3.1.5 Other Effects

The main traffic means among Banding Agung, Kotabatu, Sukabanjar and other villages are boats, and there are wooden landing stages in every village. After start of the operation of the Ranau regulating dam, however, these landing stages are required to be extended or replaced with floating-type landing stages.

The lowering of the water level of the Lake Ranau will bring down the groundwater table in the surrounding area of the lake, where about 800 ha of paddy field exist. This phenomenon will increase the vertical percolation in the paddy fields, and some paddy fields may dry up in the dry season. In order to solve this problem, the construction of tirol-type weirs on the nearby streams is proposed to divert irrigation water to these paddy fields, wherever the perennial stream flow is available.

3.2 Impacts of Dam Construction

3.2.1 Inundated Area

The following table presents the number of house and areas to be inundated by three proposed reservoirs, i.e. the Komering No.1, the Komering No.2 and the Muaradua reservoirs, which are mainly obtained based on the aerial photo maps on a scale of 1:20,000 prepared by JICA in 1979.

Reservoir	Size by Dam Height (m)	Houses (nos.)	Cultivated Area (ha)	Non-Cultivated Area (ha)	Proportion Cultivated (%)
Komering No.1	85	40	80	920	8
Komering No.2	65	10	10	30	25
Muaradua	30	160	460	1,940	19
Total		210	550	2,890	(16)

3.2.2 Flood Control

In the design of the dam spillways, any function of flood control is not given to the reservoir in all cases, but the flood peak would be cut to some extent due to raise of reservoir water level by the flow depth over the spillway crest.

3.2.3 Fishery

Although fish is an important source of protein in rural area, the marketing of fish is largely undeveloped; rather, fishing activity in the area is limited to self-sufficiency. After creation of the reservoir, however, the potential fish production in the area will be increased to great extent, and it would be possible for the settlers to manage fish culture. For their fish culture, the government fisheries offices concerned should be invited to provide their assistance to the settlers.

The most productive reservoir is likely to be that with a large surface area in relation to depth. In this view, the Muaradua reservoir will be the most productive one. This reservoir will have about 30 km^2, and the potential yield of fish from this reservoir is estimated to be 450-500 tons per annum. In addition, the increase of yield potential of fish would be expected in the Komering No.1 and No.2 reservoirs.

3.2.4 Transportation and Tourism

Construction of the dam is expected to influence the local transportation. At present, there is no motorable road and bridge along the upper reaches of the Komering river. After completion of the dam, however, the access roads to be provided for the dam construction, particularly from Teluk Agung to the Komering No.1 dam and from Karang Pendeta to the Komering No.2 dam, which will pass through coffee plantation, will fully be used for the transportation of coffee to be harvested in the area and the local traffic.

The creation of reservoir will also induce a significant increase of recreational opportunities to the region. The recreational activities will include fishing, boating, swimming, camping, picnicking and just simply enjoying the outdoor experience of the reservoir setting. Many of the

reservoirs constructed in past years have become the recreation centers of the present, and this will undoubtedly be repeated in the future.

3.2.5 Biological Impact of the Reservoir

The area to be inundated by the reservoir mainly consists of the cultivated lands and the tropical rain forest, but this area is relatively small as compared with its total catchment area. Therefore, the creation of reservoir will not seriously affect the vegetation and the wildlife in the region.

After the creation of the reservoir, the river water system will change from fluvial system to stationary water system. This will make it impossible for fish to go up and come down the stream. The food-chain in the river will be changed subsequently from the chain of periphyton → aquatic insect → stream fishes, to the chain of plankton → fishes. And species of fish will also be changed. In other words, the aquatic life including periphyton, aquatic insect and fish is expected to adjust themselves to the new circumstances.

3.2.6 Water Quality

One of the influential factors to water quality after creation of the reservoirs is the inflow of organic matters to the reservoirs. Future increase in inflow of organic matters to the reservoirs will however be extreamly small because of less population and less agricultural activities in the catchment area. Another factor influencing the water quality in the reservoir is unlogged trees in the submerged area. The unlogged trees will change its material and leave organic matter in the water which will affect water quality. Other conceivable affects of the reservoir will be prolongation of muddy water flow and lowering of water temperature in the downstream of the Komering river, if the water is taken from the deeper portion of the reservoir. Therefore, the position of the off-take structure for water release from the reservoir should carefully be studied considering these adverse affects of the reservoirs.

3.2.7 Bed Variation of the Komering Rivers

After completion of the dams in the upper reaches of the Komering river, most of the sediment discharge will be checked by the dams, and there will be less supply of sediment loads to the downstream. This would cause the river bed variation from upstream to downward, and it may affect the free intake practices at Kurungan Nyawa and Muncak Kabau, though this problem will occur in remote future; in the order of 50 years, because of (1) some sediment discharge from the residual basin even after creation of the reservoirs, (2) a long distance between the dam sites and the intake sites and (3) a large amount of bed materials to be carried to the downstream.

In order to assess the bed variation along the lower reaches, particularly for the reaches between Muaradua to Muncak Kabau, the following study is made on preliminary basis.

(1) Conditions and assumptions of study

(a) This study is made for 95 km from Muaradua to Muncak Kabau by dividing the reaches of river into 40 sections.

(b) The study is made for the case after completion of the Muaradua dam.

(c) The assessment of the rate of bed variation is made using the annual mean discharge of 18 years from 1963 to 1980 at Martapura; 206 m^3/sec.

(d) In the assessment, the sediment discharge from the residual basin is disregarded.

(e) The average grain size of river bed materials; 2 mm, is used in the assessment.

(f) The river bed rock is not taken into account in the assessment, though the rock portions are observed on the river bed in some reaches.

(g) The deposition of sediment loads on the bed of high-water channel of the river is not considered in the calculation, though a lot of deposition will occur particularly in the upstream of the Perjaya headworks.

(2) Calculation formulas

For the calculation of the degree of bed variation, the following formulas are used.

(a) River flow formula:

- Equation of motion

$$\frac{1}{g} \cdot \frac{\partial v}{\partial t} + \frac{\partial h}{\partial x} + \frac{\partial z}{\partial x} + \frac{\partial}{\partial x} \cdot \left(\frac{v^2}{2g}\right) + \frac{n^2 v^2}{R^{\frac{4}{3}}} = 0$$

- Equation of continuity

$$\frac{\partial Q}{\partial x} = -\frac{\partial A}{\partial t}$$

(b) Sediment transport formula:

- Equation of continuity

$$\frac{\partial z}{\partial t} + \frac{1}{1-\lambda} \cdot \frac{\partial qB}{\partial x} = 0$$

- Equation of motion

$$qB = f\ (U_*, \tau_*)$$

where, Q: river discharge (m^3/sec)
A: flow area (m^2)
v: velocity (m/sec)
h: water depth (m)
n: Manning's roughness coefficient
g: acceleration of gravity (m^2/sec)
z: bed variation height (m)
x: distance (m)
R: perimeter (m)

t: time (sec)

λ: porosity of bed material

qB: discharge of sediment loads (m^3/sec)

f: function composing of U_*, τ_*

U_*: friction velocity ($=\sqrt{\tau_*/\rho}$)

τ_*: tractive force ($= \rho \cdot g \cdot R \cdot Ie$)

ρ: density of fluid

Ie: energy gradient

For the estimation of discharge of sediment loads, the following Laursen's formula is employed:

$$\frac{\bar{C}}{(\frac{d}{h})^{7/6} \cdot (\frac{\tau_o'}{\tau_c} - 1)} = f\ (\frac{U_*}{w_o})$$

$$\frac{\tau_o'}{\rho} = \frac{v^2}{(7.66)^2} \cdot (\frac{d}{h})^{1/3}$$

$$\frac{\tau_c}{\rho} = \psi_c \cdot (\sigma/\rho - 1) \cdot g \cdot d$$

$$\bar{C} = 265 \cdot qB/q$$

where, τ_o': effective tractive force

τ_c: critical tractive force

ψ_c: parameter (= 0.03-0.05)

d: grain size

$\bar{C}$: average density of sediment in weight

(3) Results of assessment

The rate of bed variation is calculated for 20 years continuously in the case after completion of the Muaradua dam, and the results are shown in Fig. IX-13. The following table shows the degraded depths at:

	Degraded Depth for 20 Years
- Kurungan Nyawa	1.7 m
- Muncak Kabau	1.0 m

As mentioned in the above, since the calculated results are obtained on the assumptions of no sediment discharge from the residual basin and no existence of river bed rock, the calculated depths of degradation would be more than the actual. Further, it is noted that the above-calculated results are obtained within a limit of accuracy of the formula so far developed, and it is impossible to assess the rate of local degradation and the depth of deposition on the bed of high-water channel of the river.

3.3 Impacts of Headworks Construction

On the sandy river like the Komering, there are very limited instances for the construction of diversion weir and it is very difficult to make a quantitative assessment on the local degradation in the downstream of the weir and on the deposition of the bed loads in the upstream. However, the past experiences show that the above phenomena are more likely to occur in the sandy rivers than the gravelly river. An elaborate study is required to be made before construction of the weir, but it will be made mainly based on the results of the qualitative assessment to be obtained through hydraulic model tests.

3.4 Impacts of Irrigated Agricultural Development

3.4.1 Impacts of Fertilizer and Chemical Use

After completion of the irrigation project, the intensive farming will be practiced, and more fertilizer and agricultural chemicals will be used in the area. Sometimes, however, a farmer uses these agricultural inputs to the extent that his knowledge and judgement suggest that it is profitable for him to do so, without considering the environmental problems which give adverse effects on wildlife and human.

These problems are mainly associated with the persistence of pesticides. This persistence is, except some cases, undesirable in environment after their intended usefulness has been served, because they affect non-target organisms and result in biological magnification. This persistence of pesticides also gives rise to deleterious residues in food and feed.

In selecting the suitable insecticides and fungicides, chemical toxicity which directly or indirectly affect the human being and animals should carefully be examined. In this context, phosphorothioate, i.e. Diazinon and Sumithion are recommended as the insecticide and antibiotic chemicals because of their low toxicity. The fertilizers to be used under the project, such as urea and TSP, are almost harmless to both human being and natural environment from the viewpoint of chemical toxicity.

In order to minimize the environmental problems, guidance to farmers for proper use of the fertilizer and chemicals is essential from the start of the project, even though the fertilizer and chemicals are of low chemical toxicity.

3.4.2 Impacts on Water-Borne Diseases

After completion of the project works, a plenty of water will be led from the Komering river to the project area and create water ponds over the project area, and the development of road network will increase a human exchange between the urban areas and the project area. This change of circumstances will create more chances for the propagation of water-borne diseases and the intrusion of new type of diseases and parasites to the area.

The first priority is given to the prevention of malaria infection by eliminating malaria mosquito. For this, there is a need for the detailed research into cost effective methods of eliminating known breeding sites-infilling and draining, tree planting in the project area, and the use of larval and mosquito predators.

Schistosomiasis is a disease of considerable gravity when endemic, and is very difficult to eradicate once it is established. None of host snails has been found to be present. However, because of the seriousness of the disease, it is strongly recommended that a malacological survey should be carried out, and the host potential of indigenous snails to the disease be examined so that recommendations on possible preventive measures can be made.

Dengue fever, cholera, typhoid fever, filariasis, etc. are at a low ebb in their epidemic cycles at present, but a long term improvement in hygiene and sanitation should be required for the prevention and control of these diseases.

3.4.3 Change of Soil Condition

The soil forming process for upland soils will be changed remarkably after start of irrigation. Gleization will predominate under irrigated paddy cultivation, instead of oxidation weathering. In gleization, metallic elements in soils such as iron, aluminium and manganese become soluble, and these compounds are translocated to and accumulated in subsoils. This phenomenon is observed when soil reaction shows strong acid and iron content is high particularly in Podzolic Soils. Excess iron frequently causes plant physiological problems, especially Akagare type-I showing "bronzing" symptom. Besides, leaching of bases from rooting zones degrades soil fertility through continuous irrigation and drainage. In order to maintain a soil productivity high, appropriate farming practices such as fertilization, deep tillage in certain internal and liming, preferably calsium-silicate, are needed.

In addition, a well-established drainage is needed for the poorly drained soils such as Humic Gley Soil and Organic Soil. By lowering the groundwater table in such areas, aeric condition in rooting zone will be improved.

3.4.4 Increase of River Discharge in Other Basins due to Irrigation Loss

In the project area, there flow four rivers to be used as the main drains of the project. These are the Macok, the Balitang, the Lempuing and the Tulangbawang rivers. Out of these, three rivers except the Tulangbawang river have less capacities and are giving flood problems to the area every year. For the use of these rivers as the main drains, it is necessary to expand their flow areas under the project.

The monthly discharge of the Tulangbawang river varies from 81 m^3/sec in the dry season to 260 m^3/sec in the rainy season. Against this variation of discharge, the irrigation loss to be drained to the river is estimated to be 20 m^3/sec in the dry season and 15 m^3/sec in the rainy season at the most, and it is judged that the influence of this increase on the river discharge would be nominal.

3.4.5 Improvement of Environmental Sanitation

The construction of the project works would have a positive effect on the overall ecology of the project area. The health and sanitary conditions would become better with drainage improvement as well as supply of fresh water through the irrigation canals.

3.5 Socio-Economic Impacts

In addition to the direct benefits stipulated in the economic evaluation, favourable but intangible socio-economic impacts are expected from the implementation of the project.

3.5.1 Foreign Exchange Saving

Under the project implementation, rice production will increase to about 480,000 tons per annum from the present production of 60,000 tons. Out of this increased production, it is expected that the marketable rice would be about 420,000 tons after deducting the local consumption. This surplus would reduce the annual amount of imported rice, resulting in the saving of foreign exchange amounting to around US$156 million equivalent.

3.5.2 Increase of Employment Opportunity to Local People

Employment opportunity to the local people will be increased by the project implementation, and a favourable impact will be given to the national economy. Furthermore, the employee will be able to gain more experience, technical know-how, skillfulness in the various working fields. These accumulations would be applied to the future development in the South Sumatra province.

3.5.3 Improvement of Local Transportation

The local transportation will be improved much by the construction of the operation and maintenance roads along the irrigation canals. The expanded road system will not only enhance the economic activity in and around the project area but also contribute to inter-regional accessibility and communication.

1. FUTURE SURVEYS AND STUDIES

For the further study on the watershed management in the upper Komering river basin, the following surveys and studies should be started immediately:

(1) Aerial photo shooting over the total basin area on a scale of 1:20,000 (preferably color photos),

(2) Preparation of topographic map on a scale of 1:20,000 with 5-m contour lines,

(3) Establishment of experimental area with 1,000-2,000 ha for the observation of actual patterns of surface flow and soil erosion,

(4) Detailed survey on the actual situation of the shifting culture in the basin,

(5) Measurement of sediment loads and water quality analysis at the proposed dams and headworks sites,

(6) Continuous observation on the change of the Komering river bed in its lower reaches,

(7) Survey on species and population of fish and wildlife in the Komering river basin including the Lake Ranau, and

(8) Survey on annual fish production and income in the Komering river basin.

Table IX-1 SEDIMENT DISCHARGE OF SUSPENDED LOAD

(Unit: m^3/sec)

Site	Observed Date	Discharge	Sediment Discharge
Kurangan Nyawa	Aug. 30, 1980	61.5	0.041
	Sep. 30, 1980	97.1	0.062
	Mar. 13, 1981	200.0	0.192
Martapura	Jan. 28, 1980	146.0	0.071
	Aug. 30, 1980	85.1	0.047
	Sep. 30, 1980	86.2	0.047
	Mar. 13, 1980	173.0	0.133
	Sep. 30, 1981	184.0	0.106
	Oct. 14, 1981	339.0	0.260

Fig. IX-1 FOREST MANAGEMENT MAP FOR UPPER KOMERING BASIN

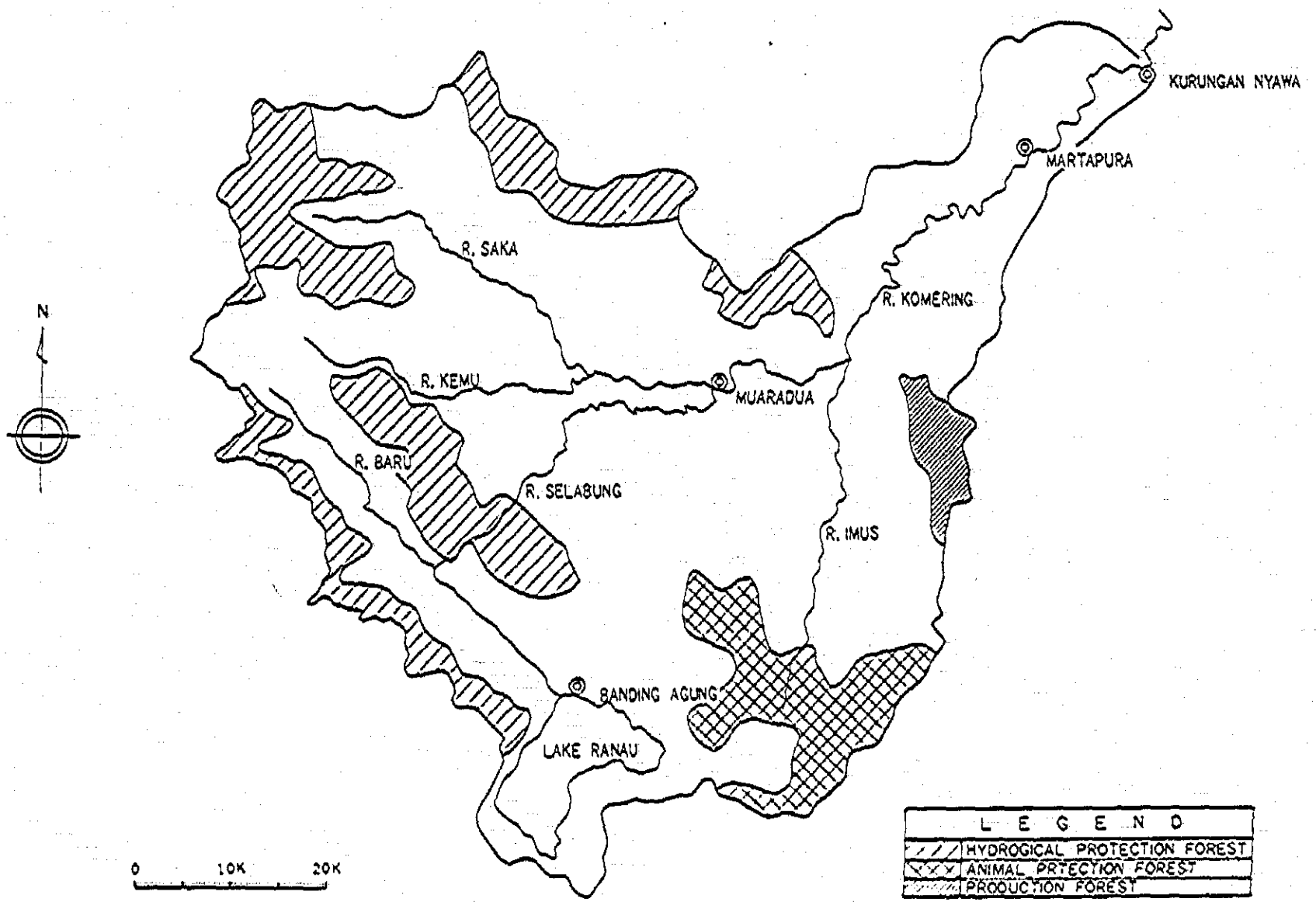


Fig. IX-2 VEGETATION IN UPPER KOMERING BASIN

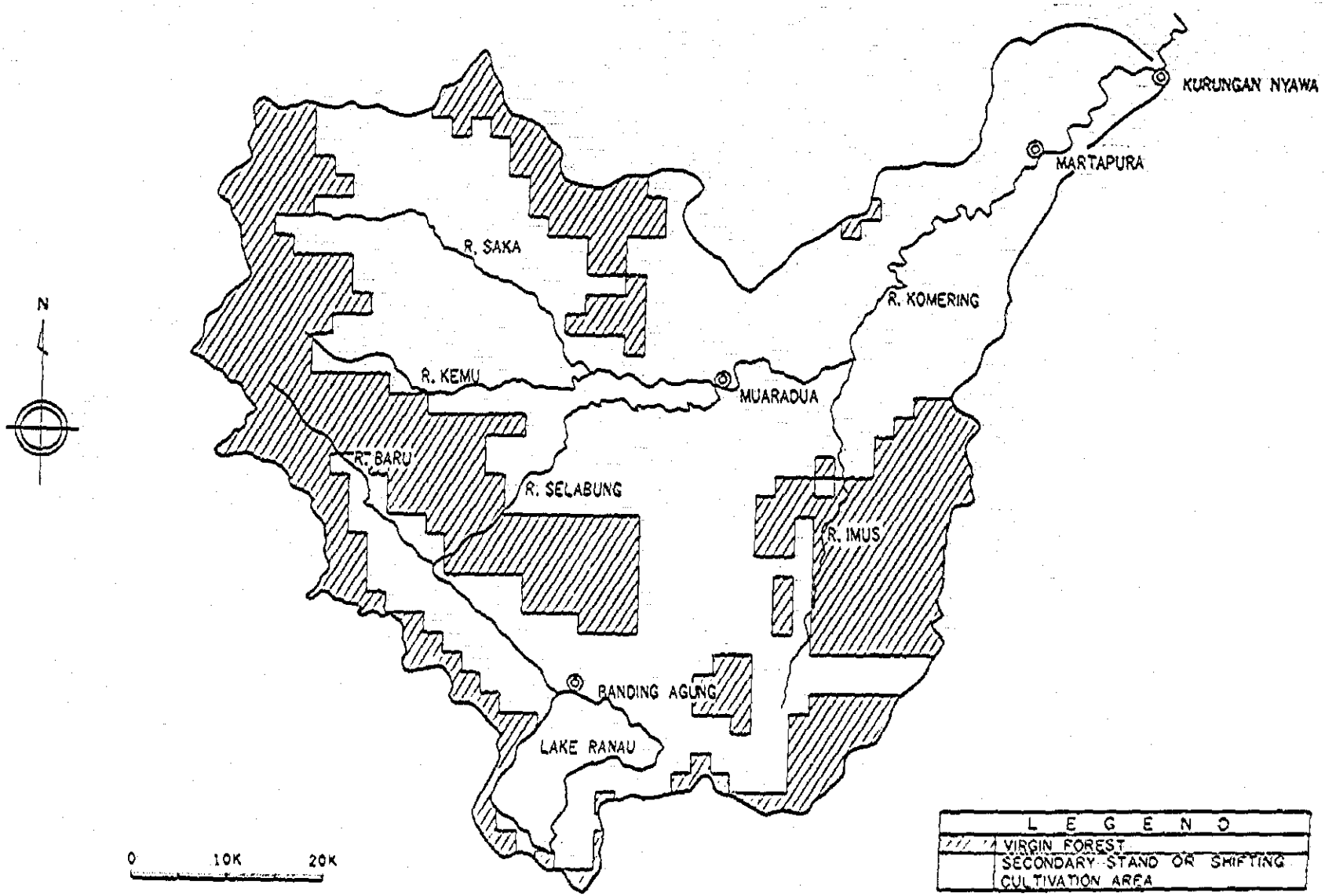


Fig. IX-3 TOPOGRAPHY (ELEVATION) OF UPPER KOMERING BASIN

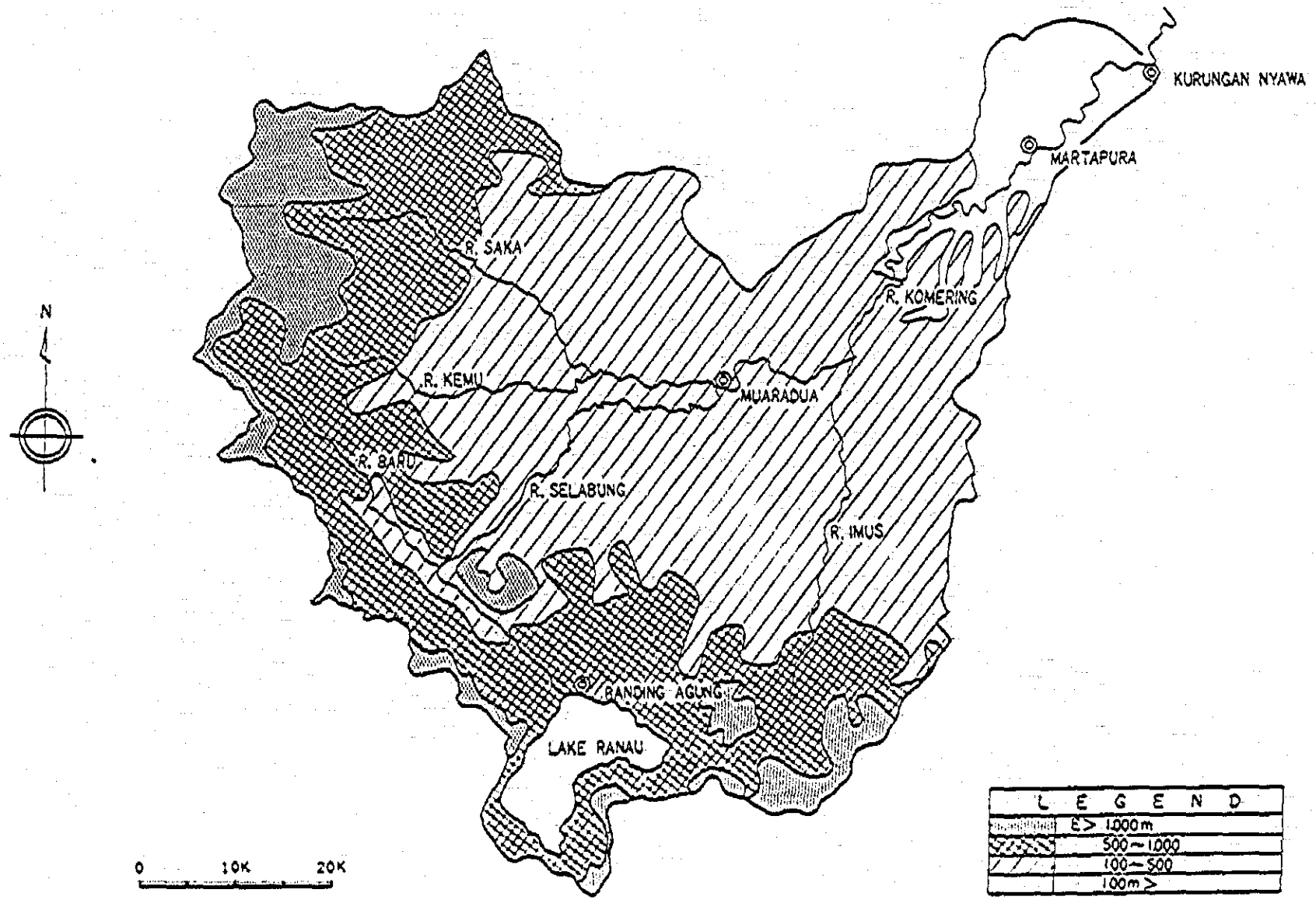


Fig. IX-4 TOPOGRAPHY (SLOPE) OF UPPER KOMERING BASIN

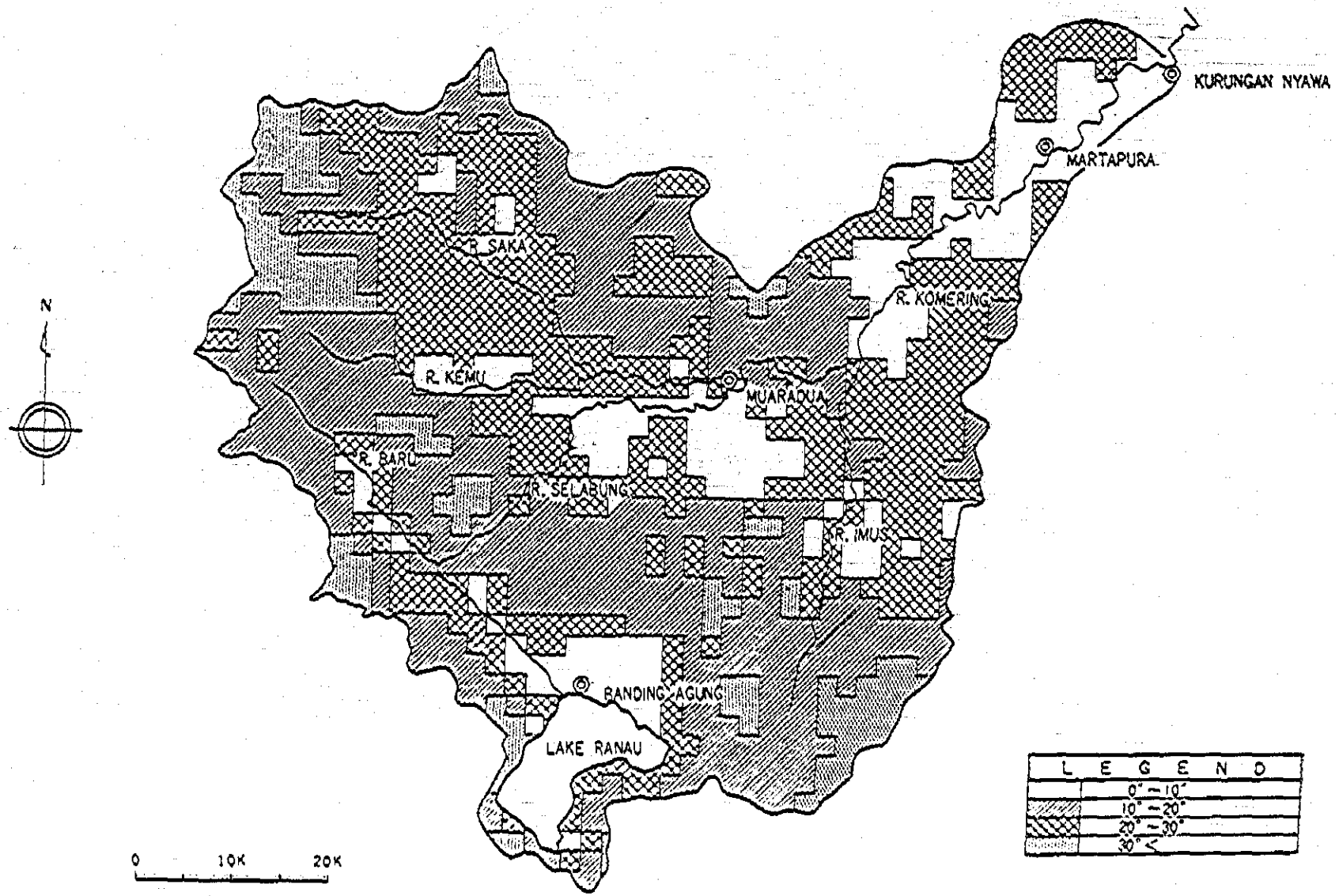


Fig. IX-5 GEOLOGY OF UPPER KOMERING BASIN

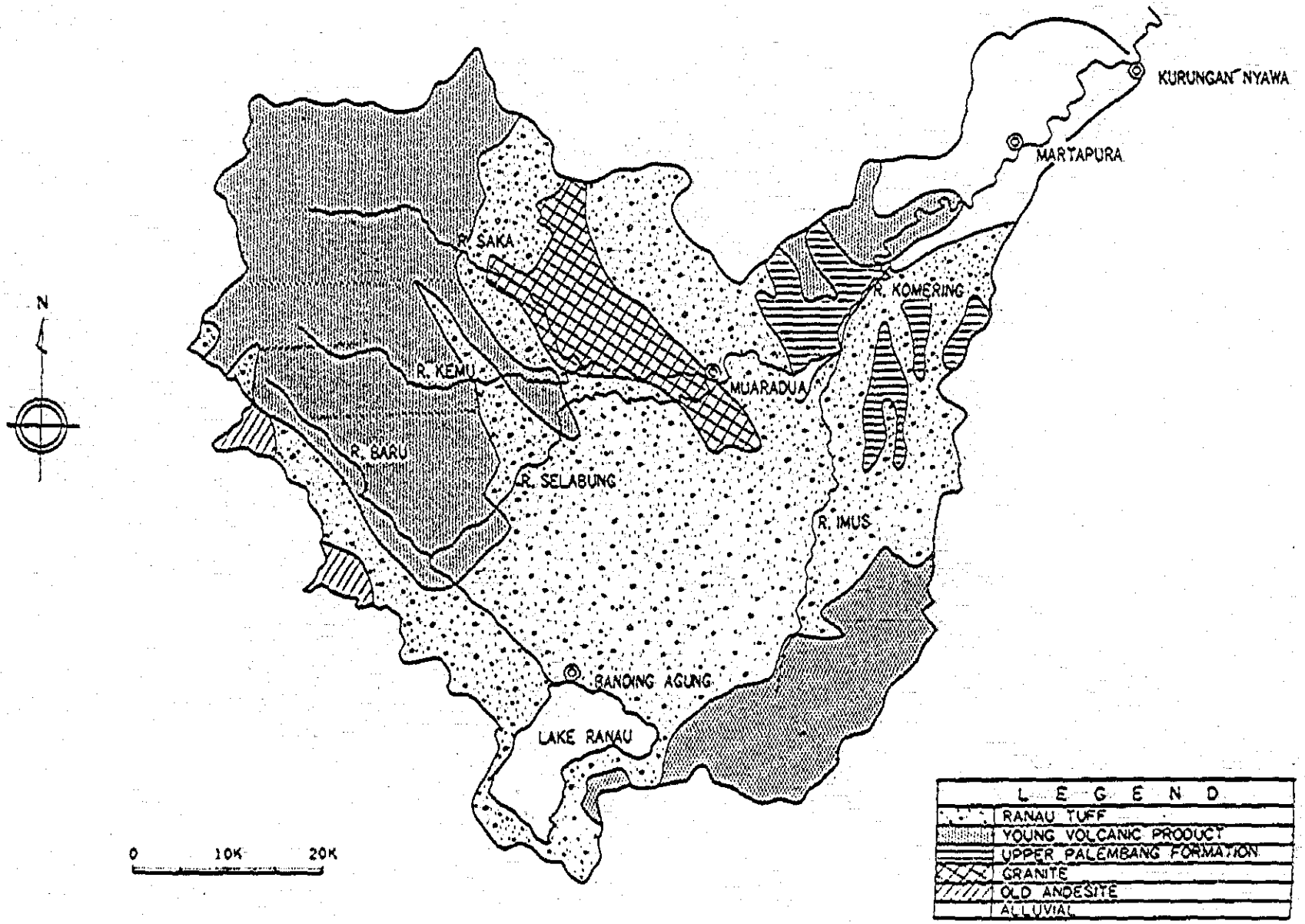


Fig. IX-6 RAINFALL DISTRIBUTION IN UPPER KOMERING BASIN

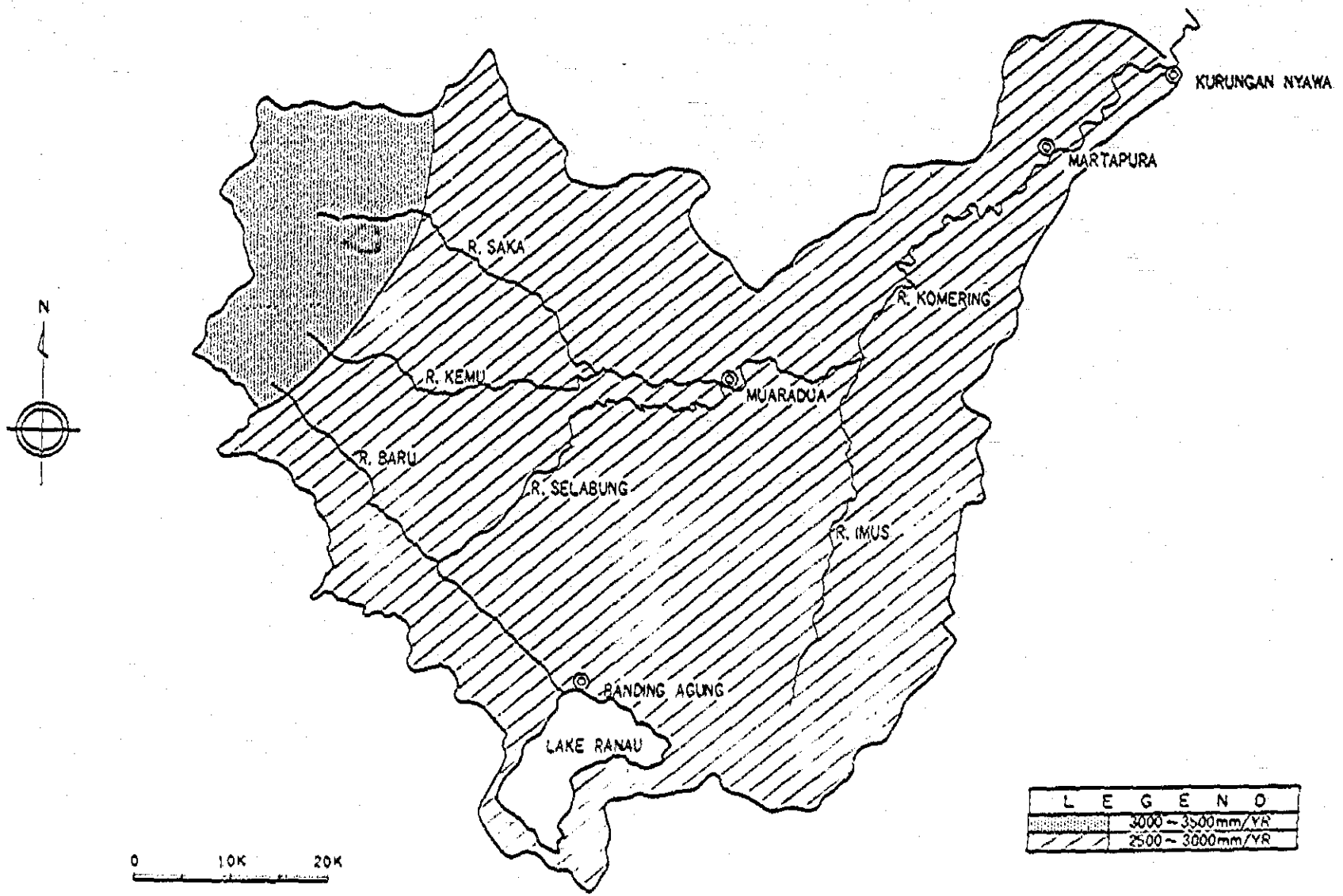


Fig. IX-7 SUSPECTED AREA FOR EROSION

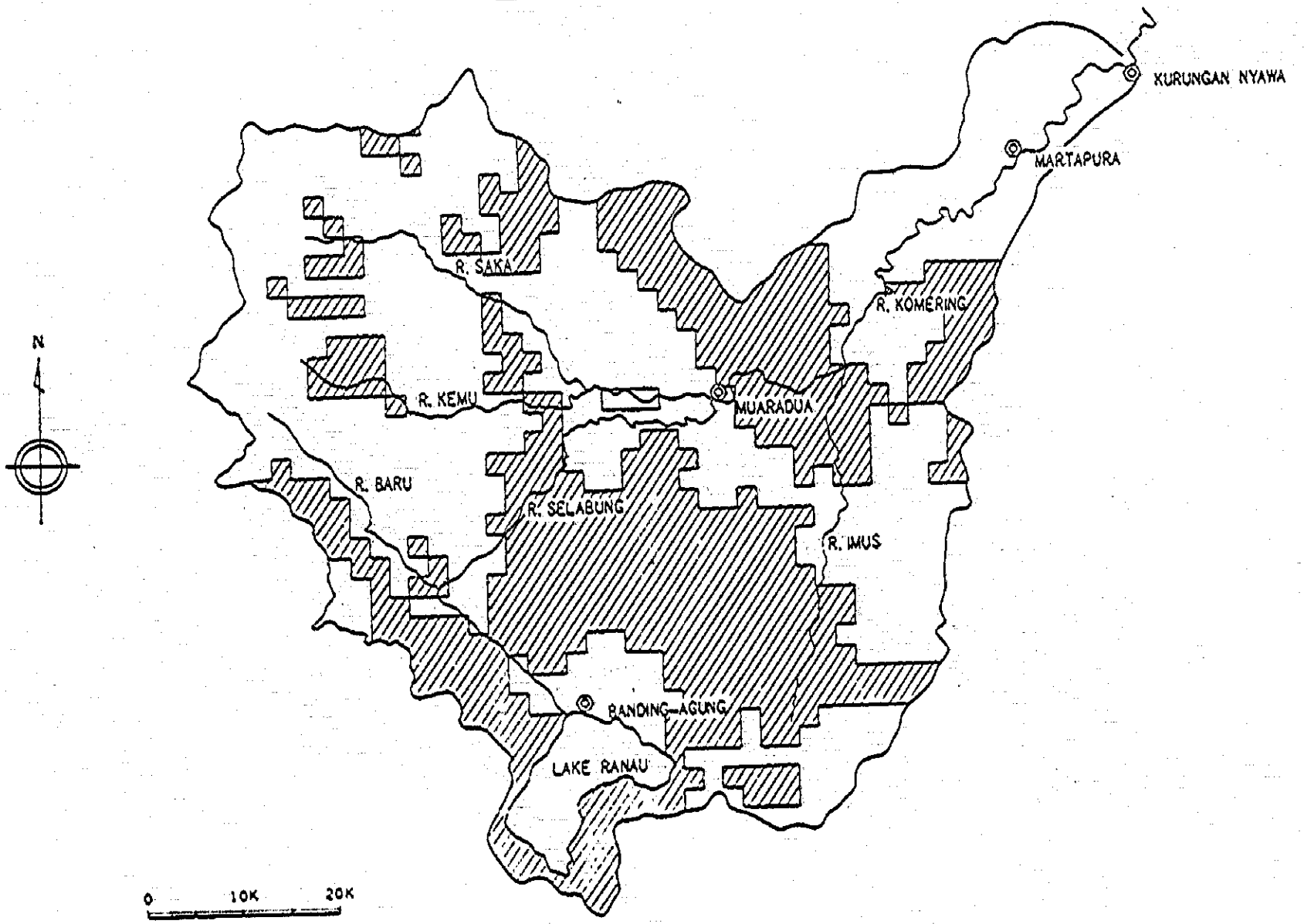


Fig. IX-8 GRAIN SIZE ACCUMULATION CURVE OF BED LOAD

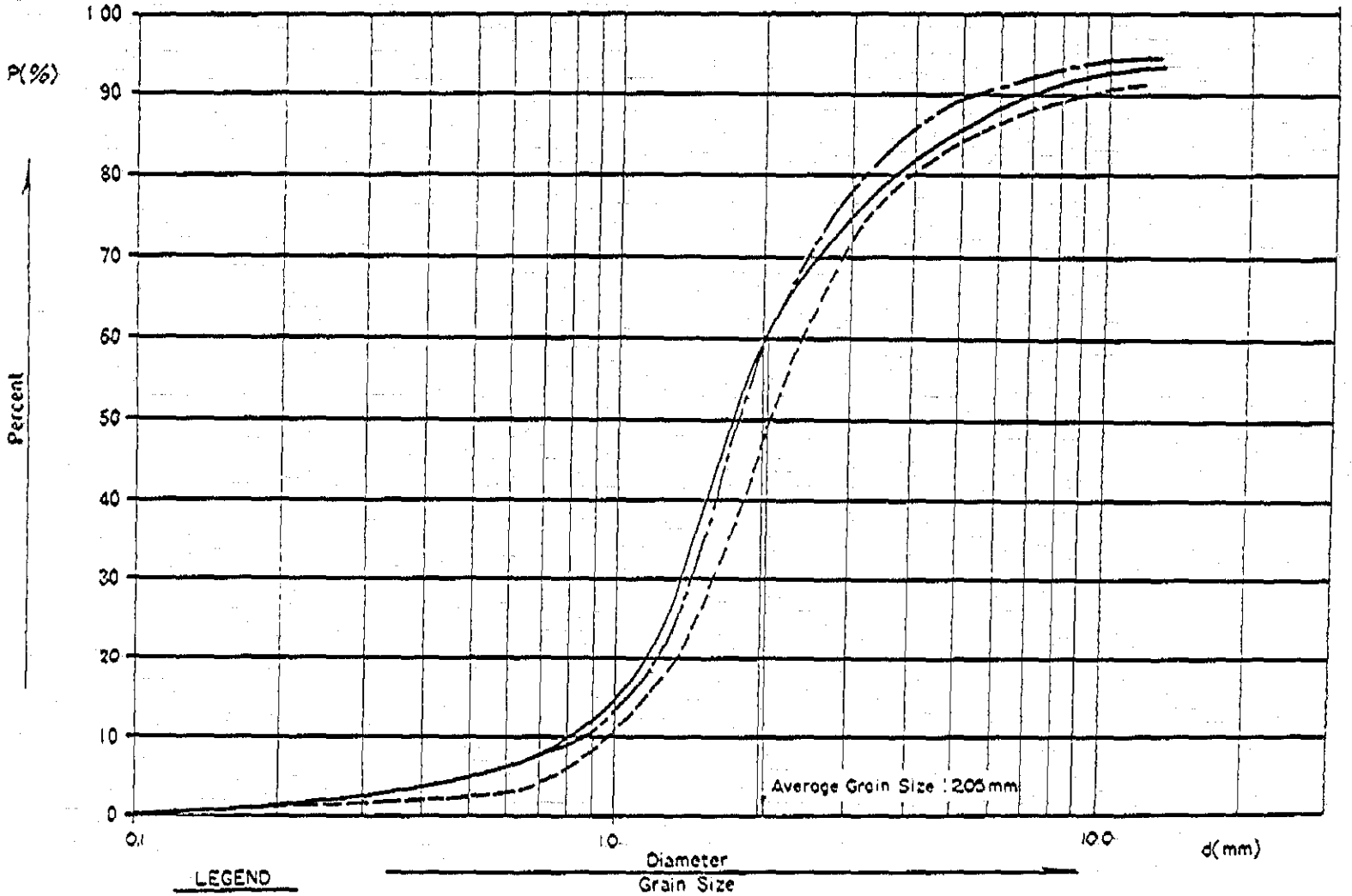


Fig. IX-9 SEDIMENT DISCNARGE RATING CURVE

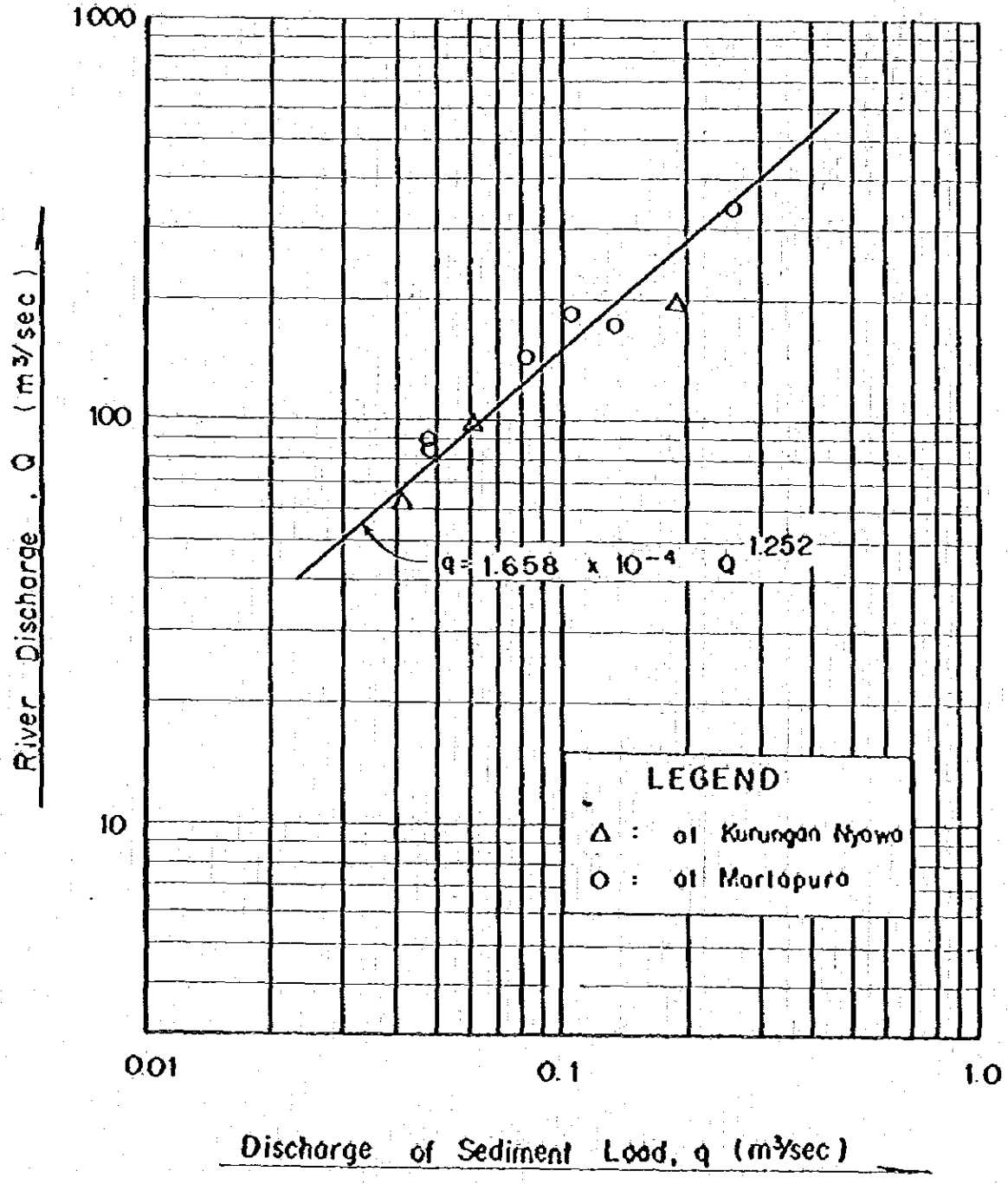


Fig. IX-10 LOCATION MAP OF PROPOSED SABO DAM

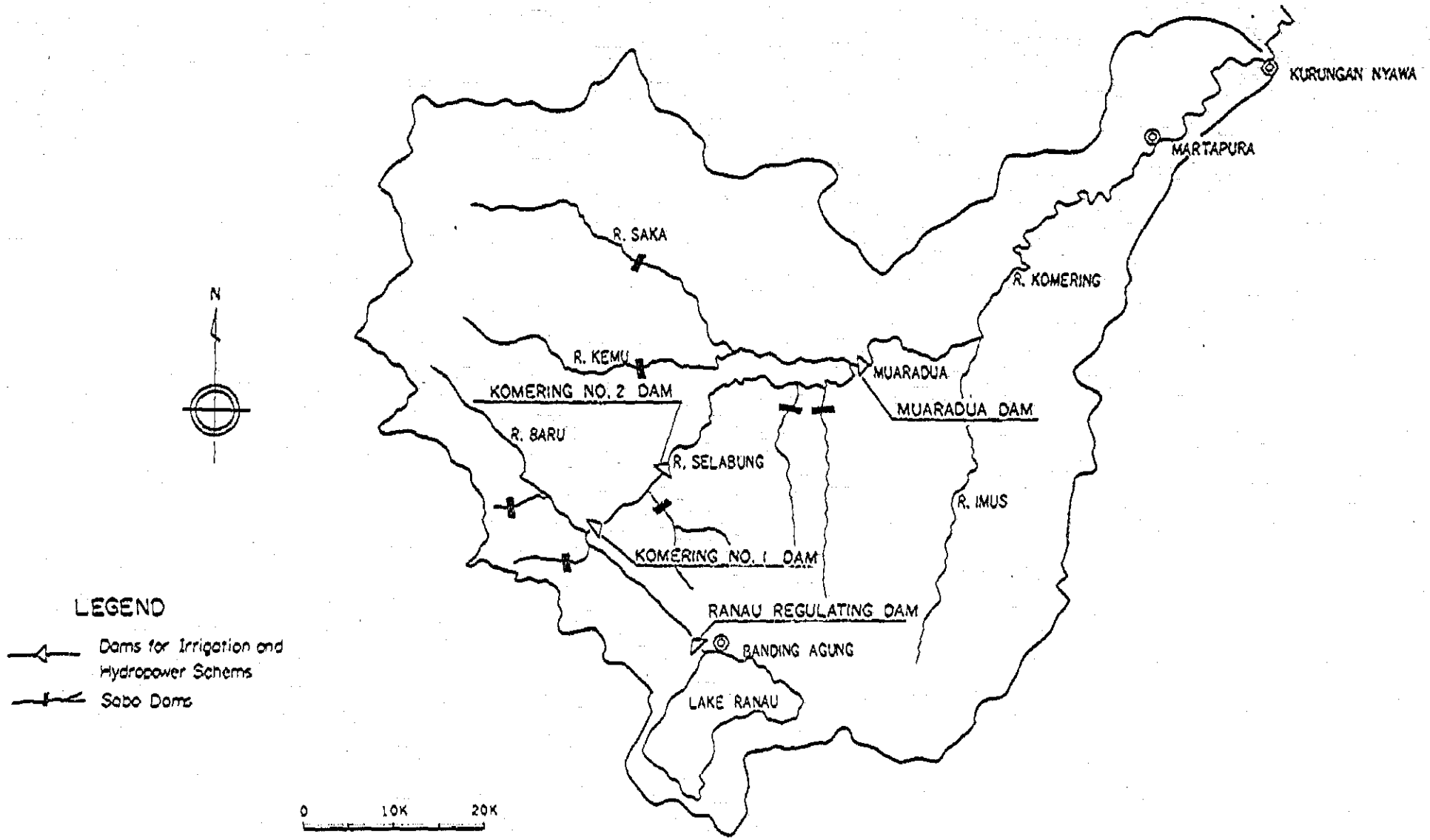
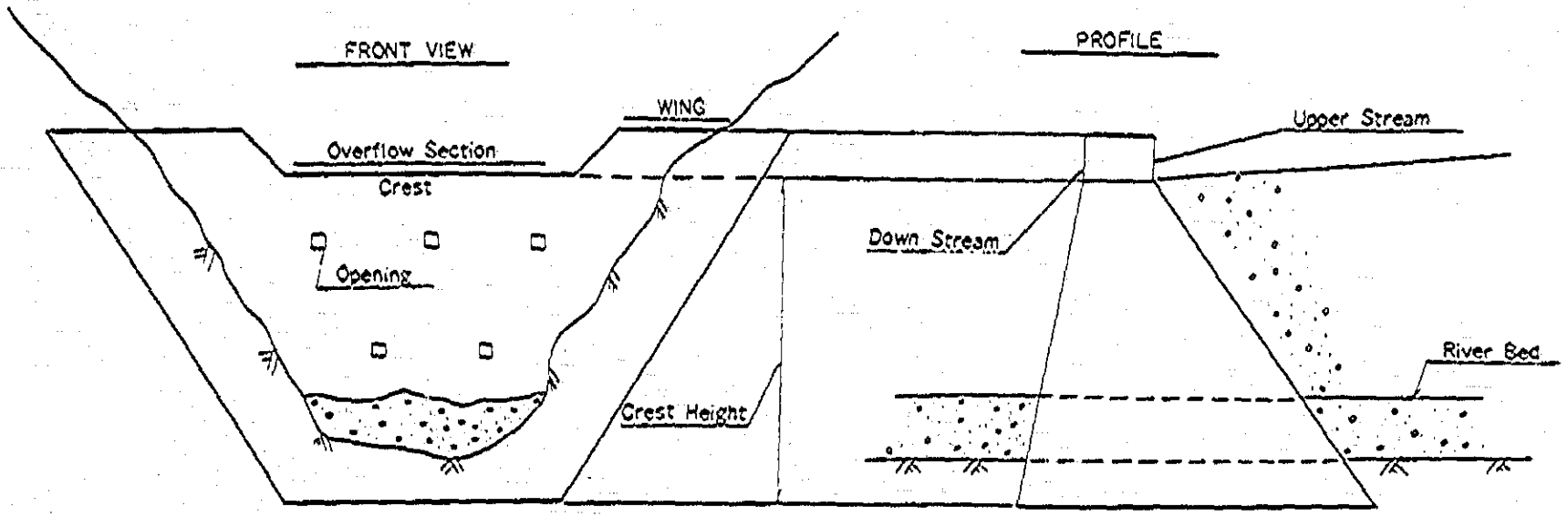


Fig. IX-11 GENERAL FEATURE OF SABO DAM



FUNCTION

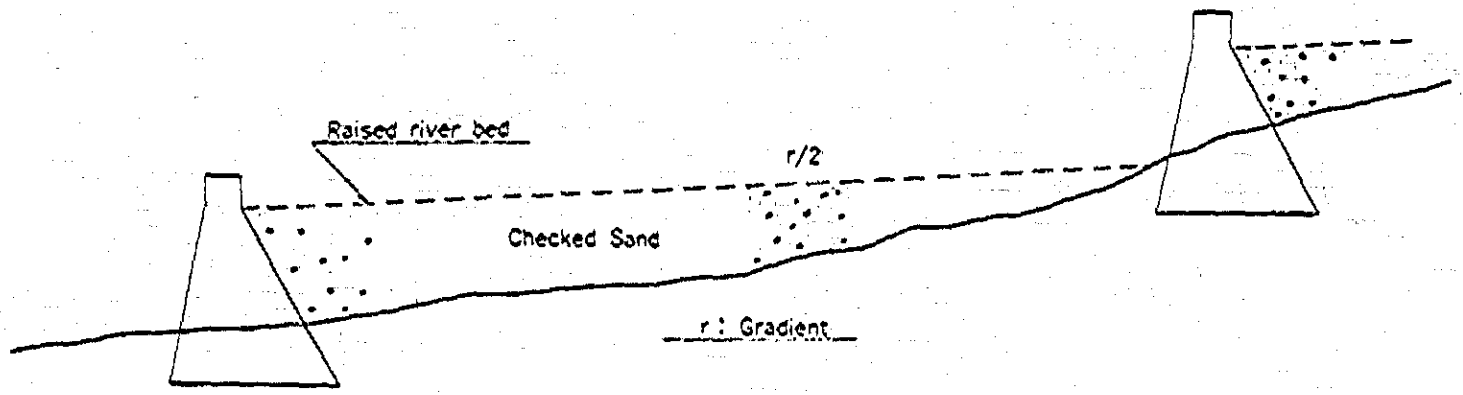
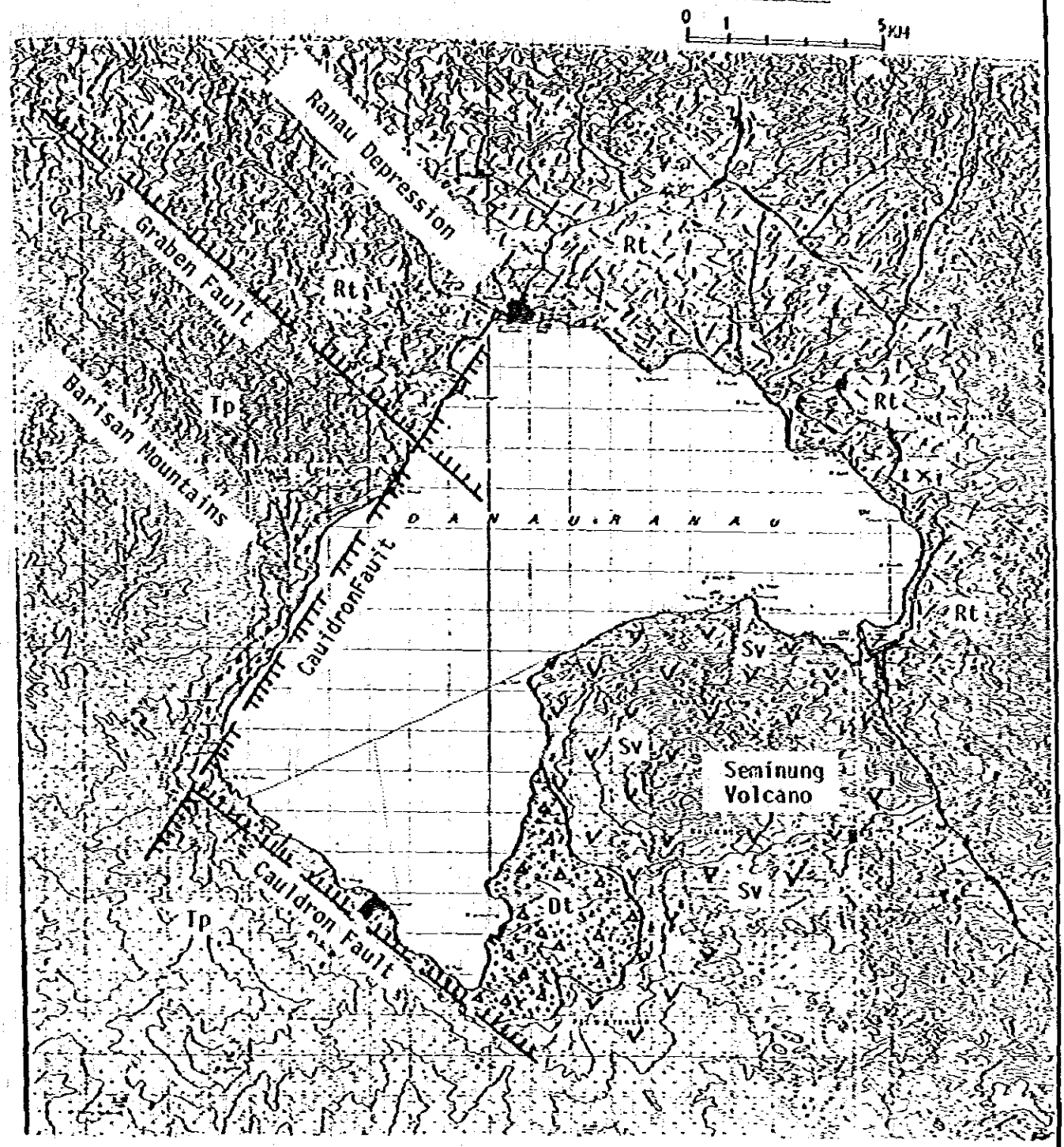


Fig. IX-12 GEOLOGICAL STRUCTURE AROUND THE RANAU LAKE

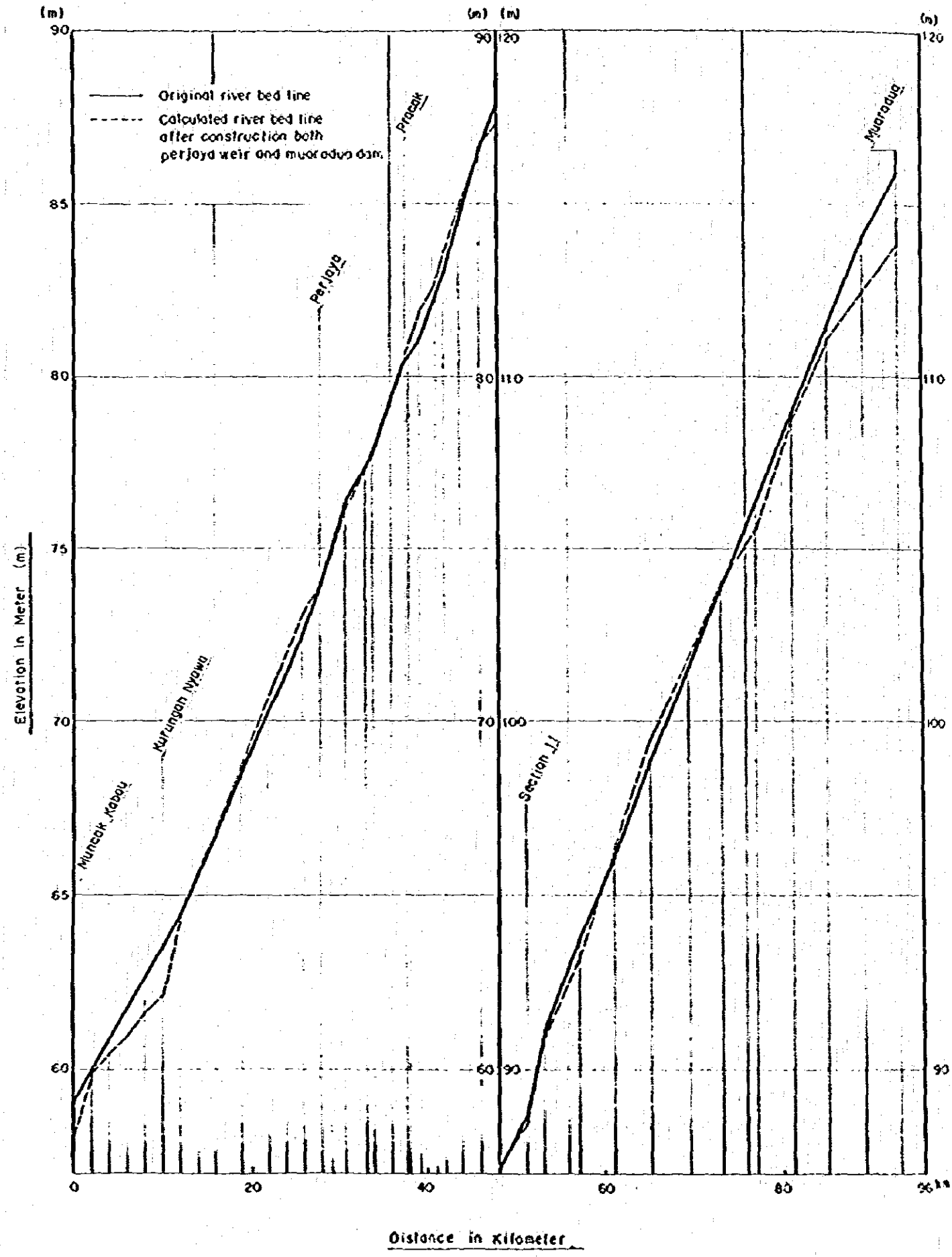


LEGEND

QUATERNARY
- HOLOCENE — Dt — TALUS DEPOSIT
- PLEISTOCENE
  - Sv — ANDESTIC LAVAS OF SEMINUNG VOLCANO
  - Rt — RANAU TUFF ACID VOLCANIC ASH

TERTIARY — PALEOGENE — Tp — SEDIMENTARY AND VOLCANIC ROCKS

Fig. IX-13 RESULT OF RIVERBED VARIATION



ANNEX X

COST ESTIMATE

ANNEX - X

COST ESTIMATE

1. CONSTRUCTION COST

1.1 Conditions of Cost Estimate

The construction cost is estimated under the following conditions:

(1) The exchange rate used in the estimate is US$1.0 = Rp 625 = ¥220.

(2) Construction works are to be executed on contract basis using contractor's own construction machinery and equipment.

(3) Taxes on the construction materials, machinery and equipment to be imported from abroad are exempted from the estimate of construction cost.

(4) The construction costs are estimated on the basis of the current prices in the South Sumatra province and the Lampung province in August 1981 and the data collected from the on-going projects in both provinces as well as the CIF prices at Palembang referring to the international prices of materials, machinery and equipment in August 1981.

(5) For the construction of the quaternary network of the irrigation project, only the costs of materials for the construction of the division boxes and culverts are included in the estimate. The construction works of the quaternary network are to be carried out by local farmers themselves under the guidance of the Project Office.

(6) Cost for jungle clearing is excluded in the construction cost, since this work is considered to be done by transmigrants who will settle before the commencement of the construction works.

(7) The physical contingency related to the work quantities for the irrigation schemes is 15% of the direct construction cost except the cost of O & M equipment, land acquisition, engineering services and administration expenses, whereas the physical contingency for the dam and power schemes is 20% of the direct construction cost.

(8) The engineering and administration cost for the irrigation schemes is assumed to be 10% of the direct construction costs, and for the dam and power schemes that is assumed to be 15%.

(9) The associated costs to be financed by the Government such as the cost for strengthening the extension services, facilities of the water users' association, and improvement of the social infrastructures are not included in the estimate.

1.2 Estimate of Construction Cost

The construction costs for the respective project components comprise direct construction cost, compensation cost for land acquisition, cost for O & M equipment, engineering and administration costs and physical contingency.

The summary and breakdown of the cost estimate are shown in Table X-1 through Table X-17.

The price of local materials and labour wages used in the estimate and unit rates for major works are shown in Table X-18 and X-19.

2. ANNUAL OPERATION AND MAINTENANCE COSTS

The annual operation and maintenance costs include the salaries of project administrative and water control staffs, the materials and labour costs for repair and maintenance of project facilities, the costs for operation, repair and maintenance of O & M equipment, and running costs of project facilities.

Annual O & M costs for irrigation development area are estimated at 32 $/ha referring to the "Feasibility Study on the Komering-I Irrigation Development Project" and similar irrigation projects in Indonesia. The O & M costs for the respective areas are summarized in Table X-20.

Annual O & M costs for dams and power schemes are estimated to be 0.5% and 2.5% of the total construction costs, respectively. The annual O & M costs thus estimated are summarized in Table X-21.

3. REPLACEMENT COST

Some of the project facilities, especially mechanical and electrical facilities, have shorter useful life than the civil works and are required replacement certain times within the project life.

The replacement costs and useful lives of these facilities are shown in Table X-22 and X-23.

Table X-1 SUMMARY OF CONSTRUCTION COST

(Unit: 10^3US$)

Item	Construction Cost
1. DAMS	
- Ranau regulating dam	3,280
- Komering No. 1 dam	83,760
- Komering No. 2 dam	51,840
- Muaradua dam	59,370
Sub-total	198,250
2. IRRIGATION SCHEMES	
- Perjaya weir	15,500
- Komering-I scheme	202,800
- Muncak Kabau Scheme	63,900
- Lempuing Scheme	85,100
- Tulangbawang Scheme	313,000
Sub-total	686,300
3. POWER SCHEMES	
- Ranau power shceme	99,470
- Komering No. 1 power scheme	93,910
- Komering No. 2 power scheme	44,690
- Muaradua power scheme	65,260
Sub-total	303,330
TOTAL	1,187,880

Table X-2

SUMMARY OF CONSTRUCTION COST

- DAMS -

(Unit: 10^3US$)

ITEM	Ranau Power Scheme	Komering No.1 Power Scheme	Komering No.2 Power Scheme	Muaradua Power Scheme
1. Preparatory Works	750	12,700	6,350	5,510
2. Diversion Tunnel	-	6,130	5,250	8,450
3. Dam and Spillway	1,660	41,640	26,000	23,090
4. Metal Works	210	4,140	3,830	6,400
Sub-total	2,620	64,610	41,430	43,450
5. Land Aquisition	10	3,000	70	5,000
6. Engineering Services and Administration Expenses	260	6,460	4,140	4,350
7. Physical Contingency	390	9,690	6,200	6,570
Total	3,280	83,760	51,840	59,370

Table X-3 CONSTRUCTION COST OF RANAU REGULATING DAM

Work Item	Unit	Q'ty	Amount (10^3US$)
1. Civil Works			2,410
1.1 Preparatory works			750
- Access road	km	2.5	375
- Construction facilities		L.S.	375
1.2 Expansion Works of River			
- Earth works	m^3	146,300	930
1.3 Dam and Spillway			730
- Excavation	m^3	2,900	21
- Concrete works	m^3	1,600	327
- Reinforcement Bar		230	230
- Miscellaneous		L.S.	150
2. Metal Works			
- Spillway gate	ton	17.5	210
Sub-total (item 1 and 2)			(2,620)
3. Land Acquisition			10
4. Engineering Services and Administration Expenses			260
5. Physical Contingency			390
Sub-total (item 3 to 5)			(650)
Total			3,280

Table X-4 CONSTRUCTION COST OF KOMERING NO.1 DAM

	Work Item	Unit	Q'ty	Amount
				(10^3US$)
1.	Civil Works			60,470
	1.1 Preparatory Works			12,700
	- Access road	km	18	2,700
	- Construction facilities		L.S.	10,000
	1.2 Diversion Tunnel			6,130
	- Tunnel excavation	m^3	29,000	2,030
	- Lining concrete	m^3	10,000	2,200
	- Reinforcement bar	ton	500	500
	- Miscellaneous		L.S.	1,400
	1.3 Dam and Spillway			41,640
	- Excavation	m^3	300,000	2,100
	- Core embankment	m^3	560,000	5,600
	- Filter embankment	m^3	190,000	2,850
	- Random embankment	m^3	140,000	1,120
	- Rock embankment	m^3	1,110,000	18,870
	- Concrete	m^3	20,000	4,000
	- Foundation treatment		L.S.	2,500
	- Reinforcement bar	ton	1,000	1,000
	- Miscellaneous		L.S.	3,600
2.	Metal Works			4,140
	- Diversion gate	ton	70	700
	- Spillway gate	ton	120	1,440
	- River outlet gate		L.S.	2,000
	Sub-total (item 1 and 2)			64,610
3.	Land Acquisition			3,000
4.	Engineering Services and Administration Expenses			6,460
5.	Physical Contingency			9,690
	Sub-total (item 3 to 5)			(19,150)
	Total			83,760

Table X-5 CONSTRUCTION COST OF KOMERING NO.2 DAM

	Work Item	Unit	Q'ty	Amount
				(10³US$)
1.	Civil Works			37,600
	1.1 Preparatory Works			6,350
	- Access road	km	9	1,350
	- Construction facilities		L.S.	5,000
	1.2 Diversion Tunnel			5,250
	- Tunnel excavation	m^3	27,000	1,890
	- Lining concrete	m^3	8,000	1,760
	- Reinforcement bar	ton	400	400
	- Miscellaneous		L.S.	1,200
	1.3 Dam and Spillway			26,000
	- Excavation	m^3	14,000	98
	- Concrete	m^3	200,000	16,000
	- Foundation treatment		L.S.	1,500
	- Reinforcement bar	ton		6,000
	- Miscellaneous		L.S.	2,402
2.	Metal Works			3,830
	- Diversion gate	ton	75	750
	- Spillway gate	ton	90	1,080
	- River outlet gate		L.S.	2,000
	Sub-total (item 1 and 2)			(41,430)
3.	Land Acquisition			70
4.	Engineering Services and Administration Expenses			4,140
5.	Physical Contingency			6,200
	Sub-total (item 3 to 5)			(10,410)
	Total			51,840

Table X-6 CONSTRUCTION COST OF MUARADUA DAM

	Work Item	Unit	Q'ty	Amount
				(10^3US$)
1.	Civil Works			48,885
	1.1 Preparatory Works			5,010
	- Access road	km	11	1,150
	- Construction facilities		L.S.	3,860
	1.2 Diversion Tunnel			7,470
	- Tunnel excavation	m^3	42,360	2,960
	- Lining concrete	m^3	10,350	2,280
	- Reinforcement bar	ton	520	520
	- Miscellaneous		L.S.	1,710
	1.3 Dam and Spillway			22,090
	- Excavation	m^3	130,890	920
	- Core embankment	m^3	1,240,000	12,400
	- Filter embankment	m^3	72,300	1,090
	- Rock embankment	m^3	20,700	350
	- Concrete	m^3	21,400	4,300
	- Reinforcement bar	ton	1,030	1,030
	- Miscellaneous		L.S.	2,000
2.	Metal Works			8,880
	- Diversion gate	ton	400	4,000
	- Spillway gate	ton	240	2,880
	- River outlet gate		L.S.	2,000
	Sub-total (item 1 and 2)			(43,450)
3.	Land Acquisition		L.S.	5,000
4.	Engineering Services and Administration Expenses			4,350
5.	Physical Contingency			6,570
	Sub-total (item 3 to 5)			(15,920)
	Total			59,370

Table X-7 CONSTRUCTION COST OF PERJAYA WEIR

Work Item	Unit	Q'ty	Amount
			(10^3US$)
1. Preparatory Works			3,520
2. Perjaya Weir			8,880
- Earth works	m^3	59,400	132
- Concrete works	m^3	38,100	4,791
- Metal works	ton	382	1,900
- Electric facilities	-	L.S.	450
- Miscellaneous	-	L.S.	1,604
Sub-total (item 1 and 2)			(12,400)
4. Engineering Services and Administration Expenses			1,240
5. Physical Contingency			1,860
Sub-total (item 4 and 5)			(3,100)
TOTAL			15,500

Table X-8 SUMMARY OF CONSTRUCTION COST

(Irrigation Facilities)

(Unit: 10³US$)

	Work Item	Komering-I (36,700 ha)	Muncak Kabau (10,700 ha)	Lempuing (13,100 ha)	Tulangbawang (44,500 ha)
1.	Preparatory Works	7,404	3,896	3,138	11,531
2.	Intake Structure and Headreach	11,173	1,973	18,207	19,378
3.	Main Canal and Inspection Road	40,871	11,452	10,919	55,910
4.	Secondary Canal and Inspection Road	23,793	6,955	8,030	33,598
5.	Tertiary Development	27,218	8,335	9,720	39,605
6.	Drainage Canal	11,205	1,937	2,448	9,701
7.	Flood Protection Dike	-	1,760	1,354	-
8.	Land Clearing and Levelling	31,784	11,776	10,790	70,191
9.	Office and Quarter	1,852	926	1,204	2,246
	Sub-total (item 1 to 9)	155,300	49,010	65,810	242,160
10.	Land Acquisition	3,730	1,030	1,050	4,260
11.	O&M Equipment	4,990	1,620	1,780	6,050
12.	Engineering Services and Administration Expenses	15,530	4,900	6,580	24,210
13.	Physical Contingency	23,250	7,340	9,880	36,320
	Sub-total (item 10 to 13)	47,500	14,890	19,290	70,840
	Total	202,800	63,900	85,100	313,000

Table X-9 CONSTRUCTION COST OF KOMERING-I AREA

	Work Item	Unit	Q'ty	Amount (10^3US$)
1.	Preparatory Works		L.S.	7,401
2.	Intake Structure and Headreach			11,173
	2.1 Intake structure			3,884
	- Each works	m^3	23,600	132
	- Concrete works	m^3	8,580	2,047
	- Metal works	ton	156	1,374
	- Miscellaneous		L.S.	427
	2.2 Driving channel			1,427
	- Earth works	m^3	232,000	373
	- Concrete lining	m^3	10,300	816
	- Miscellaneous		L.S.	238
	2.3 Settling basin			2,082
	- Earth works	m^3	32,500	54
	- Concrete works	m^3	6,580	1,209
	- Metal works	ton	33	543
	- Miscellaneous		L.S.	276
	2.4 Headreach and inspection road			3,775
	- Earth works	m^3	1,282,000	2,035
	- Gravel pavement	m^2	74,690	413
	- Related structure		L.S.	1,327
3.	North Main Canal (50 km)			15,689
	3.1 Main canal			11,168
	- Earth works	m^3	3,425,000	6,084
	- Concrete lining	m^3	9,600	570
	- Related structure	nos.	97	4,514
	3.2 Main inspection road			4,521
	- Earth works	m^3	1,075,000	2,455
	- Gravel pavement	m^2	385,000	2,066

(to be continued)

	Work Item	Unit	Q'ty	Amount
				(103US$)
4.	South Main Canal (85 km)			25,182
	4.1 Main canal			16,781
	- Earth works	m^3	5,549,000	10,262
	- Concrete lining	m^3	14,700	874
	- Related structure	nos.	125	5,645
	4.2 Main inspection road			8,401
	- Earth works	m^3	2,239,000	4,896
	- Gravel pavement	m^2	653,000	3,505
5.	Secondary Canal and Inspection Road	km	237	23,793
6.	Tertiary Development	ha	36,700	27,218
7.	Drainage Canal	km	489	11,205
8.	Land Clearing	ha	16,330	10,422
9.	Land Levelling	ha	23,380	21,362
10.	Office and Quarter		L.S.	1,852
	Sub-total (item 1 to 10)			(155,300)
11.	Land Acquisition		L.S.	3,730
12.	O&M Equipment		L.S.	4,990
13.	Engineering Services and Administration Expenses		L.S.	15,530
14.	Physical Contingency		L.S.	23,250
	Sub-total (item 12 to 14)			(47,500)
	Total			202,800

Table X-10 CONSTRUCTION COST OF MUNCAK KABAU AREA

	Work Item	Unit	Q'ty	Amount
				(10³US$)
1.	Preparatory Works		L.S.	3,896
2.	Diversion Weir			1,008
	- Earth works	m^3	16,000	45
	- Concrete works	m^3	5,300	420
	- Miscellaneous		L.S.	543
3.	Intake Structure and Settling Basin			965
	- Earth works	m^3	20,000	40
	- Concrete works	m^3	3,500	650
	- Metal works	ton	28	275
4.	Main Canal and Inspection Road (48 km)			11,452
	4.1 Main canal			7,825
	- Earth works	m^3	1,929,000	3,489
	- Concrete lining	m^2	8,900	539
	- Related structure	nos.	57	3,797
	4.2 Main inspection road			3,627
	- Earth works	m^3	1,021,000	2,332
	- Gravel pavement	m^3	366,000	1,295
5.	Secondary Canal and Inspection Road	km	90	6,955
6.	Tertiary Development	ha	10,700	8,335
7.	Drainage Canal	km	91	1,937
8.	Flood Protection Dike	km	13	1,760
9.	Land Clearing	ha	6,440	4,110
10.	Land Levelling	ha	8,400	7,666
11.	Office and Quarter		L.S.	926
	Sub-total (item 1 to 11)			(49,010)
12.	Land Acquisition		L.S.	1,030
13.	O&M Equipment		L.S.	1,620
14.	Engineering Services and Administration Expenses		L.S.	4,900
15.	Physical Contingency		L.S.	7,340
	Sub-total (item 12 to 15)			(14,890)
	Total			63,900

Table X-11 CONSTRUCTION OF LEMUING AREA

	Work Item	Unit	Q'ty	Amount (10³US$)
1.	Preparatory Works			3,138
2.	Expension of Joint Facilities			18,207
	2.1 Intake structure			1,024
	- Earth works	m^3	5,900	12
	- Concrete works	m^3	2,145	562
	- Metal works	ton	39	343
	- Miscellaneous		L.S.	103
	2.2 Driving channel			492
	- Earth works	m^3	35,000	80
	- Concrete lining	m^3	4,000	317
	- Miscellaneous		L.S.	95
	2.3 Settling basin			1,104
	- Earth works	m^3	17,100	28
	- Concrete works	m^3	3,630	666
	- Metal works	ton	17	272
	- Miscellaneous		L.S.	138
	2.4 Headreach and inspection road			891
	- Earth works	m^3	310,000	707
	- Related structure		L.S.	184
	2.5 North main canal and inspection road			14,700
	- Earth works	m^3	2,044,000	4,999
	- Concrete lining	m^3	14,500	1,299
	- Related structure		L.S.	8,402
3.	Main Canal and Inspection Road (41 km)			10,919
	3.1 Main canal			7,211
	- Earth works	m^3	1,628,000	2,539
	- Concrete lining	m^2	12,900	781
	- Related structure	nos.	79	3,891
	3.2 Main inspection road			3,708
	- Earth works	m^3	882,000	2,013
	- Gravel pavement	m^2	316,000	1,695
4.	Secondary Canal and Inspection Road	km	110	8,030

(to be continued)

	Work Item	Unit	Q'ty	Amount (10^3US$)
5.	Tertiary Development	ha	13,100	9,720
6.	Drainage Canal	km	106	2,448
7.	Flood Protection Dike	km	11	1,354
8.	Land Clearing	ha	4,380	2,795
9.	Land Levelling	ha	8,600	7,995
10.	Office and Quarter		L.S.	1,201
	Sub-total (item 1 to 9)			(65,810)
11.	Land Acquisition		L.S.	1,050
12.	O&M Equipment		L.S.	1,780
13.	Engineering Services and Administration Expenses		L.S.	6,580
14.	Physical Contingency		L.S.	9,880
	Sub-total (item 10 to 13)			(19,290)
	Total			85,100

Table X-12 CONSTRUCTION COST OF TULANGBAWANG AREA

	Work Item	Unit	Q'ty	Amount
				(10^3US$)
1.	Preparatory Works		L.S.	11,531
2.	Expension Works of Joint Facilities			19,378
	2.1 Intake structure			2,396
	- Earth works	m^3	11,800	21
	- Concrete works	m^3	4,290	1,024
	- Metal works	ton	117	1,031
	- Miscellaneous		L.S.	320
	2.2 Driving channel			951
	- Earth works	m^3	101,000	231
	- Concrete lining	m^3	7,000	555
	- Miscellaneous		L.S.	165
	2.3 Settling basin			2,223
	- Earth works	m^3	35,800	60
	- Concrete works	m^3	7,240	1,330
	- Metal works	ton	33	543
	- Miscellaneous		L.S.	290
	2.4 Headreach and inspection road			2,321
	- Earth works	m^3	795,000	1,841
	- Related structure		L.S.	480
	2.5 South main canal and inspection road			11,487
	- Earth works	m^3	2,453	6,112
	- Concrete lining	m^3	10,700	909
	- Related structure		L.S.	4,466
3.	Main Canal and Inspection Road (91 km)			55,910
	3.1 Main canal			47,682
	- Earth works	m^3	13,553,000	24,679
	- Concrete lining	m^3	81,300	4,921
	- Related structure	nos.	176	18,082
	3.2 Main inspection road			8,228
	- Earth works	m^3	1,957,000	4,467
	- Gravel pavement	m^2	701,000	3,761
4.	Secondary Canal and Inspection Road	km	447	33,598

(to be continued)

	Work Item	Unit	Q'ty	Amount
				(10³US$)
5.	Tertiary Development	ha	44,500	39,605
6.	Drainage Canal	km	467	9,701
7.	Land Clearing	ha	39,300	25,081
8.	Land Levelling	ha	44,220	45,110
9.	Office and Quarter		L.S.	2,246
	Sub-total (item 1 to 8)			(242,160)
10.	Land Acquisition		L.S.	4,260
11.	O&M Equipment		L.S.	6,050
12.	Engineering Services and Administration Expenses		L.S.	24,210
13.	Physical Contingency		L.S.	36,320
	Sub-total (item 9 to 12)			(70,840)
	Total			313,000

Table X-13 SUMMARY OF CONSTRUCTION COST

- POWER FACILITIES -

(Unit: 10^3US$)

ITEM	Ranau Power Scheme	Komering No.1 Power Scheme	Komering No.2 Power Scheme	Muaradua Power Scheme
1. Preparatory Works	1,500	1,500	1,500	1,450
2. Intake	1,750	1,940	1,610	5,000
3. Tunnel and penstock	52,530	43,100	9,620	19,670
4. Power House	7,470	8,090	7,550	5,850
5. Generating Equipment	15,550	19,800	14,870	20,140
6. Transmission Line	800	700	600	100
Sub-total	79,570	75,130	35,750	52,210
7. Engineering Services and Administration Expenses	7,960	7,510	3,580	5,220
8. Physical Contingency	19,900	11,270	5,360	7,830
Total	99,470	93,910	44,690	65,260

Table X-14 CONSTRUCTION COST OF RANAU POWER STATION

Work Item	Unit	Q'ty	Amount (10³US$)
1. Preparatory Works			1,500
- Access road	km	5	750
- Construction facilities		L.S.	750
2. Intake			1,750
- Excavation	m^3	2,500	18
- Concrete	m^3	2,700	540
- Intake gate	ton	100	1,000
- Reinforcement bar	ton	125	125
- Miscellaneous		L.S.	67
3. Tunnel and Penstock			52,500
- Excavation	m^3	274,700	19,210
- Concrete lining	m^3	88,600	19,490
- Steel lining	ton	370	1,000
- Reinforcement bar	ton	7,090	7,090
- Miscellaneous		L.S.	5,710
4. Power House			7,470
- Excavation	m^3	27,500	1,930
- Concrete	m^3	15,300	3,370
- Outlet gate	ton	30	300
- Reinforcement bar	ton	1,220	1,220
- Miscellaneous		L.S.	650
5. Generating Equipment		One lot	15,550
6. Transmission Line	km	40	800
Sub-total (item 1 to 6)			(79,570)
7. Engineering Services and Administration Expenses			7,950
8. Physical Contingency			11,940
Sub-total (item 7 and 8)			(19,900)
Total			99,470

Table X-15 CONSTRUCTION COST OF KOMERING NO.1 POWER STATION

Work Item	Unit	Q'ty	Amount
			(10³US$)
1. Preparatory Works			1,500
- Access road	km	5	750
- Construction facilities		L.S.	750
2. Intake			1,940
- Excavation	m^3	3,000	20
- Concrete	m^3	1,000	200
- Reinforcement bar	ton	50	50
- Intake gate	ton	150	1,500
- Miscellaneous		L.S.	170
3. Tunnel and Penstock			43,100
- Excavation	m^3	230,000	16,100
- Concrete lining	m^3	72,000	14,400
- Reinforcement bar	ton	5,760	5,760
- Steel lining	ton	410	1,100
- Miscellaneous		L.S.	5,740
4. Power House			8,090
- Excavation	m^3	32,000	2,240
- Concrete	m^3	18,000	3,960
- Outlet gate	ton	37	370
- Reinforcement bar	ton	900	900
- Miscellaneous		L.S.	620
5. Generating Equipment		One lot	19,800
6. Transmission Line	km	35	700
Sub-total (item 1 to 6)			(75,130)
7. Engineering Services and Administration Expenses			7,510
8. Physical Contingency			11,270
Sub-total (item 7 and 8)			(18,780)
Total			93,910

Table X-16 CONSTRUCTION COST OF KOMERING NO.2 POWER STATION

Work Item	Unit	Q'ty	Amount
			(10^3US$)
1. Preparatory Works			1,500
- Access road	km	5	750
- Construction facilities		L.S.	750
2. Intake			1,610
- Excavation	m^3	1,000	10
- Concrete	m^3	1,000	200
- Reinforcement bar	ton	170	170
- Intake gate	ton	120	1,070
- Miscellaneous		L.S.	160
3. Tunnel and Penstock			9,620
- Excavation	m^3	75,500	2,400
- Concrete	m^3	22,400	3,110
- Reinforcement bar	ton	1,800	1,230
- Steel lining	ton	1,100	2,000
- Miscellaneous		L.S.	880
4. Power House			7,550
- Excavation	m^3	29,800	2,090
- Concrete	m^3	14,300	3,150
- Outlet gate	ton	48	480
- Reinforcement bar	ton	1,140	1,140
- Miscellaneous		L.S.	690
5. Generating Equipment		One lot	14,870
6. Transmission Line	km	30	600
Sub-total (item 1 to 6)			(35,750)
7. Engineering Services and Administration Expenses			3,580
8. Physical Contingency			5,360
Sub-total (item 7 and 8)			(8,940)
Total			44,690

Table X-17 CONSTRUCTION COST OF MUARADUA POWER STATION

Work Item	Unit	Q'ty	Amount
			(10³US$)
1. Preparatory Works			1,450
- Access road	km	3	450
- Construction facilities		L.S.	1,000
2. Intake			5,000
- Excavation	m³	10,000	700
- Concrete	m³	5,000	1,000
- Reinforcement bar	ton	250	250
- Intake gate	ton	240	2,390
- Miscellaneous		L.S.	660
3. Tunnel and Penstock			19,670
- Excavation	m³	39,200	2,740
- Concrete	m³	13,070	2,880
- Reinforcement bar	ton	1,050	1,050
- Steel lining	ton	4,150	11,200
- Miscellaneous		L.S.	1,800
4. Power House			5,850
- Excavation	m³	11,600	810
- Concrete	m³	11,600	2,550
- Outlet gate	ton	100	1,000
- Reinforcement bar	ton	930	930
- Miscellneous		L.S.	560
5. Generating Equipment		One lot	20,140
6. Transmission Line	km	5	100
Sub-total (item 1 to 6)			(52,210)
7. Engineering Services and Administration Expenses			5,220
8. Physical Contingency			7,830
Sub-total (item 7 and 8)			13,050
Total			65,260

Table X-18 UNIT RATES FOR MAIN CIVIL WORK ITEMS

(1981 Current Prices)

	Work Item	Unit	Unit Rate (US$)
1.	Land clearing	ha	638
2.	Land levelling	m^3	1.94
3.	Land levelling (finishing)	m^3	0.84
4.	Stripping of topsoils	m^3	0.77
5.	Excavation, rock, at dam site	m^3	4.57
6.	Excavation, rock, at structure site	m^3	3.05
7.	Excavation, rock, for canal	m^3	2.47
8.	Excavation, common, at structure site	m^3	2.04
9.	Excavation, common, for canal	m^3	1.55
10.	Embankment with excavated materials	m^3	1.06
11.	Embankment with borrowed materials	m^3	2.48
12.	Back-fill for structure	m^3	1.55
13.	Sod facing	m^2	0.17
14.	Concrete, Type-A (for reinforcement concrete)	m^3	76.5
15.	Concrete, Type-B (for plain concrete)	m^3	61.9
16.	Concrete, Type-C (for lining)	m^3	60.5
17.	Mortar	m^3	79.8
18.	Reinforcement bar	ton	1,290
19.	Concrete form, wooden	m^2	10.3
20.	Concrete form, metal	m^2	4.33
21.	Wet stone masonry (for canal)	m^3	16.8
22.	Wet stone masonry (for structure)		50.4
23.	Dry stone masonry		8.58

Table X-19 PRICE LIST OF LOCAL MATERIALS AND LABOR WAGES

(1981 Current Prices)

Item	Unit	Unit Price (Rp)
I. Materials		
1. Gravel (sieved)	m^3	11,000
2. Gravel (not sieved)	m^3	10,000
3. Sand	m^3	5,000
4. Crushed stone	m^3	20,000
5. Masonry stone	m^3	12,000
6. Timber	m^3	150,000
7. Nail	kg	750
II. Fuel and Lubricant		
1. Gasoline	lit	175
2. Kerosene	lit	75
3. Light diesel oil	lit	45
4. Grease	galon	800
III. Labor Wages		
1. Forman	man-day	3,250
2. Skilled labor	man-day	2,500
3. Common labor	man-day	1,500
4. Mason	man-day	2,500
5. Carpenter	man-day	2,500
6. Blacksmith	man-day	2,500
7. Welder	man-day	2,000
8. Driver	man-day	2,000
9. Operator	man-day	2,500

Table X-20 ANNUAL OPERATION & MAINTENANCE COST

(Irrigation Facilities)

(Unit: 10^3US$)

Item	Komering-I Area (36,700 ha)	Muncak Kabau Area (10,700 ha)	Lempuing Area (13,100 ha)	Tulangbawang Area (44,500 ha)
1. Salaries and Wages of Project Administrative and Water Control Staff	242	71	87	294
2. Office Expenses	12	3.5	4.2	14
3. Operation Cost of Facilities and O&M Equipment	57	16.5	6.5	69
4. Maintenance Cost of Project Facilities	829	242	296	1,006
5. Miscellaneous	30	87 1/	16.3	37
Total	1,170	420	410	1,420

Note: 1/ including annual dredging cost of main canal.

Table X-21 ANNUAL OPERATION & MAINTENANCE COST

(Dam and Power Facilities)

(Unit: 10^3US$)

Item	Ranau	Komering-No.1	Komering-No.2	Muaradua
1. Dam	20	400	260	270
2. Power Station	2,490	2,350	1,120	1,630
3. Transmission Line	10	10	10	-
Total	2,520	2,760	1,390	1,900

Table X-22 REPLACEMENT COST AND USEFUL LIFE OF FACILITIES

(Irrigation Facilities)

(Unit: 10^3US$)

Item	Useful Life (year)	Komering-I Area	Muncak Kabau Area	Lempuing Area	Tulangbawang Area
1. Gates	25	10,220	2,980	3,650	12,400
2. Electrical Facilities	20	450	130	160	550
3. O&M Equipment	10	4,990	1,620	1,780	6,050

Table X-23 REPLACEMENT COST AND USEFUL LIFE OF FACILITIES

(Dam and Power Facilities)

(Unit: 10^3US$)

Item	Useful Life (year)	Ranau	Komering No.1	Komering No.2	Muaradua
A. Dam - Gates	50	210	4,140	3,830	8,880
B. Power Station					
1. Gates	50	1,300	1,870	1,550	3,390
2. Generating Equipment	40	15,550	19,800	14,870	20,140
3. Transmission Line	35	800	700	600	100

ANNEX XI

PROJECT EVALUATION

ANNEX - XI

PROJECT EVALUATION

1. GENERAL

The economic feasibility for the respective irrigation development areas and the hydropower schemes is evaluated in terms of economic internal rate of return (EIRR), in order to assess the development plan in the upper Komering river basin. For the economic evaluation, the following basic assumptions are established:

(1) The construction periods for each development area and the hydropower scheme are as follows;

Dams	Construction Period (year)
- Ranau Regulating Dam	3
- Komering No.1 Dam	5
- Komering No.2 Dam	5
- Muaradua Dam	5
Irrigation Development Area	
- Komering-I area	7
- Muncak Kabau area	5
- Lempuing area	5
- Tulangubawang area	7
Hydro-power Schemes	
- Ranau Power Scheme	5
- Komering No.1 Power Scheme	5
- Komering No.2 Power Scheme	5
- Muaradua Power Scheme	5

(2) Only direct benefit is counted in the evaluation and any indirect or intangible benefits are not taken into account;

(3) The economic prices estimated on the basis of the international market prices projected by IBRD for the period of 1990 in 1981 constant dollars are used in the evaluation;

(4) The exchange rate of Indonesian Rupiah to US Dollar is taken as Rp.625 equivalent to US$1.0; and

(5) The economic useful life of the project is taken as 50 years for the dams, irrigation facilities and other civil works and 35 years for the hydropower generating plants.

2. PROJECT COSTS

2.1 Economic Costs

The economic investment costs are derived from the financial cost by deducting the transfer payment of land acquisition cost. Following construction costs for the irrigation development areas are also counted as the economic costs:

i) The construction costs for the on-farm development works to be done by farmers themselves are estimated to be 83 $/ha using the opportunity cost for labour of US$0.50/day/laborer, referring to the "Feasibility Study Report on the Komering-I Irrigation Development Project";

ii) The cost for jungle clearing will be done by the transmigrants to be settled before the commencement of the construction works. The unit cost is estimated to be 360 $/ha applying the above opportunity cost for labor;

Irrigation Area	On-farm Development Cost (10^3US$)	Jungle Clearing Cost (10^3US$)	Total (10^3US$)
- Komering-I area	3,050	2,950	6,000
- Muncak Kabau area	890	1,910	2,800
- Lempuing area	1,090	1,010	2,100
- Tulangbawang area	3,690	10,010	13,700

The total economic costs and annual disbursements for the respective development areas and hydropower schemes thus estimated are shown in Table XI-2.

2.2 Cost Allocation

The project involves construction of joint facilities to serve for respective irrigation development areas and power schemes. The estimated economic construction costs of the joint facilities are allocated to each development area and power scheme concerned in order to assess the economic feasibility of each area and scheme. The joint facilities are as follows:

i) Ranau Regulating Dam ; to all the irrigation development and the Ranau hydropower scheme,

ii) Komering No.1 Dam ; to all the irrigation development area and Komering No.1 hydropower scheme,

iii) Komering No.2 Dam ; to Komering No.2 hydropower scheme,

iv) Muaradua Dam ; to all the irrigation development area and Muaradua hydropower schemes,

v) Perjaya Headworks ; to Komering-I area, Lempuing area and Tulangbawang area.

The allocation of the estimated joint costs is firstly made between the irrigation schemes and the hydropower schemes using the "separable costs - remaining benefits method" as shown in Table XI-3 to XI-5. Then, the total cost thus allocated is re-allocated to each irrigation development area using the ratio of the annual amount of the water demands in the respective irrigation development areas. The economic construction cost of the Perjaya headworks is also allocated to each development area using the ratio of the annual amount of the water demands in the respective development area. In this study, the economic construction costs of the dams are not allocated to the irrigation projects in the Lebak area, though these project areas will be benefited by the construction of the dams. Table XI-1 shows the economic cost for each irrigation scheme and hydropower scheme after allocation of the joint costs.

2.3 Annual Operation and Maintenance Costs

The annual O & M costs for agricultural development areas and hydropower schemes are estimated in ANNEX-X. The annual increase of the O & M costs of hydropower schemes are presented in Table XI-7 through XI-9.

2.4 Replacement Costs

The replacement costs estimated in ANNEX-X will be required at the interval of the economic useful life of each facilities.

3. PROJECT BENEFITS

The agricultural benefits arising from the agricultural development are estimated for both cases of "without project" and "with project" in the full operation stage of the project. The details are presented in ANNEX-V. The net incremental benefits of the project are summarized in Table XI-6.

For the economic evaluation, the benefits are assumed to be realized fully within 5 to 7 years delay from the start of irrigation water supply (vide ANNEX-V), even before the completion of total construction works. The benefits are expected to take liner increase within the above build-up period.

The annual equivalent benefit to unit value of power generation is estimated to be US$124/kW for the capacity value and 64.4 mills/kWh for the energy value based on the estimate of an alternative thermal power plant described in ANNEX-VIII. The annual power benefits for respective power schemes are also shown in Table XI-6.

4. ECONOMIC EVALUATION

The economic viabilities for the respective irrigation schemes and hydropower schemes are evaluated by calculating the economic internal rate of return (EIRR). Further, the net present value (NPV) which is the difference between the present values of benefit and cost discounted at the discount rate of 12% and 15% is also calculated for each scheme.

The cost-benefit stream tables for the respective irrigation schemes and power schemes are prepared as shown in Table XI-7 through XI-9, based on all the assumptions and results of the study described in the preceding chapters, and the values of EIRR are graphically obtained as shown in Fig. XI-1. The following table shows the values of EIRR and NPV obtained for the respective irrigation schemes and the hydropower schemes as well as the values of EIRR and NPV of the whole project case.

	EIRR (%)	NPV (Unit: 10^6US$) 12%	15%
(i) Agricultural Development Areas			
- Komering-I area	15.1	45.4	1.1
- Muncak Kabau area	14.3	12.6	-2.6
- Lempuing area	13.1	7.9	-9.5
- Tulangbawang	11.9	-1.7	-50.4
- Overall	13.3	64.3	-61.4
(ii) Power Development Schemes			
- Ranau Power Schemes	14.4	16.6	-2.9
- Komering No.1 Power Scheme	23.7	114.2	62.5
- Komering No.2 Power Scheme	13.4	9.2	-7.4
- Muaradua Power Scheme	10.5	-6.6	-15.2
- Overall	16.8	133.4	36.9
(iii) Whole Project Case	14.6	197.7	-24.5

Table XI-1 SUMMARY OF ALLOCATED ECONOMIC COSTS

(Unit: 10^3US$)

Proposed Works	Before Allocation	After Allocation
1. DAM	190,170	
- Ranau Regulating Dam	3,270	-
- Komering No.1 Dam	80,760	-
- Komering No.2 Dam	51,770	-
- Muaradua Dam	54,370	-
2. AGRICULTURAL DEVELOPMENT AREA	691,830	790,450
- Perjaya Weir	15,500	-
- Komering-I Area	205,070	247,880
- Muncak Kabau Area	65,670	26,170
- Lempuing Area	86,150	100,880
- Tulangbawang Area	322,440	365,520
3. HYDROPOWER SCHEMES	303,330	397,880
- Ranau Power Scheme	99,470	101,230
- Komering No.1 Scheme	93,910	128,780
- Komering No.2 Scheme	44,690	96,460
- Muaradua Scheme	65,260	71,410
TOTAL	1,188,330	1,188,330

Table XI-2 ANNUAL DISBURSEMENT SCHEDULE OF ALLOCATED ECONOMIC CONSTRUCTION COST

(Unit: 10^3US$)

	Total	Year						
		1st	2nd	3rd	4th	5th	6th	7th
1. IRRIGATION AREAS	790,450							
- Komering-I Area	247,880	14,900	24,800	37,200	54,500	54,500	37,200	24,780
- Muncak Kabau Area	76,170	7,600	11,400	22,900	22,900	11,370	-	-
- Lempuing Area	100,880	10,100	15,100	30,300	30,300	15,080	-	-
- Tulangbawang Area	365,520	18,300	36,600	54,800	73,100	73,100	73,100	36,520
2. POWER SCHEMES	397,880							
- Ranau P.S.	101,230	10,100	15,200	30,400	30,400	15,130	-	-
- Komering No.1 P.S.	128,780	12,900	19,300	38,600	38,600	19,380	-	-
- Komering No.2 P.S.	96,460	9,600	14,500	28,900	28,900	14,560	-	-
- Muaradua P.S.	71,410	7,100	10,700	21,400	21,400	10,810	-	-
TOTAL	1,188,330	90,600	147,600	264,500	300,100	213,930	110,300	61,300

Table XI-3 COST ALLOCATION (RANAU)

(Unit: 10^6US$)

Item	Irrigation	Power	Total
1. Cost to be allocated	-	-	468.47
2. Benefits (capitalized)	910	214	-
3. Alternative costs	368	102	470
4. Justifiable expenditure	368	102	470
5. Separable costs	366.47	100.47	466.94
6. Remaining justifiable expenditure	1.53	1.53	3.06
7. Percent distribution	50	50	100
8. Remaining joint cost	0.77	0.76	1.53
9. Total allocated costs	367.24	101.23	468.47

Note: Line 1; Total cost to be allocated.

Line 2; The Benefits capitalized at 8% over 50 years.

Line 3; The costs of single purpose alternatives.

Line 4; The lesser of line 2 and line 3.

Line 5; The separable costs estimated as the total costs less the estimated cost with the function omitted.

Line 6; Remaining justifiable expenditure subtracted line 5 from line 4.

Line 8; Remaining joint cost distributed according to percentages.

Line 9; Total allocated cost is the sum of the separable costs and the allocated joint costs.

Table XI-1 COST ALLOCATION (KOMERING NO.1)

(Unit: 10^6US$)

Item	Irrigation	Power	Total
1. Cost to be allocated	-	-	285.57
2. Benefits (capitalized)	235	497	-
3. Alternative costs	181	153	334
4. Justifiable expenditure	181	153	334
5. Separable costs	132.57	104.57	237.14
6. Remaining justifiable expenditure	48.43	48.43	96.86
7. Percent distribution	50	50	100
8. Remaining joint cost	24.22	24.21	48.43
9. Total allocated costs	156.79	128.78	285.57

Note: Line 1; Total cost to be allocated.

Line 2; The Benefits capitalized at 8% over 50 years.

Line 3; The costs of single purpose alternatives.

Line 4; The lesser of line 2 and line 3.

Line 5; The separable costs estimated as the total costs less the estimated cost with the function omitted.

Line 6; Remaining justifiable expenditure subtracted line 5 from line 4.

Line 8; Remaining joint cost distributed according to percentages.

Line 9; Total allocated cost is the sum of the separable costs and the allocated joint costs.

Table XI-5 COST ALLOCATION (MUARAIMA)

(Unit: 10^6US$)

Item	Irrigation	Power	Total
1. Cost to be allocated	-	-	337.83
2. Benefits (capitalized)	462	103	442
3. Alternative costs	284	89	373
4. Justifiable expenditure	284	89	373
5. Separable costs	248.83	53.83	302.66
6. Remaining justifiable expenditure	35.17	35.17	70.34
7. Percent distribution	50	50	100
8. Remaining joint cost	17.59	17.58	35.17
9. Total allocated costs	266.42	71.41	337.83

Note: Line 1; Total cost to be allocated.

Line 2; The Benefits capitalized at 8% over 50 years.

Line 3; The costs of single purpose alternatives.

Line 4; The lesser of line 2 and line 3.

Line 5; The separable costs estimated as the total costs less the estimated cost with the function omitted.

Line 6; Remaining justifiable expenditure subtracted line 5 from line 4.

Line 8; Remaining joint cost distributed according to percentages.

Line 9; Total allocated cost is the sum of the separable costs and the allocated joint costs.

Table XI-6 ANNUAL INCREMENTAL AGRICULTURAL AND POWER BENEFITS

(Unit: 10^3US$)

Item	Annual Incremental Benefits
1. Agricultural Development Areas	
- Komering-I area	45,300
- Muncak Kabau area	14,600
- Lempuing area	17,300
- Tulangbawang area	59,000
Sub-total	136,200
2. Power Schemes	
- Ranau power scheme	20,100
- Komering No.1 power scheme	43,500
- Komering No.2 power scheme	16,800
- Muaradua power scheme	10,400
Sub-total	90,800
TOTAL	227,000

TABLE XI-7 COST-BENEFIT STREAM FOR WHOLE PROJECT

1. Irrigation Scheme

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	50900	0	0	0
2	87900	0	0	0
3	185200	0	0	1300
4	180800	0	500	8700
5	154050	0	940	36600
6	110300	0	2410	64000
7	61300	0	3900	90200
8	0	0	3900	111000
9	0	0	3900	121300
10	0	0	3900	129600
11	0	0	3900	133100
12	0	0	3900	134600
13	0	0	3900	135600
14	0	0	3900	136200
15	0	14440	3900	136200
16	0	0	3900	136200
17	0	0	3900	136200
18	0	0	3900	136200
19	0	0	3900	136200
20	0	0	3900	136200
21	0	0	3900	136200
22	0	0	3900	136200
23	0	0	3900	136200
24	0	0	3900	136200
25	0	15730	3900	136200
26	0	0	3900	136200
27	0	0	3900	136200
28	0	0	3900	136200
29	0	0	3900	136200
30	0	29170	3900	136200
31	0	0	3900	136200
32	0	0	3900	136200
33	0	0	3900	136200
34	0	0	3900	136200
35	0	14440	3900	136200
36	0	0	3900	136200
37	0	0	3900	136200
38	0	0	3900	136200
39	0	0	3900	136200
40	0	0	3900	136200
41	0	0	3900	136200
42	0	0	3900	136200
43	0	0	3900	136200
44	0	0	3900	136200
45	0	15730	3900	136200
46	0	0	3900	136200
47	0	0	3900	136200
48	0	0	3900	136200
49	0	0	3900	136200
50	0	0	3900	136200
51	0	0	3900	136200
52	0	0	3900	136200
53	0	0	3900	136200
54	0	0	3900	136200
55	0	0	3900	136200

PRESENT WORTH

INTEREST	COST	BENEFIT
4	772363	2314674
6	688787	1526905
8	626524	1067595
10	572272	781322
12	528175	592470
14	490030	461878
16	456481	368105
18	426629	298610
20	399843	245798

IRR = 13.3 %

2. Hydropower Scheme

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	39700	0	0	0
2	59700	0	0	0
3	119300	0	0	0
4	119300	0	0	0
5	59800	0	6470	65500
6	0	0	8090	90800
7	0	0	8090	90800
8	0	0	8090	90800
9	0	0	8090	90800
10	0	0	8090	90800
11	0	0	8090	90800
12	0	0	8090	90800
13	0	0	8090	90800
14	0	0	8090	90800
15	0	0	8090	90800
16	0	0	8090	90800
17	0	0	8090	90800
18	0	0	8090	90800
19	0	0	8090	90800
20	0	0	8090	90800
21	0	0	8090	90800
22	0	0	8090	90800
23	0	0	8090	90800
24	0	0	8090	90800
25	0	0	8090	90800
26	0	0	8090	90800
27	0	0	8090	90800
28	0	0	8090	90800
29	0	0	8090	90800
30	0	0	8090	90800
31	0	0	8090	90800
32	0	0	8090	90800
33	0	0	8090	90800
34	0	0	8090	90800
35	0	2200	8090	90800
36	0	0	8090	90800
37	0	0	8090	90800
38	0	0	8090	90800
39	0	0	8090	90800
40	0	70360	8090	90800
41	0	0	8090	90800
42	0	0	8090	90800
43	0	0	8090	90800
44	0	0	8090	90800
45	0	0	8090	90800
46	0	0	8090	90800
47	0	0	8090	90800
48	0	0	8090	90800
49	0	0	8090	90800
50	0	0	8090	90800
51	0	0	8090	90800
52	0	0	8090	90800
53	0	0	8090	90800
54	0	0	8090	90800
55	0	0	8090	90800

PRESENT WORTH

INTEREST	COST	BENEFIT
4	513996	1640674
6	457242	1103459
8	386236	796959
10	349181	587246
12	320340	453685
14	296745	359998
16	276757	291696
18	259406	240330
20	244084	200718

IRR = 14.8 %

3. Whole Project

CURREN ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	90600	0	0	0
2	147600	0	0	0
3	244500	0	0	1360
4	300100	0	500	8700
5	213950	0	7410	82100
6	110300	0	10500	154800
7	61300	0	11990	181000
8	0	0	11990	201800
9	0	0	11990	212100
10	0	0	11990	220400
11	0	0	11990	223900
12	0	0	11990	225200
13	0	0	11990	226400
14	0	0	11990	227000
15	0	14440	11990	227000
16	0	0	11990	227000
17	0	0	11990	227000
18	0	0	11990	227000
19	0	0	11990	227000
20	0	0	11990	227000
21	0	0	11990	227000
22	0	0	11990	227000
23	0	0	11990	227000
24	0	0	11990	227000
25	0	0	11990	227000
26	0	15730	11990	227000
27	0	0	11990	227000
28	0	0	11990	227000
29	0	0	11990	227000
30	0	29170	11990	227000
31	0	0	11990	227000
32	0	0	11990	227000
33	0	0	11990	227000
34	0	0	11990	227000
35	0	16640	11990	227000
36	0	0	11990	227000
37	0	0	11990	227000
38	0	0	11990	227000
39	0	0	11990	227000
40	0	70360	11990	227000
41	0	0	11990	227000
42	0	0	11990	227000
43	0	0	11990	227000
44	0	0	11990	227000
45	0	15730	11990	227000
46	0	0	11990	227000
47	0	0	11990	227000
48	0	0	11990	227000
49	0	0	11990	227000
50	0	0	11990	227000
51	0	0	11990	227000
52	0	0	11990	227000
53	0	0	11990	227000
54	0	0	11990	227000
55	0	0	11990	227000

PRESENT WORTH

INTEREST	COST	BENEFIT
4	1286358	3955306
6	1126027	2630364
8	1010760	1854554
10	921453	1360567
12	848515	1046155
14	786774	821896
16	733238	654801
18	688036	536934
20	649327	446516

IRR = 14.6 %

TABLE XI-8 COST-BENEFIT STREAM FOR IRRIGATION SCHEMES

PROJECT : KOMERING I

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	14900	0	0	0
2	24800	0	0	0
3	37200	0	0	200
4	54500	0	0	2100
5	54500	0	0	19000
6	37200	0	670	27100
7	24780	0	1350	34500
8	0	0	1350	40700
9	0	0	1350	43500
10	0	0	1350	44600
11	0	0	1350	45100
12	0	0	1350	45300
13	0	0	1350	45300
14	0	0	1350	45300
15	0	4990	1350	45300
16	0	0	1350	45300
17	0	0	1350	45300
18	0	0	1350	45300
19	0	0	1350	45300
20	0	0	1350	45300
21	0	0	1350	45300
22	0	0	1350	45300
23	0	0	1350	45300
24	0	0	1350	45300
25	0	5440	1350	45300
26	0	0	1350	45300
27	0	0	1350	45300
28	0	0	1350	45300
29	0	0	1350	45300
30	0	10220	1350	45300
31	0	0	1350	45300
32	0	0	1350	45300
33	0	0	1350	45300
34	0	0	1350	45300
35	0	4990	1350	45300
36	0	0	1350	45300
37	0	0	1350	45300
38	0	0	1350	45300
39	0	0	1350	45300
40	0	0	1350	45300
41	0	0	1350	45300
42	0	0	1350	45300
43	0	0	1350	45300
44	0	0	1350	45300
45	0	5440	1350	45300
46	0	0	1350	45300
47	0	0	1350	45300
48	0	0	1350	45300
49	0	0	1350	45300
50	0	0	1350	45300
51	0	0	1350	45300
52	0	0	1350	45300
53	0	0	1350	45300
54	0	0	1350	45300
55	0	0	1350	45300

PRESENT WORTH

INTEREST	COST	BENEFIT
4	243996	788801
6	215556	524373
8	194363	369990
10	177231	272578
12	162986	206237
14	150549	159530
16	139793	124211
18	130190	107127
20	121666	88710

PROJECT : MUNCAK KABAU

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	7600	0	0	0
2	11400	0	0	0
3	22900	0	0	400
4	22900	0	230	2200
5	11370	0	470	5800
6	0	0	470	8800
7	0	0	470	12000
8	0	0	470	13300
9	0	0	470	14000
10	0	0	470	14600
11	0	0	470	14600
12	0	0	470	14600
13	0	0	470	14600
14	0	0	470	14600
15	0	1620	470	14600
16	0	0	470	14600
17	0	0	470	14600
18	0	0	470	14600
19	0	0	470	14600
20	0	0	470	14600
21	0	0	470	14600
22	0	0	470	14600
23	0	0	470	14600
24	0	0	470	14600
25	0	1750	470	14600
26	0	0	470	14600
27	0	0	470	14600
28	0	0	470	14600
29	0	0	470	14600
30	0	2900	470	14600
31	0	0	470	14600
32	0	0	470	14600
33	0	0	470	14600
34	0	0	470	14600
35	0	1620	470	14600
36	0	0	470	14600
37	0	0	470	14600
38	0	0	470	14600
39	0	0	470	14600
40	0	0	470	14600
41	0	0	470	14600
42	0	0	470	14600
43	0	0	470	14600
44	0	0	470	14600
45	0	1750	470	14600
46	0	0	470	14600
47	0	0	470	14600
48	0	0	470	14600
49	0	0	470	14600
50	0	0	470	14600
51	0	0	470	14600
52	0	0	470	14600
53	0	0	470	14600
54	0	0	470	14600
55	0	0	470	14600

PRESENT WORTH

INTEREST	COST	BENEFIT
4	79168	256861
6	71174	171385
8	65181	121266
10	60376	89818
12	56343	68916
14	52982	53349
16	49767	43797
18	47002	35813
20	44498	29871

PROJECT : LEMPUING

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	10100	0	0	0
2	15100	0	0	0
3	30300	0	0	500
4	30300	0	270	2600
5	15080	0	470	6900
6	0	0	470	10400
7	0	0	470	14200
8	0	0	470	15700
9	0	0	470	16600
10	0	0	470	17300
11	0	0	470	17300
12	0	0	470	17300
13	0	0	470	17300
14	0	0	470	17300
15	0	1780	470	17300
16	0	0	470	17300
17	0	0	470	17300
18	0	0	470	17300
19	0	0	470	17300
20	0	0	470	17300
21	0	0	470	17300
22	0	0	470	17300
23	0	0	470	17300
24	0	0	470	17300
25	0	1940	470	17300
26	0	0	470	17300
27	0	0	470	17300
28	0	0	470	17300
29	0	0	470	17300
30	0	3650	470	17300
31	0	0	470	17300
32	0	0	470	17300
33	0	0	470	17300
34	0	0	470	17300
35	0	1780	470	17300
36	0	0	470	17300
37	0	0	470	17300
38	0	0	470	17300
39	0	0	470	17300
40	0	0	470	17300
41	0	0	470	17300
42	0	0	470	17300
43	0	0	470	17300
44	0	0	470	17300
45	0	1940	470	17300
46	0	0	470	17300
47	0	0	470	17300
48	0	0	470	17300
49	0	0	470	17300
50	0	0	470	17300
51	0	0	470	17300
52	0	0	470	17300
53	0	0	470	17300
54	0	0	470	17300
55	0	0	470	17300

PRESENT WORTH

INTEREST	COST	BENEFIT
4	101445	304331
6	91980	203059
8	84709	143671
10	78759	106411
12	73695	81648
14	69269	64389
16	65320	51989
18	61763	42869
20	58528	35341

PROJECT : TULANGBAWANG

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	18300	0	0	0
2	36600	0	0	0
3	54800	0	0	500
4	73100	0	0	1800
5	73100	0	0	5900
6	73100	0	800	17700
7	36520	0	1610	29500
8	0	0	1610	41300
9	0	0	1610	47200
10	0	0	1610	53100
11	0	0	1610	56100
12	0	0	1610	57200
13	0	0	1610	58400
14	0	0	1610	59000
15	0	6050	1610	59000
16	0	0	1610	59000
17	0	0	1610	59000
18	0	0	1610	59000
19	0	0	1610	59000
20	0	0	1610	59000
21	0	0	1610	59000
22	0	0	1610	59000
23	0	0	1610	59000
24	0	0	1610	59000
25	0	6600	1610	59000
26	0	0	1610	59000
27	0	0	1610	59000
28	0	0	1610	59000
29	0	0	1610	59000
30	0	12400	1610	59000
31	0	0	1610	59000
32	0	0	1610	59000
33	0	0	1610	59000
34	0	0	1610	59000
35	0	6050	1610	59000
36	0	0	1610	59000
37	0	0	1610	59000
38	0	0	1610	59000
39	0	0	1610	59000
40	0	0	1610	59000
41	0	0	1610	59000
42	0	0	1610	59000
43	0	0	1610	59000
44	0	0	1610	59000
45	0	6600	1610	59000
46	0	0	1610	59000
47	0	0	1610	59000
48	0	0	1610	59000
49	0	0	1610	59000
50	0	0	1610	59000
51	0	0	1610	59000
52	0	0	1610	59000
53	0	0	1610	59000
54	0	0	1610	59000
55	0	0	1610	59000

PRESENT WORTH

INTEREST	COST	BENEFIT
4	348354	964681
6	310076	628093
8	280296	433109
10	255906	312515
12	235250	233669
14	217364	179630
16	201681	141207
18	187675	113028
20	175172	91827

PROJECT : NAMU POWER SCHEME

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	10100	0	0	0
2	15200	0	0	0
3	9400	0	0	0
4	9400	0	0	0
5	15130	0	2510	10100
6	0	0	2510	20100
7	0	0	2510	20100
8	0	0	2510	20100
9	0	0	2510	20100
10	0	0	2510	20100
11	0	0	2510	20100
12	0	0	2510	20100
13	0	0	2510	20100
14	0	0	2510	20100
15	0	0	2510	20100
16	0	0	2510	20100
17	0	0	2510	20100
18	0	0	2510	20100
19	0	0	2510	20100
20	0	0	2510	20100
21	0	0	2510	20100
22	0	0	2510	20100
23	0	0	2510	20100
24	0	0	2510	20100
25	0	0	2510	20100
26	0	0	2510	20100
27	0	0	2510	20100
28	0	0	2510	20100
29	0	0	2510	20100
30	0	0	2510	20100
31	0	0	2510	20100
32	0	0	2510	20100
33	0	0	2510	20100
34	0	0	2510	20100
35	0	400	2510	20100
36	0	0	2510	20100
37	0	0	2510	20100
38	0	0	2510	20100
39	0	0	2510	20100
40	0	15550	2510	20100
41	0	0	2510	20100
42	0	0	2510	20100
43	0	0	2510	20100
44	0	0	2510	20100
45	0	0	2510	20100
46	0	0	2510	20100
47	0	0	2510	20100
48	0	0	2510	20100
49	0	0	2510	20100
50	0	0	2510	20100
51	0	0	2510	20100
52	0	0	2510	20100
53	0	0	2510	20100
54	0	0	2510	20100
55	0	0	2510	20100

PRESENT WORTH

INTEREST	COST	BENEFIT
4	138634	343203
6	116447	246289
8	102194	176225
10	91814	130013
12	83829	100486
14	77365	79706
16	71959	64505
18	67267	53215
20	63168	44443

IRR = 14.4 %

PROJECT : KORENTAU I POWER SCHEME

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	12900	0	0	0
2	19300	0	0	0
3	38600	0	0	0
4	38600	0	0	0
5	19300	0	2020	21800
6	0	0	2530	43500
7	0	0	2530	43500
8	0	0	2530	43500
9	0	0	2530	43500
10	0	0	2530	43500
11	0	0	2530	43500
12	0	0	2530	43500
13	0	0	2530	43500
14	0	0	2530	43500
15	0	0	2530	43500
16	0	0	2530	43500
17	0	0	2530	43500
18	0	0	2530	43500
19	0	0	2530	43500
20	0	0	2530	43500
21	0	0	2530	43500
22	0	0	2530	43500
23	0	0	2530	43500
24	0	0	2530	43500
25	0	0	2530	43500
26	0	0	2530	43500
27	0	0	2530	43500
28	0	0	2530	43500
29	0	0	2530	43500
30	0	0	2530	43500
31	0	0	2530	43500
32	0	0	2530	43500
33	0	0	2530	43500
34	0	0	2530	43500
35	0	700	2530	43500
36	0	0	2530	43500
37	0	0	2530	43500
38	0	0	2530	43500
39	0	0	2530	43500
40	0	14800	2530	43500
41	0	0	2530	43500
42	0	0	2530	43500
43	0	0	2530	43500
44	0	0	2530	43500
45	0	0	2530	43500
46	0	0	2530	43500
47	0	0	2530	43500
48	0	0	2530	43500
49	0	0	2530	43500
50	0	0	2530	43500
51	0	0	2530	43500
52	0	0	2530	43500
53	0	0	2530	43500
54	0	0	2530	43500
55	0	0	2530	43500

PRESENT WORTH

INTEREST	COST	BENEFIT
4	95673	172467
6	84281	139745
8	75721	115137
10	69004	96160
12	64402	81221
14	60427	69261
16	56810	59546
18	53603	51559
20	50663	44924

IRR = 25.7 %

PROJECT : KORENTAU 2 POWER SCHEME

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	9800	0	0	0
2	14500	0	0	0
3	29000	0	0	0
4	29000	0	0	0
5	14500	0	1110	8400
6	0	0	1390	16800
7	0	0	1390	16800
8	0	0	1390	16800
9	0	0	1390	16800
10	0	0	1390	16800
11	0	0	1390	16800
12	0	0	1390	16800
13	0	0	1390	16800
14	0	0	1390	16800
15	0	0	1390	16800
16	0	0	1390	16800
17	0	0	1390	16800
18	0	0	1390	16800
19	0	0	1390	16800
20	0	0	1390	16800
21	0	0	1390	16800
22	0	0	1390	16800
23	0	0	1390	16800
24	0	0	1390	16800
25	0	0	1390	16800
26	0	0	1390	16800
27	0	0	1390	16800
28	0	0	1390	16800
29	0	0	1390	16800
30	0	0	1390	16800
31	0	0	1390	16800
32	0	0	1390	16800
33	0	0	1390	16800
34	0	0	1390	16800
35	0	600	1390	16800
36	0	0	1390	16800
37	0	0	1390	16800
38	0	0	1390	16800
39	0	0	1390	16800
40	0	14070	1390	16800
41	0	0	1390	16800
42	0	0	1390	16800
43	0	0	1390	16800
44	0	0	1390	16800
45	0	0	1390	16800
46	0	0	1390	16800
47	0	0	1390	16800
48	0	0	1390	16800
49	0	0	1390	16800
50	0	0	1390	16800
51	0	0	1390	16800
52	0	0	1390	16800
53	0	0	1390	16800
54	0	0	1390	16800
55	0	0	1390	16800

PRESENT WORTH

INTEREST	COST	BENEFIT
4	113708	303638
6	98723	204150
8	88467	145592
10	80860	108642
12	74680	83931
14	69569	66598
16	65165	53961
18	61291	44458
20	57832	37130

IRR = 15.4 %

PROJECT : RUMMUN POWER SCHEME

ANNUAL DISBURSEMENT SCHEDULE

(UNIT : US$ 1000)

YEAR	COST			BENEFIT
	CAPITAL	REPLACE	O & M	
1	7100	0	0	0
2	10700	0	0	0
3	21400	0	0	0
4	21400	0	0	0
5	10010	0	1330	5200
6	0	0	1660	10400
7	0	0	1660	10400
8	0	0	1660	10400
9	0	0	1660	10400
10	0	0	1660	10400
11	0	0	1660	10400
12	0	0	1660	10400
13	0	0	1660	10400
14	0	0	1660	10400
15	0	0	1660	10400
16	0	0	1660	10400
17	0	0	1660	10400
18	0	0	1660	10400
19	0	0	1660	10400
20	0	0	1660	10400
21	0	0	1660	10400
22	0	0	1660	10400
23	0	0	1660	10400
24	0	0	1660	10400
25	0	0	1660	10400
26	0	0	1660	10400
27	0	0	1660	10400
28	0	0	1660	10400
29	0	0	1660	10400
30	0	0	1660	10400
31	0	0	1660	10400
32	0	0	1660	10400
33	0	0	1660	10400
34	0	0	1660	10400
35	0	100	1660	10400
36	0	0	1660	10400
37	0	0	1660	10400
38	0	0	1660	10400
39	0	0	1660	10400
40	0	0	1660	10400
41	0	20140	1660	10400
42	0	0	1660	10400
43	0	0	1660	10400
44	0	0	1660	10400
45	0	0	1660	10400
46	0	0	1660	10400
47	0	0	1660	10400
48	0	0	1660	10400
49	0	0	1660	10400
50	0	0	1660	10400
51	0	0	1660	10400
52	0	0	1660	10400
53	0	0	1660	10400
54	0	0	1660	10400
55	0	0	1660	10400

PRESENT WORTH

INTEREST	COST	BENEFIT
4	97546	187905
6	81734	126379
8	71482	90126
10	64198	67255
12	58631	51957
14	54138	41227
16	50372	33405
18	47128	27522
20	44280	22985

IRR = 10.5 %

Fig. XI-1 RESULTS OF ECONOMIC EVALUATION

Agricultural Development Schemes

Hydro-power Development Schemes