

No. 02

REPUBLIC OF INDONESIA  
MINISTRY OF PUBLIC WORKS  
DIRECTORATE OF WATER RESOURCES DEVELOPMENT

FEASIBILITY STUDY  
ON  
BATANG KUMU IRRIGATION PROJECT  
IN RIAU PROVINCE

SUMMARY REPORT

MARCH 1989

JAPAN INTERNATIONAL COOPERATION AGENCY  
TOKYO, JAPAN

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## PREFACE

In response to a request from the Government of the Republic of Indonesia, the Japanese Government decided to conduct a study on Batang Kumu Irrigation Project and entrusted the study to the Japan International Cooperation Agency(JICA).

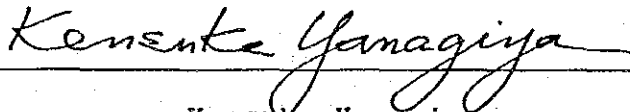
JICA sent to the Republic of Indonesia a study team headed by Mr. Takeshi Nomoto, Japan Irrigation and Reclamation Consultants Co., Ltd., from June, 1988 to January, 1989.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia and conducted a field survey in Riau Province. After the team returned to Japan, further studies were made and the present report was prepared.

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

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

March, 1989



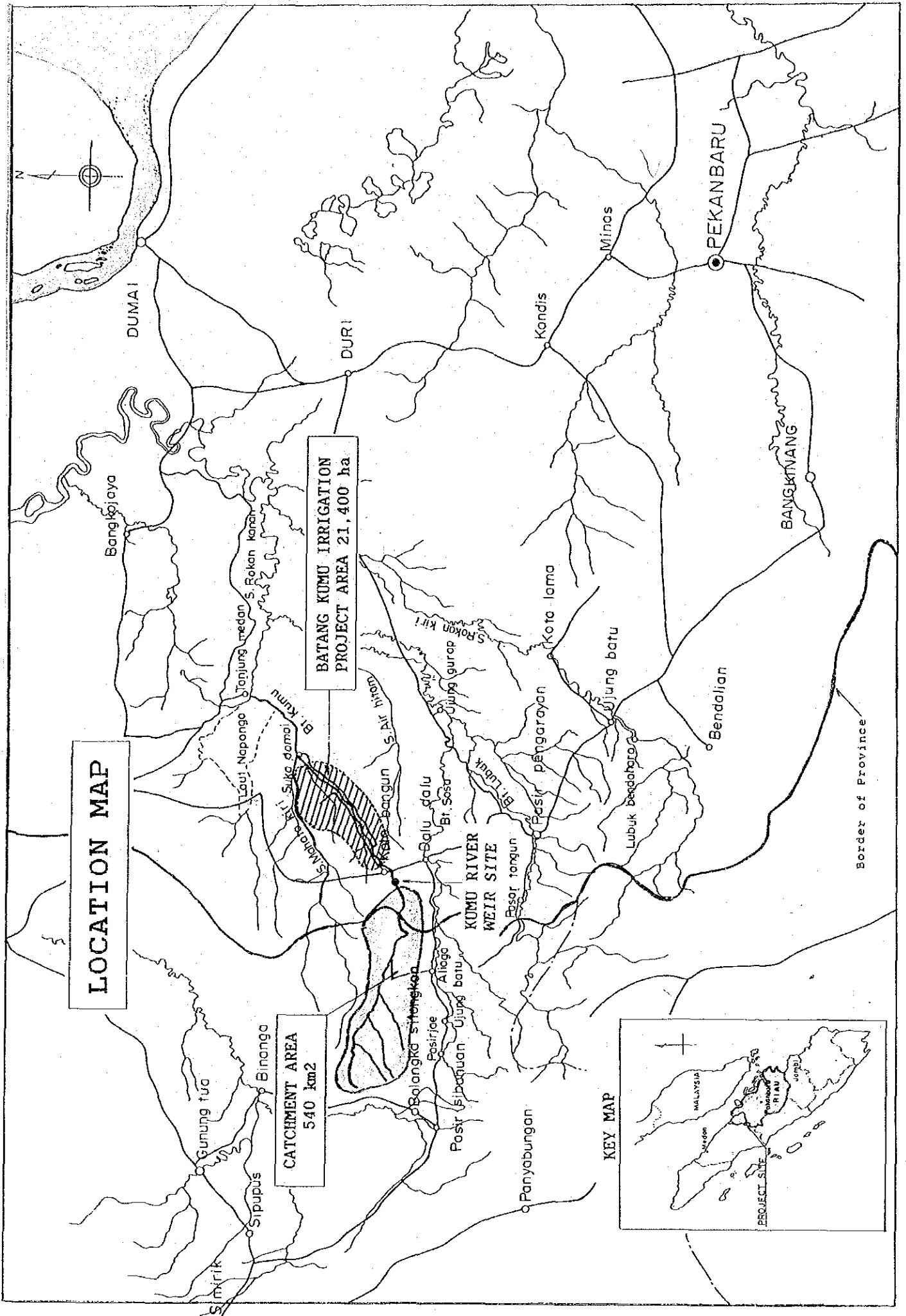
Kensuke Yanagiya

President

Japan International Cooperation Agency



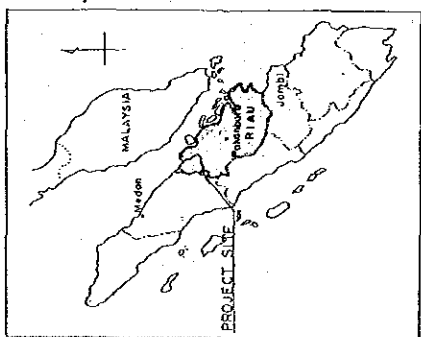




**LOCATION MAP**

**BATANG KUMU IRRIGATION PROJECT AREA 21,400 ha**

**CATCHMENT AREA 540 km<sup>2</sup>**



**KEY MAP**

Border of Province



FEASIBILITY STUDY  
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LOCATION MAP

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## INTRODUCTION

1. The feasibility study (Second Stage) on the Batang Kumu Irrigation Project in the Riau Province of the Republic of Indonesia has been carried out since June 1988 as a final step of the study, for which the first stage one had been done in 1985, in accordance with the Scope of Work agreed upon in November 1984 between the Government of Indonesia and the Government of Japan. This report presents the results of the field survey and the analysis in Japan for the feasibility study on the Project.

2. The Government of Indonesia has embarked on the fourth five-year development plan (REPELITA IV; 1984/85-1988/89), of which the development plan for the agricultural sector puts primary emphasis on the following major objectives:

- a) To increase agricultural production to meet domestic requirements for food and industry,
- b) To promote the export oriented crops,
- c) To improve and stabilize farmers' income,
- d) To support regional development, and
- e) To promote transmigration activities.

3. It is said that the above major objectives will be continued in the coming fifth five-year development plan (1989/90-1993/94) and the Riau Provincial Government has expected that the agricultural sector would continue to play more important role for promotion of agro-industrial development and achievement of a more balanced economy in the Riau Province.

4. The Project area is the transmigration area where about 3,070 households of transmigrants have settled since 1981. The transmigration program has played an important role in sparsely populated area in the outer islands for agricultural development and contributed in the regional development. Especially in the Riau Province, GDP excluding oil and gas has remained lower in comparison with those of other provinces and the rice production could not meet it's demand. Therefore, the Provincial Government aims at the realization of a balanced development among agricultural sector and other sectors in the Province.

5. The Project area is situated on the both sides of the Kumu river near Kota Bangun at the most upstream part of the benefited area and has 21,400 ha on the mostly terrace with flat topography which is hardly found in the Riau Province. The transmigration program has been proceeded allocating 0.25 ha for homeyard, 1.0 ha for paddy field and 0.75 ha for tree crops (rubber, hybridcoconut, etc.) per one family of the transmigrants in the Project area. Judging from possible intake discharge on the Kumu river, the net irrigable area is estimated at 7,300 ha of paddy in the wet season, and 3,100 ha of paddy and 2,700 ha of polowijo (groundnut, soybean and maize) in the dry season. The intake facility is a weir with 5.5 m in height and 50.0 m of width, and is located near the benefited area and the irrigation

water can be efficiently conveyed through the linking canal of 4.60 Km.

6. As the net irrigable area for paddy is 7,300 ha and the number of family of existing transmigrants is 3,070, it is possible to newly settle about 4,200 families of transmigrants. As for the re-settlement, about 2,000 families are scheduled from the submerged area due to the construction of a hydroelectric power dam with the height of 58 m planned on the Kampar Kanan river near Kota Panjang about 80 Km to the south from the Project area, and other re-settlements will be planned from the higher part near the project area and other areas.

7. In the Project area, the Second Stage Development Program has been carried out by the Ministry of Transmigration under the finance and technical cooperation of the World Bank. The Project aims to improve the welfare and low income of large numbers of transmigration and includes the support for tree crop cultivation for which 0.75 ha is allocated per one family in the Area, and the urgent delineation of irrigated area has been expected.

8. Moreover, the Program Highway Six of the Asian Highway is now carried out with the IBRD loan near the Project area and in the north outside the Project area, the construction of trunk road connecting Dumai port to the North Sumatora Province has been planned. After the completion, the above roads will be very effective for taking out the agricultural products from the Project area.

9. Therefore, to promote irrigation development in the Project area situated in the agricultural region contemplated by the Provincial Government is not only to promote agricultural production including export oriented crops and to contribute to the economic stabilization of the transmigrant in the Project encourage the transmigration scheme and the regional development.

## GENERAL ECONOMIC AND AGRICULTURAL BACKGROUND

10. The agricultural sector has a dominant role in the Indonesian's economy. About 55% of the total labor force is engaged in the agricultural sector, and two-thirds of the total population are depending on agriculture for their livelihood. In 1986, the sector contributed about 26% of GDP, and accounted for about 27% of total exports or about 55% of non-oil exports.

11. The relatively high rate of growth in agricultural production during 1981-1986 was largely due to record paddy. Paddy production increased by an annual rate of 3.9% during the same period to reach 39.7 million tons in 1986.

Cash crops such as rubber, palm oil, coconut and coffee are major export crops. The exports of rubber and coffee are particularly important. In 1986, the production of these two crops was estimated at 1.5 million tons, and these export value was about US\$ 1.5 billion or 20.8% of non-oil exports.

12. Until recently, Indonesia had imported its staple food, rice. However, the situation has improved, and now country has attained self-sufficiency. However, there is a forecast that a deficit of about one million tons at the lowest estimate will occur in the year, 2,005. It can be said that the increase in rice production through a continuous expansion of irrigation area and a powerful extension of crop intensification programs would be prerequisite to meet domestic demand increasing along with population growth.

13. The Riau Province is located in the northern part of Sumatra island and has an area of 94,560 km<sup>2</sup>. The total population in 1986 was estimated at about 2.7 million with population growth of 3.9% on average from 1981 to 1986, which is considerably higher than an average growth rate of 2.15% per annum in the country. Of the total workforce, about 60% were in the agricultural sector.

14. In 1986, out of the Gross Regional Domestic Product (GRDP) at current market prices in this province, 67% was derived from the mining sector including petroleum production and the agricultural sector only accounts for 6.7%. Per-capita GRDP at current market prices was estimated at Rp.2.04 million or US\$ 1,233 in 1986, which is higher than the national average figure of Rp.574,000 (US\$ 347) in the same period, but per-capita GRDP excluding petroleum amounted only to Rp.522,000 (US\$ 315).

15. Because half of the land in Riau Province is covered by swamp, with the exception of some perennial crops such as oil palm and coconut, the crop production in this province are limited in the mountain slope and high land areas distributed along the border of the Provinces of West Sumatra, North Sumatra and Jambi. During the previous 3 years from 1984 to 1986, the harvested area of wet land paddy only averages about 97,000 ha.

Recently, the planted area of rubber and oil palm have increased rapidly. These planted areas expanded 354,000 ha and 95,400 ha in 1986, respectively.

16. Although the production of rice in Indonesia attained a self-sufficiency, rice production in the Riau Province could not meet its demand. In Riau Province, about 384,000 tons of rice were consumed in 1986, on the contrary, total supply of rice was about 254,000 tons with a deficit of 130,000 tons in the same year.

17. Total families of transmigrants in the country has amounted 616,000 since 1950 and during the previous 3 years from 1984 to 1986, about 15,700 families accounting for 14.4% in the country settled in this Province.

In Riau Province, it has rendered significant services to promote transmigration, in order to develop the agricultural sector. About 65,000 families accounting for 10% of total families in this province are migrants who had been settled as farmers during the past 19 years from 1969/1970 to 1987/1988. In addition, the Government of Riau Province has planned to be settled about 56,000 families between 1989/1990 and 1993/1994.



## THE PROJECT AREA

18. The Project area is situated in the Tambusai district (Kecamatan), Kampar regency (Kabupaten) in the northwest about 230 Km far from Pekanbaru, the capital of Riau Province along the road, and the center of the Area is located at 1°15' North Latitude and 100°20' East Longitude.

The Project area belongs to the northern area of Riau Province and is near the boundary to the North Sumatra Province. Proposed weir site is located at the place of about 5 Km in the downstream of the Kumu river from the boundary to the North Sumatra Province and the center of the benefited are of the Project is about 25 Km far from the boundary.

The Project area is about 21,400 ha in total dividing into about 11,400 ha on the left side of the Kumu river and about 10,000 ha on the right side of the river.

19. The left side area for the Project is terrace and alluvial plain and the right side area is terrace. The elevation of the above areas gradually changes from 75 m to 15 m to the direction of northeast and the slope of the ground is averagely about 1 to 700 to the northeast.

20. The geological conditions at the proposed weir site are favorable in foundation of the weir to be constructed because the Tup Formation of bed rock is overlaid by some 5 meters thick of the alluvial sediments. However, the sediments consisting of coarse to fine textured materials with white color, are widely found below 60-120 cm from the ground surface, especially on the terraces in the Project area. The special attention should be given to excavating works for canal construction and clearing, grading and leveling works for making fields especially on the terrace.

21. In the light of the morphological characteristics, the soils in the Project area are classified into 9 soil units, according to the national soil classification system in Indonesia. Generally speaking, irrigated paddy is recommendable as the land use type for the Project area taking into account the low natural fertility and high acidity. On the other hand, the soils in the Project area are not or marginally suitable for upland crops due to the low soil fertility and the risk of aluminum toxicity.

22. Average annual rainfall in the Project area is approximately 2,500 mm. Generally, the year may be divided into the wet season from September to February and the dry season from March to August, but the rainfall distribution is about 60% to 40% and does not vary so much. Average annual air temperature is 27.6°C with small fluctuation. Average annual relative humidity, sunshine duration, solar radiation and wind velocity are respectively, 80%, 46%, 311 Cal/cm<sup>2</sup>/day and 35,2 km/day. Annual pan evaporation is about 1,720 mm and the average daily one is 4,7 mm/day.

23. The catchment area of the proposed weir site is estimated at 540 km<sup>2</sup> of which 475 km<sup>2</sup> belongs to the North Sumatra Province. The catchment area in the North Sumatra has undulated area with the highest elevation of 280 m. Annual average run off at the proposed weir site is 15.5 m<sup>3</sup>/sec. The maximum monthly runoff of 29.2m<sup>3</sup>/sec in December and the minimum of about 9.2 m<sup>3</sup>/sec in July are estimated. The annual sediment transport is roughly estimated at about 8,000 m<sup>3</sup>/year. The water in the Kumu river can be used for irrigation, but it is not suitable for drinking judging from evaporated residue and the amount of KMnO<sub>4</sub> demand.

24. The Project area is the transmigration project area called WPPXIb Tanjung Medan SKP-C and SKP-D, where the settlement started in December 1981. In the Project area, farmers account for 3,070 families. The farm population is estimates at 15,100 and average size of a farmer's family is 4.9 persons. The family labour force per a farm household averages 2.5 persons.

25. No irrigation paddy field is found in the Project area demarcated to be 21,400 ha in total and rain-fed paddy field accounts for only 180 ha. In the upland field estimated at 2,120 ha (9.9%), dry land paddy, corn, soybean, groundnut, etc. are cultivated. About 70% or 15,030 ha in the Project area are covered with forest, and remaining 19% consist of grass land, village (home yard) and others such as river and road. A private company had the right to cut trees of the forest in the left side area of the Project area, but the Ministry of Forest approved to develop the area for Transmigration in July 1988.

26. According to the standard of the Transmigration Office, the area of land to be allocated to the transmigrants is 2.00 ha per one family, which consists of 0.25 ha of home yard, 1.00 ha for paddy field (first arable farm land) and 0.75 ha for tree crops (second arable farm land). The land clearing for the first arable farm land is done by the Ministry of Transmigration and, that for the second arable farm land is carried out by the transmigrants themselves. Moreover, the land of 0.25 ha per one family is generally kept for public land. Each transmigration village has public facilities such as mosque, school, market and government offices nearly in the center, home yards surrounding them, the second arable farm land surrounding first. More than 80% of the first arable farm land were already cleared by the Government, but the land reclamation in the second arable farm land has been hardly performed by the transmigrants and its progress is about 40%.

27. All the farm fields in the Project area are put under rainfed condition. The cultivation pattern is generally affected by seasonal distribution of rainfall, and the harvested and/or planted areas fluctuate year by year, depending on the available rainfall water. In the Project area, the cultivation of wet land paddy is concentrated in the wet season, while dry land paddy and polowijo crops are generally planted in the both seasons. In general, most of wet season crops are sown in August and September and harvested from December to February. The dry season crops start in February/March, after harvest of the wet season crops. Mixed culture of polowijo crops is common practices in the Project area.

28. In the farming practices for wet land and dry land paddy, plowing is made by using animal and man power, and fertilizers and agro-chemicals are commonly applied. The cultivation method of polowejo crops are very simple, but fertilizers and insecticides are actually applied, except for cassava.

29. Present crop yields in the Project area very low. Of these, the biggest constraint is water stress such as drought. The average crop yield in the Project area is 2.8 ton/ha for wet land paddy, 1.2 ton/ha for dry land paddy, 1.3 ton/ha for maize, 0.9 ton/ha for groundmeet, 0.7 ton/ha for soybeans and 7.0 ton/ha for cassava. The total production of crop in the Project area is estimated at 1.673 ton for paddy, 760 ton for maize, 280 ton for soybeans and 1.650 ton for cassava.

30. In the Project area, most paddy and polowejo crops are consumed by farmers themselves, and a small quantity is sold at local markets in and around the Project area either by the farmers themselves or through brokers in order to get some cash income. In the Project area, the net supply of rice was estimated at about 1,077 ton. On the contrary, the demand of rice for the total population of 15,100 was 1,963 ton. As a result, the rice shortage of about 886 ton was estimated in the area. This shortage quantity has been supplied mainly from North Sumatra Province.

31. The present farm gate prices of major farm products prevailing in the Project area are per Kg, Rp. 650 for rice, Rp 210 for dry grain paddy, Rp. 175 for maige, Rp 680 for groundnut, Rp 500 for soybeans, Rp 600 for greenbeans and Rp 50 for cassava. DOLOG controls the price of rice in the market.

32. The farmers' economy in the Project area remains at the subsistence level, the farmers have received a considerable amount of subsidy from WFP (FAO Project) through the transmigration office. It is equivalent to about Rp 220,000 per one family per year.

33. In the Project area, 6 KUDs have been organized so far. The total number of KUD members including candidates is about 49% of total farm household in the area. The Project area is covered by the Rural Extension Center (BPP) Dalu-Dalu located at Kota Bangung. The total number of staff in this BPP are 2 extension supervisors and 14 field extension workers.

34. There is no sub-branch office of the Indonesian People's Bank (BRI) in the Project area and the farmers/KUDs must go to Pasirpangarajan to receive credit services from BRI.

35. In the Project area, there are one FAO program, three World Bank projects and one private project as described below:

- a) WFP  
The WFP has been executed by the Ministry of Transmigration with the objective of the food supply to settlers.

- b) **Second Stage Development Program (SSDP)**  
 The Second Stage Development Program has been carried out by the Ministry of Transmigration under the finance and technical cooperation of the World Bank. The Project aims to improve the welfare and low income of large numbers of transmigrants. In the Project area, the following works have been planned by this project. (1) Rehabilitation of road between the center of transmigration area and Dulu-Dulu (2) Rehabilitation of road and bridge in each transmigration village, (3) Improvement of shallow wells, (4) Reconstruction of houses and (5) Land clearing and relocation of farm land. The feasibility study commenced from January 1987 and finished in February 1988, the detailed design started from August 1987 and the tender documents for a part of the objective area are completed. After the loan agreement scheduled in March 1989, the construction work is scheduled to be started. However, in the case of the Project area, it is necessary for the SSDP to revise a part of the plan due to the irrigable area, plan of irrigation and drainage canals, plan of road, etc. of the Batang Kumu Project because it is said that the World Bank has a concept to give priority to the irrigation project.
- c) **Smallholder Rubber Development Project (SRDP)**  
 The executing agency of SRDP is the Bureau of Estate. The project period ranges from 1986 to 1990. In order to increase rubber production, SRDP has given credit to small farmers, which consist of rubber seedling and land reclamation cost of rubber estate in the Project area.
- d) **IFAD Project**  
 The objective is to supply animal power to farmers in the Project area. The period of this Project is ten years from 1983 to 1992.
- e) **Plantation Project**  
 A private firm, P.T. HUTAHAEN has a plan to construct a plantation of about 4,800 ha on the right side of the Kumu river in the Project area. The construction is scheduled to start from the end of 1988 or the beginning of 1989.

36. The higher land in the outside of the border in the southwest of the Project area is the protection area of the forest by the Forestry office. Other land surrounding the Project area consists of the permissible land in which the special trees could be cut, non-specified land, the land scheduled for transmigration, etc. In the catchment area of the North Sumatra Province, the transmigration area (Ujung Batu DK-I/V) of 5,625 ha in total was developed.

## THE PROJECT

37. The objective of the Project is to implement an irrigation project mainly for paddy cultivation aiming at contributing to increase the yield for food products, to realize an economic stability in the region, and encourage the transmigration scheme and the regional development. For this purpose, it is necessary to realize prompt implementation of the following matters for the Project area to be transmigration area and with no irrigation and drainage facilities using water resources effectively.

- a) Construction of systematic irrigation facilities
- b) Improvement of drainage conditions by the construction of drainage facilities
- c) Development of paddy field and farm land in the uncultivated land
- d) Coordination to the new transmigration plan in newly developed farm land
- e) Construction of operation and maintenance facilities
- f) Arrangement of agricultural support services and organization

38. The Project is formulated with the following concepts of

- a) The Project area is selected on the both sides of the Kumu river with transmigrants settled
- b) The water source facility and intake water level are planned so as not to give the influence of backwater to the North Sumatra Province
- c) The plan of supplemental facilities for irrigation is taken as the one for the future
- d) The irrigable areas are delineated taking into account the above intake facility and water level, possible intake discharge, land suitability, topography, etc.
- e) Taking into consideration the Government's policy for development, the farm land is allocated to be 1.0 ha for paddy field and 0.75 ha for tree crop land (rubber, hybridcoconut, etc.) per one transmigration family
- f) A general plan for new transmigration in the Project area is studied
- g) To introduce diversified cropping pattern, the irrigation for paddy and polowijo crops in the dry season is planned

- h) Considerable parts of canal are lined taking into account the soil mechanical condition in the Project area
- i) The Project is formulated taking into account the future operation and maintenance as much as possible
- j) The construction of mini-hydroelectric power plants is costly in comparison with the diezel generation.

39. The Project area is demarcated to be 21,400 ha in gross on the both sides of the Kumu river taking into account the possible intake discharge at the propose weir sits on the Kumu river, planning intake water level, cropping pattern, water requirement, irrigable area, present condition of transmigration, land use, land suitability, possible number of families of new transmigrants, allocated land, the Government's policy for development, etc. The proposed land use for the Project is as follows:

<u>Division</u>	<u>Left Side</u> (ha)	<u>Right Side</u> (ha)	<u>Total</u> (ha)
Gross Irrigation Area	5,000	3,110	8,110
Net Irrigation Area	(4,500)	(2,800)	(7,300)
Tree Crop Land	3,175	2,100	5,275
Home Yard	1,025	700	1,725
Public Land	1,025	700	1,725
Others	1,175	3,390	4,565
<hr/>			
Total	11,400	10,000	21,400
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40. The group system (nucleate agricultural village community) is adopted for the layout of new transmigration villages with about 400 households per each village. The numbers of transmigration families and villages are planned as follows:

<u>Division</u>	<u>Left Side</u> (ha)	<u>Right Side</u> (ha)	<u>Total</u> (ha)
Households			
Settled Already	1,619	1,451	3,070
New/Re-settlement	2,880	1,350	4,230
Total	4,499	2,801	7,300
Villages			
Settled Already	4	4	8
New/Re-settlement	6	3	9
Total	10	7	17

41. Wet season paddy is cultivated in the irrigation area of 7,300 ha in net and the dry season paddy is cultivated in 3,100 ha and polowijo crops (groundnut, soybeans and maize) in 2,700 ha are introduced taking into consideration the diversification of

agricultural products. The annual crop production under the future with project condition is estimated as follows, on condition that the unit yields will increase gradually from the present level to the anticipated yields in the 5th year after completion of the Project.

<u>Crops</u>	<u>Unit Yield</u> ton/ha	<u>Area</u> ha	<u>Production</u> ton
Wet season paddy	5.0	7,300	36,500
Dry season paddy	5.0	3,100	15,500
Groundnut	0.9	900	810
Soybean	0.7	900	630
Maize	1.3	900	1,170

42. After implementation of the irrigation facilities, year round irrigation would be provided to all farmers in the Project area. Crop production cost under the future with project condition would increase substantially due to application of increased amounts of labour force and farm inputs such as fertilizers and agro-chemicals, but a significant increase in yield and production of crop would be expected. As a result, a significant increase in farm income would be also expected in the future with project condition.

43. Two alternative sites on the Kumu river for the weir were thoroughly surveyed and studied from the technical and economical viewpoints. As the results, the site at about 3.5 km in the upstream from Kota Bangung is recommendable for constructing diversion weir at an elevation of 60.50 m in its intake water level.

44. The irrigation water requirement for the Project is estimated for the proposed cropping pattern with irrigation efficiency to be 55%. As the results, the maximum ten days requirements are estimated at 1.28 l/sec/ha for wet season paddy, 1.54 l/sec/ha for dry season paddy and 0.32 l/sec/ha for polowijo crops respectively. The maximum diversion requirement at the proposed weir site is estimated at 9.34 m<sup>3</sup>/sec in the wet season and 4.77 m<sup>3</sup>/sec in the dry season.

45. The irrigation water is diverted by gravity method from the weir and conveyed through the linking canal of 2.61 km on the left side of the Kumu river, and then diverted to two main canals for the left side and the right side of the Kumu river. The right main canal crosses the Kumu river by a siphon structure.

46. The following table shows the salient features of the weir, irrigation, drainage and road networks.

- 1) Weir
  - Intake water level : EL 60.50 m
  - Weir height : 5.50 m
  - Weir width : 50 m
  - Flood way : 14 m × 3 spans
  - Scouring sluice : Undersluice (2 m × 2 spans)
  - Intake : Sluice gate (2.5 m × 3 spans)
- 2) Linking canal
  - Length : 2.61 km
  - Canal Slope : 1/5,300
  - Type of canal : Trapezoidal, lined
  - Width of canal base : 3.30 m
- 3) Main irrigation canals
  - Length left : 25.6 km
  - right : 18.7 km
  - Type of canal : Trapezoidal, 90% lined
  - Related structures, left : 114 Nos.
  - right : 74 Nos.
- 4) Secondary irrigation canals
  - Length, left : 50.1 km
  - right : 30.1 km
  - Type of canal : Trapezoidal, unlined
  - Related structures, left : 236 Nos.
  - right : 144 Nos.
- 5) Drainage canals
  - Drainage canal, left : 27.7 km
  - right : 28.7 km
- 6) Inspection roads and other roads
  - Main road : 44.3 km
  - Secondary road : 80.2 km
  - Other road : 33.3 km
- 7) Tertiary system and farm road
  - Irrigation canal : 486 km
  - Drainage canal : 192 km
  - Farm road : 146 km
- 8) Land reclamation
  - Land clearing : 1,000 ha
  - Land leveling : 5,000 ha
- 9) Operation and Maintenance
  - Equipment : L.S
  - Facilities : L.S

47. The Ministry of Public Works (DPU) is responsible for implementation of irrigation projects. For the construction works of these projects, the responsibility of DPU is generally limited up to the secondary canal and tertiary box. On-farm development within the tertiary irrigation block such as tertiary canal, quaternary canal, farm ditch, farm road and land reclamation of field are left to the farmer's hand. Because of the lack of fund and insufficient technique, however, this on-farm development is usually delayed in its commencements. Although there are various technical and credit services by the Ministry of Agriculture, the construction cost for the works described the article 46 should be included in the Project taking into consideration the lack of fund of the farmers in the Project area. On the other hand, the project cost for new transmigra-



tion/re-settlement of about 4,200 families including the costs for home yard, house, well, road, first arable farm land, etc. would be left to the Ministry of Transmigration.

48. First of all, the detailed design is needed for the implementation of the Project. The whole project works would be generally divided into two stages, that is, the first stage for the existing transmigration areas (six work divisions) and the second stage for the areas for new transmigration/re-settlement (two work divisions). It is recommendable to construct the weir and linking canal at first and then others facilities to the downstream in order taking into account the above stage plan.

49. The Directorate General of Water Resources Development (DGWRD), the Ministry of Public Works, the Government of the Republic of Indonesia would be the executing agency for the implementation of the Batang Kumu Irrigation Project. DGWRD would be responsible for both the engineering works and the construction works of the Project. It would coordinate all activities of the relevant Government agencies and regional administrative organizations in connection with the project implementation. The Directorate of Irrigation-II under the said DGWRD would direct responsibility for the project implementation. Riau Regional Public Works would coordinate the construction of the Project at the provincial level on behalf of Ministry of Public Works. In order to implement the Project successfully, it is proposed to establish the Batang Kumu Irrigating Project Office under the superintendence of the Directorate of Irrigation II.

50. After completion of the construction works, the Project Office will be reorganized into the O&M office which will responsible for the operation and maintenance of all facilities down to inlets to tertiary blocks. The operation and maintenance of the tertiary blocks down to terminal facilities will be entrusted to the water user's association (P3A) and farmers themselves.

51. The total project costs required are estimated to be about US\$43 million which comprise US\$23.9 million of foreign portion and US\$18.6 million equivalent of local portion, which include the physical contingency of about 5% of direct cost and price contingency of about 4% per annum for the foreign currency portion and 10% per annum for the local currency portion. The annual operation and maintenance costs are estimated at about Rp 162 million per annum. (US\$1.0 = Rp 1,710)

52. The agricultural net incremental benefit through the irrigation project is estimated at about Rp 8,563 million per annum. The economic feasibility of the Project is evaluated in terms of internal rate of return of the basis of a 50 years useful life including the project costs for new transmigration/re-settlement. The calculated internal rate of return is around 12.7% excluding the benefits from the tree crop areas, which indicates the economic soundness of the Project.

## RECOMMENDATIONS

1. The Project is an irrigation project for the both transmigration areas already settled and newly settled, expects the implementation of new transmigration as planned. In addition, there are some related projects implemented in the Project area. Therefore, it is recommendable to establish a special committee to coordinate all activities of relevant Government agencies and regional administrative organizations in connection with the Project implementation.

2. For the successful implementation of the Project, the following works are required to be carried out particularly during the detailed design.

- a) Supplemental topographic survey on the parts of the right side of the Kumu river with the lack of topo-map of 1/5,000 should be carried out.
- b) The selection of the proposed canal routes and their survey on plan and profile of 1/2,000 scale should be performed.
- c) To assure soil profile, test pits with about 500 m intervals on the proposed canal routes should be done.
- d) The location of borrow pits for embankment materials and their soil mechanical properties should be studied for canal construction.
- e) For the confirmation of percolation loss of water on irrigated paddy field, the field percolation test and checking of surface soil depth should be carried out.
- f) It is recommendable to establish a climatological station in the center of the Project area and install some automatic rainfall recorders in the catchment area of the Kumu river.
- g) To select appropriate varieties, establish advanced farming practices and reduce production cost for polowijo crops to be introduced in the soil conditions with serious constraints of the Project area, it is recommendable to establish a pilot farm in the Project area.

3. The conservation of the catchment for the Kumu river is important, because it is indispensable to assure stable river discharge for the irrigation to the Project area. It is recommendable to propose the forest conservation and erosion prevention to the North Sumatra Province.

4. The plan of operation and maintenance for the weir and canal system should be studied in more details during the detailed design.

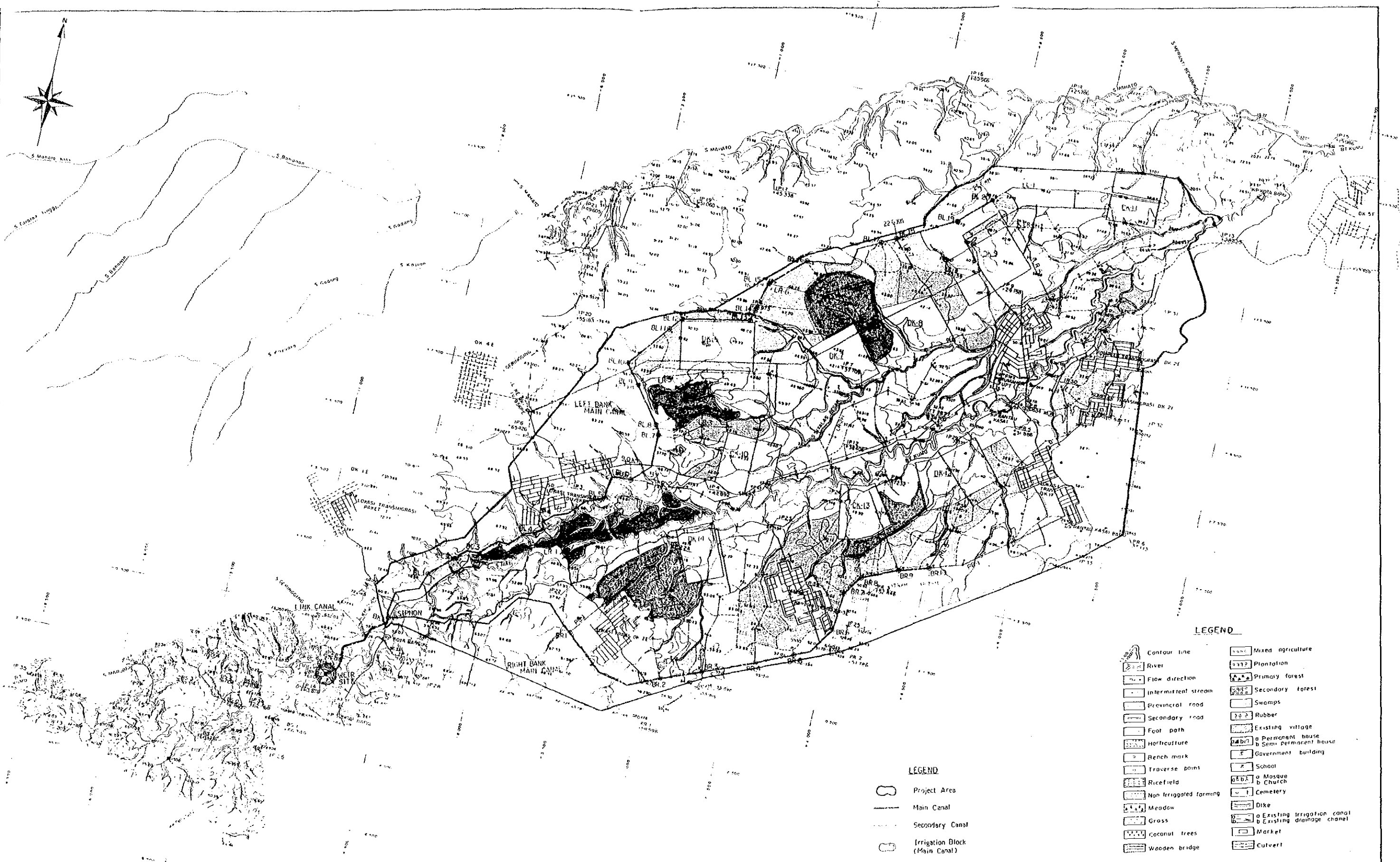
5. The plan of supplemental irrigation facilities for the Mahato river would suggest the possibility to develop the remaining area on the left side of the Kumu river in the future.

6. In order to increase agricultural production in the future, it is indispensable to arrange not only irrigation facilities, but institutional services such as agricultural extension, credit, farm input supply and marketing.

Table 1 SUMMARY OF PROJECT COST

Unit: 10<sup>3</sup> US\$

Item	Foreign Portion	Local Portion	Total
1. Preparatory Expenses	840	360	1,200
2. Civil Work for 1st Stage			
2.1 Head Work (Div-I )	1,719	583	2,302
Link Canal ( " )	393	261	654
2.2 Main & Sec. (Div-II )	1,698	1,347	3,045
Tertiary ( " )	214	92	306
2.3 Main & Sec. (Div-III )	1,616	1,192	2,808
Tertiary ( " )	318	136	454
2.4 Main & Sec. (Div-IV )	1,049	773	1,822
Tertiary ( " )	154	66	220
2.5 Main & Sec. (Div-V )	1,671	1,218	2,889
Tertiary ( " )	186	80	266
2.6 Main & Sec. (Div-VI )	1,471	1,088	2,559
Tertiary ( " )	428	183	611
Sub-Total	10,917	7,019	17,936
3. Civil Work for 2nd Stage			
3.1 Secondary (Div-VII )	756	593	1,349
Tertiary ( " )	1,220	523	1,743
3.2 Secondary (Div-VIII)	312	269	581
Tertiary ( " )	573	246	819
Sub-Total	2,861	1,631	4,492
4. O&M Facilities	524	175	699
5. Land Acquisition Cost	-	180	180
6. Administration Cost	-	657	657
7. Engineering Service			
7.1 Detailed Design	1,440	160	1,600
7.2 Construction S/V	2,160	240	2,400
Sub-Total	3,600	400	4,000
<b>Total</b>	<b>18,742</b>	<b>10,422</b>	<b>29,164</b>
8. Physical Contingency	937	521	1,458
<b>Total</b>	<b>19,679</b>	<b>10,943</b>	<b>30,622</b>
9. Price Contingency	4,261	7,641	11,902
<b>Grand Total</b>	<b>23,940</b>	<b>18,584</b>	<b>42,524</b>



LEGEND

- Contour line
- River
- Flow direction
- Intermittent stream
- Provincial road
- Secondary road
- Foot path
- Horticulture
- Bench mark
- Traverse point
- Ricefield
- Non irrigated farming
- Meadow
- Grass
- Coconut trees
- Wooden bridge
- Mixed agriculture
- Plantation
- Primary forest
- Secondary forest
- Swamps
- Rubber
- Existing village
- Permanent house
- Semi permanent house
- Government building
- School
- Mosque
- Church
- Cemetery
- Dike
- Existing irrigation canal
- Existing drainage channel
- Market
- Culvert

LEGEND

- Project Area
- Main Canal
- Secondary Canal
- Irrigation Block (Main Canal)
- Irrigation Block (Secondary Canal)
- Transmigration Road
- Transmigration Area

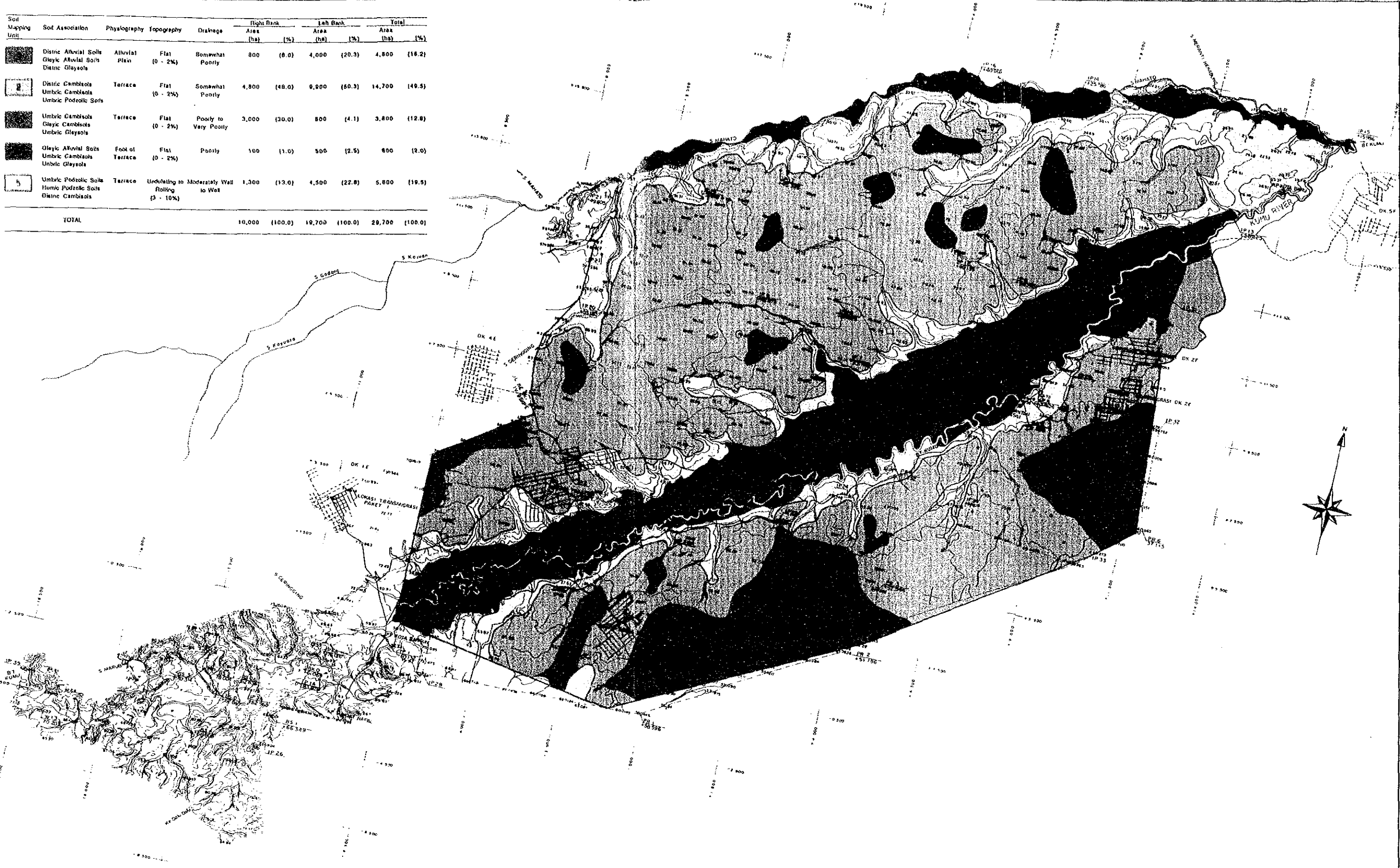
SCALE



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**BATANG KUMU IRRIGATION PROJECT**  
 FEASIBILITY STUDY

**GENERAL PLAN**

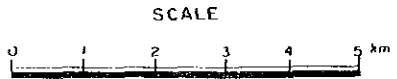
Soil Mapping Unit	Soil Association	Physiography	Topography	Drainage	Right Bank		Left Bank		Total	
					Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
1	Dystric Alluvial Soils Gleyic Alluvial Soils Dystric Gleysols	Alluvial Plain	Flat (0 - 2%)	Somewhat Poorly	800	(8.0)	4,000	(20.3)	4,800	(18.2)
2	Dystric Cambisols Umbric Cambisols Umbric Podzolic Soils	Terrace	Flat (0 - 2%)	Somewhat Poorly	4,800	(48.0)	9,900	(50.3)	14,700	(49.5)
3	Umbric Cambisols Gleyic Cambisols Umbric Gleysols	Terrace	Flat (0 - 2%)	Poorly to Very Poorly	3,000	(30.0)	800	(4.1)	3,800	(12.8)
4	Gleyic Alluvial Soils Umbric Cambisols Umbric Gleysols	Foot of Terrace	Flat (0 - 2%)	Poorly	100	(1.0)	500	(2.5)	600	(2.0)
5	Umbric Podzolic Soils Humic Podzolic Soils Dystric Cambisols	Terrace	Undulating to Rolling (3 - 10%)	Moderately Well to Well	1,300	(13.0)	4,500	(22.8)	5,800	(19.5)
TOTAL					10,000	(100.0)	19,700	(100.0)	29,700	(100.0)



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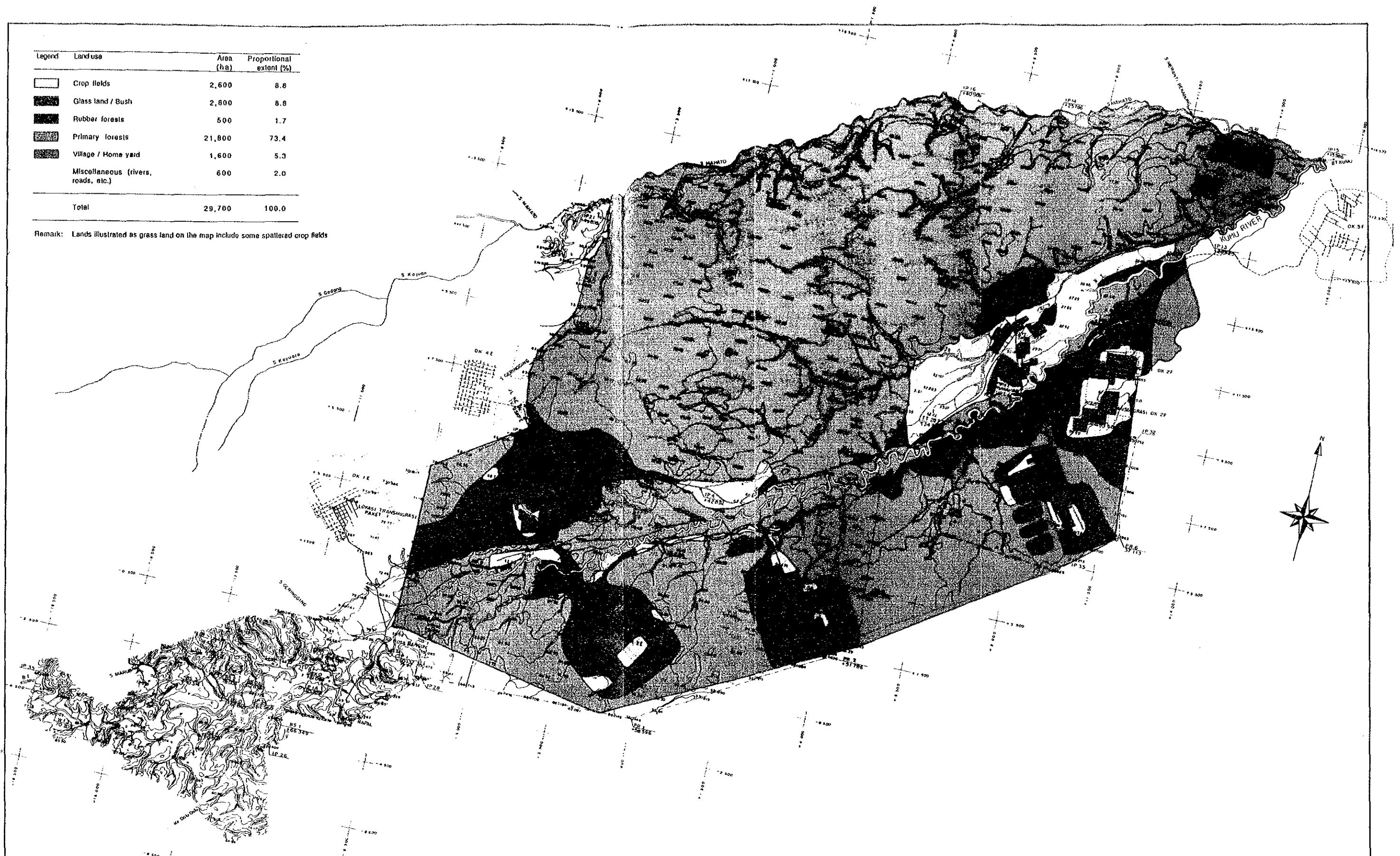
**SOIL MAP**

JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO (JICA)      DWG. NO. 2



Legend	Land use	Area (ha)	Proportional extent (%)
	Crop fields	2,600	8.8
	Glass land / Bush	2,600	8.8
	Rubber forests	500	1.7
	Primary forests	21,800	73.4
	Village / Home yard	1,600	5.3
	Miscellaneous (rivers, roads, etc.)	600	2.0
	<b>Total</b>	<b>29,700</b>	<b>100.0</b>

Remark: Lands illustrated as grass land on the map include some spattered crop fields



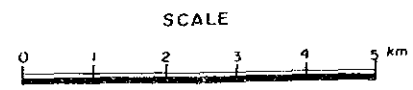
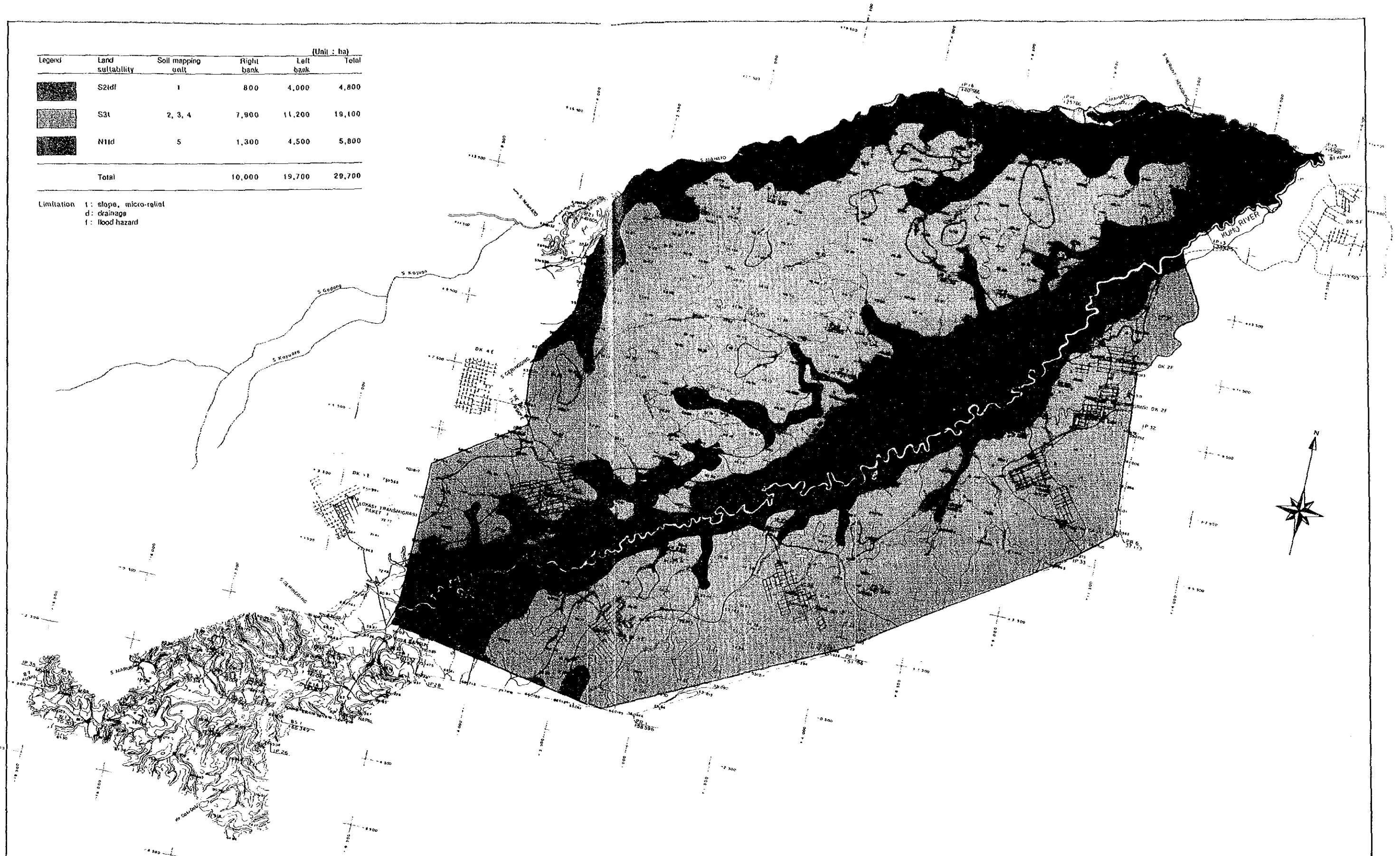
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FEASIBILITY STUDY

**PRESENT LAND USE MAP**

JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO (JICA) DWG. NO. 3

Legend	Land suitability	Soil mapping unit	(Unit : ha)		
			Right bank	Left bank	Total
	S2idf	1	800	4,000	4,800
	S3t	2, 3, 4	7,900	11,200	19,100
	N1td	5	1,300	4,500	5,800
Total			10,000	19,700	29,700

Limitation  
 1: slope, micro-relief  
 d: drainage  
 f: flood hazard



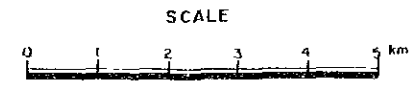
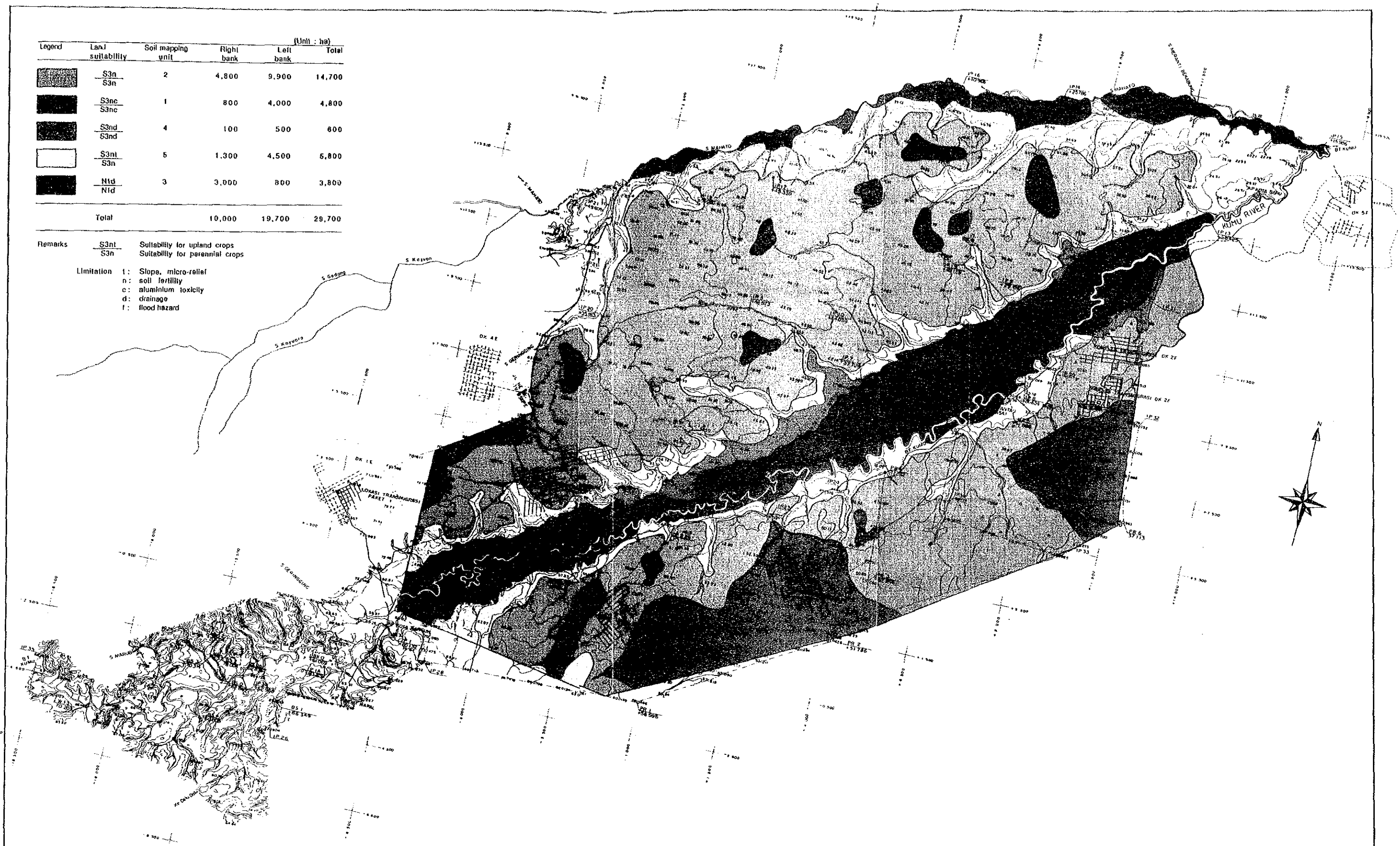
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 BATANG KUMU IRRIGATION PROJECT  
 FEASIBILITY STUDY  
**LAND SUITABILITY MAP  
 FOR PADDY**  
 JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO (JICA) DWG NO 4



Legend	Land suitability	Soil mapping unit	(Unit : ha)		
			Right bank	Left bank	Total
	S3n	2	4,800	9,900	14,700
	S3nc	1	800	4,000	4,800
	S3nd	4	100	500	600
	S3nt	5	1,300	4,500	5,800
	N1d	3	3,000	800	3,800
Total			10,000	19,700	29,700

Remarks S3nt Suitability for upland crops  
S3n Suitability for perennial crops

Limitation  
t: Slope, micro-relief  
n: soil fertility  
c: aluminum toxicity  
d: drainage  
f: flood hazard

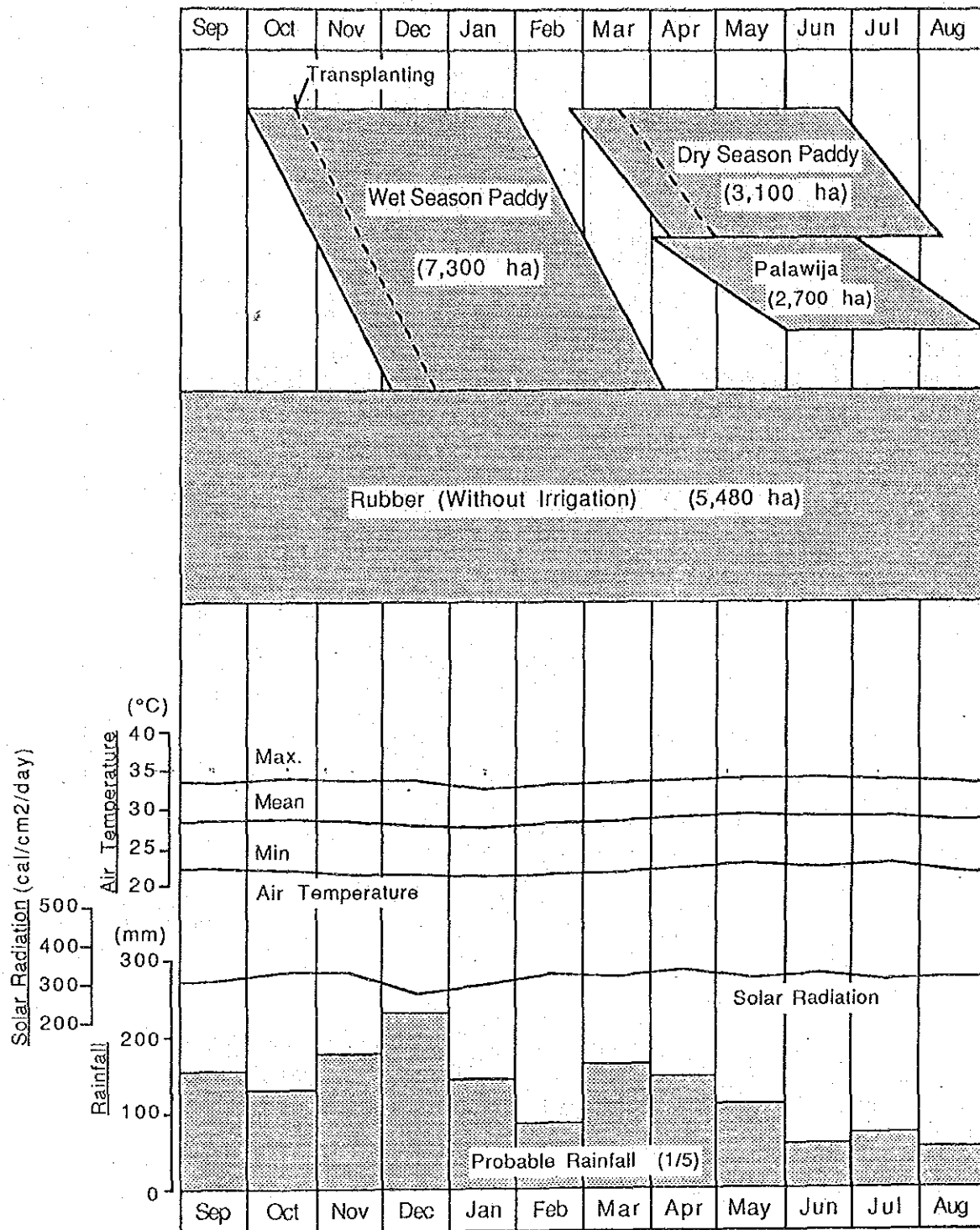


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BATANG KUMU IRRIGATION PROJECT  
FEASIBILITY STUDY

**LAND SUITABILITY MAP FOR  
UPLAND AND PERENNIAL CROPS**

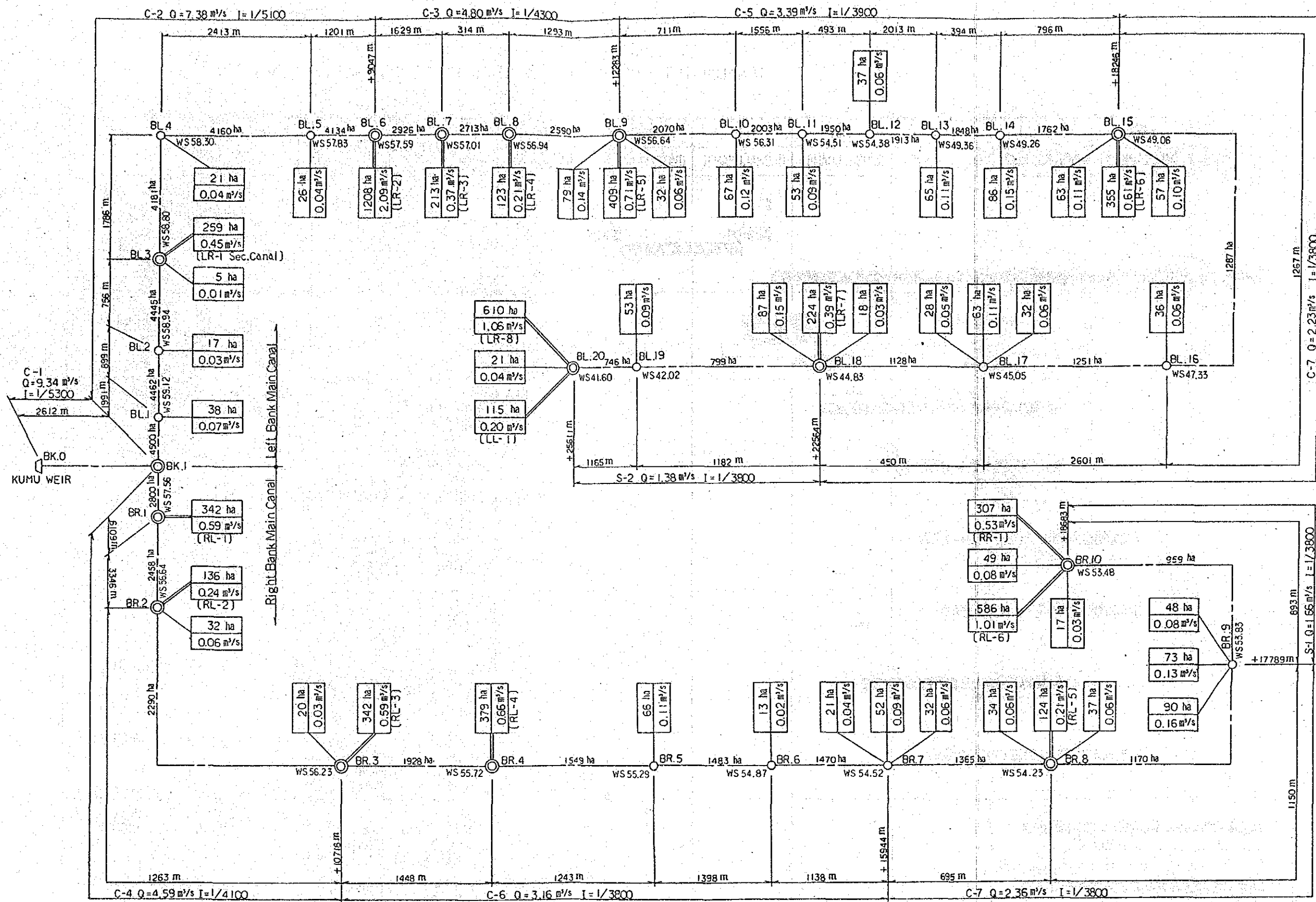
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TOKYO (JICA) DWG NO. 5





Station : Pasir Pengarayan

Fig. 6 Proposed Cropping Pattern



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 BATANG KUMU IRRIGATION PROJECT  
 FEASIBILITY STUDY (SECOND STAGE)  
 WATER DISTRIBUTION OF MAIN SYSTEM  
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TOKYO  
 DWG. NO. 7







JICA