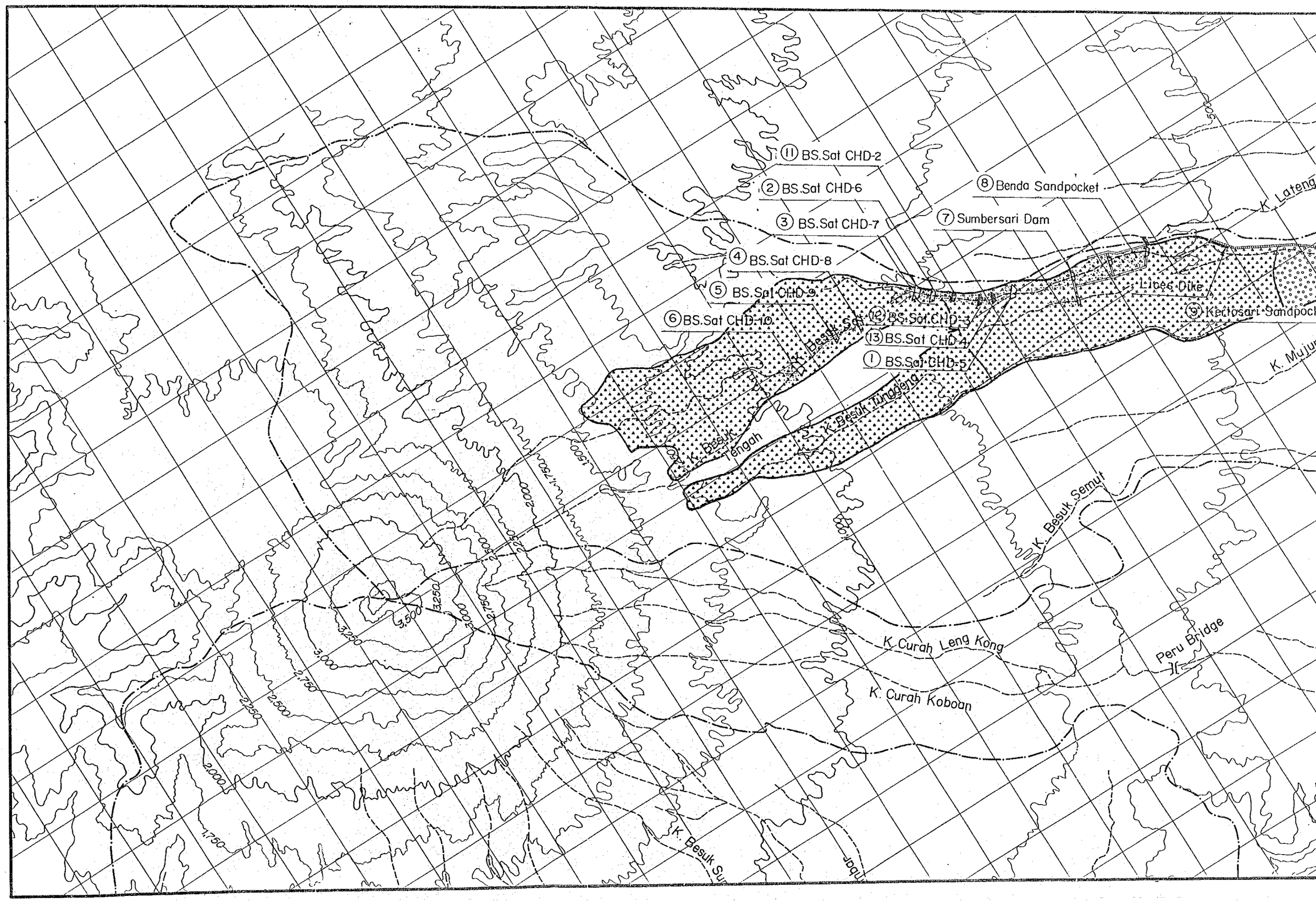
② The construction of the proposed facilities must be started with check dams situated at the upstream of the existing check dam. And the construction must be continued toward the upper stream.

③ After most of the check dams are completed, the construction of sandpockets situated in the fan area must be started from the head of the fan toward the down stream.

Table-5.1 Construction Order

Construction Order	Facility
1	11. BS. Sat check dam-2, 12. BS. Sat check dam-3, 13. BS. Sat check dam-4
2	3. BS. Sat check dam-7
3	1. BS. Sat check dam-5, 2. BS. Sat check dam-6
4	4. BS. Sat check dam-8, 5. BS. Sat check dam-9, 6. BS. Sat check dam-10
5	7. Sumbersari check dam
6	8. Benda sandpocket
7	9. Kertosari sandpocket, 10. Kloposawit sandpocket

By dividing the construction order into some stages, six alternatives have been chosen as shown in Table-5.2. Alternative plan of P2-0 in the table consists of the existing check dams.


⑪ BS.Sat CHD-2
② BS.Sat CHD-6
③ BS.Sat CHD-7
④ BS.Sat CHD-8
⑤ BS.Sat CHD-9
⑥ BS.Sat CHD-10
⑫ BS.Sat CHD-3
⑬ BS.Sat CHD-4
① BS.Sat CHD-5
⑧ Benda Sandpocket
⑦ Sumbersari Dam
Lipes Dike
⑨ Kertosari Sandpocket
K. Lateng
K. Mujur
K. Besuk Sat
K. Besuk Tengah
K. Besuk Tunggeng
K. Besuk Semut
K. Curah Leng Kong
K. Curah Koboan
Peru Bridge
K. Besuk Su
Dabar
2000
1,750
2,250
2,500
2,750
3,000
3,250
3,500

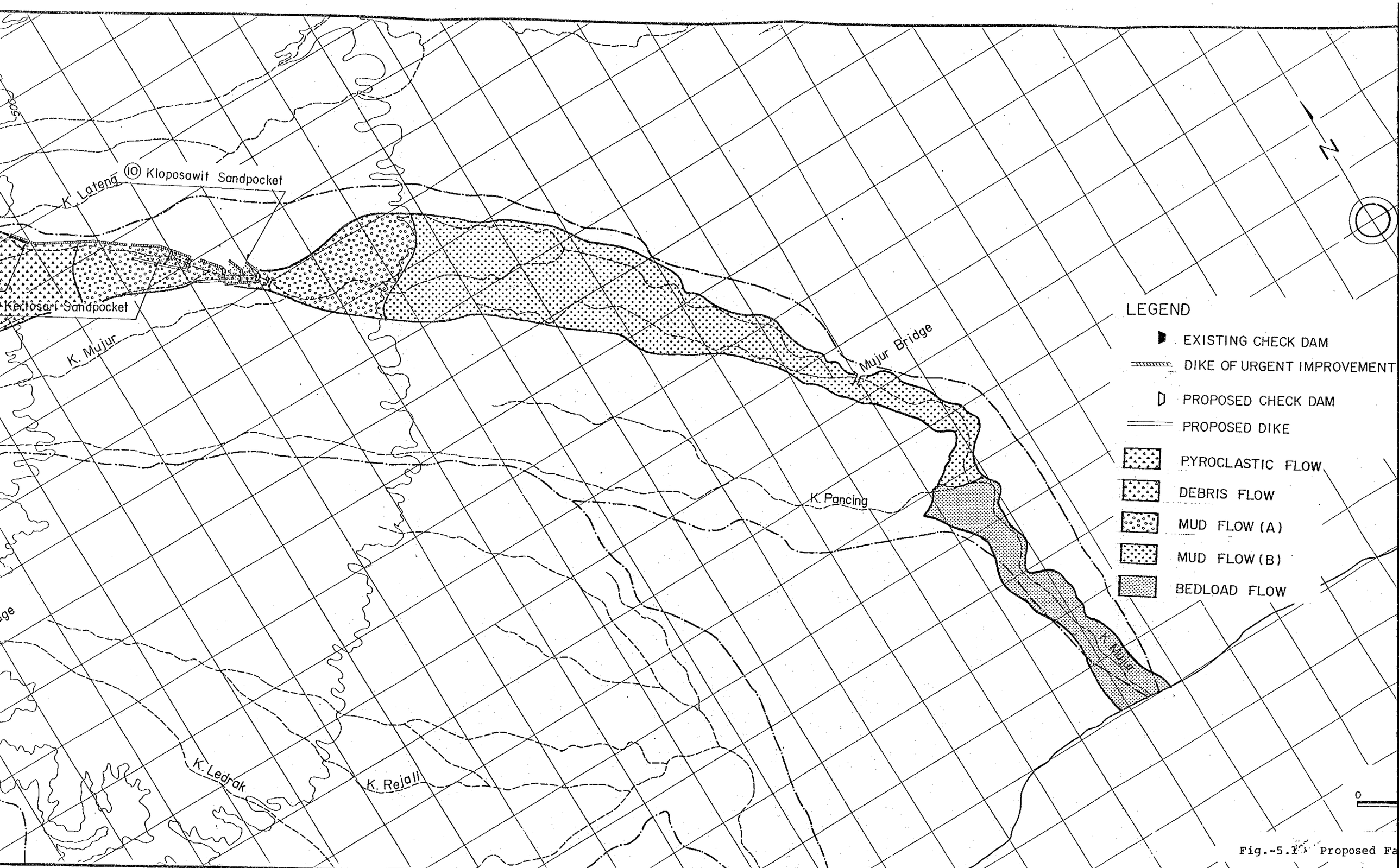


Fig.-5.1 Proposed Fa

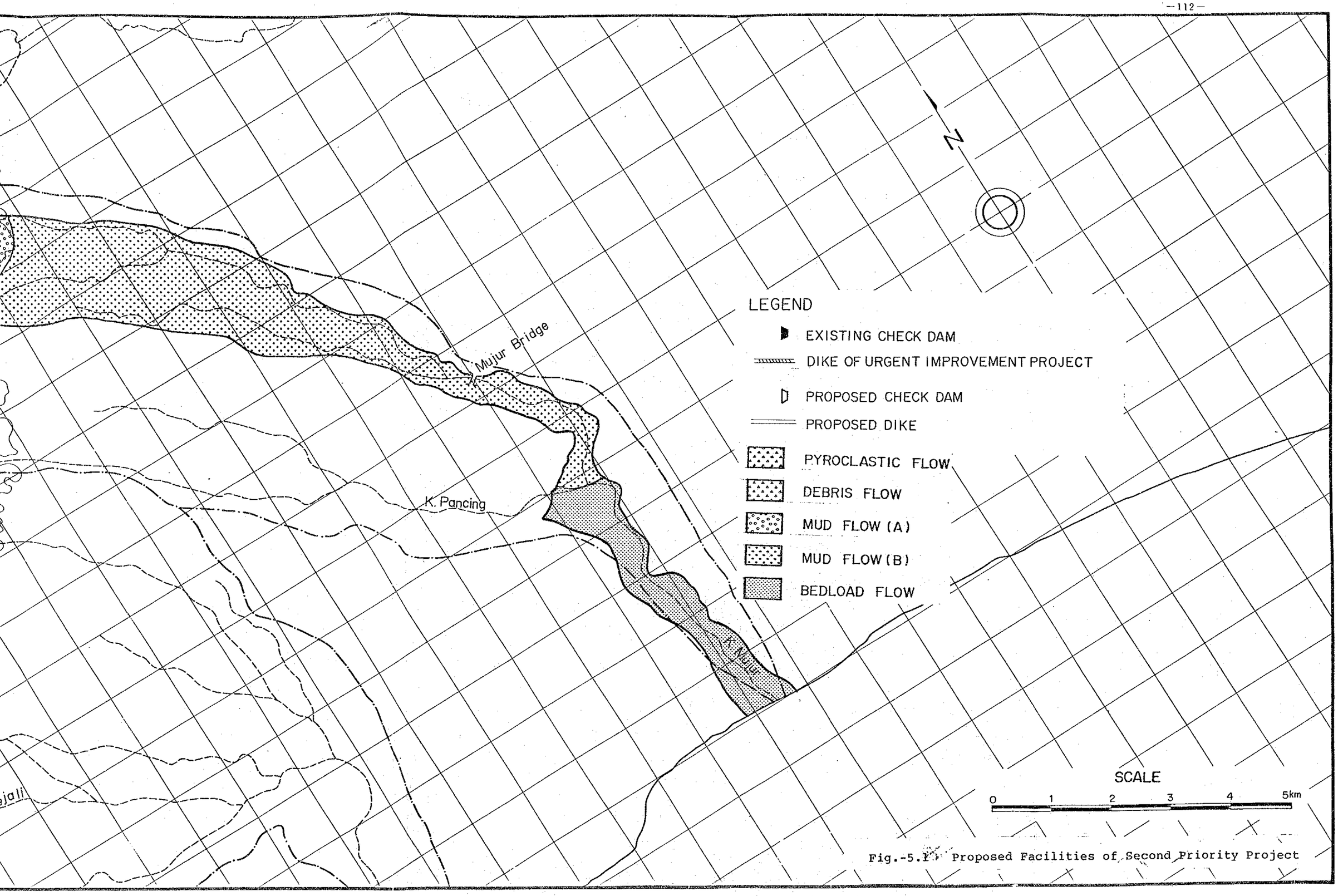


Fig.-5.1 Proposed Facilities of Second Priority Project

Table-5.2 Alternative plans for Second Priority Project

Alternative Plan No.	Sediment Control Function	Combination of Facilities	Sediment Control Volume (10^3m^3)	Return Period of Plan (year)
P2-0	F1, F2	11 , 12 , 13 , (Existing ones only)	(273)	(5)
P2-1	F1, F2	11 , 12 , 13 , 3 ,	400	10
P2-2	F1, F2	11 , 12 , 13 , 1 , 2 , 3	1,210	20
P2-3	F1, F2	11 , 12 , 13 , 1 , 2, 3 , 4 , 5 , 6	2,068	40
P2-4	F2, F2	11 , 12 , 13 , 1 , 2, 3 , 4 , 5 , 6 , 7	2,703	55
P2-5	F1, F2, F3	11 , 12 , 13 , 1 , 2, 3 , 4 , 5 , 6 , 7 , 8	3,821	75
P2-6	F1, F2, F3	11 , 12 , 13 , 1 , 2, 3 , 4 , 5 , 6 , 7 , 8 9 , 10	4,575	90

Table-5.3 Proposed Facilities for Second Priority Project

	Facilities	Sediment control volume (10^3m^3)		Facilities	Sediment control volume (10^3m^3)
1	BS. Sat check dam- 5	30	9	Kertosari sandpocket	331
2	" - 6	130	10	Kloposawit "	423
3	" - 7	1,050	11	BS. Sat check dam-2	164
4	" - 8	240	12	" -3	94
5	" - 9	340	13	" -4	15
6	" -10	278			
7	Sumbersari dam	635	11 12 13 ; Existing facility		
8	Benda Sandpocket	1,118			

Note: Sediment Control Function

F1: Sediment Yield Suppression
F2: Sediment Runoff Regulation
F3: Sediment Runoff Storage
F4: Sediment Transport Adjustment

5.2 PROJECT COST

(1) Outline of Facilities

(A) BS. Sat check dam No. 5, No. 6 and No. 7

They are planned aiming at sediment run-off regulation and sediment yield suppression. They are also planned as one of the step dams as well as the existing check dams.

They are gravity-type masonry concrete dams with gravel foundation. Since the foundation is composed of gravel, a concrete apron and a water cushion both are designed.

(B) BS. Sat check dam No. 8, No. 9, No. 10

They are planned aiming at sediment yield suppression. They are planned as one of the step dams which are connected with BS. sat check dam No. 7.

They are gravity-type masonry concrete dams. BS. Sat check dam No. 8 has the gravel foundation, while others have the rock-foundation. Regarding the water cushion and apron, the design concept is the same as the above-mentioned check dams.

(C) Sumbersari check dam

Sumbersari check dam is situated at the end of the downstream of the valley area. Its main function is designed for sediment run-off regulation. It is composed of three parts, namely a check dam in K. BS. Sat, a check dam in K. BS. Tunggeng and a concrete wall which joins these two dams.
It is a gravity-type masonry concrete dam with gravels foundation. A concrete apron and a water cushion both are designed.

(D) Benda sandpocket

It is planned aiming at sediment run-off storage on the head of the fan area. It is composed of two spillways and dikes which are aiming to promote sediment storage.

The spillways are gravity-type masonry concrete dams with gravels foundation. The dikes are embankment of earth with gabion work revetment.

(E) Kertosari sandpocket and kloposawit sandpocket

They are planned aiming at sediment run-off storage using the dikes included in the Urgent Improvement Project.

Kertosari sandpocket is composed of two spillways and dikes. Kloposawit sandpocket is composed of three spillways and dikes. These materials are the same as Benda sandpocket.

The spillway shall have two overflow section for low water and high water. Low water overflow section shall be fitted with the same elevation as the present riverbed lest the deposition may occure with harmless sediment in normal season.

(2) Economic Cost

Economic cost of the Second Priority Project is calculated by the same method as in the First Priority Facility Project and shown in Table-5.4.

Table-5.4 Economic Cost of Sediment Control Facilities for the Second Priority Project

No.	Facility	Economic Life (Year)	Economic Cost (10^6 Rp)	Maintenance Cost (10^6Rp/year)
1	BS. Sat check dam No.5	80	248	-
2	BS. Sat check dam No.6	80	315	-
3	BS. Sat check dam No.7	80	4,177	-
4	BS. Sat check dam No.8	80	204	-
5	BS. Sat check dam No.9	80	574	-
6	BS. Sat check dam No.10	80	379	-
7	Sumbersari dam	80	5,898	-
8	Benda sandpocket	50	9,405	40
9	Kertosari sandpocket	50	513	30
10	Kloposawit sandpocket	50	811	37
11	BS. Sat check dam No.2	80	469	-
12	BS. Sat check dam No.3	80	408	-
13	BS. Sat check dam No.4	80	285	-

Based on the price level of fiscal year 1982

5.3 PROJECT BENEFIT

The economic benefit with the sediment control facilities is the direct and indirect damage mitigation amount. For the second priority project, it was estimated by the same way as for the first priority facility project discussed in chapter 4.

5.3.1 DISASTER MODEL

(1) Possible Disaster Area

The possible disaster area of the K. Mujur in the Revised Master Plan stretches far left-ward. But the Urgent Rehabilitation Project is now being carried out in order to prevent the disaster in the left-side of the disaster area of K. Mujur. Therefore after the completion of the Urgent Rehabilitation Project, the left-side disaster area of K. Mujur shall be excluded from the possible disaster area. Refer to Table-5.5 and 5.6.

Table-5.5 Possible Disaster Area of K. Mujur after Urgent Rehabilitation Project

Zone	I	II	III	IV	V	Total
Acreage (km^2)	-	8.03	5.23	12.05	3.43	28.74

Table-5.6 Desas in Potential Disaster Area of K. Mujur after Urgent Rehabilitation Project

Name of Kecamatan	Name of Desa
Pasirian	Nguter, Selok Awar-2, Madu Rejo, Semeru
Tempeh	Tastisari, Lempeni, Padanwangi, Gesang
Candipuro	Penaggal, Kloposawit, Tumpeng, Sumber Mujur

(2) Design Sediment Volume

The designed sediment volume of K. Mujur for each return period is shown on Table-5.7.

Table-5.7 Design Sediment Volume (K. Mujur)

Return Period (year)	Designed excess sediment volume (10^3m^3)	Magnitude of disaster
3	250	0.0235
5	270	0.0254
10	330	0.0310
20	1,250	0.1175
40	2,070	0.1945
70	3,480	0.3271
100	5,040	0.4737
Maximum Deposit Volume	10,640	1.00

(3) Magnitude of Disaster

The Magnitude of disaster is calculated by dividing the design sediment volume of each return period by maximum deposits volume as mentioned in the chapter 4. It is shown on Table-5.7.

(4) Damage ratio

The damage ratio is determined according to the thickness of sediment deposit in the same way mentioned in the chapter 4.

The thickness of sediment deposit is determined for each zone based on the investigation results. See Table-5.8.

Table-5.8 Average Thickness of Sediment Deposit

(Unit: m)

Name of Basin	Possible Disaster Zone				
	I	II	III	IV	V
K. Mujur	-	0.38	0.31	0.39	0.37

5.3.2 DIRECT DAMAGE

The following six items are selected as the direct damage categories.

- General assets
- Agricultural products
- Livestock and fowls
- Human productivities
- Public facilities
- Sediment removal expense

The estimated potential damage value in the possible disaster area is shown in Table-5.9.

Table-5.9 Estimated Damage Potentisl Value of K. Mujur after Urgent Rehabilitation Project

(Unit: 10^6 Rp)

Item \ Zone	I	II	III	IV	V	Total
General Assets	-	2,997	933	5,310	3,777	13,017
Agricultural Products	-	164	44	266	157	631
Livestock	-	398	107	705	1,212	2,422
Human	-	5,244	1,389	9,080	5,895	21,608
Public Facilities	-	370	55	964	6	1,395
Total	-	9,173	2,528	16,325	11,047	39,073

Based on price level of fiscal year 1982/1983

5.3.3 INDIRECT DAMAGE

Indirect damage is estimated by the same way as in the first priority project, namely, the approximate indirect damage amount is set up at Rp. 2,000 per capita.

5.3.4 ANNUAL DIRECT AND INDIRECT DAMAGE

(1) Annual direct damage

The maximum direct damage which shows the direct damage for whole the possible disaster area and the direct damage for each return period are calculated by the same way as in the first priority project, and shown in Table-5.10.

The annual direct damage for each return period is calculated using the result of Table-5.10 and taking into consideration the increment of assets.

Table-5.10 Direct Damage of K. Mujur

10^6 Rp

Return Period	Asset	Crop	Cattle	People	Facility	Reh.Land	Total
3	138	10	8	34	6	120	316
5	150	10	8	37	6	129	340
10	183	13	10	45	8	158	417
20	692	50	39	170	30	599	1,580
40	1,146	83	65	281	49	991	2,615
70	1,298	140	109	472	82	1,667	3,768
100	2,791	203	157	684	119	2,414	6,368
Max. Damage	5,893	429	332	1,444	251	5,095	13,444

(2) Annual indirect damage

The annual indirect damage is calculated by the same way as direct damage.

5.3.5 DAMAGE MITIGATION EFFECT BY SEDIMENT CONTROL FACILITIES

The damage mitigation effect of the sediment control facilities is calculated by the differences between the damage areas with and without the facilities. The differences above are in proportion to the sediment volume to be controlled by each facility.

The sediment volume controlled by each facility is quoted from the Master Plan and shown in Table-5.11. In Table-5.11, the coefficient of disaster mitigation is obtained by dividing the controlled sediment volume by the designed excess sediment volume.

Benefits from a sediment control plan is defined as the mitigation effects which may reduce direct and indirect damages. It is calculated by using the annual damage for each return period and the sediment control effects by each facility. Annual benefit is shown in Table-5.12.

Table-5.12 Annual Beneift of the Second Priority Project at 1992

(Unit: 10^6Rp)

Item / Plan	Direct damage mitigation amount	Indirect damage mitigation amount
P2-1	336	1
P2-2	342	1
P2-3	368	1
P2-4	377	1
P2-5	385	1
P2-6	388	1

5.4 EVALUATION

5.4.1 ECONOMIC EVALUATION

Using the costs and benefits mentioned above, economic analysis for each alternative was carried out in the same procedure as chapter 4. The results are summarized in Table-5.13 and Fig.-5.2 for the period of the project life of 40 years.

According to Fig.-5.2, the I.R.R. and the net present value (N.P.V.) are decreased abruptly starting at the return period of 40 years. It is desirable, therefore, that the design magnitude of the second priority project shall be at 40 years return period from economic point of view. The alternative P2-3 is the most recommendable project. It has the economic cost of 7,059 million Rp. and the I.R.R. of 5.3%.

Table-5.11 Sediment control effect in K. Mujur

	Facilities	Control Sediment volume (10^3m^3)	Coefficient of disaster mitigation for each retrun period						
			3 year	5	10	20	40	70	100
1.	BS. Sat check dam No. 5	30	0.120	0.111	0.0909	0.024	0.014	0.009	0.006
2.	No. 6	130	0.520	0.481	0.394	0.104	0.063	0.037	0.026
3.	No. 7	1,050	1.00	1.00	1.00	0.840	0.507	0.302	0.208
4.	No. 8	240	0.96	0.889	0.727	0.192	0.116	0.069	0.048
5.	No. 9	340	1.00	1.00	1.00	0.272	0.164	0.098	0.067
6.	No. 10	278	1.00	1.00	0.842	0.222	0.134	0.080	0.055
7.	Sumbersari check dam	635	1.00	1.00	1.00	0.508	0.307	0.183	0.126
8.	Benda dandpocket	1,118	1.00	1.00	1.00	0.894	0.540	0.321	0.222
9.	Kertosari sandpocket	331	1.00	1.00	1.00	0.265	0.160	0.095	0.066
10.	Kloposawit sandpocket	423	1.00	1.00	1.00	0.338	0.204	0.122	0.084
11.	BS. Sat check dam No. 2	164	0.656	0.607	0.497	0.131	0.079	0.047	0.033
12.	" No. 3	94	0.376	0.348	0.285	0.075	0.045	0.027	0.019
13.	" No. 4	15	0.060	0.056	0.045	0.012	0.007	0.004	0.003

No. 11, 12 and 13 : Existing facilities

Table-5.13 Result of Economic Evaluation for Second Priority Project

Alternative Plan	Combination of Facilities	Magnitude of Plan (year)	Economic Cost: Capital Cost (10^6Rp)	Economic Cost: Maintenance Cost (10^6Rp/year)	I.R.R (%)	N.P.V.
P2-1	11, 12, 12, 3	10	5,339	0	6.48	12.1
P2-2	11, 12, 13, 1, 2, 3	20	5,902	0	5.91	12.1
P2-3	11, 12, 13, 1, 2, 3, 4, 5, 6	40	7,059	0	5.29	12.7
P2-4	11, 12, 13, 1, 2, 3, 4, 5, 6, 7	55	13,057	0	2.54	10.3
P2-5	11, 12, 13, 1, 2, 3, 4, 5, 6, 7, 8	75	22,462	40	0.51	2.9
P2-6	11, 12, 13, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	90	23,786	107	0	-

No.	Facility name	No.	Facility name
1	BS. Sat check dam No. 5	8	Benda sandpocket
2	" No. 6	9	Kertosari sandpocket
3	" No. 7	10	Kloposawit sandpocket
4	" No. 8	11	BS. Sat check dam No. 2
5	" No. 9	12	" No. 3
6	" No. 10	13	" No. 4
7	Sumbersari check dam		

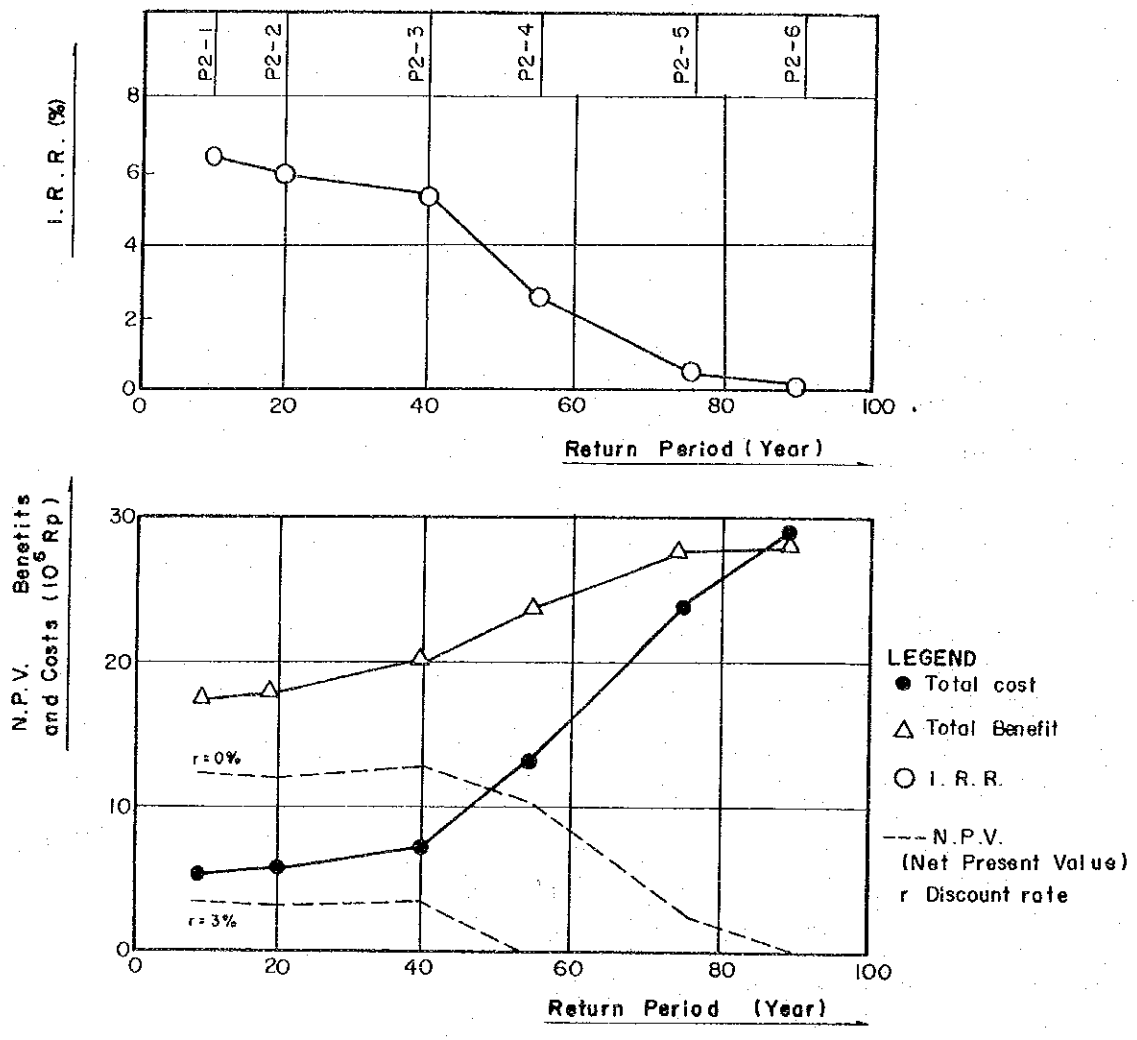


Fig.-5.2 I.R.R., N.P.V., Benefits and Costs

5.4.2 SOCIAL EVALUATION

The possible disaster area of K. Mujur has some 20 thousands inhabitants and much properties as shown in Table-5.14. A lot of people and assets are always confronted with fear of disaster.

Those who had lost their houses were transmitted to other places and, as such social insecurity brought about by the sediment disaster is high in the area.

It is impossible to prevent these damages by mere construction of local dike; and therefore, a comprehensive sediment control work in the area is needed.

Although economic value of intangible benefits which contribute greatly to the maintenance of social stability in the area would be difficult to assess, a sediment control project is extremely important from social standpoint. Such intangible benefits are listed below.

Protection of Human Life

Stabilization of Inhabitant's Livelihood:

Safety, security and stability of inhabitants will be strengthened by freeing them from the fear of debris disaster.

Table-5.14 Properties in the Possible Disasters Area of K. Mujur

Item	Quantity	Item	Quantity
Mosque and Church	34 houses	Cultivated field	1,637 ha
School	15 "	Liestock	4,787 heads
Factory	4 "	Poultry	23,166 "
Store	40 "	People	19,644 persons
House and Office	4,252 "		

5.4.3 TOTAL EVALUATION

As stated previously, the highest I.R.R. of the alternative plan for second priority project is 5.3%. However, execution of a plan will certainly strengthen the basis of the total development plan for the area. Therefore this project of this nature is indispensable.

Design magnitude of a plan should be 40 years for I.R.R. and N.P.V. begin to decline abruptly starting this period as shown by the result of economic evaluation. Accordingly, the alternative plan P2-3 is recommended as the second priority project.

The disaster in this area tends to cause a great loss of live. Because such a tragedy has an unfathomable impact on the local society, it would be desirable to carry out the execution of the recommended project as soon as possible.

5.5 IMPLEMENTATION PLAN OF SECOND PRIORITY PROJECT

5.5.1 OUTLINE OF PROJECT

Facilities to be constructed by the second priority project are shown in Table-5.15 and drawings in Supplement-5.

Table-5.15 Outline of Second Priority Project

No.	Facility	Specification		
1	BS. Sat check dam 5	H= 8m	L=190m	Vc= 7,800m^3
2	BS. Sat check dam 6	H= 8m	L=186m	Vc=10,000m^3
3	BS. Sat check dam 7	H=19m	L=320m	Vc=49,000m^3
4	BS. Sat check dam 8	H=11m	L=102m	Vc= 6,400m^3
5	BS. Sat check dam 9	H=17m	L=198m	Vc=18,000m^3
6	BS. Sat check dam 10	H=17.5m	L= 72m	Vc=12,000m^3
11	BS. Sat check dam 2	H=11.0m	L=197m	Vc=14,000m^3
12	BS. Sat check dam 3	H= 9.0m	L=200m	Vc=13,000m^3
13	BS. Sat check dam 4	H=10.5m	L=203m	Vc= 9,100m^3

H : Dam height
L : Dam length
Vc: Volume of masonry concrete
No.11, No.12, No.13: existing facilities

5.5.2 CONSTRUCTION SCHEDULE

The construction period of the second priority project is six years including surveying, detail designing, tender and preparatory works.

Schedule for the entire construction works is shown in Table-5.16. As shown in Table-5.16, the design work, tender work and procurement process of the construction equipment are executed in the first year. The construction works are started in the second year and completed for next 5 years.

Table-5.16 Project Work Schedule for Second Priority Project

Description \ Fiscal year	1st			2nd			3rd			4th			5th			6th		
	4	9	3	4	9	3	4	9	3	4	9	3	4	9	3	4	9	3
1. Engineering Service																		
(1) Design																		
(2) Tender																		
(3) Procurement Process																		
(4) Construction Supervision																		
2. Civil Works																		
(1) BS. Sat check dam 5																		
(2) BS. Sat check dam 6																		
(3) BS. Sat check dam 7																		
(4) BS. Sat check dam 8																		
(5) BS. Sat check dam 9																		
(6) BS. Sat check dam 10																		
(7) Preparation work																		

5.5.3 CONSTRUCTION METHOD AND EQUIPMENT

(1) Concrete work

The main work of the project is the placing of concrete of the check dams. Masonry concrete, which consists of stone and plain concrete, will be used for the dam body.

With the manpower method of dam concrete placing which has been used up until now, the annual maximum concrete placing volume is estimated to be around 7,000 m^3. This method will not, therefore, be capable of meeting the concrete placing requirement for BS. Sat check dam No.7 which has a large quantity of concrete. The production of concrete aggregate, the production of concrete and the concrete placing is accordingly planned to be carried out using machines for BS. Sat check dam No.7.

The other check dams, which have a volume of dam body less than 20,000 m^3, will be constructed using the ordinary construction method employed in the Mt. Semeru Project Office.

The system of concrete work with machinery consists of the aggregate plant, the concrete production plant and the concrete placing plant as same as in the first priority project.

(2) Method of Other Construction Work

The excavation of the dam foundation will be mainly done by back hoe with supplementary assistance by hand.

(3) Construction Equipment

Construction equipment and spare parts to be newly purchased for the main work are as shown in Table-5.17

Table-5.17 Price List of Construction Equipment for Second Priority Project

Item	Description Power (kw)	Weight (ton)	Amount (10^3 yen)
1. Equipment			
(1) Aggregate Plant	2,107 PS 207.65 KW	354.1	274,622
(2) Concrete Plant	1,417 PS 33.65 KW	530.9	149,278
(3) Concrete Placing Plant	1,100 PS 465.1 KW	432.0	485,923
(4) Paving Equipment	315 PS 109 KW	64.1	94,500
(5) Laboratory Equipment		1.5	5,000
Sub Total	5,019 PS 815.4 KW	1,382.6	1,009,323
2. Spare Parts			
(1) Aggregate Plant			47,223
(2) Concrete Plant			43,943
(3) Concrete Placing Plant			101,367
(4) Paving Equipment			32,790
(5) Laboratory Equipment			2,000
Sub Total		310	227,323
Total	5,019 PS 815.4 KW	1,692.6	1,236,646

5.5.4 PROJECT COST

According to the above-mentioned construction procedure, the project cost is summarized as shown in Table-5.18. Refer to Table-5.19.

Table-5.18 Financial Cost of the Second Priority Project

Item	Foreign Currency 10^6 yen	Local Currency 10^6 Rp	Total 10^6 yen
1. Construction equipment	1,010	-	1,010
2. Spare parts and consumable materials	227	-	227
3. Civil works	224	3,169	1,398
4. Land acquisition	-	26	10
5. Engineering services	233	232	319
6. Government administration	-	248	92
7. Contingency	220	1,365	726
Total 10^6Yen	1,914	1,867	3,781
Total 10^6Rp	5,168	5,040	10,208
(%)	50.6%	39.4%	100%

Based on the price level of fiscal year 1982.

Yen evaluation: US$1 = ¥240 = Rp650, 1 Yen = 2.7 Rp

5.5.5 EVALUATION

The economic cost of the second priority project excluding the existing check dams was estimated based on the above mentioned inplementation plan, and shown in Table-5.20. Accordingly, the economic cost including the existing check dams amounts to 7,059 million Rp. As a result of the economic analysis using the cost refined as in Table-5.20, total benefit and I.R.R. of the second priority project are concluded as 19,740 million Rp and 5.3% respectively. Refer to Table-5.21.

Table-5.19 Annual Financial Cost of The Second Priority Project

Item \ Year	1		2		3		4		5		6		Total		Grand Total 10^6 yen
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	
1. Construction equipment	1,010	-	-	-	-	-	-	-	-	-	-	-	1,010	-	1,010
2. Spare parts and consumable materials	227	-	-	-	-	-	-	-	-	-	-	-	227	-	227
3. Civil works	0	0	18	1,102	52	523	73	741	57	569	24	234	224	3,169	1,398
4. Land acquisition	-	26	-	-	-	-	-	-	-	-	-	-	-	26	10
5. Engineering services	114	45	30	45	30	45	30	45	29	45	-	7	233	232	319
6. Government administration	-	43	-	41	-	41	-	40	-	40	-	43	-	248	92
7. Contingency	135	11	7	238	17	189	27	356	25	369	9	202	220	1,365	726
Total	1,486	125	55	1,426	99	798	130	1,182	111	1,023	33	486	1,914	5,040	3,781
Japanese yen equivalent (10^6 yen)	1,486	46	55	528	99	296	130	438	111	379	33	180	1,914	1,867	
	1,532		583		395		568		460		213		3,781		

Based on the price level of fiscal year 1982

Yen evaluation US$1 = ¥240 = Rp 650 (1982)

Unit F.C.: 10^6 Yen

L.C.: 10^6 Rp

Table-5.20 Annual Economic Cost of The Second Priority Project
(Excluding the existing check dams)

Item \ Year	1		2		3		4		5		6		Total		Grand Total 10^6 yen
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	
1. Construction equipment hire cost	0	-	1	-	134	-	194	-	144	-	2	-	475	-	475
2. Civil works	0	0	18	543	55	470	77	666	59	510	24	202	233	2,391	1,119
3. Land acquisition	-	26	-	0	-	0	-	0	-	0	-	0	-	26	10
4. Engineering services	114	45	30	45	30	45	30	45	29	45	0	7	233	233	318
5. Government administration	-	30	-	28	-	28	-	28	-	28	-	30	-	172	64
6. Contingency	11	11	5	61	22	44	30	73	23	58	2	27	93	284	198
Total	125	112	54	677	241	597	331	812	255	641	28	266	1,034	3,105	2,184
Japanese yen equivalent (10^6 yen)	125	41	54	251	241	221	331	301	255	237	28	99	1,034	1,150	
	166		305		462		632		492		127		2,184		

Based on the price level of fiscal year 1982

Yen evaluation US$1 = ¥240 = Rp650 (1982)

Unit F.C.: 10^6 Yen

L.C.: 10^6 Rp

Table-5.21 Economic Evaluation of the Second Priority Project

YEAR	COST			BENEFIT				
	TOTAL	CONSTRUCTION	MAINTENANCE	TOTAL	DIRECT	INDIRECT	IRRIG.	SALVAGE V.
1986	3024.0	3024.0	.0	.0	.0	.0	.0	.0
1987	1865.0	1865.0	.0	225.9	225.3	.7	.0	.0
1988	1765.0	1765.0	.0	255.0	254.3	.8	.0	.0
1989	290.0	290.0	.0	335.7	334.7	1.0	.0	.0
1990	115.0	115.0	.0	354.8	353.7	1.0	.0	.0
1991	.0	.0	.0	365.1	364.0	1.1	.0	.0
1992	.0	.0	.0	369.2	368.1	1.1	.0	.0
1993	.0	.0	.0	364.9	363.8	1.1	.0	.0
1994	.0	.0	.0	368.1	367.0	1.1	.0	.0
1995	.0	.0	.0	371.4	370.2	1.1	.0	.0
1996	.0	.0	.0	374.7	373.5	1.1	.0	.0
1997	.0	.0	.0	378.0	376.9	1.2	.0	.0
1998	.0	.0	.0	381.4	380.2	1.2	.0	.0
1999	.0	.0	.0	384.9	383.7	1.2	.0	.0
2000	.0	.0	.0	388.4	387.2	1.2	.0	.0
2001	.0	.0	.0	391.9	390.7	1.2	.0	.0
2002	.0	.0	.0	395.6	394.3	1.2	.0	.0
2003	.0	.0	.0	399.2	398.0	1.2	.0	.0
2004	.0	.0	.0	403.0	401.7	1.3	.0	.0
2005	.0	.0	.0	406.8	405.5	1.3	.0	.0
2006	.0	.0	.0	410.7	409.4	1.3	.0	.0
2007	.0	.0	.0	414.6	413.3	1.3	.0	.0
2008	.0	.0	.0	418.6	417.3	1.3	.0	.0
2009	.0	.0	.0	422.7	421.3	1.3	.0	.0
2010	.0	.0	.0	426.8	425.5	1.3	.0	.0
2011	.0	.0	.0	431.0	429.7	1.4	.0	.0
2012	.0	.0	.0	435.3	433.9	1.4	.0	.0
2013	.0	.0	.0	439.7	438.3	1.4	.0	.0
2014	.0	.0	.0	444.1	442.7	1.4	.0	.0
2015	.0	.0	.0	448.6	447.2	1.4	.0	.0
2016	.0	.0	.0	453.2	451.7	1.4	.0	.0
2017	.0	.0	.0	457.8	456.4	1.5	.0	.0
2018	.0	.0	.0	462.6	461.1	1.5	.0	.0
2019	.0	.0	.0	467.4	465.9	1.5	.0	.0
2020	.0	.0	.0	472.4	470.9	1.5	.0	.0
2021	.0	.0	.0	477.4	475.8	1.5	.0	.0
2022	.0	.0	.0	482.5	480.9	1.5	.0	.0
2023	.0	.0	.0	487.7	486.1	1.6	.0	.0
2024	.0	.0	.0	493.0	491.4	1.6	.0	.0
2025	.0	.0	.0	4284.0	496.8	1.6	.0	3785.6

DISCOUT RATE	ACCUM. DISCOUNTED COST	ACCUM. DISCOUNTED BENEFIT	B/C RATIO	NPV
0	7059.	19744.	2.7970	12685.
1	6924.	15380.	2.2214	8457.
2	6793.	12189.	1.7944	5396.
3	6666.	9824.	1.4738	3158.
4	6543.	8049.	1.2301	1505.
5	6425.	6698.	1.0425	273.
6	6310.	5655.	.8962	-655.
7	6199.	4840.	.7807	-1360.
8	6091.	4193.	.6883	-1899.
9	5987.	3673.	.6135	-2314.
10	5886.	3250.	.5522	-2636.
11	5788.	2901.	.5013	-2886.
12	5693.	2611.	.4586	-3082.
13	5600.	2366.	.4225	-3234.
14	5510.	2158.	.3915	-3353.
15	5423.	1979.	.3648	-3445.
16	5339.	1823.	.3415	-3515.
17	5256.	1688.	.3211	-3569.
18	5176.	1568.	.3030	-3608.
19	5098.	1463.	.2869	-3636.
20	5023.	1368.	.2725	-3654.
21	4949.	1284.	.2595	-3665.
22	4877.	1208.	.2477	-3669.
23	4807.	1139.	.2370	-3668.
24	4739.	1077.	.2272	-3662.
25	4673.	1020.	.2182	-3653.
26	4608.	968.	.2100	-3641.
27	4545.	920.	.2024	-3626.
28	4484.	876.	.1953	-3608.
29	4424.	835.	.1887	-3589.
30	4366.	797.	.1826	-3568.

INTERNAL RATE OF RETURN 5.29 PER CENT

6. WATER CONSERVATION STUDY

6.1 GENERAL

(1) Objective of Study

The objectives of the water conservation study are as follows:

- An assessment of the hydrologic situation of the area, in order to estimate the surface base flow of K. Mujur, K. Rejali and K. Glidik at each discharge reference point;

- An assessment of the hydrogeologic situation of the K. Lengkong Fan area, in order to evaluate the groundwater potential;

- An assessment of the potential of land and water, in order to select the area of land and water use;

- A preparation of preliminary plan for water conservation of the area, and a preestimatation of its feasibility.

(2) Study Flowchart

The study flowchart is shown in Fig.-6.1.

6.2 WATER RESOURCES POTENTIAL

6.2.1 SURFACE BASE FLOW

The base flow of the following points during the last 30 years (1953 - 1983) were obtained by using the base flow model (statistic response computer model which was verified against the rainfall and flow data aquired during the investigation).

- The intake Rowojedang of K. Mujur (A = 69.1 km^2)
- The Leprak No. 1 check dam of K. Rejali (A = 27.6 km^2)
- The planned Pronojiwo Dam of K. Glidik (A = 54.3 km^2)

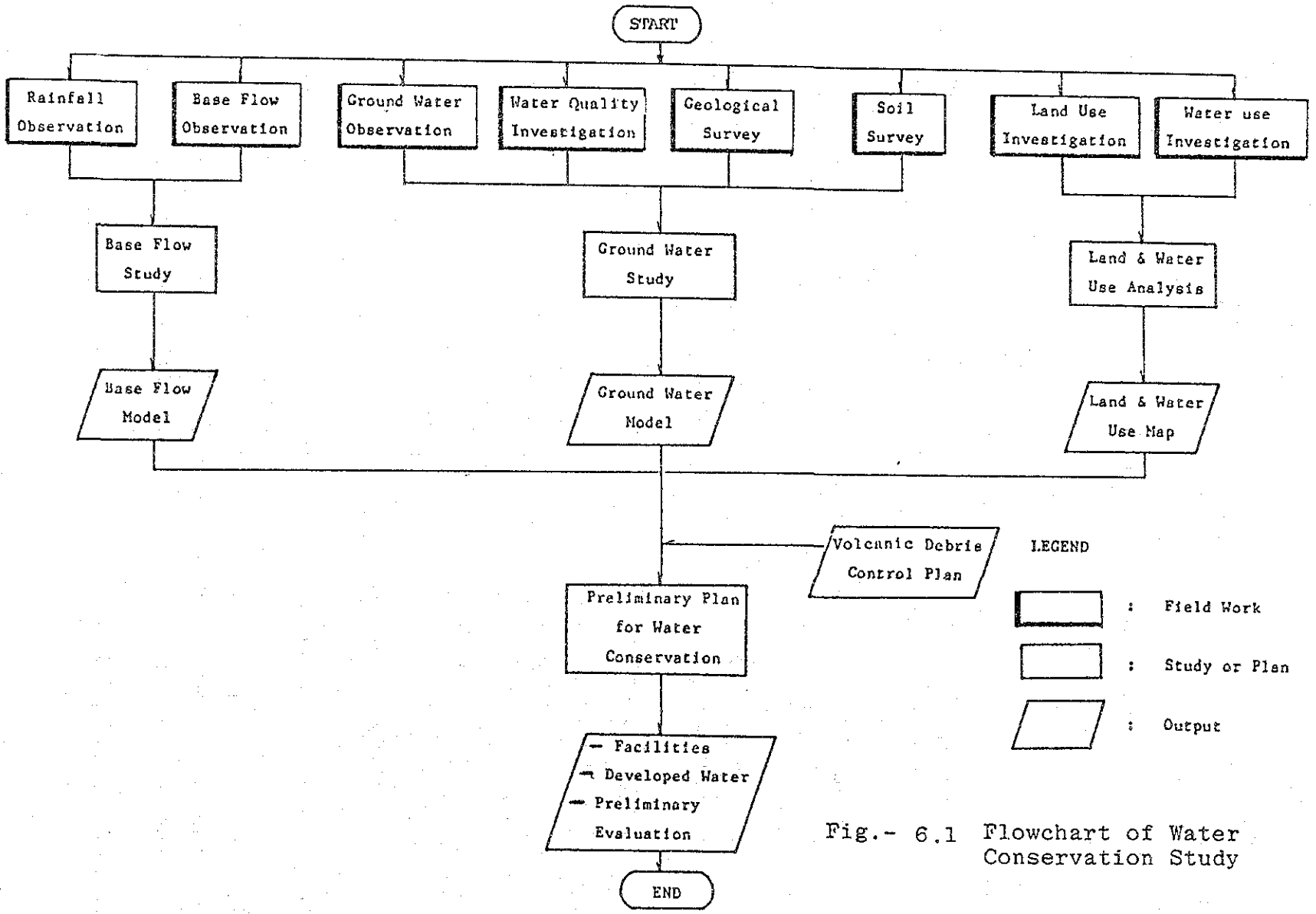


Fig.- 6.1 Flowchart of Water Conservation Study

The simulation results are summerized below. Refer to Fig.-6.2.

① The monthly mean base flow (Q), the standard deviation (n), a coefficient of fluctuation (c_f = n/Q) and specific mean base flow (q = Q/A) at the base points are shown in Table-6.1.

Table-6.1 Simulated Base Flow

Reference Point \ Items	Q (m^3/s)	n (m^3/s)	c_f (N.D.)	q ($m^3/s/km^2$)
(M) Intake Rowojedang of K. Mujur	0.898	0.258	0.287	0.013
(R) Leprak No. 1 Check Dam of K. Rejali	0.992	0.309	0.312	0.036
(G) Planned Pronojwio Dam of K. Glidik	2,468	0.681	0.276	0.045

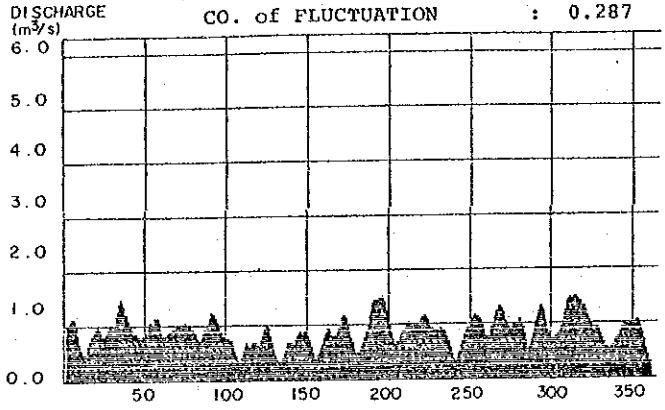
② Among three points, the highest amounts of mean base flow and specific mean base flow are obtained at the planned Pronojiwo dam site of K. Glidik. The fluctuation coefficient is smallest at the same site. This means that the area upstream of the point possesses a greater natural underground reservoir being created in the Mt. Semeru body than the others.

③ The periodicity of the monthly base flow is noted although the interval is not always one but two or three years.

④ The fluctuation of each annual mean monthly base flow is rather leveled due to the reason stated above in ③.

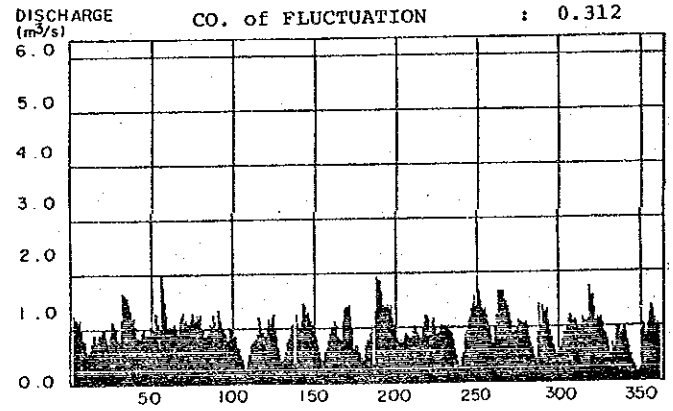
① K.MUJUR

MEAN BASE FLOW Q(m^3/s) : 0.898
S.D. of Q : 0.258
CO. of FLUCTUATION : 0.287



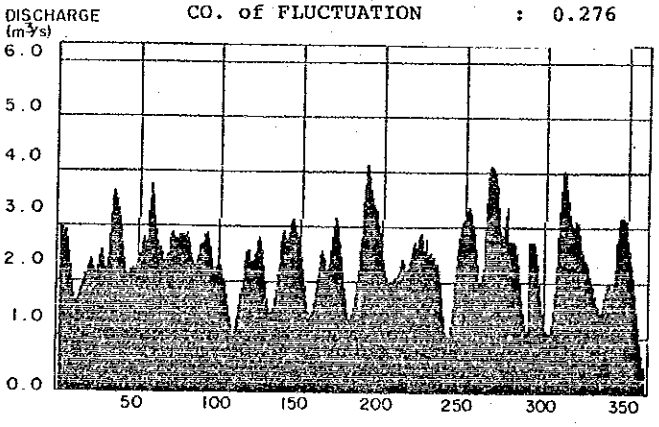
② K.REJALI

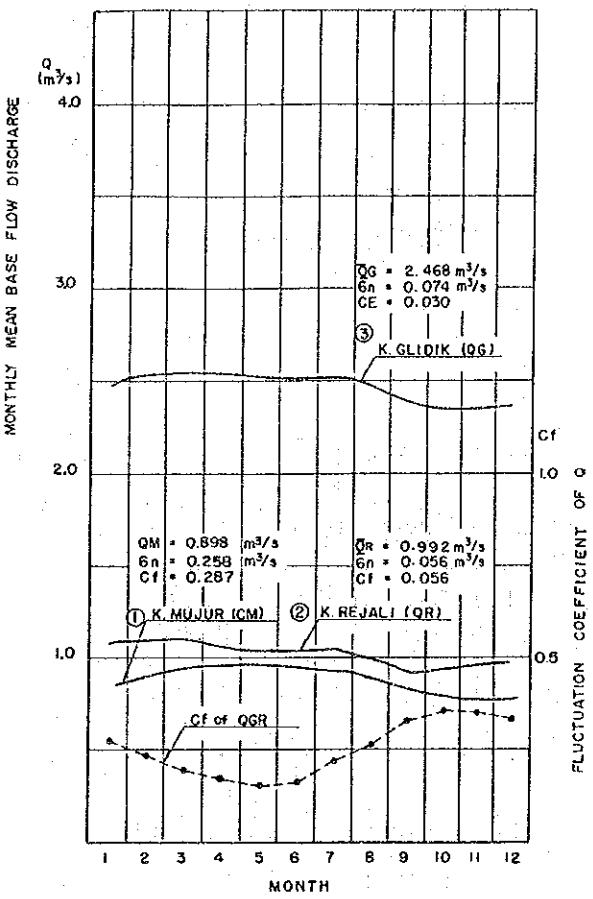
MEAN BASE FLOW Q(m^3/s) : 0.992
S.D. of Q : 0.309
CO. of FLUCTUATION : 0.312



③ K.GLIDIK

MEAN BASE FLOW Q(m^3/s) : 2.468
S.D. of Q : 0.681
CO. of FLUCTUATION : 0.276





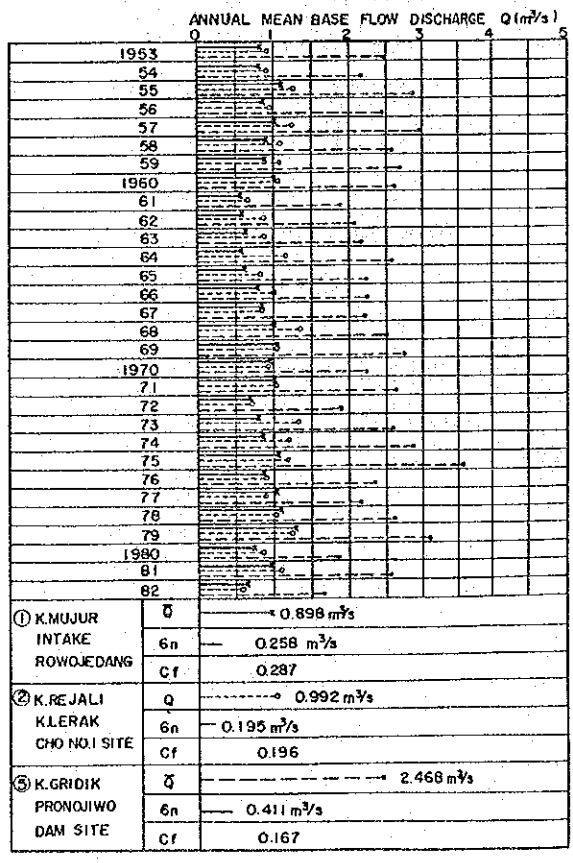


Fig.-6.2 Result of Base Flow Simulation

6.2.2 GROUNDWATER

The hydrogeological structure and the potential groundwater volume of the K. Lengkong Fan, which provides the groundwater basin, are summarized below. Refer to Fig.-6.3 and Fig.-6.4.

① The groundwater basin is formed in the area surrounded by the underground ridge of tuff which runs north to south in the west of the fan and by the Tertiary mountains to the south of Mt. Semeru.

② The lahar deposit which covers this groundwater basin can become an aquifer. The permeability and the aquiferability of this aquifer are estimated respectively to be 10^{-4} cm/s - 10^{-2} cm/s in terms of its coefficient of permeability, and about 20% in its effective percentage of void.

③ Main sources of groundwater supply are considered to be the infiltration of rain over the basin area, the infiltration of surface water over the upper slope of Mt. Semeru and the inflow of groundwater from Mt. Semeru.

④ The groundwater basin volume can be supposed to be some 100 x $10^6 m^3$ based on the above information, however the annual mean developable groundwater will be some 1.0 m^3/s at the maximum judging from the results of the groundwater simulation.

6.2.3 WATER QUALITY

The quality of surface water and the groundwater sampled at 40 points is summarized below.

① Some groundwater is unsuitable for drinking but all of it can be used for irrigation.

② The groundwater is vadose water consisting of relatively new precipitation.

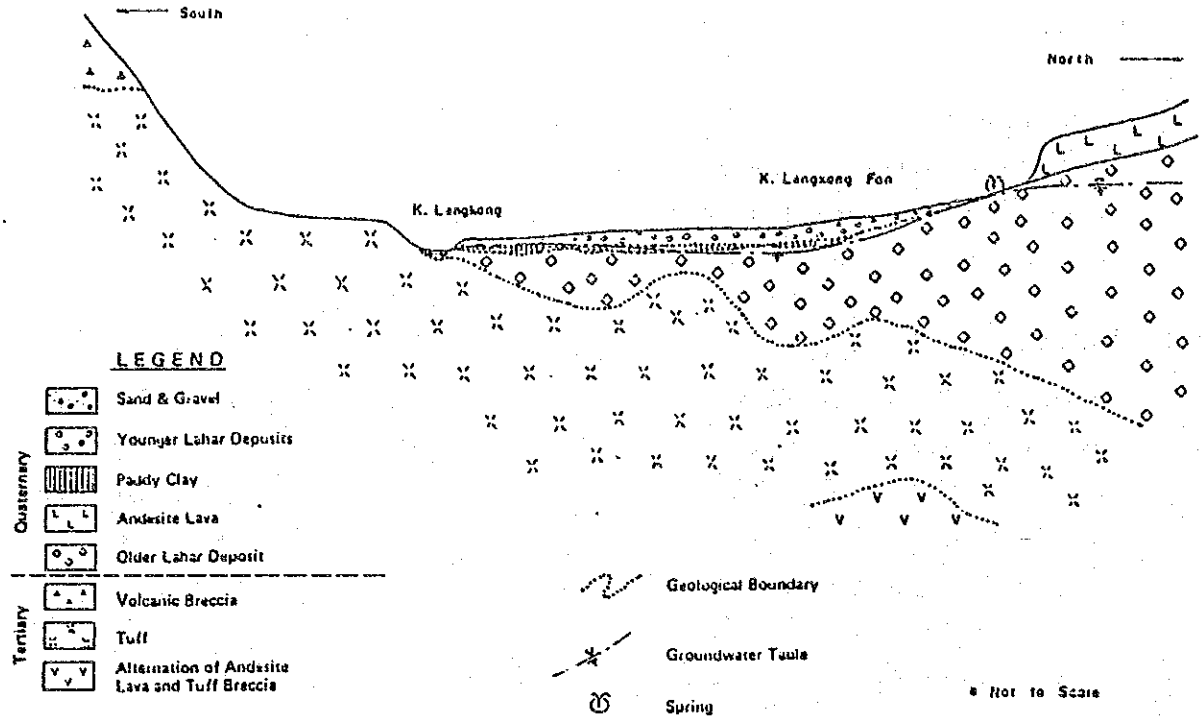


Fig.-6.3 Schematic Gelogocial Profile of K. Lengkong Fan

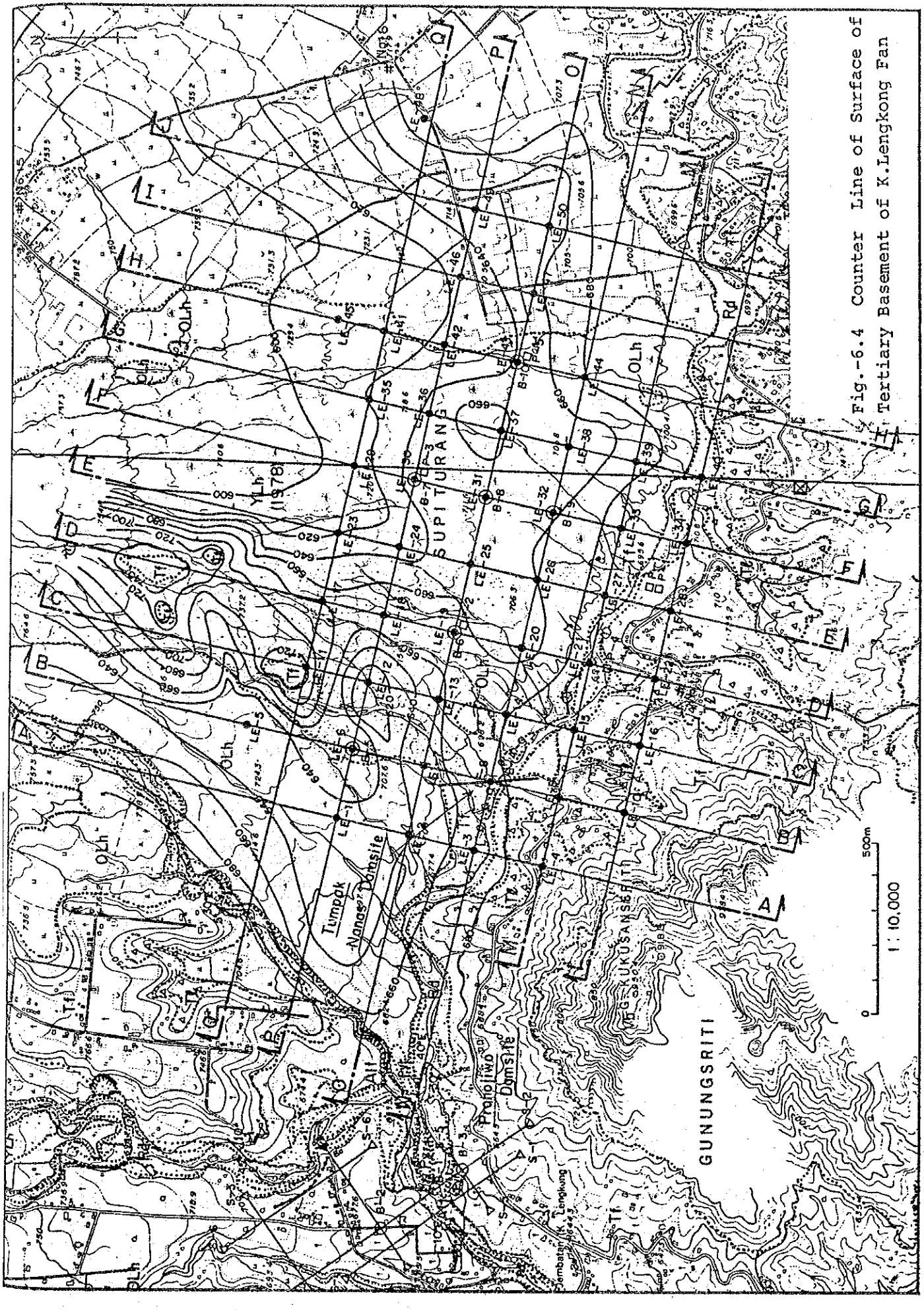


Fig.-6.4 Counter Line of Surface of Tertiary Basement of K.Lengkong Fan

6.3 WATER CONSERVATION PLANS

6.3.1 GENERAL

(1) Study Flowchart

The study flowchart of the water conservation preliminary plan is shown in Fig.-6.5.

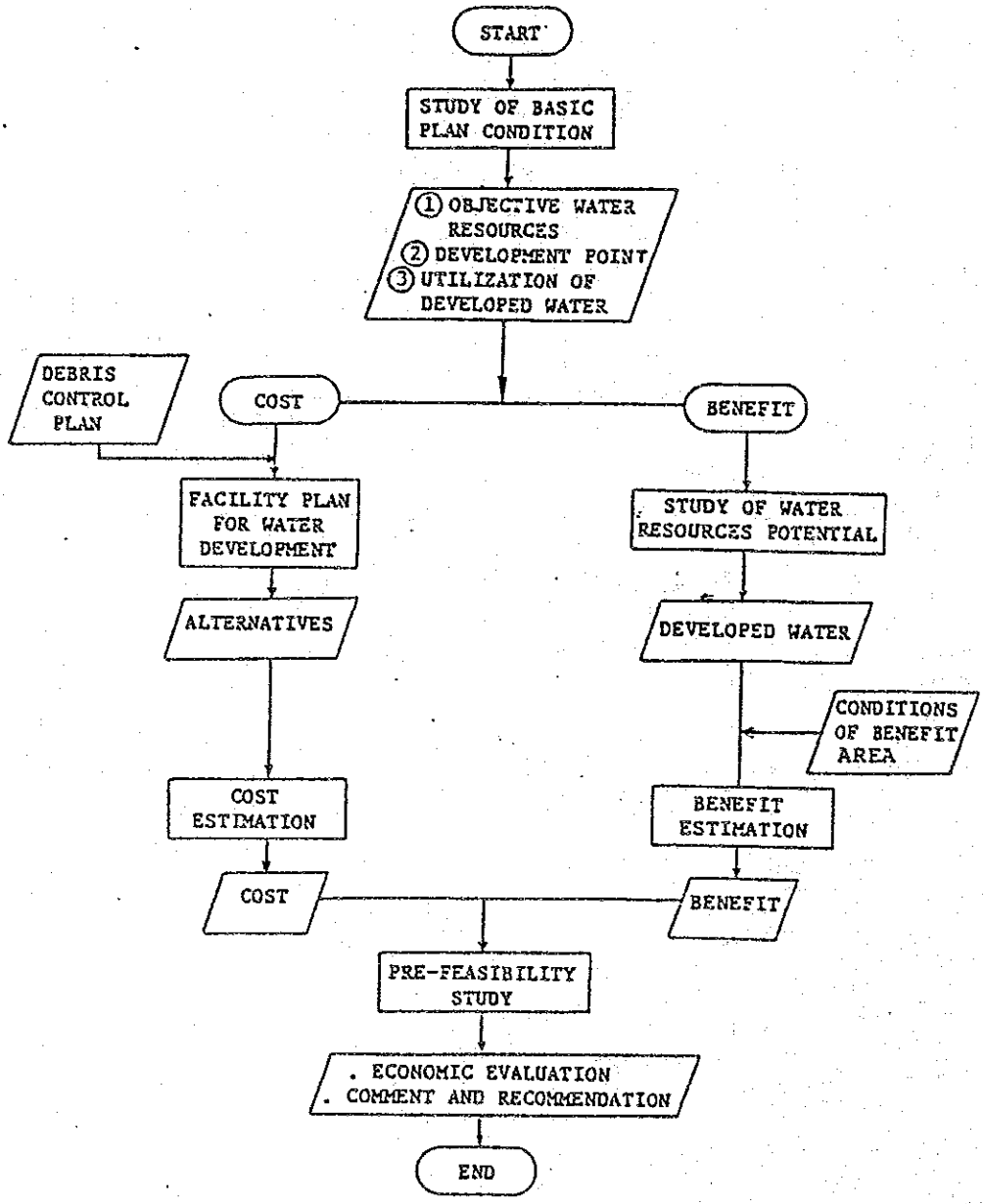


Fig.-6.5 Study Flowchart of Water Conservation Preliminary Plan

(2) Basic Plan Conditions

(a) Preconditions for Local Prevention of Disaster

- The disaster prevention in the exploitation area is assured as the sediment control project is achieved to a certain degree.

- The Pronojiwo dam is constructed according to the diversion plan, which is on integral part of the sediment control project.

(b) Objective Water Resources

- The base flow of K. Besuk Bang and K. Lengkong in the K. Glidik basin.

- The groundwater of the K. Lengkong Fan.

- The base flow of K. Besuk Kobo'an in the K. Rejali basin.

(c) Exploitation Point

- The planned Pronojiwo dam site along K. Glidik.

- The sites for the K. Leprak No. 1 check.

(d) Use of Exploited Water

- Purpose of water use is irrigation and generation of electric power.

- Surface water (the base runoff) is used all the year round and groundwater is used during the dry season.

- Benefited areas of water use are K. Rejali basin and K. Besuk Semut basin for irrigation and Lumajang prefecture for power generation .

6.3.2 FACILITY PLANS

On the basis of the planning conditions mentioned in 6.3.1, the following facilities are planned.

① Intake Facilities

Take the base flow discharge of K. Besuk Bang and K. Lengkong and the groundwater exploited at Lengkon Fan.

② Groundwater Exploitation Facilities at K. Lengkong Fan to

Pump up the ground water through well and pump.

③ Water Conveyance Facilities (1)

Convey the water through tunnel or open channel from K. Gridik to K. Rejali

④ Power Generating Stations

Generate hydro-electric power at the bottom of water conveyance facilities (1).

⑤ Water Conveyance Facility (2)

Convey the water through open channel from K. Rejali to the irrigation area.

⑥ Cultivated Paddy Field

Land improvement program to reclaim the waste land to be paddy fields in the K. Rejali and K. Semut basin.

Specifications and estimated construction costs of these facilities are shown in Table-6.2. (Also refer to Fig.-6.6 and 6.7)

Table-6.2 Alternatives for Water Conservation Facilities

(1) Economic Cost of Facility

(Unit: 10^6Rp.)

NO.		FACILITY	CONSTRUCTION COST ① DIRECT	② UNDIRECT	③ TOTAL	④ LAND AQUISITION	⑤ ENGINEERING SERVISES	⑥ ADMINISTRATION	⑦ CONTINGENCY	⑧ Total
①	1	INTAKE	210.3	31.5	241.8	0.8	24.2	24.2	24.2	315.2
②	2.1	PUMPING WELLS(1)	1,050.2	157.5	1,207.7	0.8	120.8	120.8	120.8	1,570.9
③	2.2	PUMPING WELLS(2)	2,100.4	315.1	2,415.5	1.6	241.6	241.6	241.6	3,141.9
④	3.1	TUNNEL	13,158.3	1,973.7	15,132.0	0.0	1,513.2	1,513.2	1,513.2	19,671.6
⑤	3.2	OPEN CHANNEL	6,889.8	1,033.5	7,923.3	19.8	792.3	792.3	792.3	10,320.0
⑥	4.1	POWER GEN. ST(1)	1,708.2	256.2	1,964.4	0.3	196.4	196.4	196.4	2,553.9
⑦	4.2	POWER GEN. ST(2)	1,708.2	256.2	1,964.4	0.3	196.4	196.4	196.4	2,553.9
⑧	4.3	POWER GEN. ST(3)	1,708.2	256.2	1,964.4	0.3	196.4	196.4	196.4	2,553.9
⑨	5	IR. OPEN CHANNEL	531.0	79.7	610.7	52.4	61.1	61.1	61.1	846.4
⑩	6.1	CUL. FIELD(1)	298.4	44.8	343.2	-	34.3	34.3	34.3	446.1
⑪	6.2	CUL. FIELD(2)	306.1	45.9	352.0	-	35.2	35.2	35.2	457.6
⑫	6.3	CUL. FIELD(3)	313.9	47.1	361.0	-	36.1	36.1	36.1	469.3

NOTE: ② = ① x 15%, ⑤ = ③ x 10%, ⑦ = ③ x 10%
③ = ① + ②, ⑥ = ③ x 10%, ⑧ = ③ + ④ + ⑤ + ⑥ + ⑦

(2) Specification of facility

NO.		FACILITY	DIMENSION	ECONOMIC COST (10 RP.)	MAIN. COST (10 RP./y)	CONST. PERIOD (YEAR)	DEP. PERIOD (YEAR)	REMARKS
①	1	INTAKE	Q_{max} = 6.0 m /s	316.2	1.7	2	80	
②	2.1	PUMPING WELLS(1)	Q = 0.5 m /s/y	1,570.9	562.9	2	50	
③	2.2	PUMPING WELLS(2)	Q = 1.0 m /s/y	3,141.9	1,126.5	3	50	
④	3.1	TUNNEL	9.160 m	19,671.6	117.8	5	50	
⑤	3.2	OPEN CHANNEL	19,120 m	10,320.0	61.8	5	50	
⑥	4.1	POWER GEN. ST(1)	16,747 MWH	2,553.9	29.0	2	50	
⑦	4.2	POWER GEN. ST(2)	18,500 MWH	2,553.9	29.0	2	50	
⑧	4.3	POWER GEN. ST(3)	19,473 MWH	2,553.9	29.0	2	50	
⑨	5	IR. OPEN CHANNEL	4,630 m	846.4	4.5	2	50	
⑩	6.1	CUL. FIELD(1)	3,500 ha	446.1	2.4	2	100	
⑪	6.2	CUL. FIELD(2)	4,000 ha	457.6	2.5	2	100	
⑫	6.3	CUL. FIELD(3)	4,500 ha	469.3	2.5	2	100	

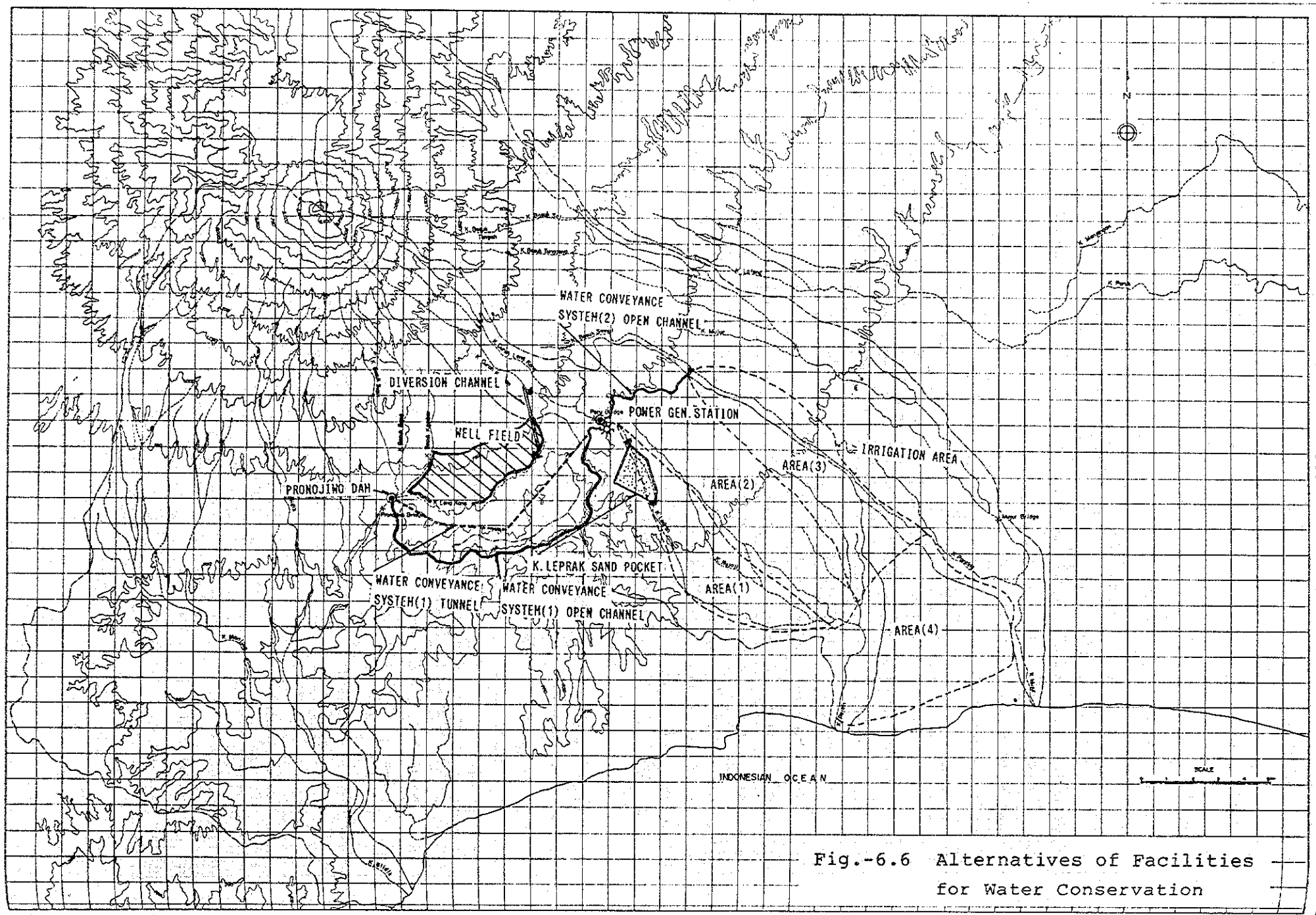
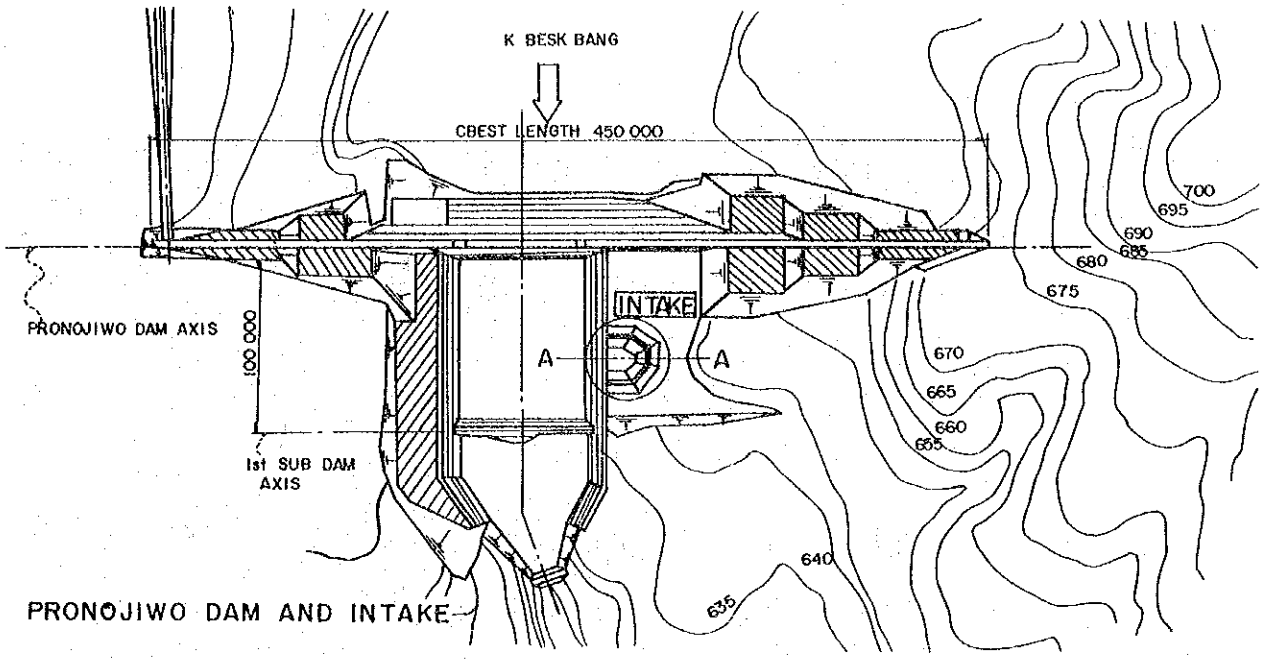
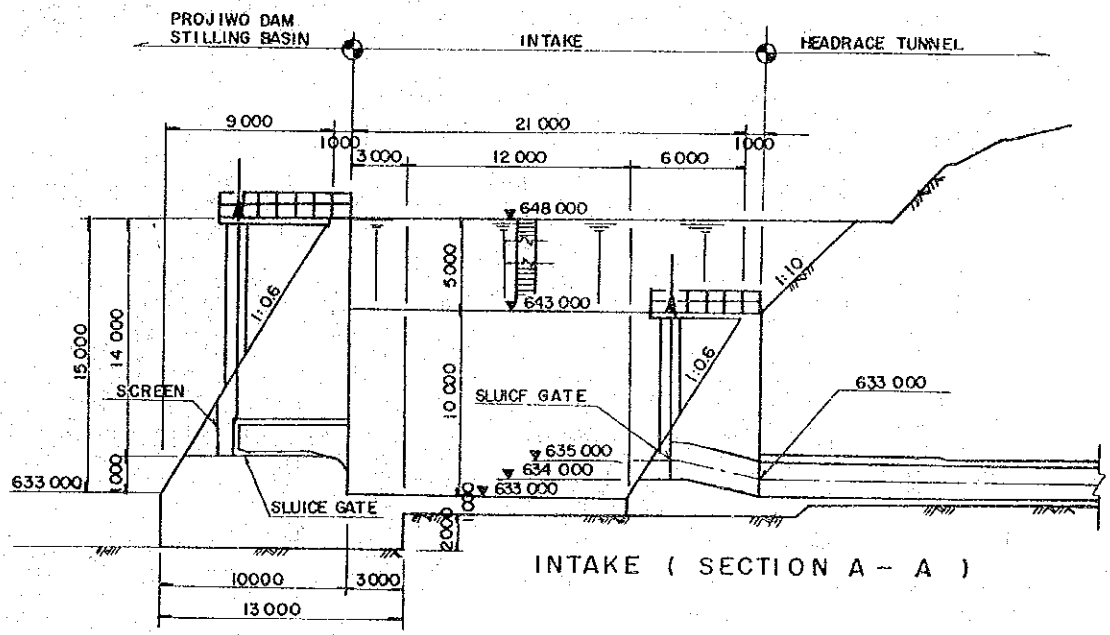


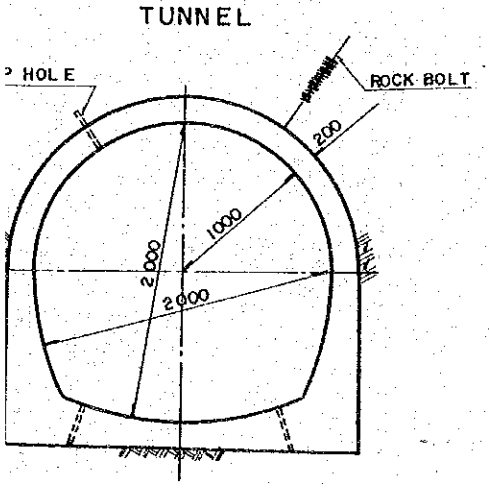
Fig.-6.6 Alternatives of Facilities for Water Conservation



PRONOJIWO DAM AND INTAKE



INTAKE (SECTION A - A)



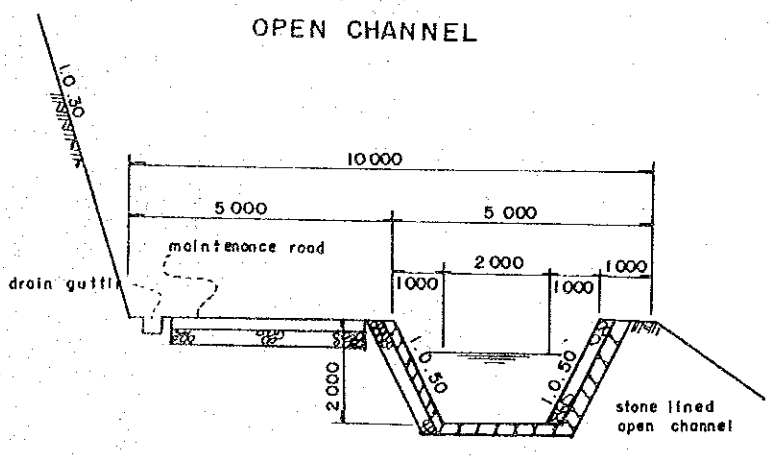


Fig.-6.7 Alternatives of Water Conservation Facilities

6.3.3 EFFECT OF WATER CONSERVATION

The following beneficial effects of the water conservation project can be expected:

- Irrigation to the newly cultivated pady fields;
- Hydro-electric power generation.

(1) Irrigation

(a) Irrigation Area

The devastated area extending from the K. Rejali basin to K. Pancing basin, not exceeding EL. 500 m, where there is no irrigation at present is chosen to be the target area for the irrigation programme.

This area is divided into the following sub-areas. Refer to Fig.-6.8.

Area-1: K. Leprak basin and K. Rejali basin. Some 580 ha will be irrigated.

Area-2: K. Seluman basin surrounded by Area-1 and Area-3. Some 720 ha will be irrigated.

Area-3: K. Pancing basin. Some 550 ha will be irrigated.

Area-4: The downstream area of K. Rejali and K. Mujur. Some 2,580 ha will be irrigated.

The maximum potential area to be irrigated will be therefore about 4,500 ha.

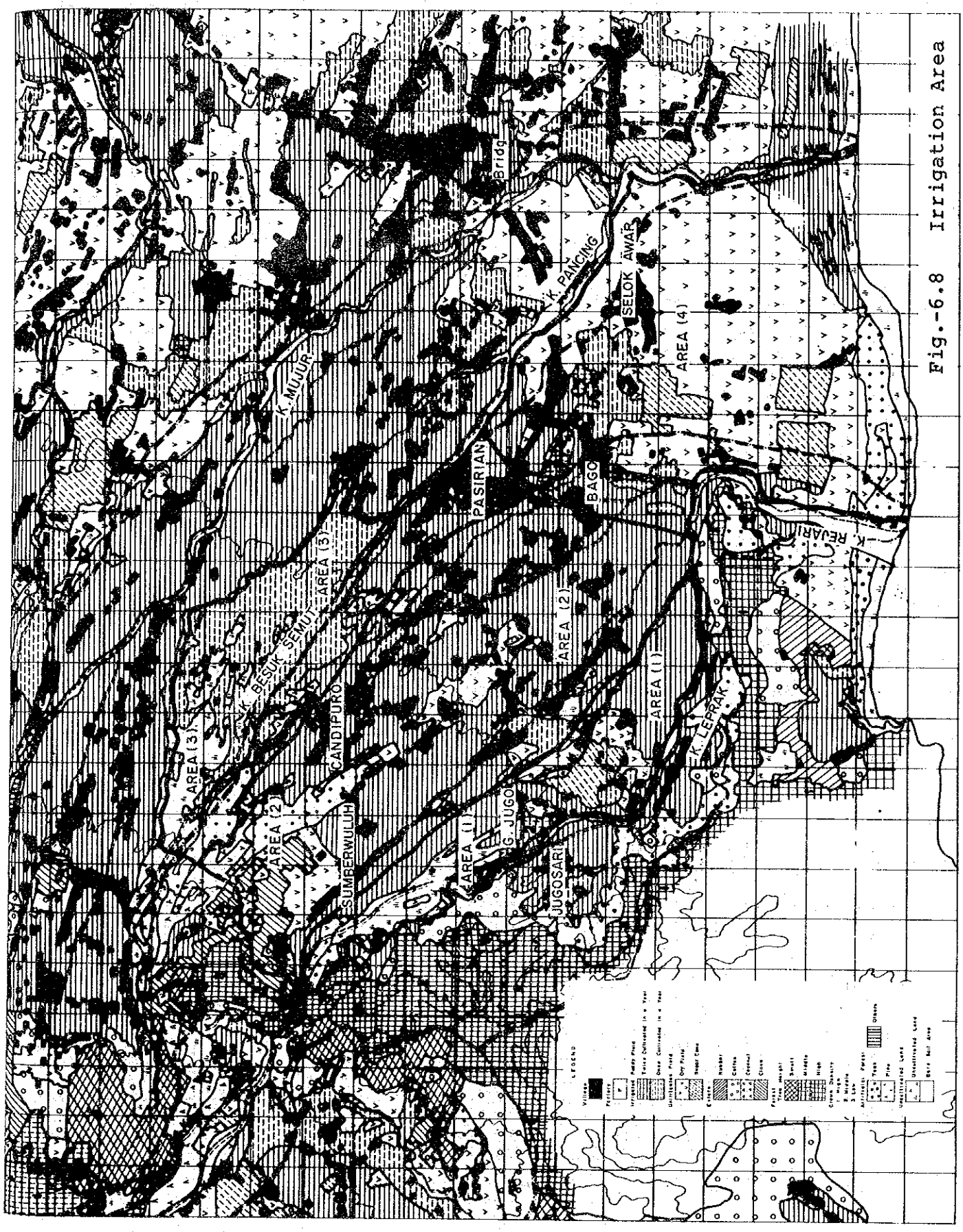


Fig.-6.8 Irrigation Area

(b) Irrigation Pattern and Gross Duty of Water

Irrigation to paddy fields will be carried out through the year, and the number of harvest times is expected to be two and a half times per one year on the basis of the actual land and water use investigation.

The gross duty of water is supposed to be 1.0 lit./s/ha from the PROSIDA data.

Accordingly, with every annual mean 1.0 m^3/s of newly developed water, 1,000 ha of paddy fields will be irrigated and a total of 2,500 ha of the same paddy fields will be harvested in a year.

Table-6.3 shows the conditions of the irrigated area

Table-6.3 Conditions of Irrigation Area

Stage	Field Classification	Crops	Items	Area No. / Field Area (ha) / Gross-Duty of Water (m³/s)	Area-1	Area-2	Area-3	Area-4			
								4.1	4.2	4.3	4.4
				Each	579.4	720.8	552.7	1,647.1	500.0	500.0	32.1
				Total	579.4	1,300.2	1,852.9	3,500.0	4,000.0	4,500.0	4,532.1
				Each	0.58	0.72	0.55	1.65	0.50	0.50	0.03
				Total	0.58	1.30	1.85	3.50	4.00	4.50	4.53
Without Project	Dry Field(1)	Field Area			102.7	0.0	0.0	200.8	60.7	61.0	4.0
		Total Field Area			102.7	102.7	102.7	303.5	364.2	425.2	429.2
		Sugar Cane	Harv. Area		102.7	0.0	0.0	200.8	60.7	61.0	4.0
			Total Harv. Area		102.7	102.7	102.7	303.5	364.2	425.2	429.2
	Dry Field(2)	Field Area			230.6	466.4	26.0	1,446.9	437.6	440.0	28.2
		Total Field Area			230.6	697.0	723.0	2,169.9	2,607.5	3,047.5	3,075.7
		Maize	Harv. Area		440.7	187.8	7.9	2,893.8	875.2	879.9	692.9
			Total Harv. Area		440.7	628.5	636.4	3,530.2	4,405.4	5,285.3	5,341.8
		Soy Bean	Harv. Area		146.9	0	0	1,446.9	437.6	440.0	28.2
			Total Harv. Area		146.9	146.9	146.9	1,593.8	2,031.4	2,471.4	2,499.6
		Cassava	Harv. Area		251.1	1,211.4	70.1	0.0	0.0	0.0	0.0
			Total Harv. Area		251.1	1,462.5	1,532.6	1,532.6	1,532.6	1,532.6	1,532.6
	Forest	Field Area			23.8	174.8	142.5	0.0	0.0	0.0	0.0
		Total Field Area			23.8	198.6	341.1	341.1	341.1	341.1	341.1
	Devastated Field	Field Area			222.3	79.6	384.2	0.0	0.0	0.0	0.0
		Total Field Area			222.3	301.9	686.1	686.1	686.1	686.1	686.1
With Project	Paddy Field	Field Area			579.4	720.8	552.7	1,647.1	500.0	500.0	32.1
		Total Field Area			579.4	1,300.2	1,852.9	3,500.0	4,000.0	4,500.0	4,532.1
		Rice	Harv. Area(x2.5)		1,448.5	1,802.0	1,381.8	4,117.8	1,250.0	1,250.0	80.3
			Total harv. Area		1,448.5	3,250.5	4,632.3	8,750.1	10,000.0	11,250.0	11,330.4

(2) Hydro-electric Power Generation

Using the developed water, the hydro-electric power generation station (90 m - water head) installed at the end of the water conveyance channel, near K. Leprak No. 1 Check Dam, will produce the following electric power according to the amount of the developed water:

① In the case of the total developed water = 3.5 $m^3/s/y$, the base flow of K. Glidik and K. Rejali (diverted portion, 46%) will be use for hydro-electric power generation;

- Maximum output, 2,200 KW
- Annual output of electric energy
  16.7×10^6 KWH/y

② In the case of the total developed water = 4.0 $m^3/s/y$, developed groundwater 0.5 $m^3/s/y$ is added to ①;

- Maximum output, 2,200 KW
- Annual output of electric energy,
  18.5×10^6 KWH/y

③ In the case of the total developed water = 4.5 $m^3/s/y$, developed groundwater 1.0 $m^3/s/y$ is added to ①;

- Maximum output, 2,200 KW
- Annual output of electric energy,
  19.5×10^6 KWH/y

6.3.4 ALTERNATIVE PLANS FOR WATER CONSERVATION

(1) Development Water

Surface Water:

Total annual mean base flow 3.5 m^3/s of K. Glidik and K. Rejali, which is estimated from the base flow simulation, is planned to be developed at Pronojiwo Check Dam and at K. Leprak No.1 Check Dam.

Ground Water:

Annual mean groundwater of 0.5 m^3/s and 1.0 m^3/s, which is likely rasonable judging from the simulation result, is planned to be developed at the K. Lengkong Fan.

(2) Alternative Plans

There can be various water conservation plans based on the different combination of facilities.

Alternative Plan A:

No groundwater exploitation. Water conveyance from K. Glidik to K. Rejali is done by tunnel. An annual average rate of 3.5 m^3/s will be used for irrigation. For power generation, 1.42m^3/s (constant) and 2.92 (annual average) will be used.

Alternative Plan B:

No groundwater exploitaton. Water conveyance from K. Glidik to K. Rejali is done by open channel. The water volume to be used for irrigation and power generation will be the same as Plan A.

Alternative Plan C:

Groundwater exploitation volume is the maximum 1.0 m^3/s and annual mean 0.5 m^3/s. Water conveyance from K. Glidik to K. Rejali is done by tunnel. Irrigation water volume will be an annual mean of 4.0 m^3/s. For power generation, 2.42 m^3/s (constant) and 3.22 m^3/s (annual average) will be used.

Alternative Plan D:

Replace the tunnel water conveyance of Plan C with an open channel water conveyance. Other particulars are the same as for Plan C.

Alternative Plan E:

Ground water exploitation is the maximum 2.0 m^3/s and annual mean 1.0 m^3/s. Water conveyance from K. Glidik to K. Rejali is done by tunnel. Irrigation water volume will be an annual average of 4.5 m^3/s. For power generation, 3.00 m^3/s (constant) and 3.27 m^3/s (annual average) will be used.

Alternative Plan F:

Replace the tunnel water conveyance of Plan E with an open channel water conveyance. Other particulars will be the same as for Plan E.

(3) Preliminary Evaluation

The benefits given by the water conservation project can be expressed by the difference of "with project" and "without project". The unit value for each crop shown in Table-6.4, which was obtained through the investigation, is employed.

Table-6.4 Unit Value for Crops

Crop	Unit Price 10^3 Rp/ton	Yield ton/ha	Input Cost 10^3 Rp/ha
Paddy Rice (wet season)	135	3.7, max. 4.5 increasing rate 1.2% p.a.	150
Paddy Rice (dry season)		4.0, max. 4.9 increasing rate 1.2% p.a.	
Sugar Cane	15	80	420
Maize	120	0.8	30
Soy Bean	300	0.92	70
Cassava	45	9.7	50

Table-6.5 shows the alternative plans for water conservation and their respective economic evaluation. From the table, the followings are summerized:

① Among the alternative plans, the plan B in which there is no groundwater development with the open channel water conveyance system shows highest I.R.R. of 16.19%;

② However, as the economic evaluation of each plan is carried out on the basis of the annual mean amount of the developed water, the stable water supply by the groundwater development during the dry seasons should be also evaluated reasonably in the next detailed study;

③ From the standpoint of maintaining the area's basis of livelihood as well as economic considerations, several of the water development plans examined are thought to be promising undertakings. Should it be judged desirable to execute such undertakings, it would be mandatory to confirm their feasibility by carrying out a more advanced study than the present one.

Table-6.5 Preliminary Economic Evaluation of Water Conservation Project

ALTERNATIVE	FACILITY						ECONOMIC COST	MAINTENACE COST	DEVELOPED WATER	POWER GENERATION	INTERNAL RATE OF RETURN (I.R.R)
	INTAKE	GROUNDWATER DEVELOPMENT SYSTEM	WATER CONEYANCE SYSTEM (1)	WATER POWER GENERATION STATION	WATER CONVEYANCE STSTEM (2)	NEWLY CULTIVATED FIELD					
							(10^6 RP)	(10^6 RP/Y)	(m^3/s)	(10^6 KWH/Y)	(%)
A	①	-	④	⑥	⑨	⑩	23,832	155.4	3.5	16.747	10.41
B	①	-	⑤	⑥	⑨	⑩	14,482	99.4	3.5	16.747	16.19
C	①	②	④	⑦	⑨	⑪	25,416	718.4	4.0	18.500	9.56
D	①	②	⑤	⑦	⑨	⑪	16,064	662.4	4.0	18.500	14.61
E	①	③	④	⑧	⑨	⑫	26,998	1,282.0	4.5	19.473	8.65
F	①	③	⑤	⑧	⑨	⑫	17,646	1,226.0	4.5	19.473	12.97

FACILITY NO. is referred to Table 6.2

6.4 COMBINED PROJECT PLAN

With the following conditions, the economic aspect of the projects combined with the sediment control facility project proposed in Chapter 4 and the water conservation projects, were studied:

- The debris control facility project is well studied at a "Feasibility Study" level, however, the water conservation projects were only preliminary studied;

- Therefore, for the final evaluation of the combined project, a total evaluation on the economic, social and technical aspect will carrried out, adding such appropriate studies as on water resources potential, on water conservation facilities, on irrigation design and on power generation plans.

Table-6.6 shows the economic evaluation of the combined project plans.

The combined project of the first priority facility project and the alternative plan-B for water conservation project shows the highest I.R.R. of 10.78%.

Table-6.6 Economic Evaluation of Combined Project Plans

Item	Alternative	A	B	C	D	E	F
Principal Facilities		Sediment Control Works; Curah Kobo'an Check Dam No. 6 K. Leprak Sand Pocket				Diversion Work	
		Tunnel	Open Channel Water Conveyance	Pumping Well (0.5 $m^3/s/y$)	Pumping Well (0.5 $m^3/s/y$)	Pumping Well (1.0 $m^3/s/y$)	Pumping Well (1.0 $m^3/s/y$)
		Hydroelectric Power Plant (Volume of Developed Water 3.5 $m^3/s/y$)	Hydroelectric Power Plant (Volume of Developed Water 3.5 $m^3/s/y$)	Hydroelectric Power Plant (Volume of Developed Water 4.0 $m^3/s/y$)	Hydroelectric Power Plant (Volume of Developed Water 4.0 $m^3/s/y$)	Hydroelectric Power Plant (Volume of Developed Water 4.5 $m^3/s/y$)	Hydroelectric Power Plant (Volume of Developed Water 4.5 $m^3/s/y$)
Economic Cost (10^6 Rp)	Debris Control	20,390.0	20,390.0	20,390.0	20,390.0	20,390.0	20,390.0
	Water conservation	23,832.0	14,482.0	25,416.3	16,064.0	26,998.0	17,646.0
	Total	44,222.0	34,872.0	45,806.0	36,454.0	47,388.0	38,036.0
Maintenance Cost (10^6 Rp/y)	Debris control	36.0	36.0	36.0	36.0	36.0	36.0
	Water conservation	155.4	99.4	718.4	662.4	1,282.0	1,226.0
	Total	233.0	135.4	754.4	698.4	1,318.0	1,262.0
I.R.R. (%)	Debris control	6.49	6.49	6.49	6.49	6.49	6.49
	Water conservation	10.41	16.19	9.56	14.61	8.65	12.97
	Total	8.58	10.78	8.11	10.18	7.63	9.55

7. CONCLUSION AND RECOMMENDATION

(1) Master Plans Review

As a result of the Master Plans review carried out based on the new survey data including the disaster of May, 1981, several problematic areas in the said plans were identified. Further, below-mentioned revisions and additions to cope with a number of problems found in the said plans are presented here.

① Basic changes in the volcanic debris control plan as well as revisions in the facility plan.

② Reinforcement of the current warning system.

③ Preliminary Plan for Water Development

We strongly believe that this plan would be embodied as part of the Master Plans finally authorized by Indonesian Government.

(2) First Priority Plan

The sediment control facility project for K. Rejali basin and the debris flow warning system project for the entire southeastern slope of Mt. Semeru has been chosen as the most feasible and recommendable first priority project.

(A) First Priority Sediment Control Facility Project

The project is composed of the following facilities and gives the beneficial economic effect of I.R.R. 8.8%.

- Three sabo dam (one at K. Rejali, two at K. Glidik)
- A set of diversion channel of 1.3km (Curah Kobo'an to K. Lengkong)
- One sand pocket at K. Rejali
- A set of water conservation facilities for paddy field irrigation of 1,000 ha.

This project to be completed in 6 years will cost as follows:

Financial cost:	29.1×10^9 Rp
Foregin currency portion:	13.2×10^9 Rp (45%) (4.90×10^9 Yen)
Local currency portion:	15.9×10^9 Rp (55%)

After the completion of the project, the properties in the area of $40km^2$ and 15,000 inhabitants of K. Rejali would be protected.

(B) Debris Flow Warning System Project

This project composed of the following systems and the facilities in the system.

- Information collection system
  - 1 small radar raingauge station
  - 8 telemeter rainfall stations
  - 4 debris flow sensing stations
  - 2 debris flow visual measuring stations
  - 6 telemeter water level stations
- Information processing system
  - A set of information processing center at Mt. Semeru Project
  - A set of monitoring station office
- Public information system
  - 11 speaker stations

This project to be completed in 5 years including the two year's test operation, will cost as follows:

Financial cost:	5.7×10^9 Rp
Foreign currency portion:	5.0×10^9 Rp (88%) (1.84×10^9 Yen)
Local currency portion:	0.7×10^9 Rp (12%)

This project would cover the entire southeastern slope of Mt. Semeru and protect 40,700 inhabitant's lives from the sediment disaster.

Execution of the debris flow warning system project can phased at 4 stages classified functionally. The Project cost at each stage is 1,021 million yen, 1,408 million yen, 1895 million yen and 2,097 million yen respectively.

(3) Second Priority Project

The sediment control facility project for K. Mujur basin has been chosen as the recommendable second priority project. This project is composed of six check dams, and gives the beneficial economic effect of I.R.R. 5.3%. This project to be completed in 6 years will cost as follows:

Financial cost:	10.2×10^9 Rp
Foreign currency portion:	5.2×10^9 Rp (51%)
	(1.91×10^9 Yen)
Local currency portion:	5.0×10^9 Rp (49%)

After the completion of the project, the properties in the area $28km^2$ and 19,000 inhabitants of K. Mujur basin would be protected.

(4) Water Conservation Plan

Assuming that the precondition of security against volcanic debris disaster in the target area has been guaranteed and further supposing water use of irrigation and production of electric power, I.R.R. of between 8.7% to 16.2% was obtained as a result of the preliminary economic evaluation for the six alternative preliminary plans.

From the standpoint of maintaining the area's basis of livelihood as well as economic considerations, several of the water development plans examined are thought to be promising undertakings. Should it be judged desirable to execute such undertakings, it would be mandatory to confirm their feasibility by carrying out a more advanced study than the present one.

(5) Proposed Project

Sediment control facility project for K. Rejali basin is hereby recommended for immediate execution as an urgent project to preserve and maintain human lives and properties as well as for stability and security of the area's living environment and livelihood.

Moreover, it would be also recommendable to execute the debris flow warning system project, which would greatly contribute toward safeguarding human lives always threaten by sediment disaster in the entire southeastern slope of Mt. Semeru, in parallel with the above-mentioned sediment control facility project.

SUPPLEMENT - 1

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT
IN THE SOUTH EASTERN SLOPE OF MT. SEMERU
IN
THE REPUBLIC OF INDONESIA

BETWEEN

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

DIRECTORATE OF RIVERS

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

MINISTRY OF PUBLIC WORKS

DECEMBER, 1981

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT
IN THE SOUTH EASTERN SLOPE OF MT. SEMERU
IN
THE REPUBLIC OF INDONESIA

I. INTRODUCTION

In response to the request made by the Government of the Republic of Indonesia, the Government of Japan has decided to assist the Government of Indonesia, in accordance with laws and regulations in force in Japan, to conduct a Feasibility Study on the Volcanic Debris Control and Water Conservation Project in the South Eastern Slope of Mt. Semeru (hereinafter referred to as "the Study").

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for Implementation of technical cooperation programs of the Government of Japan, will carry out the Study in close cooperation with the authorities concerned of the Government of Republic of Indoneisa.

The following scope of works was set forth, based on the Terms of Reference prepared in November 1980 and the result of the JICA's preliminary survey carried out in December 1981.

II. OBJECTIVES OF THE STUDY

The objectives of the study are:

1. To verify the feasibility of the disaster prevention plan as selected sites.
2. To formulate a land and water conservation plan, and
3. To improve the capability of the Indonesian counterpart personnel.

III. STUDY AREA

The study area covers the southeastern slope of Mt. Semeru extending the area of 730 km^2, and their surrounding area, namely Kali Mujur, Kali Rejali, Kali Glidik, Kota Lumajang, part of Kabupaten Lumajang, Pasirian, Candipuro and Tempeh in East Java Province. (See attached map).

IV. SCOPE OF THE STUDY

The activities to be undertaken in the Study are as follows:

1. Map Preparation (Phase I)

   Terrestrial survey and mapping with a scale of 1/10,000 covering the Study area.

2. Main Study (Phase II)

   1) Collection of existing data and information

      a. Hydrology and hydraulics.
      b. Meteorology.
      c. Geology and geomorphology.
      d. Regional economy.
      e. Damage and behavior of sediment and flood.
      f. Construction cost and construction materials.
      g. Others.

   2) Field Survey

      a. Terrestrial survey.
      b. Geological survey.
      c. Soil survey.
      d. Hydrological and hydraulic survey.
      e. Survey on river condition.
      f. Survey on sediment and flood area.
      g. Survey on present land use.
      h. Survey on present water use.
      i. Others.

3) Study and Analysis

a. Review of the Master Plan prepared by the Government of Indonesia, other materials relevant to the Study and on-going projects.
b. Regional economy.
c. Hydrology, hydraulics, sedimentation and erosion.
d. Potential of land and water resources development.
e. Land and water conservation plan.
   * Land classification with respect to vulnerability and productivity.
f. Disaster prevention plan.
   * Structural and non-structural measures.
g. Preliminary design of disaster prevention facilities.
h. Construction materials, labour force, construction method, and equipment.
i. Organization for the implementation.

4) Verification of feasibility for disaster prevention plan.

a. Estimation of costs for construction, operation and maintenance.
b. Estimation of benefits.
c. Economic and financial evaluation.
d. Social and environmental aspect.
e. Implementation schedule.

V. REPORTS

JICA will prepare and submit the following reports in English to the Government of the Republic of Indonesia.

1. Inception Report
   * Thirty (30) copies at the beginning of the Study.

2. Progress Report I
   * Thirty (30) copies at the end of September 1982.

   Progress Report II
   * Thirty (30) copies at the end of the first works in Indoneisa.

3. Interim Report
   * Thirty (30) copies at the end of the first works in Japan.
   * Discussion on the Interim Report will be held after the submission.

4. Progress Report III
   * Thirty (30) copies at the end of second works in Indonesia.

5. Draft Final Report
   * Thirty (30) copies within four (4) months after the commencement of the second works in Japan.
   * The Government of the Republic of Indonesia will provide JICA with its comments within one (1) month after the discussion on the Draft Final Report.

6. Final Report
   * Fifty (50) copies within two (2) months after the receipt of the comments on the Draft Final Report from the Government of the Republic of Indonesia.

VI. UNDERTAKING BY THE GOVERNMENT OF THE REPUBLIC OF INDONESIA

For the purpose of the Study, the Government of the Republic of Indonesia will undertake.

1. To provide the Japanese Study Team with available data, information and materials concerned for its use access to such sources of information as are considered necessary for the execution of the Study.
2. To carry out such works as terrestrial survey, geological survey, material and soil test, hydrological observation and economic situation survey.
3. To secure permission for entry into private properties and restricted area in connection with the field survey, according to prevailing Government of Indonesia regulations.

4. To exempt the Team from any taxes and duties for materials, equipment and personal effects necessary for the study performance which are to be brought into Indonesia by the Team.

5. To assign counterpart personnels and clerical staffs to the Team during the Study period.

6. To provide the Team with suitable office space with necessary equipment and services for the Study (in Jakarta and the project site).

7. To make arrangements for accommodations for the team should be paid by the team.

8. To provide drivers, fuel and maintenance cost for vehicles to be provided by JICA, and other survey equipment necessary for the Study.

9. To provide fund for local counterpart salaries assigned to the Study and operational cost.

10. To provide any other available facilities that may be required for the execution of the Study.

11. To allow the team to use necessary frequency band for transceiver, in accordance with the permission of the Government of Indonesia.

12. To assist the team a quick access to medical services during its stay in Indonesia, if requested.

13. To make arrangements for the team to take all data, maps and materials concerned including aerophoto out of the Republic of Indonesia to Japan according to the regulation in Indonesia, and they will be used only for the purpose of the Study, and

14. To bear claims if any, against the Study occurring in course of, or otherwise connected with the discharge of their official functions in the Republic of Indoneisa, except for those claims arising from the wilfull misconduct or gross negligence of the team members.

VII. UNDERTAKING BY JICA

For the purpose of the Study, JICA will undertake.

1. To send the Japanese Study Team to conduct the Study.
2. To make maps necessary for the Study (scale: 1/10,000).
3. To carry out on-the-job training and transfer of knowledge to the Indonesian counterpart personnel in Indonesia and Japan during the Study period, and
4. To provide vehicles and equipment necessary for the efficient implementation of the Study.

VIII. STUDY SCHEDULE

The whole work will be conducted in accordance with the attached schedule.

TENTAT STUDY SCHEDULE

Activity \ Year / Month	1982												1983												1984											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
*Phase I (Mapping)																																				
Work in Indonesia	———																																			
Work in Japan					- - - - - -																															
*Phase II (Main Study)																																				
Work in Indonesia	———																																			
Work in Japan																			- - - - -									- - - - -							
Inception Report	○																																			
Progress Report										○ (I)							○ I/P																			
Interim Report																					○ (II)															
Draft Final Report																						○									○ (III)					
Comments on Draft Final Report																																				
Final Report																																				

SUPPLEMENT - 2

MEMBERS LIST

1. Members of Advisory Committee

Title	Name
Chief of Committee	Masayoshi Matsubayashi
Member of Committee	Tomomitsu Yasue
"	Tooru Miura
"	Masayuki Watanabe
"	Katsumi Seno (1983 - 1984)
"	Susumu Tsuchiya (1982 - 1983)
"	Masao Kiyono (1982)

2. Members of Study Team

Speciality	Name
Team Leader	
General Management Sabo Plan	Koichi Hirao
Sub-team Leader	
Socio-economy	Kazuo Mizue
Member	
Economy	Masaki Kobayashi
"	Tsuneji Sasaki
Water Conservation	Toru Takahashi
Geology	Nobuhiko Uchiseto
Land Condition	Yosuke Sasaki
Ground Water	Yoshiyuki Uemura
River	Masatomo Watanabe
Hydrology	Hidetoshi Kanamura
Sabo Facility	Yoshifumi Shimoda
Dam Design	Takashi Ishizaka
Construction Plan	Akira Takahashi
Disaster Study, Land Use	Kazuo Ikeda
Mud-flow	Shuji Hamana
Physical Exploration	Minoru Nakazawa
Warning System	Hideo Nishizawa
Survey	Hitoshi Koami
"	Hiroyuki Koshikawa
"	Akito Yasuda
"	Masumi Ikuno
"	Mitsuaki Matsuzaki

SUPPLEMENT - 3

MINUTES OF MEETING

1. Minutes of Meeting on the Scope of Work
   (December 18, 1981)

2. Minutes of Meeting on the Summary on Review of the Master Plans and Selection of the First Priority Project
   (August 30, 1982)

3. Minutes of Meeting on the Progress Report (I)
   (November 16, 1982)

4. Minutes of Meeting on Progress Report (II)
   (November 15, 1983)

5. Minutes of Meeting on Interim Report
   (February 17, 1984)

6. Minutes of Meeting on Second Priority Project Feature
   (July, 25, 1984)

7. Minutes of Meeting on Draft Final Report
   (November 15, 1984)

1. MINUTES OF MEETING ON THE SCOPE OF WORK FOR THE FEASIBILITY STUDY OF THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH - EASTERN SLOPE OF MT. SEMERU IN THE REPUBLIC OF INDONESIA.

The preliminary Study Team of Japan International Cooperation Agency (JICA) for the Volcanic Debris Control and Water Conservation Project in the South - Eastern Slope of Mt. Semeru and the Directorate of Rivers of the Directorate General of Water Resources Development, Ministry of Public Works, the Government of the Republic of Indonesia exchanged their views on the draft of Scope of Work for the said Feasibility Study prepared by the JICA Team.

Both parties agreed with some modifications to the draft and finalized the Scope of Work (refer to the attachment) with the following understandings:

1. The Government of Indonesia will undertake additional aerial photo - taking of 1:10,000 scale covering surrounding area of Kota Lumajang totalling about 85 km^2 and retaking of a part of the existing aerial photo prepared by the Government of Indonesia which is not sufficient for mapping required for the feasibility study.
2. The Government of Indonesia requests JICA to present all reports concerning the study two weeks before the date of discussion.
3. JICA shall provide necessary vehicles for the implementation of the study. In case JICA is not able to provide the vehicles sufficiently, the Government of Indonesia will make its best efforts to fulfill the remaining requirement.

4. With regard to the training of Indonesian counterpart in Japan, the Government of Indonesia expressed its request that JICA shall provide opportunities for training in Japan especially during the period of study work in Japan.

5. Based on the request of the Government of Indonesia, JICA shall provide the following hydrologic and hydraulic equipment:
   - 3 automatic recording rain gauges,
   - 11 automatic recording water level gauges,
   - 2 portable water level gauges, and
   - water level gauging staffs totalling 15 m length.

6. The Government of Indonesia shall install the above equipment at the places as recommended by the Team as soon as possible.

7. The Government of Indonesia will carry out appropriate operation and maintenance including data collection of the above equipment in accordance with the manuals concerned.

8. The Government of Indonesia will collect the data of rainfall and discharge of Kali Bondoyudo, which will be further analysed by the Study Team for the purpose of formulation of the rainfall and discharge relationship needed for the water resources potential study.

9. The Government of Indonesia shall conduct underground water level survey once a week by using portable water level gauges at the key wells, neighbouring wells, and the surrounding areas, to obtain underground water level contour line for the study of potential underground water development.

10. The Government of Indonesia will send the negative and positive areal photo film of the study area to the JICA Team through the Japanese Embassy at the latest on the middle of January, 1982, provided that it is in accordance with the Indonesian security regulation.

11. The JICA Team will prepare the recommendation for the Imple-

12. The JICA Team will carry out the study of the forecasting and warning system in the study area.

13. The Government of Indonesia strongly requests to the JICA Team to make its best effort to accelerate the study in such a way that the implementation of the disaster prevention works proposed by the study will become the continuation of the urgent rehabilitation works.

Jakarta, December 18, 1981.

Mr, Masayuki Watanabe,
Leader of JICA Preliminary
Survey Team for the
Feasibility Study of the
Volcanic Debris Control
and Water Conservation
Project in the South -
Eastern Slope of Mt. Semeru,
Government of Japan.

Ir. Putra Duarsa,
Director of Rivers,
Directorate General of
Water
Resources Development,
Ministry of Public Works,
Government of Indonesia.

2. MINUTES OF MEETING ON THE SUMMARY ON REVIEW OF THE MASTER PLANS AND SELECTION OF THE FIRST PRIORITY PROJECT

The JICA Feasibility Study Team submitted the attached Summary on Review of the existing Master Plans and Selection of the First Priority Project for the Feasibility Study on the volcanic Debris Control and Water Conservation Project in the South Eastern Slope of Mt. Semeru to the Government of the Republic of Indonesia, and lenghty discussinns concerning the above Summary were held on August 30, 1982 with Directorate of Rivers, Directorate-General of Water Resources Development, Ministry of Public Works.

As a result of the meeting, the Government of Indonesia accepted the Summary with the following ammendments. (attendants of the meeting are listed in the Appendix hereof.)

1. Design Control Sediment Volume of K. Mujur and K. Rejali

The last sentence of both 2.2.-(1) and 2.2.-(2) on page 4 shall be deleted in its entirety and be substituted by the following new sentences under item 2.2.-(3)

" 2.2.-(3) Evaluation of Design Control Sediment Volume of K. Mujur and K. Rejali

The absolute value of design control sediment is not very relevant at this stage, because the main purpose at this stage is to select the First Priority Project.

Therefore, the JICA Study Team adopts these values for the time being for the purpose of selection of the First Priority Project.

Detailed study of these values will be carried out during this Feasibility Study to be followed.

2. Priority Projects

The introductory sentence of item 3.2 Priority Project on page 14 should now read as

" JICA Study Team selects the following priority projects from among the disaster prevention works which are planned in the existing Master Plans and recommended by the Team. "

instead of

" JICA Study Team selects the follwing priority projects from among the disaster prevention works which are Planned in the existing Master Plans revised taking JICA Study Team recommendations into consideration. "

3. Conclusion of the Priority Projects

The Conclusion of the Priority Projects in item 3.2.-(5) shall be deleted in its entirety and substituted by the following new sentences.

(5) Conclusion

The Urgent Improvement Works of the highest priority is to start construction in 1983 and will give much effect to K. Mujur basin in the near future.

Therefore, the first priority should be given to K.Rejali project and the second priority to K. Mujur due to the following reason.

- K. Rejali is more disasterous than K. Mujur after the Urgent Improvement Works.

- The percentage of high grade disaster area of K. Rejali is larger than of K. Mujur.
- In the master plans, specific sediment volume of K. Rejali is about 3 times as large as K. Mujur.
- The disaster frequancy of K. Rejali after 1942 (alternation of catchment area) is 1.6 times as often as K. Mujur.
- The total capacity of existing sediment control works of K. Rejali is considered to be lower than of K. Mujur.

Jakarta, August 30, 1982

On behalf of Directorate of Rivers
Directorate General of Water Resources
Development

Dr. Koichi Hirao
Team Leader of JICA Study Team

Ir. Amir Muryadi
Chief of Sub Directorate
of River Planning & Design

3. MINUTES OF MEETING ON THE PROGRESS REPORT (I) FOR THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH EASTERN SLOPE OF MT. SEMERU

The Advisory Committe and JICA Feasibility Study Team for Volcanic Debris Control and Water Conservation Project in the South Eastern Slope of Mt. Semeru (hereinafter referred to as Japanese Side) and the Directorate of Rivers, Directorate General of Water Resources Development, Ministry of Public Works (hereinafter referred to as Indonesian Side) held a joint meeting in Jakarta on 15 and 16 November, 1982.

Both sides agreed to accept the Progress Report (I) with the following understandings.

1. Progress Report (II) will be submitted by the end of October 1983 and Interim Report by the middle of February 1984.

2. In preparing the reports mentioned above, results of hydrological observation covering the next wet season and other experiences including counter measures related to Mt. Galunggung's disaster will be fully taken into account.

Attendants of the meeting are listed in the Appendix.

Jakarta, 16 November 1982

Mr. Masayuki Watanabe
Leader of JICA Advisory Member Team

Ir. Hartono Pramudo,Dip.H.E
Act. Director of Rivers
Directorate General of Water
Resources Development,
Ministry of Public Works.

4. MINUTES OF MEETING ON PROGRESS REPORT (II)

The JICA Study Team submitted the Progress Report (II) on "THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTHEASTERN SLOPE OF MT. SEMERU" to the Government of Indonesia on November 5,1983. The meeting on the above Progress Report (II) was held on November 15,1983 between JICA and Directorate of Rivers, Directorate General of Water Resources Development, Ministry of Public Works.(Attendants of the meeting are listed in the Appendix hereof).

As a result of the meeting, the Government of Indonesia accepted the Progress Report (II) and the following items have reached mutual agreement.

1. MASTER PLAN

The result of the review on the existing Master Plan is acknowledged to be technically reasonable and, will be fully considered by the Government of Indonesia in the revision of the Master Plan.

2. FIRST PRIORITY PROJECT

2.1. The First Priority Project proposed by the JICA Study Team is acknowledged to be promising and feasible among the Sabo works in Indonesia.

2.2. The Government of Indonesia intends to promote the First Priority Project including the Warning System to secure human lives in the entire southeastern slope of Mt. Semeru, which is suitable for the local condition.

3. WATER CONSERVATION PLAN

The result of water conservation study is considered to be appropriate for the future procedure.

4. TIME SCHEDULED CHANGED

According to the alteration of submittion schedule of Progress Report(II), Progress Report(III) has become unnecessary. The Contents to be dealt in Progress Report(III) will be ddscussed in Final Draft Report..

Jakarta, November 15, 1983

Mr. Katsumi Senoo
for JICA Advisory Committee

Ir. Sunoto
Acting Director of Rivers,
Derectorate General of Water
Resources Development

5. MINUTES OF MEETING ON INTERIM REPORT

The JICA Study Team submitted the Interim Report on "THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTHEASTERN SLOPE OF MT.SEMERU" to the Government of Indonesia on February 7, 1984.
The meeting on the above Interim Report was held on February 17, 1984 between JICA and Directorate of Rivers, Directorate General of Water Resources Development, Ministry of Public Works. (Attendants of the meeting are listed in the Appendix hereof).

As a result of the meeting, the Government of Indonesia accepted the Interim Report and the following items have reached mutual agreement.

1. SEDIMENT CONTROL PLAN

The sediment control plan of the First Project proposed by the JICA Study Team is agreed to be promissing and feasible among the Sabo Works in Indonesia.

2. WARNING SYSTEM

2.1. FORECASTING SYSTEM

The establishment of early forecasting system is aknow - ledged to be the most effective method to secure human lives against Lahar disaster.

The Government of Indonesia requests to the JICA Study Team to complete the whole plan of early forecasting system of three river basins; K. Mujur, K. Rejali and K. Glidik.

2.2. DISASTAROUS POTENTIAL MAP

The Government of Indonesia would like to have complemen - tary information concerning the disastarous potential map of the southeastern slope of Mt. Semeru in order to execute the effective evacuation.

Jakarta, February 17, 1984

MR. KOICHI HIRAO
Leader of JICA Study Team

IR. HARTONO PRAMUDO
Director of Rivers, Directorate General of Water Resources Development

6. MINUTES OF MEETING
ON
SECOND PRIORITY PROJECT FEATURE

The Advisory Committee and JICA Feasibility Study Team for Volcanic Debris Control and Water Conservation Project in the South Eastern Slope of MT. Semeru (hereinafter referred to as Japanese side) and the Directorate of Rivers, Directorate General of Water Resources Development, Ministry of Public Works (hereinafter referred to as Indonesian side) held the meeting about Second Priority Project feature in Jakarta on 25th July, 1984.

As a result of the meeting, both sides agreed to fix the following sediment control facility plan for Second Priority Project;
Nine check dams of PLAN - 3, including three existing check dams, which is shown on Table - 5.1 in " Note of Discussion for Second Priority Project " submitted by Japanese side to Indonesian side on 25th of July,1984.

However, after the construction of the second priority scheme, consolidation dams will be considered to be constructed to protect irrigation intakes from sediment disaster.

Jakarta, July 25th, 1984.

DR. KOICHI HIRAO
Leader of JICA Study Team

IR. HARTONO PRAMUDO
Director of Rivers,
Directorate General of
Water Resources
Development

7. MINUTES OF MEETING ON THE DRAFT FINAL REPORT

The JICA Study Team submitted the Draft Final Report on " THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH EASTERN SLOPE OF MT. SEMERU IN THE REPUBLIC OF INDONESIA " to the Government of Indonesia on November 15, 1984. The meeting on the above Draft Final Report was held on November 15, 1984 between JICA Study Team and Directorate of Rivers, Directorate General of Water Resources Development, Ministry of Public Works.

As a result of the meeting, the Government of Indonesia accepted the Draft Final Report, and both sides reached the following agreements,

1. Indonesian side request the Study Team to submit modified Debris Flow Warning System Plan by phasing the proposed plan from most simple basic system to fully complete system using the existing traditional warning system.
2. Indonesian side request the Study Team to incorporate in the report a suggestion concerning evacuation system in the MT. Semeru area.
3. The Government of Indonesia will provide JICA with the comments on the Draft Final Report within three weeks after the meeting.
4. JICA will submit the Final Report within one month after receipt of the above comments.

Jakarta, November 15, 1984

DR. KOICHI HIRAO
Leader of JICA
Study Team

IR. K. PUTERA DUARSA
Assistant Director General
for River Development
Ministry of Public Works
Government of the Republic
of Indonesia