

Fig. II-14 RELATION BETWEEN DEPTH AND COEFFICIENT OF PERMEABILITY

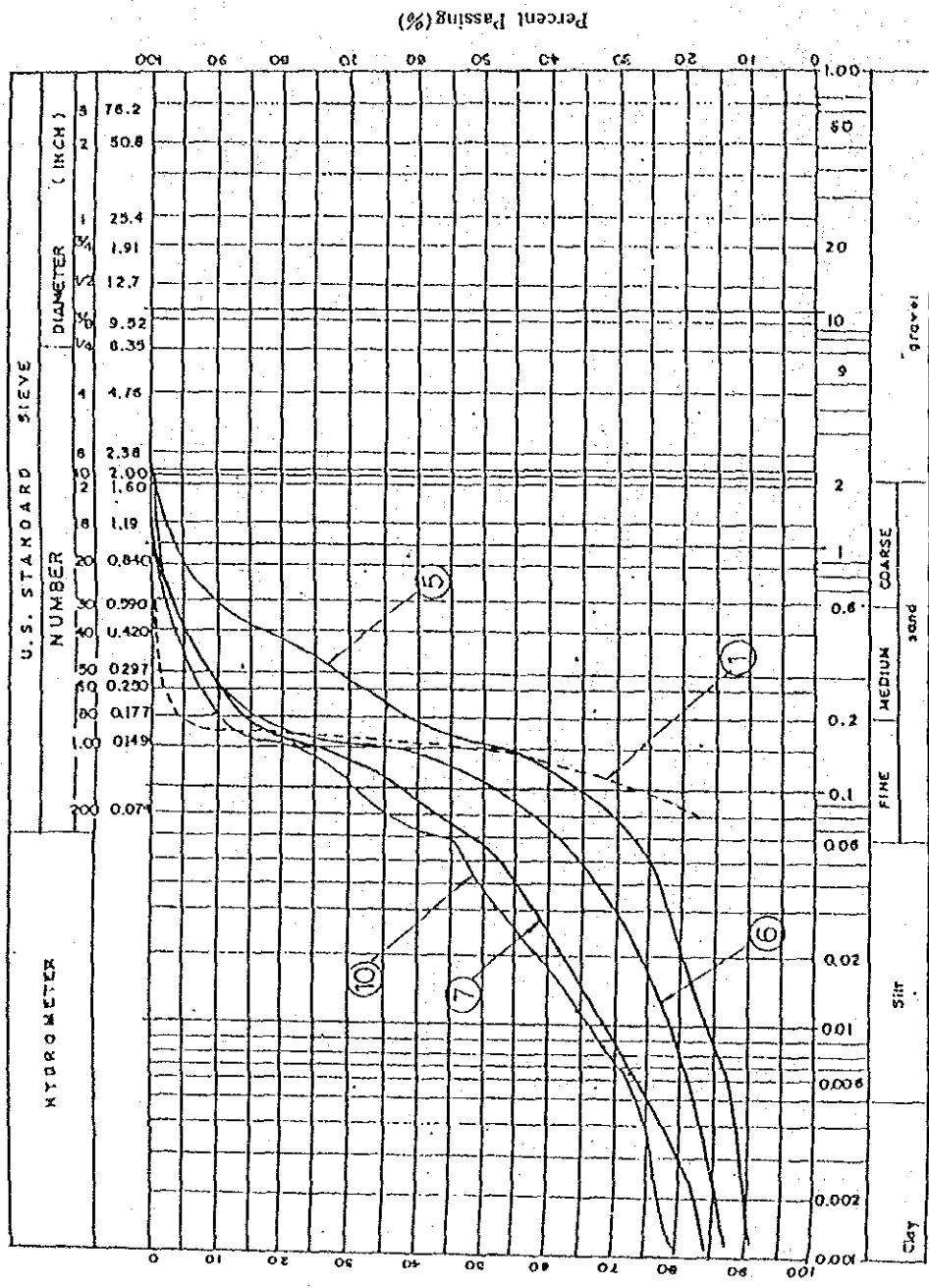
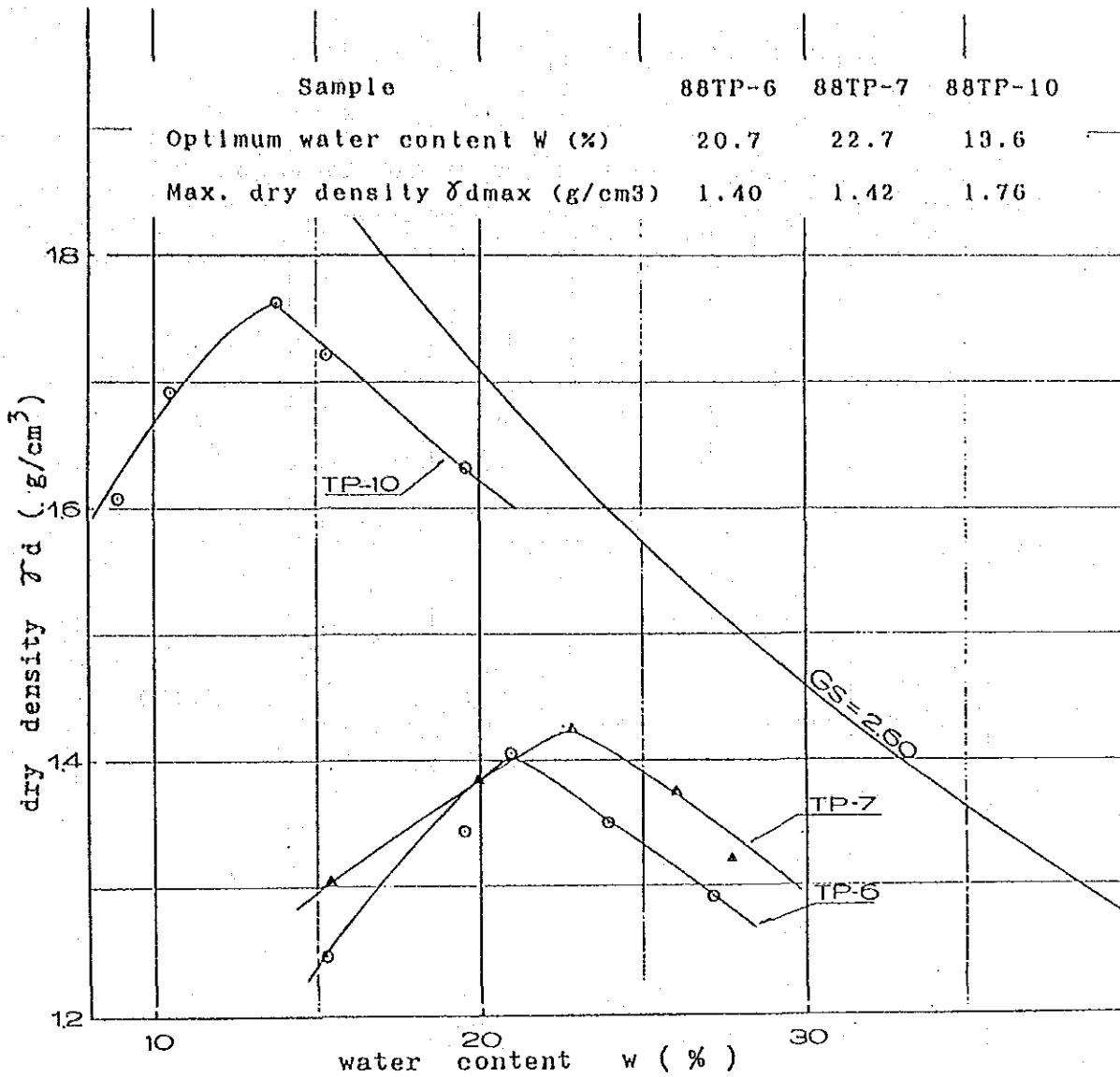


Fig. II-15 Result of Grain Size Analysis



Relative equations for dry density  $\gamma_d$  g/cm<sup>3</sup>, degree of saturation S%, water content w%, is shown as below

$$\gamma_d = \frac{G_s \cdot \gamma_w}{1 + \frac{w \cdot G_s}{S}}$$

where  $G_s$  ; Specific gravity  
 $\gamma_w$  ; unit weight of water = 1 g/cm<sup>3</sup>  
 this equation corresponds to zero air void curve when S is 100%

Fig.II-16 Result of Compaction Test

LEGEND

- ▲ 88TP-1 2.8m , Fine sand , "Qh"
- ▼ 88TP-2 1.4m , - ditto -
- 88TP-8 2.0m , - ditto -
- 88TP10 1.6m , Clay , "Qp"

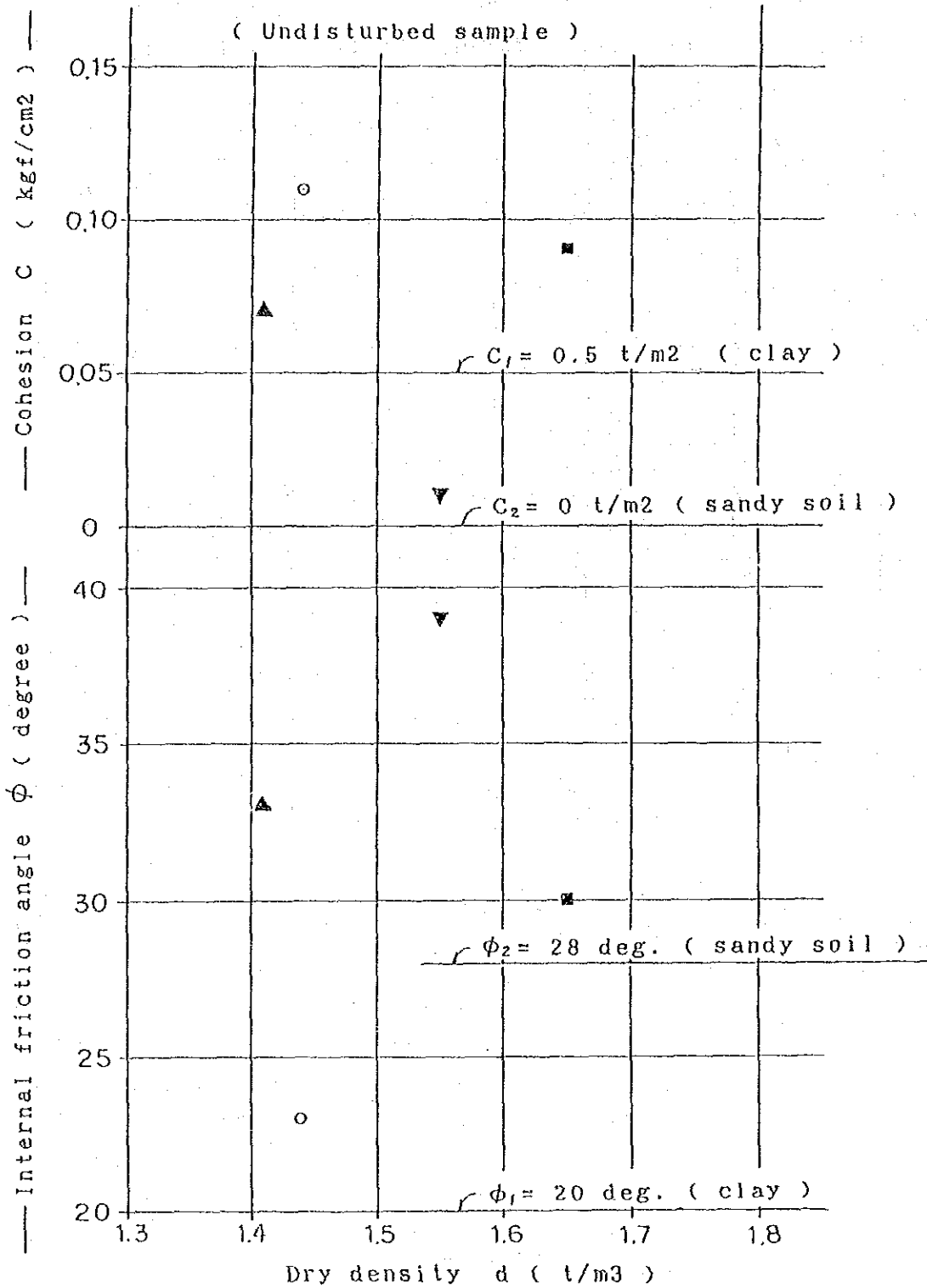
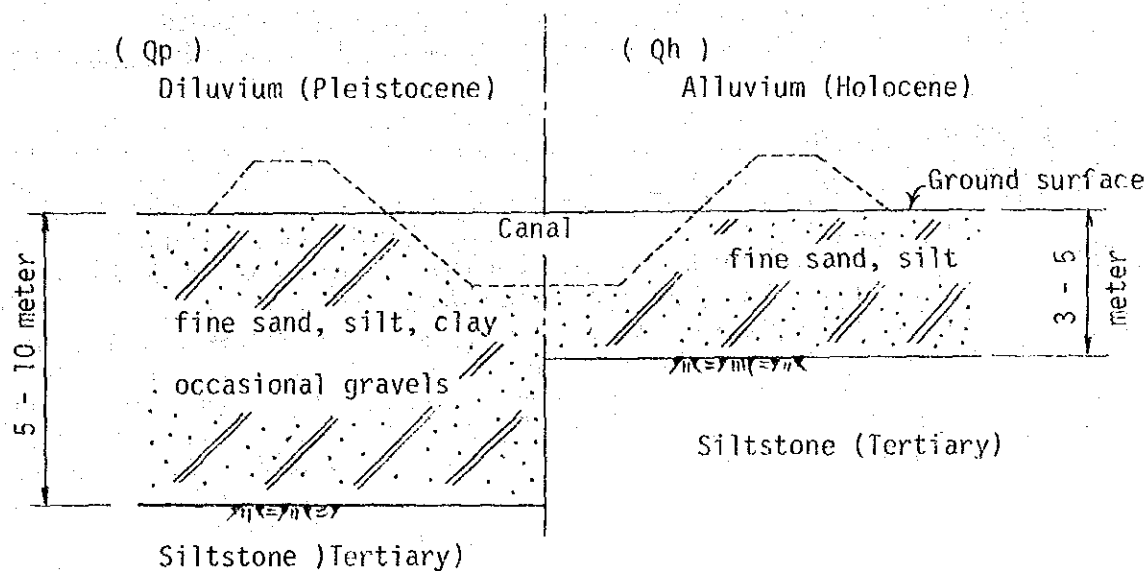


Fig.II-17 Result of Direct Shear Test

## CHAPTER 6 FOUNDATION OF MAIN CANAL

### 6.1 Geological Structure

The below figure shows the geological structure of canal route except the surrounding area of the starting point of Link canal. The bed rock is supposed to be overlaid by 3 ~ 5 m of Alluvials or 5 ~ 10 m of Deluvials.



## 6.2 Shear Strength and Permeability

### (1) Shear Strength

Shear strength of Quaternary layer is shown in Fig. II-17. Proposed design values are follows:

clay :  $C = 0.5 \text{ t/m}^2$ ,  $\phi = 20 \text{ deg.}$   
sandy soil :  $C = 0$ ,  $\phi = 28 \text{ deg.}$

### (2) Permeability

Because coefficient of permeability of fine sand to sand layer is  $10^{-3}$  cm/sec order as mentioned in 5-2, facing works is necessary.

### (3) Consideration

While left bank of BT. Kumu consists of fine materials comparatively with right bank, fine sand to sand layers predominate of canal route in both bank. These materials may be weak to erosion by surface flow water and/or to destruction by seepage water. It should be protected by the facing works.

## CHAPTER 7 CONSTRUCTION MATERIALS

### (a) Impervious materials

Weathering products of the bed rock of tup or Tmt Formation are suitable for impermeable materials for the weir. It will be able to obtain from northern slopes at the downstream weir site and from both slopes at the upstream weir site.

Impervious materials for canals will not be able to obtain along the canal route. The largest portion of the sediment of Pleistocene contains silty clay in some portion, and the thickness expected less than 1 meter.

Weathering products of shale in tup Formation will be able to use for impervious materials in upstream portion of main canal.

### (b) Semipervious Materials

Semipervious materials are used for embankment of downstream side of weir or of canals except channels. Sands and gravels of Pleistocene sediments are suitable for semipervious materials. Sand and gravel layer dots in the project area and it exists on the right side of the Kumu river and Mahato river. The sands and gravels are well graded.

### (c) Rock Materials

Paleozoic slates and sandstones (Puku) and Mesozoic volcanics are suitable for rock materials. Tertiary sedimentary rocks are unsuitable because of their susceptibility of weathering.

Rock materials can not obtain within the project area. Paleozoic slates and sandstones exist some 70 kilometers west of Daludalu, but there is not quarry for these rocks. Sands and gravels originated in these rocks are used as materials.

Metamorphic limestones and volcanics (Pukup), pegmatites and granites exist some 10 kilometers west of Pasirpangarayan. There is no quarry.

### (d) Sand and gravel in the Kumu river

Sands and gravels produced from the Kumu river in the project area classify into gravelly sands. It is generally low gravel content and its maximum particle size is about 10 centimeters. Sand and gravel which contains relatively high gravel exists at riverside in DU of SKP-F.

Sand and gravel produced near the proposed weir site is unsuitable for aggregate.





APPENDIX III

SOIL AND LAND SUITABILITY



## CHAPTER 1. SOIL

### 1.1 General

A semi-detailed reconnaissance soil survey and land suitability evaluation study of the transmigration areas Tanjung Medan SKP C and D was made by the Brawijaya University from October 1980 to March 1981. They used 1:20,000 scale air photographs taken in July 1980 and the results were published in March 1981 with 1:20,000 and 1:50,000 scale soil maps. This initial study is not very satisfactory because the study does not cover the whole areas of the Batang Kumu Irrigation Project, the field study was limited and the soil boundaries are drawn on inaccurate topographic maps.

The soil survey of the Batang Kumu Irrigation Project was done in two stages. The first survey was carried out by P.T. ISUDA PARAMA in 1985/86 under the contract agreement with DGWRD. The second survey was made by JICA experts from August to November 1988 in cooperation with Indonesian counterparts. The surveys aim at identifying major soil groups and their distribution and examining the suitability of each soil group for irrigated farming on the basis of field investigation and the findings of the previous study mentioned above.

The present report deals with the procedure of the field investigation, major characteristics and land capability of the soil identified in the survey area. The results of the study are summarized in the SOIL MAP (Drawing III-1).

### 1.2 Survey Area

The soil survey was carried out over the total area of about 29,700 ha. The survey area is broadly divided into two areas: the Batang Kumu left bank (19,700 ha) which is bounded by the Mahato Kiri river on the north and the Batang Kumu right bank (10,000 ha).

The topography of the survey area is characterized by the flat alluvial plain and flat or almost flat terraces.

The alluvial plain of the Batang Kumu river runs from southwest to northeast and mostly extends on the left bank. That of the Mahato Kiri river is very narrow and the area is generally swampy.

The terraces cover the major part of the survey area and are found on both banks of the Batang Kumu river. The terraces are flat but is slightly declining toward the northeast, from 60-70 m above sea level in the southwest to 20-30 m in the northeast, and the edges of the terraces are dissected by small valleys. A fairly notable discontinuity of topography bordered by the terrace escarpment with more than 5% slopes is found between the alluvial plains and the terraces.

### 1.3 Survey Method

The previous survey classified the soils in the survey area into five great soil groups, i.e. Podzolic Soils, Cambisols, Alluvial Soils, Gleysols and Organic Soils, in accordance with the national soil classification system of Indonesia (D/S system, 1978). The previous survey also shows such soil characteristics as soil colors, textures, drainability, topography, etc. This information was fully taken into consideration when the pre-study was made.

Prior to the field survey, pre-study on the topographic conditions was made using the topographic maps scaled 1:5,000 and 1:50,000. In the selection of sites for test pitting and soil sampling, the following matters were considered:

- (1) Distribution of areas having the same kind of soils with reference to the results of the past soil survey
- (2) Accessibility to sites
- (3) Distribution of areas having the same kind of topography with reference to the results of the pre-study

The soil profile survey was then made and a total of 49 soil pits were dug to a depth of about 1.2 m, when possible. Each soil profile was observed according to the standards of "Guidelines for Soil Profile Description" published by the Food and Agriculture Organization of the United Nation (FAO). Furthermore, test boring observation with a one meter soil auger was also done for adjustment of provisional soil boundaries. The location of the pit sites is shown in the SOIL MAP.

For physico-chemical analysis in laboratory, a total of 55 soil samples and 21 core samples were taken from the respective horizons in 13 profiles through first and second survey. These soil samples were analyzed at the Bogor Agricultural University. The items of physico-chemical analysis were as follows:

- (1) Particle size analysis
- (2) Bulk density (2nd survey only)
- (3) pH (H<sub>2</sub>O, KCl)
- (4) Electric conductivity (2nd survey only)
- (5) Total carbon
- (6) Total nitrogen
- (7) Total potassium (1st survey only)
- (8) Cation exchange capacity (CEC)
- (9) Exchangeable base (Ca, Mg, K, Na and Al)
- (10) Free iron (2nd survey only)
- (11) Available phosphate
- (12) Total phosphate

The results are given in Table III-1. The criteria of soil chemical properties is shown in Table III-2.

### 1.4 Present Land Use

The present land use in the survey area is illustrated in Drawing III-2 and tabulated below:

Land use category	Area (ha)	(%)
Farm lands	3,100	10.4
- Paddy fields	(190)	(0.6)
- Upland crop fields	(2,410)	(8.1)
- Perennial crop fields	(500)	(1.7)
Grass lands	2,600	8.8
Forest	21,800	73.4
Villages	1,610	5.4
Others	590	2.0
<b>Total</b>	<b>29,700</b>	<b>100.0</b>

The lands in the survey area have been reclaimed since 1981 when the settlement of transmigrants started. About 10.4 % or 3,100 ha of the survey area is occupied by farm lands including paddy fields, upland crop fields and perennial crop fields in which upland and lowland paddy, maize, groundnut, rubber, etc. have been cultivated. Productivity of the crops especially upland crops is very low due to the low fertilizer input coupled with the low natural fertility and poor drainage status of the soils. The cultivation of the upland crops is terminated after three to four years of reclamation, and some farmers have opened new lands outside the transmigration areas. At present about 41 % or 990 ha of the upland crop fields extend outside the transmigration areas.

Perennial crop fields (mostly rubber fields) of 500 ha are mainly managed by existing local farmers and extend outside the transmigration areas. Grass lands, which are mainly abandoned farm lands, occupied 8.8 % or 2,600 ha of the survey area. About 74.3 % or 21,800 ha of the survey area are still under primary forest, and the remaining 7.4 % or 2,200 ha consists of villages and other areas such as rivers and roads.

## 1.5 Soil Classification

### 1.5.1 Soil Genesis and General Soil Condition

In the survey area sedimental materials are extensive. They are younger Pleistocene to Holocene age and are thick consisting of rather coarse textured materials, rich in quartz and with a conspicuous white color.

Soils on the terraces have been developed from the said quaternary sediments and are very variable in texture, ranging from sandy loam to clay. Near the edges of the terraces, the soils are moderately well to well drained. But elsewhere they are somewhat poorly to very poorly drained due to the flat

topography, permanently high water tables and the weakly developed drainage system. The groundwater table ranges from 30 cm - 120 cm throughout the year. Surface peat has developed on the poorly drained areas, but the peaty layer does not exceed 15 cm. The effective soil depth is moderately deep to deep and typically the soils overlie very thick, white sandy sediments found below 60-120 cm from the ground surface. The sediments are very compact but loose when wet.

Soils on the alluvial plain have been derived from recent riverine alluvium. The soils are generally clay loam to clay textured with dark colored topsoils and yellowish brown to grayish yellow subsoils and are somewhat poorly to poorly drained. Some soils are influenced by high groundwater table and/or periodic stagnant water from seasonal floods and heavy rainfall, and show hydromorphic properties.

In general, the soils in the survey area have been leached out their inherent bases through hydromorphic and oxidation weathering under the tropical humid climate, and then are acid to very acid with pH values ranging between 4.5 - 5.5 and have low to very low fertility.

#### 1.5.2 Soil classification

The soils were classified based on the national soil classification system (TOR No. 59a/1983, Soil Research Institute, Bogor). The system is correlated with D/S system and FAO/UNESCO soil classification system in 1974 as summarized in Table III-3.

The soils in the survey area are classified into 4 great soil groups and 9 sub-groups from the morphological characteristics and the results of laboratory analysis.

The principal characteristics of each great group and sub-group are as follows :

##### (1) Cambisols (K)

These soils have been derived from the quaternary sediments and extend over flat terraces. The soils have dark colored topsoils and grayish yellow to yellowish brown subsoils, and are sandy loam to clay in texture. The effective soil depth is moderately deep to deep. As for chemical properties, they are acid (pH 4.5-5.5) and are low to very low in nutrients. Typically the soils overlie white quaternary sediments found below 60-120 cm from the ground surface.

They are subdivided into three sub-groups :

a) District Cambisols (Kd)

These soils are found on the terrace and the escarpment slopes. The soils are moderately well to somewhat poorly drained. The topsoils are black (7.5Y 1.7/1) to brownish black (10YR 2/3) in matrix color, sandy loam to clay loam textured, weak granular or subangular blocky and have non-sticky to slightly sticky and non-plastic to slightly plastic (wet) consistence. The subsoils are dull yellow (10YR 5/2) to yellowish brown (10YR 5/6) in matrix color, sandy loam to clay textured, weak to moderate angular or subangular blocky and have slightly sticky to sticky and slightly plastic (wet) consistence. They are immature with no predominant morphological characteristics except for cambic B horizon.

b) Umbric Cambisols (Ku)

These soils have umbric A horizon. They are somewhat poorly to poorly drained and extend over the terraces. The land of these soils is flat to almost flat with slopes less than 2% and are influenced by high water tables and/or periodic stagnant water by heavy rainfall. The topsoils are deep, black (10YR 2/1) to brownish black (10YR 2/3) in matrix color, sandy loam to clay loam in texture, weak granular or subangular blocky, and have non-sticky to slightly sticky and non-plastic to plastic (wet) consistence. The subsoils are grayish yellow brown (10YR 5/2) to dull orange (7.5YR 7/4) in matrix color, sandy loam to silty clay in texture, structureless and have slightly sticky to sticky and slightly plastic to plastic (wet) consistence.

c) Gleyic Cambisols (Kg)

This unit is found on the poorly to very poorly drained parts of the terraces. The topsoils are brownish black (10YR 2/3), sandy loam textured, weak subangular blocky and have non-sticky to slightly sticky and non-plastic to slightly plastic (wet) consistence. The subsoils are dull yellowish brown (10YR 4/3) to dull brown (7.5YR 5/3) in matrix color, sandy loam in texture, weak subangular blocky and have slightly sticky and slightly plastic (wet) consistence. These soils have been formed under the condition of permanent high water table and show hydromorphic properties between 50-100 cm from the ground surface.

(2) Alluvial Soils (A)

These soils have been derived from recent alluvial deposits. The effective soil depth is deep to very deep. The color ranges from yellowish brown to yellow orange, with clay loam to clay in texture. As for chemical properties, the soils are acid to very acid (pH 4.2-5.0) and low to very low in

available nutrients. They are characterized by its high content of exchangeable aluminium. Aluminium saturation ratio of the soils ranges from 30% to 70%.

These soils are subdivided into two sub-groups:

a) Distric Alluvial Soils (Ad)

The topsoils are brown (10YR 4/4) in matrix color, silty clay to clay textured, weak to moderate blocky and have sticky to very sticky and plastic to very plastic (wet) consistence. The subsoils are bright brown (7.5YR 5/6) to yellowish brown (10YR 7/6) in matrix color with complex textural distribution, ranging from sandy loam to clay. These soils are somewhat poorly drained. They are generally immature will no predominant morphological characteristics.

b) Gleyic Alluvial Soils (Ag)

The topsoils are black (10YR 2/1) to brownish black (10YR 2/3) in matrix color, silty loam to clay textured, structureless crumb to moderate subangular blocky and have slightly sticky to very sticky and slightly plastic to very plastic (wet) consistence. The subsoils are grayish yellow brown (10YR 6/2) to yellowish brown (10YR 5/6) with faint to distinct mottlings. The textural distribution is often complex ranging loamy sand to clay. These soils are somewhat poorly drained. They have been influenced by high water table and/or periodic stagnant water by seasonal flood and heavy rainfalls and show hydromorphic properties between 50 and 100 cm from the ground surface.

(3) Gleysols (G)

These soils have hydromorphic properties within 50 cm below the ground surface and are found both on the terraces and alluvial plain. Most Gley Soils have a dark colored surface horizon and grayish colored subsurface horizon. External and internal drainage are very poor.

Groundwater table is generally at or near the surface throughout the year. The effective soil depth is deep to very deep in the soil of the alluvial plain but is moderately deep in the terrace soils. As for chemical properties, the soils are very acid to acid and are low to very low in available nutrients. The alluvium origin soils, particularly, are characterized by high content of exchangeable aluminium in common with Alluvial Soils.

These soils are subdivided into following two sub-groups:



a) Distric Gleysols (Gd)

These soils have been derived from recent alluvium and found on the alluvial plains of the Batang Kumu and Mahato Kiri rivers. They are somewhat poorly drained. The topsoils are dark brown (10YR 3/4) to bright brown (7.5YR 5/6) in matrix color, clay loam to clay, weak to moderate angular or subangular blocky and have slightly to very sticky and slightly to very plastic (wet) consistence. The subsoils are yellow orange (10YR 6/4) to light gray (2.5Y 7/1) in matrix color with distinct reddish yellow mottlings, clayey, structureless massive and have sticky to very sticky and plastic to very plastic (wet) consistence.

b) Umbric Gleysols (Gu)

These soils have been developed from quaternary sediments and found on the flat terraces. They are poorly to very poorly drained due to its flat topography, permanent high water table and weakly developed drainage system. The topsoils are deep, black (10YR 1.7/1) to brownish black (10YR 2/3) in matrix color, sandy loam to silty loam in texture, weak granular and have non-sticky to slightly sticky and non-plastic to slightly plastic (wet) consistence. The subsoils are yellowish brown (2.5Y 5/3) to brownish gray (7.5YR 4/1) in matrix color, sandy clay loam to clay in texture, weak to moderate angular blocky and have slightly sticky to sticky and slightly plastic to plastic (wet) consistence. The effective soil depth is moderately deep and typically thick, white sandy sediments underlie below 50-90 cm from the ground surface.

(4) Podzolic Soils (P)

These soils have been derived from quaternary sediments through weathering and leaching. They are mostly found near the edges of the terraces and on the escarpment slopes where the land are gently sloping or slightly undulating. The soils are well to somewhat poorly drained and have a distinct argillic B horizon within 125 cm from the ground surface. The effective soil depth is moderately deep to deep and the texture is medium in the topsoils and rather finer in the subsoils. The soil color varies depending on its drainage condition. These soils are acid (pH 4.8-5.5) and are low to very low in available nutrients. They typically overlies white, quaternary sandy sediments found below 75-125 cm from the ground surface.

They are subdivided into following two sub-groups:

a) Umbric Podzolic Soils (Pu)

The topsoils are black (10YR 2/1) to brownish black (10YR 3/2) in matrix color, loam to clay loam textured, weak angular or subangular blocky and have non-sticky to sticky and non-plastic to slightly plastic (wet) consistence. The subsoils are grayish brown (7.5YR 5/2) to bright yellowish brown (10YR 6/6) in matrix color, clay loam to silty clay in texture, moderate angular or subangular blocky and sticky and plastic (wet) consistence. They are moderately well to somewhat poorly drained and have umbric A horizon.

b) Humic Podzolic Soils (Ph)

The topsoils are dark brown (10YR 3/4) to olive brown (2.5Y 4/4) in matrix color, sandy loam to loam in texture, structureless or weak subangular blocky and have non-sticky to slight sticky and non-plastic to slightly plastic (wet) consistence. The subsoils are brownish black (7.5YR 3/2) to bright yellowish brown (10YR 6/6) in matrix color, sandy loam to sandy clay loam in texture, weak to moderate subangular blocky and have slightly sticky to sticky and slightly plastic to plastic (wet) consistence. These soils generally have organic matter rich horizon just above the argillic B horizon.

Soil profile description of all observation sites is given in Table III-9.

### 1.5.3 Mapping Unit Legend

It is quite difficult to illustrate the locations and extent of most soils on a map, because many of them are fractionally dispersed and associated with each other. It becomes necessary to adopt a special mapping unit illustrating the general distribution of various major soil groups. In the survey area five mapping units are distinguished by applying the soil association system with physiographic soil features as its basement.

The complete soil mapping unit legend developed for the survey area with the acreage and proportional extent is presented in Table III-4.

- (1) Mapping Unit 1 : Association of Distric Alluvial Soils, Gleyic Alluvial Soils and Distric Gleysols

This mapping unit covers the alluvial plains of the Batang Kumu and Mahato Kiri rivers. The land of this unit is flat to almost flat with slopes less than 2% and is sloping down to the stream flow direction. The elevation of the lands varies from 55 m in the southwest to 20 m in the northeast. The soils of this

unit have been derived from recent alluvial deposits. They are deep, generally clay loam to clay in texture and are somewhat poorly to poorly drained. Some soils are under the reductive condition throughout the year and show hydromorphic properties. Although fertility is low and the soils have a risk of aluminium toxicity, they have more favorable physical properties than the other soils..

The areas of this unit are most extensively used for crop production, though half of the areas are still under primary forest. Upland and lowland paddy, groundnuts and maize are dominant in this area.

This unit covers 4,800 ha or 16.2 % of the survey area.

(2) Mapping Unit 2 : Association of Distric Cambisols, Umbric Cambisols and Umbric Podzolic Soils

This mapping unit widely extends over the flat terraces both in the left and right banks of the Batang Kumu river. The land of this unit is flat to almost flat with slopes less than 2% and is slightly declining toward the northeast. The soils have been developed from quaternary sediments and have a horizon sequence of A-B-C. The soils are moderately deep to deep and are somewhat poorly to poorly drained with permanent high water table. The texture varies in locations ranging sandy loam to clay. These soils are generally immature without predominant morphological characteristics, though some have organic matter rich umbric A horizon. The soils are acid to very acid and are low to very low in available nutrients. Typically thick, white, quaternary sandy sediments underlie below 60-120 cm from the ground surface.

The areas of this unit are mostly under primary forest in the left bank of the Batang Kumu river, but in the right bank some areas have been used for crop production and rubber plantation or are left fallow after rough reclamation.

This unit occupies 14,700 ha or 49.5 % of the survey area.

(3) Mapping Unit 3 : Association of Umbric Gleysols, Umbric Cambisols and Gleyic Cambisols

This mapping unit exists on the terraces. The land with these soils is flat or slightly depressed and the drainage condition is poorly to very poorly. The soils are influenced by permanent high water table and/or prolonged stagnant water from by heavy rainfall, and some show hydromorphic properties within 100 cm from the ground surface. The topsoils are very dark colored, thick and are rich in organic matter. A peaty layer has been formed and accumulated with a thickness of 10-15 cm, where surface drainage is very poorly. Typically the soils overlie white quaternary sandy sediments found below 55-100 cm

from the ground surface.

The areas of this unit are mostly under primary forest, but in the transmigration areas in the Batang Kumu right bank, some have been used mainly for paddy cultivation in the rainy season.

This unit occupies 3,800 ha or 12.8 % of the survey area.

(4) Mapping Unit 4 : Association of Gleyic Alluvial Soils, Umbric Gleysols and Umbric Cambisols

This mapping unit is observed at the foot of the terraces, which are subject to submergence by the excess water draining from the terraces. The soils of this unit have been developed from alluvial deposits derived from the adjacent terraces or from quaternary sediments. They are moderately deep to deep and are poorly drained. The texture is variable, from sandy loam to clay with very dark colored topsoils and grayish colored subsoils. The soils have been influenced by high water table and/or periodical stagnant water by flooding and heavy rainfalls, and some show hydromorphic properties within 100 cm from the ground surface.

They are mostly under primary forest. The rainfed crop cultivation is also practiced in the limited area.

This unit covers 600 ha or 2.0 % of the survey area.

(5) Mapping Unit 5 : Association of Distric Cambisols, Umbric Podzolic Soils and Humic Podzolic Soils

This mapping unit exists on or near the edges of terraces and on the escarpment. The lands of this unit are gently sloping to sloping, and in the southwestern and northeastern parts of the survey area they are gently undulating. The soils have been derived from quaternary sediment, with a horizon sequence of A-B-C, moderately deep to deep and are well to somewhat poorly drained. The topsoils are black to brown in matrix color and are sandy loam to clay loam textured. The subsoils are yellowish brown to grayish brown in matrix color and are sandy loam to sandy clay textured. Fertility is extremely low. The deeper subsoils consisted of white, quaternary sandy sediment are found below 75-135 cm from the ground surface.

Most of these soils are still under primary forest, though some areas are used for rubber plantations or upland crop cultivation.

This unit occupies 5,800 ha or 19.5 % of the survey area.

## CHAPTER 2. LAND SUITABILITY CLASSIFICATION

### 2.1 General

The land suitability classification follows the principles of the FAO system and the criteria by the Soil Research Institute, Bogor (TOR No. 59b/1982) with some modification. The lands were assessed in terms of their relative suitability for a specific type of use (potential land suitability). The Batang Kumu Irrigation Project aims at increasing crop production, especially rice, under irrigated condition as described in APPENDIX IV.

In the FAO system, the land suitability for each specific utilization type is classified into 5 classes reflecting degree of suitability or of limitations, i.e. S1 (highly suitable), S2 (moderately suitable), S3 (marginally suitable), N1 (currently unsuitable) and N2 (permanently unsuitable).

The summary description of each class is as follows:

#### S1: Highly Suitable Land

The land which is expected to be highly productive for the defined use and to have high enough benefits to justify the capital and recurrent costs required for the development and crop production. There are no limitations that will reduce crop yields or increase recurrent costs for the production or soil and land conservation.

#### S2: Moderately Suitable Land

The land so classified into this land grade could be expected to be moderately productive for the defined use and or yielding moderate benefits, which would be sufficiently high to justify the required capital and recurrent farm inputs. There are moderately severe limitations likely to reduce crop yield and/or increase recurrent costs for the crop production and conservation.

#### S3: Marginally Suitable Land

The land which is expected to have a low productivity for the defined use, while its benefits would be enough to justify the capital cost and the recurrent farm inputs. There are limitations which in aggregate are sufficiently severe to reduce crop yield and/or increase production cost and conservation cost.

N1: Currently not suitable

The land has very severe limitations which cannot be corrected with existing knowledge at currently acceptable cost, and is precluded from sustained use of the land in the given manner.

N2: Permanently not suitable

The land has very severe limitations so as to preclude any possibilities of successful sustained use of the land in the given manner.

## 2.2 Specification for Land Suitability Classification

In the land suitability classification, the following factors were used to place land in any given class and sub-class:

- (1) effective soil depth
- (2) topsoil texture (0-30 cm)
- (3) permeability of subsoil/1
- (4) gravel contents of topsoil
- (5) water holding capacity/2
- (6) soil fertility
- (7) soil reaction
- (8) soil chemical hazard
- (9) slope and land form
- (10) micro-relief
- (11) soil erodibility/2
- (12) drainability
- (13) frequency of flood hazard
- (14) salinities

These specifications of the land suitability classification are outlined in Table III-5 and explained as follows:

### (1) Effective Soil Depth

Effective soil depth is defined as the soils to be usable for crop production and the depth up to bedrock, hard pan, sandy layer or gravel layer in which plant roots can not penetrate. This effective soil depth is mainly the limiting factor on rooting of crops for paddy rice cultivation, while in case of upland crop cultivation under irrigated condition, the soil depth is not only the limiting factor on rooting but also the factor on soil-water management such as irrigation and drainage operation.

-----  
/1 : factor for paddy only  
/2 : factor for upland crops

## (2) Topsoil Texture

Topsoil texture is closely correlated to the land suitability for germination of seeds and initial root development of the young seedlings, and also for assessing the land tillability or arability. Generally, sandy soils are easier to plow but have difficulties in puddling and construction of ridge.

## (3) Permeability of Subsoil

This factor is the basis for determining the land suitability for maintaining surface water for paddy cultivation and to assess the drainability of land. The permeability is interrelated with percolation rate and is affected by high groundwater table in practice, i.e. the percolation loss is low where the groundwater table is high even if the permeability is high. Permeability of subsoils in the survey area is moderate to slow as shown in Table III-6.

## (4) Gravel Content of Topsoils

This factor is expressed by the percentage of the exposed surface area of gravel in the soil profile and reflects the workability and/or tillability of soils.

## (5) Water Holding Capacity

Water holding capacity, also sometimes termed available water capacity, is defined as the volume of water that can be retained in the soil and that can be absorbed by plant roots. This factor is only applied for upland crops and used for the assessment of wet or drought injury of crops. WHC of the soils in the survey area is estimated moderate to high as presented in Table III-7.

## (6) Chemical Soil Fertility

This factor is the land quality for determining crop productivity. It is evaluated by the contents of available nitrogen and phosphate, and exchangeable bases such as Ca, Mg and K in combination with the cation exchange capacity and the base saturation. Interpretation of data on CEC (Cation Exchange Capacity) is particularly important in predicting soil fertilizer response as well as providing a guideline to the present nutrient level, although the importance is somewhat reduced in flooded conditions.

(7) Soil Reaction (Soil pH)

Soil reaction or pH is an important indicator of soil nutrient availability and base status. Special consideration is given to paddy as the flooded condition or paddy field will tend to increase pH on acid soils and even strongly acid soils are acceptable.

(8) Soil chemical hazard (Aluminium Toxicity)

Aluminium is an important element detrimental to plant growth because it fixes soil phosphate, a primary element, in a form unavailable to plants and because it directly inhibits root growth. The risk of aluminium toxicity is evaluated by the percentage of exchangeable sites occupied by exchangeable aluminium.

(9) Slope and Land Form

This factor is the essential basis for evaluating the suitability of land for irrigated agriculture particularly for gravity irrigation because it is closely related to the land development cost.

(10) Micro-relief

Micro-relief can be a big physical constraint for irrigation development. So as to properly operate uniform water distribution to the farm plots and to smoothly drain out the excess surface water, land grading or leveling would be required in certain degree. The degree of micro-relief is expressed in the average difference in height between low and high spots.

(11) Soil Erodibility Factor

This factor (so called K factor) reflect a combination of many soil characteristics of which texture quality of the surface soils, contents of organic matter, structure, soil permeability coefficient and contents of coarse fragments are the essential element. Erodibility class of the soils in the survey area is roughly estimated medium to low.

(12) Drainability

This factor is determined based on the observation of certain direct or indirect evidences of drainage. The drainability of the land is affected by several factors such as permeability, groundwater table, topography, etc. Flat and/or depressed land are the topographic constraints in drainage improvement program.



### (13) Frequency of Flood Hazard

Floods having deep depth, and intermittent or sheet flooding which may cause damages to the land, crops and infrastructure facilities, are a strong limitation, if occurring frequently. The class of this factor is determined by its frequency.

### (14) Salinity

Excessive salts hinder crop growth, not only by toxicity effects, but by reducing water availability through the action of osmotic pressure and by unbalanced nutrient uptake. The salinity of soils is assessed through measuring the electrical conductivity of the saturation extract (ECe).

## 2.3 Land Suitability Classification

The land suitability class is determined as the lowest class of the factors mentioned in the previous section. In this study the lands are assessed in terms of their potential suitability for paddy and upland crops cultivations under irrigated condition and for perennial crops under rainfed condition.

The following assumptions have been made:

- the optimum amount of water can be supplied for all areas covered by the irrigation system.
- the amount of fertilizers applied will be increased through the introduction of technical farming practices.
- the large volume of earth movement required for land leveling will be restricted because thick sandy subsoil is present at a rather shallow depth.

Suitability evaluation of each soil mapping unit is shown in Table III-8. Land suitability classification maps are presented in Drawings III-3 and III-4.

### (1) Land Suitability for Paddy

The results of soil analysis indicate that the soils in the survey area are acid and have low to very low natural fertility. These unfavorable soil characteristics, however, would be changed under paddy cultivation, i.e. the flooding condition would increase soil pH to an optimum level, and the availability of most essential plant nutrients and the total nutrient concentration are increased through atmospheric nitrogen fixation by azotobacter and blue green algae, from decreased losses due to

leaching and by addition from irrigation water. The land suitability for paddy in the survey area was made considering the matters above, and is classified as shown below:

S2tdf Lands on the alluvial plain belong to this suitability subclass. They are moderately suitable for paddy cultivation. The degree of micro relief, the somewhat poor drainage condition and the frequency of flood hazard are moderate limitations.

S3t Lands of this unit are marginally suitable for paddy cultivation. The high degree of the micro-relief is a severe limitation and the land require leveling to a certain degree. The moderate permeability is another big limitation, though the present drainage condition of the lands is at a desirable level due to the high groundwater table. This suggests the necessity of careful water management.

N1td Lands of this unit are currently unsuitable for paddy due to rather steep topography and the moderately to well-drained condition.

(Unit : ha)

Land suitability	Soil mapping unit	Right bank	Left bank	Total
S2tdf	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

(2) Land Suitability for Upland Crops

S3n Lands of this unit are marginally suitable for upland crops due to the poor soil fertility. All plant nutrients must be supplied through fertilizers, and the soil acidity must be reduced.

S3nc Lands of this unit are marginally suitable for upland crops due to the poor soil chemical properties. The soils have the need for heavy fertilizer application, and have the risk of aluminum toxicity under acid conditions. These lands extend over alluvial plains.

S3nd Lands of this unit are marginally suitable for upland crops due to the low soil fertility, and the somewhat poorly drainage condition.

S3nt Lands of this unit are marginally suitable for the cultivation of upland crops. The lands have undulating to gently rolling relief and due to their physical properties they are susceptible to erosion. The low fertility status of the soils is an additional severe limitation.

N1d Lands of this unit are currently not suitable due to the very poor drainage condition especially in wet season, which cannot be corrected at currently acceptable cost. The extremely gentle slope gradient, permanently high groundwater table as well as the sandy subsoil would make drainage improvement difficult.

(Unit : ha)

Land suitability	Soil mapping unit	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

### (3) Land Suitability for Perennial Crops

S3n Lands of this unit are marginally suitable for perennial crops due to the poor soil fertility. In order to increase the crop productivity, all plant nutrients must be supplied through fertilizers, and the soil acidity must be reduced.

S3nc Lands of this unit are marginally suitable for perennial crops due to the poor soil chemical properties. The soils have the need for heavy fertilizer application, and have the risk of aluminium toxicity under acid condition. These lands extend over alluvial plains.

S3nd Lands of this unit are marginally suitable for perennial crops due to the low soil fertility, and the somewhat poorly drainage condition.

N1d Lands of this unit are currently not suitable due to the very poor drainage condition, which cannot be corrected at currently acceptable cost. The extremely gentle slope gradient, permanently high groundwater table as well as the sandy subsoil would make the drainage improvement difficult.

(Unit : ha)

Land suitability	Soil mapping unit	Right bank	Left bank	Total
S3n	2,5	6,100	14,400	20,500
S3nc	1	800	4,000	4,800
S3nd	4	100	500	600
N1d	3	3,000	800	3,800
Total		10,000	19,700	29,700

### CHAPTER 3. CONCLUSION AND RECOMMENDATION

The soils in the survey areas are quite deficient in the essential nutrients, such as nitrogen, phosphorus and potash, acid to very acid throughout the profile, and are poorly drained. In order to realize the profitable farming, rather high capital investment and recurrent cost will be required for the land reclamation, drainage improvement and crop production.

Paddy cultivation under irrigation is widely adaptable to soil environments and is recommendable as the land use type for the survey area, taking into consideration of the poor soil properties stated above.

Regarding the suitability of the land for upland crops, the quality is estimated to be lower than that for paddy from economical and technical points of view. Poor internal and external drainage, acid soil reaction and high content of exchangeable aluminium will prevent their vigorous growth. Proper liming can raise the soil pH to a optimum level in a short period and, at the same time, contribute to prevent Al toxicity. In Southern Sumatra, a rate of one ton/ha burned limestone has been adequate to sustain crop production on the soils with pH's (KCl) below 4.0 and low level of exchangeable Ca ( $< 1.0 \text{ me}/100\text{g soil}$ )\*<sup>1</sup>. This amount of lime become a standard to the survey area, though the requirement should be determined in detail in a field trial. Anyhow, in order to find out the most rational and profitable procedures for the upland crop cultivation, a pilot farm is recommended in the area in advance of the introduction of upland crops.

Meanwhile, on the terraces sandy sediment exists at shallow depth and the land has irregular micro-relief. This suggests that field plot will be limited to a small size and that special attention should be paid to land clearing, grading and leveling works so as not to expose the sandy subsoil.

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\*1: Source: "Cropping Systems to Preserve Fertility of Red-Yellow Podzolic Soils in Indonesia" by J.L. McIntosh et al. International Symposium on Distribution, Characteristics and Utilization of Problem Soils, TARC, 1981

Table III-1 RESULTS OF SOIL ANALYSIS (1/2)

Soil Unit No.	Pit Horizon	Depth (cm)	Texture			pH(1:1)	EC (mS/cm)	C (%)	N (%)	C/N	P2O5 (ppm)			Bray I	Exchangeable cation (me/100g)				Fe2O3 (%)	CEC (me/100g)	Saturation ratio (%)		Bulk density (g/cc)	
			Sand (%)	Silt (%)	Clay (%)						Class	H2O	KCl		Ca	Mg	K	Na			Al	H		B.S.
Ku P-1	O	0 - 8																						
	A1	8 - 29	64	12	24	SCL	5.3	4.5	1.47	0.21	7	3.6	3.8	14.2	4.8	0.5	0.1	0.2	0.6	1.1	19.0	28	3	-
	B1	29 - 37	67	8	25	SCL	5.6	4.4	0.44	0.07	6	0.9	1.1	5.4	4.8	0.3	0.1	1.0	0.4	0.6	17.2	30	2	-
	B2	37 - 85	62	10	28	SCL	5.6	4.5	0.40	0.05	8	1.7	9.5	4.3	9.3	0.7	0.1	1.0	0.1	0.6	16.4	62	1	-
Ad P-2	O	0 - 5																						
	A1	5 - 14	24	33	43	C	4.8	3.6	1.05	0.18	6	7.8	12.1	4.0	5.3	1.7	0.3	0.7	2.1	12.0	33.8	22	6	-
	C1	14 - 44	21	23	56	C	4.6	3.6	0.57	0.10	6	1.0	4.0	2.9	4.6	1.4	0.2	0.4	5.1	10.8	32.0	19	16	-
	C2	44 - 120	29	23	48	C	4.4	3.6	0.41	0.05	8	1.8	1.7	14.2	1.9	0.8	0.2	0.3	6.5	14.6	30.5	10	21	-
Kd P-3	O	0 - 9																						
	A1	9 - 19	51	13	36	SC	4.7	4.2	0.36	0.14	6	7.8	11.0	12.2	4.1	0.2	0.3	0.6	1.1	2.7	21.3	22	5	-
	B1	19 - 33	54	18	28	SCL	5.1	4.2	0.76	0.10	8	1.0	0.3	6.6	5.0	0.8	0.3	0.6	0.9	1.4	20.1	30	4	-
	B2	33 - 64	44	18	38	CL	5.5	4.1	0.74	0.09	8	5.8	2.4	7.5	5.1	0.2	0.2	0.3	0.3	2.0	18.9	29	2	-
Pu P-4	O	0 - 13																						
	A1	13 - 24	67	15	18	SL	5.0	4.2	1.00	0.20	5	6.0	5.0	9.3	5.1	0.2	0.2	0.2	1.5	1.2	17.9	31	8	-
	B1	24 - 34	50	20	30	SCL	5.1	4.2	0.64	0.10	6	4.2	1.0	6.5	5.3	0.2	0.2	0.2	0.6	2.7	16.2	35	4	-
	B2	34 - 50	46	18	36	SC	5.2	4.1	0.59	0.09	7	0.0	0.3	4.5	4.7	0.6	0.1	0.2	0.5	0.8	14.0	39	4	-
Pu P-5	O	0 - 13																						
	A1	13 - 24	74	13	13	SL	4.8	4.3	2.41	0.28	9	7.2	13.0	5.8	3.4	0.1	0.1	0.2	0.9	1.7	20.2	18	4	-
	B1	24 - 33	52	18	30	SCL	5.2	4.3	0.62	0.07	9	0.9	8.2	4.0	4.4	0.5	0.1	0.1	0.7	0.8	16.7	30	4	-
	B2	33 - 52	45	10	45	SC	5.5	4.3	0.29	0.03	10	6.6	1.1	5.2	4.2	0.2	0.2	0.1	0.5	0.8	14.4	32	3	-
Ad P-6	O	0 - 5																						
	A1	5 - 22	19	48	33	SiCL	4.2	3.7	0.73	0.33	11	-	17.7	10.1	2.3	0.1	0.2	0.1	8.5	2.6	15.0	17	57	-
	C1	22 - 35	16	31	53	C	5.0	3.6	1.50	0.07	21	-	3.2	14.1	0.6	0.1	0.1	18.3	2.0	17.0	5	108	-	
	C2	35 - 50	29	32	39	CL	5.2	3.6	0.24	0.06	4	-	-	14.1	0.4	0.5	0.2	0.1	13.4	1.9	41.0	3	33	-
Ku P-7	O	0 - 10																						
	A1	10 - 35	74	8	18	SL	5.0	3.6	1.59	0.21	8	3.6	4.4	9.3	4.7	1.3	0.3	0.2	0.4	10.1	27.8	23	1	-
	B1	35 - 45	63	25	12	SL	4.7	3.5	1.44	0.18	8	4.1	3.2	6.7	3.3	1.6	0.3	0.6	0.7	13.6	22.0	24	3	-
	C	45 - 60	76	10	14	SL	4.7	3.5	0.54	0.06	9	2.7	2.8	5.8	2.7	0.9	0.3	0.6	0.8	13.7	20.4	19	4	-

Table III-1 RESULTS OF SOIL ANALYSIS (2/2)

Soil Unit No.	Pit Horizon	Depth (cm)	Texture (%)			pH(1:1)	EC (mΩ/cm)	C (%)	N (%)	C/N	P205 (ppm)		K2O HCl 25% (mg/100g)		Fe2O (%)	Exchangeable cation (me/100g)				CEC (me/100g)	Saturation ratio (%)		Bulk density (g/cc)				
			Sand (%)	Silt (%)	Clay (%)						Class	Bray I	HCl 25%	Ca		Mg	K	Na	Al		H	B.S.		Al			
Kd P-8	O	0 - 5																									
	A1	5 - 30	34	39	27	L	4.9	4.1	-	5.79	0.07	83	-	9.8	10.1	-	1.0	0.2	0.2	1.6	7.9	1.6	17.0	8	46	-	
	B1	30 - 75	37	27	36	L	5.1	4.3	-	1.03	0.07	15	-	0.9	14.4	-	1.0	0.1	0.1	2.1	2.7	2.1	9.0	13	30	-	
	B2	75 - 100	31	23	46	C	4.7	4.0	-	0.56	0.04	14	-	-	7.0	-	1.0	0.1	0.1	1.5	0.1	1.9	25.0	5	0	-	
	BC	> 100	52	39	9	L	5.4	4.6	-	0.07	0.02	4	-	0.1	9.5	-	1.1	0.1	0.1	2.1	6.1	2.6	16.0	8	38	-	
Gd P-9	A1	0 - 20	19	34	47	C	4.6	3.6	4.00	8.03	0.33	24	13.7	12.6	-	0.93	1.9	0.7	0.1	0.0	2.4	0.3	27.0	10	9	0.71	
	B1	20 - 25	17	49	34	SCL	4.9	3.9	0.90	1.81	0.13	14	0.5	10.8	-	0.60	1.6	0.3	0.1	0.1	0.7	0.2	15.4	13	5	0.82	
	B2g	25 - 60	24	73	3	SIL	5.0	4.0	0.57	1.26	0.06	21	tr	4.3	-	0.48	1.4	0.4	tr	tr	0.8	0.3	14.1	13	6	0.82	
	C	60 - 90	37	60	3	SIL	5.5	4.5	1.68	0.02	0.03	1	tr	1.2	-	0.03	1.1	0.1	0.0	0.1	tr	0.2	1.6	76	0	0.82	
Gd P-10	Ap1	0 - 5	36	51	13	SIL	5.2	4.2	3.40	5.51	0.26	21	1.2	17.9	-	0.63	3.2	0.6	0.3	0.3	0.9	0.2	20.4	20	4	0.63	
	Ap2	5 - 18	35	38	27	L	5.0	4.0	1.43	2.03	0.11	18	tr	3.2	-	0.44	1.9	0.5	0.1	0.2	0.2	0.3	11.3	22	2	0.63	
	B1	18 - 31	42	28	30	CL	5.2	4.2	1.20	1.15	0.07	16	tr	3.2	-	0.30	1.4	0.2	0.1	0.2	0.1	0.3	9.4	18	1	0.84	
	B21g	31 - 40	56	26	18	SL	5.1	4.1	0.75	0.65	0.04	16	tr	0.9	-	0.09	1.4	0.3	tr	tr	0.2	0.3	4.7	36	4	1.18	
	B22	40 - 54	39	43	18	L	5.1	4.1	1.41	2.83	0.14	20	4.5	2.2	-	0.53	1.7	0.4	0.2	0.2	0.2	0.3	13.5	17	1	1.16	
Kd P-11	A1	0 - 5	54	25	21	SCL	4.8	3.8	1.28	2.26	tr	tr	1.2	9.2	-	1.07	1.3	0.1	0.1	0.3	1.1	0.3	6.9	22	16	0.92	
	B1	5 - 25	54	23	23	SCL	4.9	3.9	1.53	0.68	0.04	17	tr	0.2	-	1.85	1.7	tr	tr	0.3	0.3	0.3	4.1	41	7	1.21	
	B21	25 - 39	53	28	19	SL	4.9	3.9	1.26	0.46	0.03	15	tr	7.6	-	2.11	1.3	0.1	tr	0.1	0.1	0.3	3.1	45	3	1.19	
	B22	39 - 110	49	27	24	SCL	5.6	4.6	0.63	0.27	0.03	9	tr	14.6	-	2.54	1.2	tr	tr	0.1	tr	0.3	2.8	43	0	1.30	
Kd P-12	A1	0 - 16	49	27	24	SCL	5.0	3.8	1.14	5.89	0.23	26	6.2	11.3	-	1.13	1.3	0.4	0.1	0.2	1.8	0.3	22.0	8	8	0.87	
	B1	16 - 36	47	25	28	SCL	4.9	3.9	1.61	0.06	0.27	tr	tr	17.2	-	1.03	1.8	0.1	0.1	0.2	1.8	0.3	9.1	22	20	1.09	
	B2	36 - 54	49	20	31	SCL	4.7	3.7	0.80	0.41	0.03	14	tr	18.9	-	1.13	1.9	0.2	0.1	0.1	1.4	0.3	6.9	32	20	1.27	
	B3	54 - 76	52	11	37	SC	4.5	3.5	0.63	0.23	0.03	8	tr	26.4	-	0.71	1.3	0.1	0.2	0.2	2.1	0.3	7.5	21	28	1.33	
	C1	76 - 100	52	12	36	SC	4.5	3.5	0.46	0.14	0.04	4	tr	4.3	-	0.38	1.3	0.3	0.1	0.1	2.8	0.3	7.2	24	39	1.35	
Gd P-14	Ap	0 - 10	45	26	29	CL	4.4	3.3	1.07	1.34	2.00	1	2.0	18.5	-	2.44	4.4	1.5	0.2	0.2	4.2	0.3	15.4	40	27	1.25	
	B1	10 - 37	47	31	22	L	4.3	3.2	0.66	0.31	tr	tr	tr	13.5	-	1.67	3.1	0.6	0.1	0.4	6.5	0.4	12.3	31	53	1.50	
	B2g	37 - 120	2	45	53	SIC	4.3	3.1	0.52	0.46	0.06	8	tr	4.3	-	2.86	3.1	0.9	0.2	0.2	16.2	0.9	27.7	15	58	1.21	

Table III-2 DESCRIPTIVE CRITERIA OF SOIL CHEMICAL PROPERTIES

Item	Very low	Low	Moderate	High	Very high	
C (%)	< 1.00	1.00 - 2.00	2.01 - 3.00	3.01 - 5.00	> 5.00	
N (%)	< 0.10	0.10 - 0.20	0.21 - 0.50	0.51 - 0.75	> 0.75	
C/N	< 5	5 - 10	11 - 15	16 - 25	> 25	
P <sub>2</sub> O <sub>5</sub> HCl 25 % (mg/100g)	< 10	10 - 20	21 - 40	41 - 60	> 60	
P <sub>2</sub> O <sub>5</sub> Bray I (ppm)	< 10	10 - 15	16 - 25	26 - 35	> 35	
P <sub>2</sub> O <sub>5</sub> Olsen (ppm)	< 10	10 - 20	21 - 40	41 - 60	> 60	
K <sub>2</sub> O HCl 25 % (mg/100g)	< 10	10 - 20	21 - 40	41 - 60	> 60	
CEC (me/100g soil)	< 5	5 - 16	17 - 24	25 - 40	> 40	
Exchangeable Cation :						
K (me/100g)	< 0.1	0.1 - 0.2	0.3 - 0.5	0.6 - 1.0	> 1.0	
Ca (me/100g)	< 2	2 - 5	6 - 10	11 - 20	> 20	
Mg (me/100g)	< 0.4	0.4 - 1.0	1.1 - 2.0	2.1 - 8.0	> 8.0	
Na (me/100g)	< 0.1	0.1 - 0.3	0.4 - 0.7	0.8 - 1.0	> 1.0	
Base Saturation (%)	< 20	20 - 35	36 - 50	51 - 70	> 70	
Aluminium Saturation (%)	< 10	10 - 20	21 - 30	31 - 60	> 60	
EC (mmhos/cm)	< 1	1 - 2	2 - 3	3 - 4	> 4	
	Very acid	Acid	Somewhat acid	Neutral	Somewhat alkaline	Alkaline
pH (H <sub>2</sub> O)	< 4.5	4.5 - 5.5	5.6 - 6.5	6.6 - 7.5	7.6 - 8.5	> 8.5

Source : Pusat Penelitian Tanah, Bogor (Soil Research Institute)



Table III-3 INDONESIAN SOIL CLASSIFICATION SYSTEM CORRELATED WITH FAO/UNESCO AND USDA SOIL TAXONOMY SYSTEM

Dudal & Soeprapto-harjo (1957, 1961)	Modified D/S system (1978/1981)	FAO/UNESCO (1974)	USDA Soil Taxonomy (1975)
1. Organosol	- Organosol	- Histosol	- Histosol
2. Litosol	- Litosol	- Litosol	- Entisol
	- Ranker	- Ranker	- Lithic] Sub Group
3. Aluvial	- Aluvial	- Fluvial	- Entisol
	- Kambisol	- Cambisol	- Inceptisol
4. Regosol	- Regosol	- Regosol	- Entisol
	- Kambisol	- Cambisol	- Inceptisol
5. Renzina	- Renzina	- Renzina	- Rendell
6. Grumusol	- Grumusol	- Vertisol	- Vertisol
7. Andosol	- Andosol	- Andosol	- Inceptisol
8. Podsolik Coklat	- Andosol	- Andosol	- Inceptisol
9. Podsolik Coklat Kekelabuan	- Podsolik	- Acrisol	- Ultisol
10. Brown Forest Soil	- Kambisol	- Cambisol	- Inceptisol
11. Latosol	- Kambisol	- Cambisol	- Inceptisol
12.	- Latosol	- Cambisol	- Inceptisol
	- Brunizem	- Cambisol	- Inceptisol
	- Nitosol	- Nitosol	- Ultisol
		- Phaeozem	- Alfisol
	- Oksisol	- Ferralsol	- Mellisol
	- Kambisol Molik/ Brunizem Molik	- Greyzem / Chernozem	- Oxisol
13. Podsolik Merah Kuning	- Podsolik	- Acrisol	- Mellisol
			- Ultisol
14. Mediteran Merah Kuning	- Mediteran	- Luvisol	- Alfisol
15. Podsol	- Podsol	- Podsol	- Spodosol
16. Podsol Air Tanah	- Podsol Humik	- Humic Podsol	- Spodosol
17. Laterit Air Tanah	- Oksisol Gleik/ Plintik	- Plinthic Ferralsol	- Aquex
18. Gleis Humus	- Gleisol Humik	- Gleysol	- Aquept
19. Gleis Humus Rendah	- Gleisol	- Gleysol	- Aquept
20. Hidromorf Kelabu	- Podsolil Gleik	- Gleyic Acrisol	- Aquult
21. Aluvial Hidromorf	- Gleisol Hidrik	- Fluvisol	- Hydraquent
22. Planosol	- Planosol	- Planosol	- Aqualf

Table III-4 SUMMARY OF SOIL AND LAND SUITABILITY CLASSIFICATION

Soil Mapping Unit	Soil Association	Physiography	Topography	Drainage condition	Land suitability				Left Bank		Total		
					Paddy	Upland crops	Perennial crops	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
1	District Alluvial Soils Gleyic Alluvial Soils District Gleysols	Alluvial Plain	Flat (0 - 2%)	Somewhat Poorly	Sstdf	S3nc	S3nc	800	(8.0)	4,000	(20.3)	4,800	(16.2)
2	District Cambisols Umbric Cambisols Umbric Podzolic Soils	Terrace	Flat (0 - 2%)	Somewhat Poorly	S3t	S3n	S3n	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	S3t	N1d	N1d	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	S3t	S3nd	S3nd	100	(1.0)	500	(2.5)	600	(2.0)
5	Umbric Podzolic Soils Humic Podzolic Soils District Cambisols	Terrace	Undulating to Rolling (3 - 10%)	Moderately Well to Well	N1td	S3nt	S3n	1,300	(13.0)	4,500	(22.8)	5,800	(19.5)
TOTAL								10,000	(100)	19,700	(100)	29,700	(100)

Note Soil limitation :  
n: soil fertility  
c: aluminium toxicity  
t: slope, land form or micro-relief  
d: drainability  
f: flood hazard

Table III-5 SPECIFICATION OF LAND SUITABILITY CLASSIFICATION

Item	S 1		S 2		S 3		S 4		S 5	
	Upland crops	Paddy	Upland crops	Paddy	Upland crops	Paddy	Upland crops	Paddy	Upland crops	Paddy
1 Effective Soil Depth	> 75 cm	> 75 cm	> 50 cm	> 50 cm	> 25 cm	> 25 cm	> 10 cm	> 10 cm	> 10 cm	> 25 cm
2 Top Soil Texture	CL - C	Medium - Fine	Medium - Fine	Medium - Fine	M. Coarse - Fine	M. Coarse - Fine	LS - C	V. Coarse - Fine	V. Coarse - Fine	V. Coarse - Fine
3 Permeability of Subsoil	Slow	M. Slow - Slow	Moderate - High	Moderate - High	Moderate - Slow	Moderate - Slow	Rapid - V. Slow	Rapid - V. Slow	Rapid - V. Slow	Rapid - V. Slow
4 Water Holding Capacity	High	High	Moderate	Moderate	Low - High	Low - High	Low - High	Low - High	Low - High	Low - High
5 Gravel Content in Top Soil	< 5%	< 5%	< 25%	< 25%	< 25%	< 25%	< 50%	< 50%	< 50%	< 75%
6 Soil Fertility	High	High	Moderate - High	Moderate - High	Low - High	Low - High	Low - High	Low - High	Low - High	Low - High
7 Soil Reaction (pH) - Mineral Soils - Peat Soils	5.5 - 7.5 4.5 - 7.5	5.5 - 7.0 4.0 - 8.0	4.5 - 7.5 4.0 - 8.0	4.5 - 7.5 4.0 - 8.0	4.0 - 8.0 3.5 - 8.5	4.0 - 8.0 3.5 - 8.5	3.5 - 8.5 3.0 - 8.5	3.5 - 8.5 3.0 - 8.5	3.5 - 8.5 3.0 - 8.5	3.5 - 8.5 3.0 - 8.5
8 Aluminium Saturation	< 60%	< 20%	< 40%	< 40%	< 80%	< 80%	< 80%	< 80%	< 80%	< 80%
9 Slope and Land Form	More than 80% of lands are below 3%	< 3%	< 8%	< 8%	More than 50% of lands are below 5%	< 8%	More than 40% of lands are below 8%	< 15%	< 15%	< 45%
10 Micro-relief	< 15 cm	< 30 cm	< 60 cm	< 60 cm	< 60 cm	< 60 cm	< 60 cm	< 60 cm	< 60 cm	< 60 cm
11 Erosibility	Very Low	Very Low	Low - V. Low	Low - V. Low	Moderate - V. Low	Moderate - V. Low	Moderate - V. Low	Moderate - V. Low	Moderate - V. Low	High - V. Low
12 Drainability	Poorly	M. Well - Well	M. Well - Well	M. Well - Well	S. Poorly - V. Poorly	S. Poorly - V. Poorly	S. Poorly - V. Poorly	S. Poorly - V. Poorly	S. Poorly - V. Poorly	Well - V. Poorly
13 Frequency of Flood Hazard	< 1 time in 10 years	< 1 time in 10 years	< 3 time in 10 years	< 3 time in 10 years	< 4 times in 10 years	< 4 times in 10 years	< 4 times in 10 years	< 4 times in 10 years	< 4 times in 10 years	Very Frequent
14 Salinities (mO/cm)	< 1,500	< 1,500	< 2,500	< 2,500	< 2,500	< 2,500	< 3,500	< 3,500	< 3,500	< 4,500

Source: Terms of Reference - Klasifikasi Ketersuaian Lahan (No. 59b/1983), Pusat Penelitian Tanah, Bogor Robinson and Soeparto, 1975

General terms

Textural classes  
 Fine textured:  
 Moderately fine-textured:  
 Medium-textured:  
 Moderately coarse-textured:  
 Coarse-textured:

Sandy clay, silty clay and clay  
 Clay loam, sandy clay loam and silty clay loam  
 Very fine sandy loam, loam, silt loam and silt  
 Sandy loam and fine sandy loam  
 Sands and loamy sands

Drainage classes

Very poorly drained:  
 Poorly drained:  
 Somewhat poorly drained:  
 Moderately well drained:  
 Well drained:

Water is removed from the soils so slowly that the water table remains at or on the surface the greater part of the time.  
 Water is removed so slowly that the soil remains wet for a large part of the time. The water table is commonly at or near the surface during a considerable part of the year.  
 Water is removed from the soil so slowly enough to keep it wet for significant periods but not all of the time.  
 Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time.  
 Water is removed from the soil readily but not rapidly.

Table III-6 PEAMEABILITY OF THE SOILS IN THE SURVEY AREA

Observation site	Soil mapping unit	Depth (m)	Permeability (cm/hr)	Class
TP 4	5	2.0	1.73	3
TP 5	2	1.0	1.87 *	3
TP 5	2	1.3	0.21	2
TP 6	3	1.3	0.39	2
TP 7	3	1.2	0.88	3
TP 8	1	1.0	1.86 *	3
TP 10	2	1.6	0.02	1

Source : JICA study, 1988

Remarks \* : Results of field permeability test

Soil Association	Permeability (cm/hr)				Soil name
	0 - 30 cm		30 - 60 cm		
	class		class		
Ad-Kg	10.67	5	0.23	2	Ad : Distric Alluvial Soils
Of-Kh	10.18	5	2.36	4	Kg : Gleyic Cambisols
Kd-Kh	2.93	4	3.91	4	Of : Fibric Organosols
Kd-Kh	18.98	6	10.67	5	Kd : Distric Cambisols
Kd-Kh	15.06	6	10.05	5	Kh : Humic Cambisols
Kd-Ph	20.87	6	5.52	4	Ph : Humic Podzolic Soils
Ph	8.03	5	0.40	2	

Source : Survai dan Pemetaan Tanah Semi Detail Daerah SKP E & F  
WPP XII Pasir Pangarayan, Propinsi Riau, 1981  
Universitas Barawijaya

Permeability class	(cm/hr)
1. Very slow	< 0.12
2. Slow	0.12 - 0.50
3. Moderately slow	0.50 - 2.00
4. Moderate	2.00 - 6.25
5. Moderately rapid	6.25 - 12.50
6. Rapid	12.50 - 25.00
7. Very rapid	> 25.00

Table III-7 ESTIMATION OF WATER HOLDING CAPACITY OF THE SOILS

Mapping Unit	Depth (cm)	Total Porosity (%)	Water content (%)		AWC (%)	Bulk density (g/cc)	AWC (cm/m)	Class
			pF 2.54	pF 4.2				
A	0 - 30	57.26	40.03	8.29	31.74	1.06	33.6	3
	30 - 60	63.78	34.99	19.32	15.67	0.92	14.4	2
Po	0 - 30	78.15	37.89	9.01	28.88	0.52	15.0	2
	30 - 60	76.42	42.88	8.91	33.97	0.58	19.7	3
P2	0 - 30	47.92	30.61	14.00	16.61	1.25	20.8	3
	30 - 60	48.74	25.64	11.35	14.29	1.27	18.1	3
P2	0 - 30	75.22	33.14	11.22	21.92	0.57	12.5	2
	30 - 60	74.51	35.36	16.76	18.60	0.62	11.5	1
P2	0 - 30	69.44	27.34	9.12	18.22	0.77	14.0	2
	30 - 60	60.28	26.53	10.40	16.13	1.07	17.3	2
P3	0 - 30	62.08	29.36	13.25	16.11	0.91	14.7	2
	30 - 60	55.47	30.88	15.42	15.46	1.14	17.6	2
U2	0 - 30	62.25	40.14	21.59	18.55	0.86	16.0	2
	30 - 60	63.16	53.14	31.14	22.00	0.94	20.7	3

Source : Survei dan Pemetaan Tanah Semi Detail Daerah SKP E & F WPP XII Pasir Pangarayan, Propinsi Riau, 1981, Universitas Barawijaya Malang

Soil Mapping Unit  
 A : Distric Alluvial Soils and Gleyic Cambisols  
 Po : Fibric Organosols and Histic Cambisols  
 P2 : Distric Cambisols and Histic or Humic Cambisols  
 P3 : Distric Cambisols and Humic Podzolic Soils  
 U2 : Humic Podzolic Soils

$$\text{AMC (\%)} = \text{WC (pF 2.54)} - \text{WC (pF 4.2)}$$

$$\text{AMC (cm/m)} = \text{AMC (\%)} \times \text{Bulk density}$$

Class of AMC (cm/m)

1 Low	< 12.0
2 Moderate	12.0 - 18.0
3 High	> 18.0

Table III-8 SUITABILITY EVALUATION OF SOIL AND LAND (1/5)

Soil Mapping Unit : 1 Association of Distric Alluvial Soils, Gleyic Alluvial Soils and Distric Gleysols

Limiting factor	Symbol	Without Project			Improvement by the project	With Project		
		P	U	T		P	U	T
1 Effective Soil Depth	s	S1	S1	S1		S1	S1	S1
2 Top Soil Texture	s	S1	S1	S1		S1	S1	S1
3 Permeability of Subsoil	s	S2	-	-	Accumulation of silt by irrigation water	S1	-	-
4 Water Holding Capacity	s	-	S2	S2		-	S2	S2
5 Gravel Content in Top Soil	s	S1	S1	S1		S1	S1	S1
6 Soil Fertility	n	S3	N1	S3	Application of fertilizers and manure	S1	S3	S3
7 Soil Reaction (pH)	a	S2	S2	S2	Saturated with irrigation water (paddy) and lime application	S1	(S1)	(S1)
8 Aluminium Saturation	c	S2	N1	S3	- do -	S1	S3	S3
9 Slope and Land Form	t	S1	S1	S1		S1	S1	S1
10 Micro-relief	t	S2	-	-		S2	-	-
11 Erosibility	e	-	S2	S2		-	S2	S2
12 Drainability	d	S2	S3	S3	Drainage improvement	S2	S2	S2
13 Frequency of Flood Hazard	f	S2	S2	-		S2	S2	-
14 Salinities	x	S1	S1	S1		S1	S1	S1
Land Suitability Class		S3n	N1nc	S3ncd		S2tdf	S3nc	S3nc

Remarks : P : Paddy, U : Upland crops, T : Perennial crops

S1 : Highly suitable  
 S2 : Moderately suitable  
 S3 : Marginally suitable  
 N1 : Currently not suitable

Table III-8 SUITABILITY EVALUATION OF SOIL AND LAND (2/5)

Soil Mapping Unit : 2 Association of Distric Cambisols, Umbric Cambisols and Umbric Podzolic Soils

Limiting factor	Symbol	Without Project			Improvement by the project	With Project		
		P	U	T		P	U	T
1 Effective Soil Depth	s	S2	S2	S2		S2	S2	S2
2 Top Soil Texture	s	S2	S2	S2		S2	S2	S2
3 Permeability of Subsoil	s	S2	-	-	Accumulation of silt by irrigation water	S1	-	-
4 Water Holding Capacity	s	-	S2	S2		-	S2	S2
5 Gravel Content in Top Soil	s	S1	S1	S1		S1	S1	S1
6 Soil Fertility	n	S3	N1	S3	Application of fertilizers and manure	S1	S3	S3
7 Soil Reaction (pH)	a	S2	S2	S2	Saturated with irri. water (paddy) and lime application	S1	S2	S2
8 Aluminium Saturation	c	S1	S1	S1		S1	S1	S1
9 Slope and Land Form	t	S1	S1	S1		S1	S1	S1
10 Micro-relief	t	S3	-	-		S3	-	-
11 Erosibility	e	-	S2	S2		-	S2	S2
12 Drainability	d	S2	S3	S3	Drainage improvement	S2	S2	S2
13 Frequency of Flood Hazard	f	S1	S1	-		S1	S1	-
14 Salinities	x	S1	S1	S1		S1	S1	S1
land suitability class		S3nt	N1n	S3nd		S3t	S3n	S3n

Remarks : P : Paddy, U : Upland crops, T : Perennial crops

S1 : Highly suitable  
 S2 : Moderately suitable  
 S3 : Marginally suitable  
 N1 : Currently not suitable

Table III-8 SUITABILITY EVALUATION OF SOIL AND LAND (3/5)

Soil Mapping Unit : 3 Association of Umbric Cambisols, Gleyic Cambisols and Umbric Gleysols

Limiting factor	Symbol	Without project			Improvement by the project	With Project		
		P	U	T		P	U	T
1 Effective Soil Depth	s	S2	S2	S2		S2	S2	S2
2 Top Soil Texture	s	S2	S2	S2		S2	S2	S2
3 Permeability of Subsoil	s	S2	-	-	Accumulation of silt by irrigation water	S1	-	-
4 Water Holding Capacity	s	-	S2	S2		-	S2	S2
5 Gravel Content in Top Soil	s	S1	S1	S1		S1	S1	S1
6 Soil Fertility	n	S3	N1	S3	Application of fertilizers and manure	S1	S3	S3
7 Soil Reaction (pH)	a	S2	S2	S2	Saturated with irri. water (paddy) and lime application	S1	S2	S2
8 Aluminium Saturation	c	S1	S1	S1		S1	S1	S1
9 Slope and Land Form	t	S1	S1	S1		S1	S1	S1
10 Micro-relief	t	S3	-	-		S3	-	-
11 Erosibility	e	-	S2	S2		-	S2	S2
12 Drainability	d	S3	N1	N1	Drainage improvement	S1	N1	N1
13 Frequency of Flood Hazard	f	S1	S1	-		S1	S1	-
14 Salinities	x	S1	S1	S1		S1	S1	S1
Land suitability class		S3ntd	N1nd	N1d		S3t	N1d	N1d

Remarks : P : Paddy, U : Upland crops, T : Perennial crops

S1 : Highly suitable  
 S2 : Moderately suitable  
 S3 : Marginally suitable  
 N1 : Currently not suitable



Table III-8 SUITABILITY EVALUATION OF SOIL AND LAND (4/5)

Soil Mapping Unit : 4

Association of Umbric Cambisols, Gleyic Alluvial Soils and Umbric Gleysols

Limiting factor	Symbol	Without Project			Improvement by the project	With Project		
		P	U	T		P	U	T
1 Effective Soil Depth	s	S2	S2	S2		S2	S2	S2
2 Top Soil Texture	s	S2	S2	S2		S2	S2	S2
3 Permeability of Subsoil	s	S2	-	-	Accumulation of silt by irrigation water	S1	-	-
4 Water Holding Capacity	s	-	S2	S2		-	S2	S2
5 Gravel Content in Top Soil	s	S1	S1	S1		S1	S1	S1
6 Soil Fertility	n	S3	N1	S3	Application of fertilizers and manure	S1	S3	S3
7 Soil Reaction (pH)	a	S2	S2	S2	Saturated with irri. water (paddy) and lime application	S1	(S1)	(S1)
8 Aluminium Saturation	c	S1	S1	S1		S1	S1	S1
9 Slope and Land Form	t	S1	S1	S1		S1	S1	S1
10 Micro-relief	t	S3	-	-		S3	-	-
11 Erosibility	e	-	S2	S2		-	S2	S2
12 Drainability	d	S3	N1	N1	Drainage improvement	S1	S3	S3
13 Frequency of Flood Hazard	f	S1	S1	-		S1	S1	-
14 Salinities	x	S1	S1	S1		S1	S1	S1
Land suitability class		S3ntd	N1nd	N1d		S3t	S3nd	S3nd

Remarks : P : Paddy, U : Upland crops, T : Perennial crops

S1 : Highly suitable  
 S2 : Moderately suitable  
 S3 : Marginally suitable  
 N1 : Currently not suitable

Table III-8 SUITABILITY EVALUATION OF SOIL AND LAND (5/5)

Soil Mapping Unit : 5 Association of Distric Cambisols, Humic Podzolic Soils and Umbric Podzolic Soils

Limiting factor	Symbol	Present condition			Improvement by the project	After the Project		
		P	U	T		P	U	T
1 Effective Soil Depth	s	S2	S2	S2		S2	S2	S2
2 Top Soil Texture	s	S2	S2	S2		S2	S2	S2
3 Permeability of Subsoil	s	S2	-	-	Accumulation of silt by irrigation water	S1	-	-
4 Water Holding Capacity	s	-	S2	S2		-	S2	S2
5 Gravel Content in Top Soil	s	S1	S1	S1		S1	S1	S1
6 Soil Fertility	n	S3	N1	S3	Application of fertilizers and manure	S1	S3	S3
7 Soil Reaction (pH)	a	S2	S2	S2	Saturated with irri. water (paddy) and lime application	S1	(S1)	(S1)
8 Aluminium Saturation	c	S1	S1	S1		S1	S1	S1
9 Slope and Land Form	t	N1	S3	S2		N1	S3	S2
10 Micro-relief	t	S3	-	-		S3	-	-
11 Erosibility	e	-	S2	S2		-	S2	S2
12 Drainability	d	N1	S1	S1		N1	S1	S1
13 Frequency of Flood Hazard	l	S1	S1	-		S1	S1	-
14 Salinities	x	S1	S1	S1		S1	S1	S1
Land suitability class		N1td	S3nt	S3n		N1td	S3nt	S3n

Remarks : P : Paddy, U : Upland crops, T : Perennial crops

S1 : Highly suitable  
 S2 : Moderately suitable  
 S3 : Marginally suitable  
 N1 : Currently not suitable

Table III-9 SOIL PROFILE DESCRIPTION (1/49)

1. Profile Number	1
2. Soil Classification	
a. Indonesian system	Umbric Cambisols
b. FAO	Humic Cambisols
3. Location	7 km west of SKP D DU
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	-

9. Profile Description

	Depth (cm)	Description
0	0 - 8	Organic matter
A <sub>1</sub>	8 - 29	Black (10YR2/1); sandy clay loam; structureless crumb; loose when moist, non-sticky when wet; many micro pores, few medium and macro pores; many fine and coarse roots; clear smooth boundary; pH 5.3
B <sub>1</sub>	29 - 37	Grayish yellow brown (10YR5/2); sandy clay loam; structureless crumb; loose when moist, non-sticky when wet; many micro pores, few medium and macro pores; common coarse roots; gradual wavy boundary; pH 5.6
B <sub>2</sub>	37 - 85	Bright yellowish brown (10YR6/8); sandy clay loam; structureless crumb; loose when moist, non-sticky when wet; many micro pores, common medium and macro pores; few coarse roots; clear smooth boundary; pH 5.6
C	85 - 120	Light gray (10YR8/1); sand; loose; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (2/49)

1. Profile Number	2
2. Soil Classification	
a. Indonesian system	Distric Alluvial Soils
b. FAO	Distric Fluvisols
3. Location	1 km South of SKP C DU
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Forest
7. Drainage Condition	Poorly
8. Groundwater Table	-

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 14	Brown (10YR4/4) moist; silty clay; weak fine blocky; sticky and plasticity when wet, loose when moist; many micro pores, few medium pores; many fine roots, common coarse roots; gradual smooth boundary; pH 4.8
C <sub>1</sub>	14 - 44	Yellowish brown (10YR5/8) moist; silty clay loam; moderate medium blocky; very sticky and plasticity when wet, firm when moist; common micro and medium pores; many fine roots, common coarse roots; gradual smooth boundary; pH 4.6
C <sub>2</sub>	44 - 120	Bright brown (7.5YR5/6) moist; silty clay loam; moderate medium blocky; sticky and slightly plasticity when wet, firm when moist

Table III-9 SOIL PROFILE DESCRIPTION (3/49)

1. Profile Number 3
2. Soil Classification
  - a. Indonesian system Distric Cambisols
  - b. FAO Distric Cambisols
3. Location 3 km North of SKP D DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Poorly
8. Groundwater Table -

9. Profile Description

	Depth (cm)	Description
0	0 - 9	Organic matter
A <sub>1</sub>	9 - 19	Dark grayish yellow (2.5Y5/2); sandy clay loam; structureless; loose when moist, non-sticky and non-plasticity when wet; many fine and coarse roots; clear smooth boundary
B <sub>1</sub>	19 - 33	Grayish yellow brown (10YR6/2); sandy clay loam; structureless crumb; loose when moist, non-sticky and non-plasticity when wet; common fine roots, many coarse roots; clean smooth boundary; pH 5.1
B <sub>2</sub>	33 - 69	Dull yellow orange (10YR6/4); clay loam; structureless crumb; loose when moist, non-sticky and non-plasticity when wet; clear smooth boundary; pH 5.5
B <sub>3</sub>	64 - 87	Dull yellow orange (10YR6/3); sandy clay loam; structureless crumb; loose when moist, non-sticky and non-plasticity when wet; many micro pore; common medium and macro pores; clear smooth boundary; pH 4.9
C	87 - 120	Light gray (10YR8/1); structureless single grain; non-sticky and non-plasticity; pH 5.1

Table III-9 SOIL PROFILE DESCRIPTION (4/49)

1. Profile Number 4
2. Soil Classification
  - a. Indonesian system Umbric Podzolic Soils
  - b. FAO Humic Acrisols
3. Location 4 km S.W. of SKP C DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Somewhat poorly
8. Groundwater Table -
9. Profile Description

	Depth (cm)	Description
0	0 - 13	Organic matter
A <sub>1</sub>	13 - 27	Brownish black (10YR2/2); sandy loam; structureless; loose when moist, non-sticky and non-plasticity when wet; many micro pores, common medium and macro pores; many fine and coarse roots; clear smooth boundary; pH 5.0
B <sub>1</sub>	27 - 34	Glaysish yellow brown (10YR4/2); loam; weak medium blocky; loose when moist, non-sticky and slightly plasticity when wet; many micro pores, common medium pores, few macro pores, many fine and coarse roots; gradual wavy boundary; pH 5.1
B <sub>2t</sub>	37 - 50	Yellowish brown (10YR5/8); clay loam; moderate medium blocky; slightly sticky and slightly plasticity; many micro pores, few medium pores; many fine roots; gradual smooth boundary; pH 5.2
B <sub>3</sub>	50 - 82	Bright yellowish brown (10YR7/6); sandy clay loam; moderate medium blocky; slightly sticky and non-plasticity; many micro pores, common medium pores; gradual smooth boundary; pH 4.9
C	82 - 120	Light gray (10YR8/1); loamy sand; structureless; non-sticky and non-plasticity; pH 5.1

Table III-9 SOIL PROFILE DESCRIPTION (5/49)

1.	Profile Number	5
2.	Soil Classification	
	a. Indonesian system	Umbric Podzolic Soils
	b. FAO	Humic Acrisols
3.	Location	8 km North of SKP C DU
4.	Physiography	Terrace
5.	Slope	Flat
6.	Vegetation or Land Use	Primary forest
7.	Drainage Condition	Somewhat poorly
8.	Groundwater Table	-
9.	Profile Description	

	Depth (cm)	Description
0	0 - 13	Organic matter
A <sub>1</sub>	13 - 24	Black (10YR2/1); sandy loam; weak medium blocky; loose when moist, non-sticky and non-plasticity when wet; many micro and medium pores, common macro pores; many fine and coarse roots; clear smooth boundary; pH 4.8
B <sub>1</sub>	24 - 33	Yellowish brown (10YR5/6); sandy clay loam; moderate medium blocky; loose when moist, slightly sticky and slightly plasticity when wet; many micro and medium pores; few macro pores; many fine and coarse roots; gradual smooth boundary; pH 5.2
B <sub>2t</sub>	33 - 52	Yellowish brown (10YR5/6); clay; moderate medium blocky; non-sticky and non-plasticity; many micro pores, common medium pores, few macro pores; many fine roots, common coarse roots; gradual smooth boundary; pH 5.5
B <sub>3</sub>	52 - 62	Bright yellowish brown (10YR6/6); clay; moderate medium blocky; non-sticky and plasticity; many micro pores, common medium pores, few macro pores; many fine roots, common coarse roots; gradual smooth boundary; pH 5.3
C	62 - 120	Light gray (10YR8/1); sand; structureless single grain; non-sticky and non-plasticity; pH 5.3

Table III-9 SOIL PROFILE DESCRIPTION (6/49)

1. Profile Number	6
2. Soil Classification	
a. Indonesian system	Distric Alluvial Soils
b. FAO	Distric Fluvisols
3. Location	5 km S.W. of SKP D DU
4. Physiography	Alluvial plain
5. Slope	Flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Poorly
8. Groundwater Table	-

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 5	Grayish yellow brown (10YR4/2); silty clay loam; weak medium blocky; firm when wet; common micro and macro pores; many fine roots, common coarse roots; clear smooth boundary pH 4.2
C <sub>1</sub>	5 - 22	Orange (7.5YR6/6-6/8); clay; weak medium blocky; firm when moist, sticky and plasticity when wet; many micro pores, few macro pores; few roots; clear smooth boundary; pH 5.0
C <sub>2</sub>	22 - 35	Grayish brown (7.5YR5/2); sandy clay loam; weak medium blocky; friable when moist, slightly sticky and slightly plasticity when wet; common micro pores, many macro pores; few coarse roots; clear smooth boundary; pH 5.2
C <sub>3</sub>	36 - 50	Dull yellow orange to bright yellow brown (10YR7/4-7/6); sandy loam; weak fine to medium blocky; loose when moist, non-sticky and non-plasticity when wet; few micro pores, many macro pores; clear smooth boundary; pH 5.0
C <sub>4</sub>	50 - 70	Light yellow orange (10YR8/3); clay loam; moderate fine to medium blocky; firm when moist, sticky and plasticity when wet; common micro pores, few macro pores, clear smooth boundary; pH 4.0
C <sub>5</sub>	70 - 120	Dull yellow orange (10YR6/4); sandy loam; weak fine to medium blocky; loose when moist, non-sticky and non-plastic when wet; clear smooth boundary; pH 4.8



Table III-9 SOIL PROFILE DESCRIPTION (7/49)

- 1. Profile Number 7
- 2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
- 3. Location 5 km N.E. of SKP C DU
- 4. Physiography Terrace
- 5. Slope Flat
- 6. Vegetation or Land Use Primary forest
- 7. Drainage Condition Somewhat poorly
- 8. Groundwater Table -

9. Profile Description

	Depth (cm)	Description
0	0 - 10	Organic matter
A <sub>1</sub>	10 - 35	Brownish black (10YR2/3); sandy loam; structureless crumb; loose when moist, non-sticky when wet; many micro pores, few medium and macro pores; many fine and coarse roots; clear smooth boundary; pH 5.0
B <sub>1</sub>	35 - 45	Grayish yellow brown (10YR5/2); sandy loam; structureless crumb; loose when moist, non-sticky when wet; many micro pores, few medium and macro pores; common fine roots; gradual wavy boundary; pH 4.7
B <sub>2</sub>	45 - 60	Bright yellowish brown (10YR6/8); loamy sand; structureless crumb; loose when moist, non-sticky when wet; many micro pores, common medium and macro pores; few fine roots; clear smooth boundary; pH 4.7
C	60 +	Light gray (10YR8/1); sand; loose; non-sticky and non-plasticity; pH 4.7

Table III-9 SOIL PROFILE DESCRIPTION (8/49)

1. Profile Number 8
2. Soil Classification
  - a. Indonesian system Distric Cambisols
  - b. FAO Distric Cambisols
3. Location 6 km N.W. of SKP D DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Somewhat poorly
8. Groundwater Table -

9. Profile Description

	<u>Depth (cm)</u>	<u>Description</u>
O	0 - 5	Organic matter
A <sub>1</sub>	5 - 30	Grayish yellow brown (10YR5/2); loam; weak to moderate fine blocky; loose when moist, slightly sticky and slightly plasticity when wet; common micro and macro pores; many fine roots, common coarse roots; gradual smooth boundary; pH 4.9
B <sub>1</sub>	39 - 75	Dull yellow orange (10YR7/2); clay loam; moderate fine to medium angular blocky; loose to friable when moist; sticky and plasticity when wet; common micro pores, few macro pores; common fine and coarse roots; clear smooth boundary; pH 5.1
B <sub>2</sub>	75 - 100	Light gray (10YR8/2); clay; moderate angular blocky; firm when moist, sticky and plasticity when wet; few micro and macro pores; few fine and coarse roots; clear smooth boundary; pH 4.7
BC	100 +	Light gray (10YR8/1); sandy loam; weak fine to medium blocky; loose when moist, non-sticky and non-plasticity when wet; common micro pores, many macro pores

Table III-9 SOIL PROFILE DESCRIPTION (9/49)

- |                           |                 |
|---------------------------|-----------------|
| 1. Profile Number         | 9               |
| 2. Soil Classification    |                 |
| a. Indonesian system      | Umbric Gleysols |
| b. FAO                    | Humic Gleysols  |
| 3. Location               | SKP C DK II     |
| 4. Physiography           | Terrace         |
| 5. Slope                  | Flat (0-2%)     |
| 6. Vegetation or Land Use | Fallow          |
| 7. Drainage Condition     | Poorly          |
| 8. Groundwater Table      | 0.35 m          |

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 20	Black (10YR1.7/1) wet; sandy loam; structureless crumb; non-sticky and non-plastic; common fine roots; clear smooth boundary
B <sub>1</sub>	20 - 25	Brownish black (2.5Y3/2) wet; sandy clay loam; weak medium angular blocky; slightly sticky and slightly plastic; clear wavy boundary
B <sub>2g</sub>	25 - 90	Yellowish brown (2.5Y5/3) wet; sandy clay loam; weak medium angular blocky; slightly sticky and slightly plastic; clear wavy boundary
C	90 - 120(+)	Gleyish yellow (2.5Y7/2) wet; sand; structureless single grain; non-sticky and non-plastic

Table III-9 SOIL PROFILE DESCRIPTION (10/49)

1. Profile Number	10
2. Soil Classification	
a. Indonesian system	Umbric Gleysols
b. FAO	Humic Gleysols
3. Location	SKP C DK III
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Crop field
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	0.9 m

9. Profile Description

	<u>Depth (cm)</u>	<u>Description</u>
Ap <sub>1</sub>	0 - 5	Brownish black (10YR2/3) moist; loam; weak fine granular; slightly sticky and slightly plastic; clear smooth boundary
Ap <sub>2</sub>	5 - 18	Brownish black (10YR3/2) moist; silty loam; weak medium blocky; slightly sticky and slightly plastic; clear smooth boundary
B <sub>1</sub>	18 - 31	Brownish black (2.5Y3/1) moist; sandy loam; moderate medium blocky; slightly sticky and slightly plastic; gradual wavy boundary
B <sub>21g</sub>	31 - 40	Yellowish gray (2.5Y5/1) moist; clay loam; moderate medium blocky; sticky and plastic; gradual wavy boundary
B <sub>22</sub>	40 - 54	Dark brown (10YR3/3) wet; clay loam; moderate medium blocky; sticky and plastic; gradual wavy boundary
C	54 - 120	Light gray (10YR8/1) wet; sand; structureless single grain non-sticky and non-plastic

Table III-9 SOIL PROFILE DESCRIPTION (11/49)

1. Profile Number 11
2. Soil Classification
  - a. Indonesian system Distric Cambisols
  - b. FAO Distric Cambisols
3. Location 5 km northeast of SKP C DK III
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Rubber forest
7. Drainage Condition Moderately well/well
8. Groundwater Table >1.5 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 5	Brown (10YR4/4) moist; sandy loam; weak fine granular; non-sticky and non-plasticity; many fine roots; accurate smooth boundary
B <sub>1</sub>	5 - 25	Yellowish brown (10YR5/6) moist; sandy loam; weak medium subangular blocky; non-sticky and non-plasticity; common few roots; gradual smooth boundary
B <sub>21</sub>	25 - 39	Brown to yellowish brown (10YR4.5/6) moist; sandy loam; weak medium subangular blocky; non-sticky and non-plasticity; gradual irregular boundary
B <sub>22</sub>	39 - 110	Bright yellowish brown (10YR6/8) moist; sandy loam; moderate medium subangular blocky; slightly sticky and slightly plastic; gradual irregular boundary
C	110 - 120	Light yellow (2.5Y7/3) moist; loamy sand structureless; non-sticky and non-plasticity, common distinct medium mottlings (5YR6/8)

Table III-9 SOIL PROFILE DESCRIPTION (12/49)

1. Profile Number	12
2. Soil Classification	
a. Indonesian system	Distric Cambisols
b. FAO	Distric Cambisols
3. Location	SKP C DU
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Alang-alang
7. Drainage Condition	Moderately well
8. Groundwater Table	1.0 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 16	Black (7.5YR1.7/1) wet; sandy loam; moderate medium blocky; non-sticky and non-plasticity; many fine roots; clear wavy boundary
B <sub>1</sub>	16 - 36	Bright yellowish brown (10YR6/6) wet; sandy clay loam; moderate medium blocky; slightly sticky and slightly plasticity; common fine roots; gradual wavy boundary
B <sub>2</sub>	36 - 54	Dull yellow orange (10YR7/4) wet; sandy clay loam; moderate medium blocky; slightly sticky and slightly plasticity; gradual wavy boundary
B <sub>3</sub>	54 - 76	Dull brown (7.5YR6/3) wet; sandy clay loam; moderate medium blocky; slightly sticky and slightly plasticity; gradual wavy boundary
C <sub>1</sub>	76 - 100	Light gray (10YR8/2) wet; loamy sand; structureless; non-sticky and non-plasticity; clear smooth boundary
C <sub>2</sub>	100 - 120	Light gray (10YR8/1) wet; sand; structureless; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (13/49)

1.	Profile Number	13
2.	Soil Classification	
	a. Indonesian system	Gleyic Cambisols
	b. FAO	Gleyic Cambisols
3.	Location	SKP D DK I
4.	Physiography	Terrace
5.	Slope	Flat
6.	Vegetation or Land Use	Fallow
7.	Drainage Condition	Somewhat poorly
8.	Groundwater Table	1.0 m
9.	Profile Description	
	<u>Depth (cm)</u>	<u>Description</u>
Ap	0 - 12	Brownish black (10YR2/3) wet; sandy loam; weak fine subangular blocky; non-sticky and non-plasticity; many fine roots; clear wavy boundary
B <sub>1</sub>	12 - 40	Brown (10YR4/4) wet; sandy loam; weak medium subangular blocky; slightly sticky and slightly plasticity; few fine roots; gradual wavy boundary
B <sub>21</sub>	40 - 55	Dull yellowish brown (10YR4/3) wet; sandy loam; weak medium subangular blocky; slightly sticky and slightly plasticity; gradual wavy boundary
B <sub>22g</sub>	55 - 72	Dull reddish brown (5YR4/3) wet; sandy loam; weak medium subangular blocky; slightly sticky and slightly plasticity; common faint fine mottlings; gradual wavy boundary
B <sub>23</sub>	72 - 86	Dull brown (7.5YR5/3) wet; sandy loam; weak medium subangular blocky; slightly sticky and slightly plasticity; clear smooth boundary
C	86 - 100+	Light gray (2.5Y8/2) wet; sand; structureless very hard; non-sticky and no-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (14/49)

1. Profile Number 14
2. Soil Classification
  - a. Indonesian system Distric Gleysols
  - b. FAO Distric Gleysols
3. Location SKP D DU
4. Physiography Alluvial plain
5. Slope Flat
6. Vegetation or Land Use Crop field
7. Drainage Condition Somewhat poorly
8. Groundwater Table >1.2 m

9. Profile Description

	Depth (cm)	Description
Ap	0 - 10	Dark brown (10YR3/4) wet; sandy clay loam; weak fine subangular blocky; slightly sticky and slightly plasticity; accurate smooth boundary
B <sub>1</sub>	10 - 37	Bright brown (7.5YR5/6) wet; silty clay; moderate medium blocky; sticky and plasticity; gradual wavy boundary
B <sub>2g</sub>	37 - 120	Grayish yellow brown (10YR6/2) wet; clay; structureless massive; very sticky and very plasticity; common distinct medium mottlings (5YR5/8)



Table III-9 SOIL PROFILE DESCRIPTION (15/49)

1. Profile Number 16
2. Soil Classification
  - a. Indonesian system Distric Cambisols
  - b. FAO Distric Cambisols
3. Location 1 km North of SKP C DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Alang-alang
7. Drainage Condition Somewhat poorly
8. Groundwater Table 0.6 m
9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 18	Black (10YR2/1) wet; sandy loam; weak fine granular; slightly sticky and slightly plasticity; many fine roots; clear wavy boundary
B <sub>1</sub>	18 - 45	Yellowish brown (10YR5/6) wet; sandy clay loam; weak fine granular; slightly sticky and slightly plasticity; common fine roots; gradual wavy boundary
B <sub>2</sub>	45 - 85	Dark brown (7.5YR3/3) wet; clay loam; weak medium subangular blocky; sticky and plasticity; few fine roots
C	85 +	Light gray (2.5Y8/1) wet; loamy sand; structureless; very hard; non-sticky and non-plasticity

Note: Augered below 60 cm

Table III-9 SOIL PROFILE DESCRIPTION (16/49)

- |                           |                          |
|---------------------------|--------------------------|
| 1. Profile Number         | 17                       |
| 2. Soil Classification    |                          |
| a. Indonesian system      | District Cambisols       |
| b. FAO                    | District Cambisols       |
| 3. Location               | 1 km North of Kampunbaru |
| 4. Physiography           | Terrace                  |
| 5. Slope                  | Flat                     |
| 6. Vegetation or Land Use | Primary forest           |
| 7. Drainage Condition     | Moderately well          |
| 8. Groundwater Table      | >1.2                     |

9. Profile Description

	Depth (cm)	Description
0	0 - 3	Organic matter
A <sub>1</sub>	3 - 20	Dark grayish yellow (2.5Y4/2) moist; clay loam; moderate fine granular; sticky and plasticity; many fine roots and common medium roots; clear smooth boundary
B <sub>1</sub>	20 - 55	Light yellow (2.5Y7/3) moist; silty clay loam; moderate medium angular blocky; sticky and plasticity; few fine roots; gradual wavy boundary
B <sub>2</sub>	55 - 100	Dull yellow orange (10YR6/3) moist; silty clay loam; weak medium angular blocky; sticky and plasticity; clear irregular boundary
C	100 - 120(+)	Light gray (5Y7/2) wet; loamy sand; structureless single grain; very hard; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (17/49)

- 1. Profile Number 18
- 2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
- 3. Location 5 km N.W. of SKP D DU
- 4. Physiography Terrace
- 5. Slope Flat
- 6. Vegetation or Land Use Primary forest
- 7. Drainage Condition Somewhat poorly
- 8. Groundwater Table >1.0 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 15	Brownish black (10YR2/2) wet; clay loam; moderate medium subangular blocky; slightly sticky and plasticity; many fine roots and common medium roots; clear smooth boundary
B <sub>1</sub>	15 - 25	Brownish black (7.5YR3/2) wet; clay loam; moderate medium angular blocky; slightly sticky and plasticity; few medium roots and common fine roots; gradual smooth boundary
B <sub>21</sub>	25 - 50	Light yellow (2.5Y7/3) wet; silty clay loam; moderate fine angular blocky; slightly sticky and plasticity; gradual smooth boundary
B <sub>22</sub>	50 - 85	Grayish yellow brown (70YR5/2) wet; silty loam; moderate fine angular blocky; slightly sticky and plasticity; clear smooth boundary
C	85 - 100(+)	Light gray (5Y8/2) wet; sand; structureless single grain, very hard; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (18/49)

1. Profile Number 19
2. Soil Classification
  - a. Indonesian system Distric Cambisol
  - b. FAO Distric Cambisols
3. Location 3 km north of SKP D DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Moderately well/Somewhat poorly
8. Groundwater Table >1.5

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 10	Very dark reddish brown (2.5YR2/3) moist; clay loam; moderate fine granular; slightly sticky and plasticity; many fine roots; clear smooth boundary
B <sub>11</sub>	10 - 50	Dull yellow (2.5Y6/2) moist; silty clay; moderate fine angular blocky; sticky and plasticity; few medium roots; clear wavy boundary
B <sub>12</sub>	50 - 85	Light yellow (2.5Y7/3) wet; silty clay; moderate medium subangular blocky; sticky and plasticity; few medium roots; clear wavy boundary
B <sub>2</sub>	85 - 105	Dull brown (7.5YR6/3) wet; clay; moderate medium subangular blocky; sticky and very plasticity; clear wavy boundary
C	105 - 120(+)	Light gray (5Y8/2) wet; silty loam; structureless; slightly sticky and plasticity

Table III-9 SOIL PROFILE DESCRIPTION (19/49)

1. Profile Number 20
2. Soil Classification
  - a. Indonesian system Distric Cambisols
  - b. FAO Distric Cambisols
3. Location SKP C DK II
4. Physiography Terrace
5. Topography Gentle sloping (2-4%)
6. Vegetation or Land Use Alang-alang
7. Drainage Condition Moderately well
8. Groundwater Table 1.0 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 10	Brownish black (10YR2/3) moist; sandy clay loam; moderate fine granular; slightly sticky and slightly plasticity; common fine roots; clear smooth boundary
B <sub>1</sub>	10 - 27	Dull yellowish brown (10YR4/3) moist; sandy clay loam; moderate fine subangular blocky; slightly sticky and slightly plasticity; few fine roots; gradual smooth boundary
B <sub>2</sub>	27 - 65	Dull yellow orange (10YR6/3) wet; sandy clay loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; gradual wavy boundary
C <sub>1</sub>	65 - 100	Light gray (5Y8/1) wet; loamy sand; structureless massive; non-sticky and non-plasticity; gradual wavy boundary
C <sub>2g</sub>	100 - +	Light gray (5Y8/1) wet; clay loam; structureless single grain; sticky and plasticity; common prominent medium mottlings (2.5YR5/6)

Table III-9 SOIL PROFILE DESCRIPTION (20/49)

1. Profile Number	21
2. Soil Classification	
a. Indonesian system	Umbric Cambisols
b. FAO	Humic Cambisols
3. Location	3 km East of SKP C DU
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Poorly
8. Groundwater Table	0.4 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 45	Brownish black (10YR2/2) wet; sandy loam; structureless; non-sticky and non-plasticity gradual smooth boundary
B	45 - 75	Grayish yellow brown (10YR4/2) wet; sandy loam structureless; non-sticky and non-plasticity
C	75 +	Light gray (5Y8/1) we; sand; structureless single grain; non-sticky and non-plasticity

Note: Augered below 45 cm

Table III-9 SOIL PROFILE DESCRIPTION (21/49)

- 1. Profile Number 22
- 2. Soil Classification
  - a. Indonesian system Gleyic Alluvial Soils
  - b. FAO Distric Fluvisols
- 3. Location 4 km East of SKP C DU
- 4. Physiography Terrace
- 5. Slope Flat
- 6. Vegetation or Land Use Fallow
- 7. Drainage Condition Somewhat poorly
- 8. Groundwater Table 1.0 m

9. Profile Description

	Depth (cm)	Description
Ap	0 - 16	Brownish black (10YR2/3) wet; silty loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; many fine roots; clear smooth boundary
C <sub>1</sub>	16 - 50	Yellowish brown (10YR5/6) wet; clay loam; moderate medium angular blocky; sticky and plasticity; few fine roots; gradual smooth boundary
C <sub>21g</sub>	50 - 90	Dull yellow orange (10YR6/3) wet; sandy loam; weak fine angular blocky; non-sticky and non-plasticity; many faint medium mottlings (10YR5/6); gradual smooth boundary
C <sub>22g</sub>	90 +	Dull yellow orange (10YR7/3) wet; loamy sand; structureless; non-sticky and non-plasticity; many faint fine mottlings (10YR5/6)

Table III-9 SOIL PROFILE DESCRIPTION (22/49)

1. Profile Number 23
2. Soil Classification
  - a. Indonesian system Distric Gleysols
  - b. FAO Distric Gleysols
3. Location 3 km N.E. of SKP D DU
4. Physiography Alluvial plain
5. Slope Flat
6. Vegetation or Land Use Fallow
7. Drainage Condition Somewhat poorly
8. Groundwater Table >1.2 m

9. Profile Description

	Depth (cm)	Description
Ap	0 - 12	Dark brown (10YR3/4) moist; clay loam; weak fine angular blocky; slightly sticky and slightly plasticity; common medium roots; clear smooth boundary
B <sub>1</sub>	12 - 45	Bright yellowish orange (10YR6/6) moist; sandy loam; structureless; slightly sticky and slightly plasticity; few fine roots; clear smooth boundary
C <sub>1g</sub>	45 - 65	Dull yellow orange (10YR6/4) moist; sandy loam; structureless; non-sticky and non-plasticity; many faint medium mottlings (5YR4/8); clear smooth boundary
C <sub>2g</sub>	65 - 120(+)	Grayish yellow (2.5Y6/2) moist; clay; structureless massive; very sticky and very plasticity; many distinct medium mottlings (5YR4/8)



Table III-9 SOIL PROFILE DESCRIPTION (23/49)

1. Profile Number	24
2. Soil Classification	
a. Indonesian system	Distric Gleysols
b. FAO	Distric Gleysols
3. Location	8 km N.E. of SKP D DU
4. Physiography	Alluvial plain
5. Slope	Gently sloping (2-6%)
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	>1.5 m

9. Profile Description

	<u>Depth (cm)</u>	<u>Description</u>
0	0 - 2	Organic matter
Ap	2 - 25	Bright brown (7.5YR5/6) moist; clay; strong medium angular blocky; very sticky and very plasticity; common medium and fine roots; clear smooth boundary
B <sub>1g</sub>	25 - 40	Light yellow (2.5Y7/4) moist; sandy clay loam; structureless massive; slightly sticky and slightly plasticity; few medium roots; common distinct medium mottlings (7.5YR5/6); gradual smooth boundary
B <sub>2g</sub>	40 - 90+	Light gray (2.5Y7/1) moist; clay; structureless massive; sticky and plasticity; common distinct medium mottlings (7.5YR5/6)

Table III-9 SOIL PROFILE DESCRIPTION (24/49)

1. Profile Number 25
2. Soil Classification
  - a. Indonesian system Humic Podzolic Soils
  - b. FAO Humic Acrisols
3. Location 10 km north of SKP C DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Well
8. Groundwater Table >1.5 m

9. Profile Description

	Depth (cm)	Description
0	0 - 8	Organic matter
A <sub>1</sub>	8 - 30	Olive brown (2.5Y4/4) moist; sandy loam; weak medium subangular blocky; slightly sticky and slightly plasticity; common medium and fine roots; clear smooth boundary
B <sub>1</sub>	30 - 42	Brownish black (2.5Y3/1) moist; sandy loam; weak medium subangular blocky; non-sticky and non-plasticity; few medium and fine roots; clear smooth boundary
B <sub>21t</sub>	42 - 70	Yellowish brown (10YR5/6) moist; sandy clay loam; weak fine subangular blocky; slightly sticky and slightly plasticity; few medium and fine roots; clear smooth boundary
B <sub>22</sub>	70 - 95	Brownish black (7.5YR3/2) moist; sandy clay loam; weak medium subangular blocky; slightly sticky and slightly plasticity; gradual smooth boundary
C	95 - 120(+)	Bright yellowish brown (10YR6/6) moist; sandy loam; structureless single grain; slightly sticky and slightly plasticity

Table III-9 SOIL PROFILE DESCRIPTION (25/49)

1. Profile Number 26
2. Soil Classification
  - a. Indonesian system Distric Cambisols
  - b. FAO Distric Cambisols
3. Location 2 km West of SKP C DK II
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Well
8. Groundwater Table >1.5 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A	5 - 18	Brown (10YR4/4) moist; sandy loam; weak fine angular blocky; slightly sticky and non-plasticity when wet, very friable when moist; common fine roots gradual smooth boundary
B <sub>1</sub>	18 - 52	Yellowish brown (2.5Y5/6) moist; sandy loam; weak fine angular blocky; slightly sticky and non-plasticity when wet, very friable when moist; gradual smooth boundary
B <sub>21</sub>	52 - 69	Bright yellowish brown (2.5Y6/8) moist; sandy loam; structureless; slightly sticky and non-plasticity when wet, very friable when moist; clear wavy boundary
B <sub>22</sub>	69 - 110	Bright yellowish brown (2.5Y6/8) moist; sandy skeltal; structureless; non-sticky and non-plasticity; gradual wavy boundary
B <sub>23</sub>	110 - 120	Bright yellowish brown (2.5Y6/8) moist; sandy loam; structureless; slightly sticky and non-plasticity when wet, very friable when moist

Table III-9 SOIL PROFILE DESCRIPTION (26/49)

1.	Profile Number	27
2.	Soil Classification	
	a. Indonesian system	Umbric Cambisols
	b. FAO	Humic Cambisols
3.	Location	2.5 km N.E. of SKP. C DK II
4.	Physiography	Terrace
5.	Slope	Flat
6.	Vegetation or Land Use	Primary forest
7.	Drainage Condition	Somewhat poorly
8.	Groundwater Table	0.6 m
9.	Profile Description	
	<u>Depth (cm)</u>	<u>Description</u>
0	0 - 10	Organic matter
A <sub>1</sub>	10 - 30	Black (10YR1.7/1) wet; loam; structureless crumb; non-sticky and non-plasticity; common fine roots clear smooth boundary
B	30 - 65	Dull yellow (2.5Y6/3) wet; sandy loam; structureless; slightly sticky and non-plasticity; gradual smooth boundary
C	65 +	Light gray (2.5Y8/1) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (27/49)

1. Profile Number	28
2. Soil Classification	
a. Indonesian system	Humic Podzolic Soils
b. FAO	Humic Acrisols
3. Location	3 km N.E. of SKP C DK II
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Moderately well
8. Groundwater Table	>1.5 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 30	Dark brown (10YR3/4) moist; sandy loam; structureless crumb; non-sticky and non-plasticity when wet, very friable when moist; few medium and fine roots; clear smooth boundary
B <sub>1</sub>	30 - 42	Black (10YR2/1) moist; sandy loam; structureless; non-sticky and non-plasticity when wet, very friable when moist; clear smooth boundary
B <sub>21t</sub>	45 - 60	Bright yellowish brown (10YR6/6) moist; sandy clay loam; weak subangular blocky; slightly sticky and slightly plasticity when wet, friable when moist; gradual smooth boundary
B <sub>22</sub>	60 - 135	Bright yellowish brown (10YR6/6) wet; sandy loam; structureless massive; non-sticky and non-plasticity; clear smooth boundary
C	135+	Light gray (2.5Y8/1) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (28/49)

- 1. Profile Number 29
- 2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
- 3. Location SKP C DK III
- 4. Physiography Terrace
- 5. Slope Flat
- 6. Vegetation or Land Use Fallow
- 7. Drainage Condition Poorly
- 8. Groundwater Table 0.7 m
- 9. Profile Description

	Depth (cm)	Description
Ap	0 - 20	Brownish black (7.5YR3/1) wet; sandy loam; weak fine granular; slightly sticky and slightly plasticity; common fine roots; clear smooth boundary
B <sub>11</sub>	20 - 25	Black (10YR1.7/1) wet; loam; structureless crumb; slightly sticky and slightly plasticity; few fine roots; clear smooth boundary
B <sub>12</sub>	25 - 55	Dark brown (10YR3/3) wet; loam; structureless crumb; slightly sticky and slightly plasticity; clear smooth boundary
B <sub>2</sub>	55 - 75	Dull yellow orange (2.5Y7/2) wet; silty loam; structureless; slightly sticky and slightly plasticity; clear wavy boundary
C	75 +	Light gray (2.5Y8/1) wet; sand; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (29/49)

1. Profile Number 30
2. Soil Classification
  - a. Indonesian system Umbric Gleysols
  - b. FAO Humic Gleysols
3. Location 0.5 km West of SKP C DK III
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Bush
7. Drainage Condition Poorly
8. Groundwater Table 0.4 m

9. Profile Description

	Depth (cm)	Description
0	0 - 3	Organic matter
A <sub>1</sub>	3 - 30	Brownish black (10YR2/3) wet; loam; structureless crumb; slightly sticky and slightly plasticity; many fine roots; many medium pores; gradual smooth boundary
B <sub>g</sub>	30 - 60	Brownish gray (7.5YR4/1) wet; sandy clay loam; slightly sticky and non-plasticity; many medium pores;
C	60 +	Light gray (10YR8/1) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Note: Augered below 40 cm

Table III-9 SOIL PROFILE DESCRIPTION (30/49)

1. Profile Number 31
2. Soil Classification
  - a. Indonesian system Umbric Gleysols
  - b. FAO Humic Gleysols
3. Location 1.5 km S.W. of SKP C DK III
4. Physiography Terrace
5. Slope Almost flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Poorly
8. Groundwater Table 0.5 m

9. Profile Description

	Depth (cm)	Description
0	0 - 7	Organic matter
A <sub>1</sub>	7 - 20	Brownish black (10YR3/2) wet; loam; weak medium granular; slightly sticky and slightly plasticity; many fine roots and few medium roots; gradual smooth boundary
B <sub>1g</sub>	20 - 32	Dark grayish yellow (2.5Y5/2) wet; clay loam; weak medium subangular blocky; sticky and slightly plasticity; few distinct medium mottlings (7.5YR5/6); many medium pores; few medium roots; gradual smooth boundary
B <sub>2g</sub>	32 - 70	Yellowish brown (2.5Y5/3) wet; clay loam; weak medium subangular blocky; sticky and plasticity; few distinct medium mottlings (7.5YR5/6); many medium pores; few medium roots
C	70 +	Light gray (2.5Y8/2) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Note: Augered below 50 cm



Table III-9 SOIL PROFILE DESCRIPTION (31/49)

1.	Profile Number	32
2.	Soil Classification	
	a. Indonesian system	Distric Cambisols
	b. FAO	Distric Cambisols
3.	Location	5 km North of SKP D DU
4.	Physiography	Terrace
5.	Slope	Almost flat
6.	Vegetation or Land Use	Primary forest
7.	Drainage Condition	Somewhat poorly
8.	Groundwater Table	1.1 m
9.	Profile Description	
	<u>Depth (cm)</u>	<u>Description</u>
A <sub>1</sub>	0 - 12	Brownish black (7.5YR3/2) wet; sandy loam; weak fine granular; slightly sticky and non-plasticity; many fine and medium roots; clear smooth boundary
B <sub>1</sub>	12 - 40	Olive brown (2.5Y4/3) wet; sandy loam; weak medium angular blocky; slightly sticky and slightly plasticity; many fine roots and common medium roots; clear wavy boundary
B <sub>21</sub>	40 - 80	Yellowish brown (10YR5/8) wet; clay loam; moderate medium angular blocky; sticky and slightly plasticity; gradual smooth boundary
B <sub>22</sub>	80 - 105	Yellowish brown (10YR5/6) wet; clay loam; moderate medium angular blocky; sticky and slightly plasticity; clear smooth boundary
C	105 - 120	Grayish yellow (2.5Y7/2) wet; loamy sand; structureless massive; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (32/49)

1. Profile Number	33
2. Soil Classification	
a. Indonesian system	Distric Cambisols
b. FAO	Distric Cambisols
3. Location	2.5 km N.W. of SKP D DU
4. Physiography	Terrace
5. Slope	Almost flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	1.1 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 8	Light gray (7.5YR8/2) wet; loam; weak fine granular; slightly sticky and slightly plasticity; clear wavy boundary
B <sub>1</sub>	8 - 23	Dull yellowish brown (10YR4/3) wet; clay loam; weak medium subangular blocky; sticky and plasticity; many fine roots, common medium roots; gradual wavy boundary
B <sub>21</sub>	23 - 40	Dull yellowish brown (10YR5/3) wet; clay loam; weak medium subangular blocky; sticky and plasticity; few medium and fine roots; gradual wavy boundary
B <sub>22</sub>	40 - 73	Light yellow (2.5Y7/3) wet; silty clay loam; weak medium subangular blocky; sticky and plasticity; few medium and fine roots; clear wavy boundary
C	73 - 110	Light gray (5Y7/2) wet; loamy sand; structureless; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (33/49)

- |                           |                         |
|---------------------------|-------------------------|
| 1. Profile Number         | 34                      |
| 2. Soil Classification    |                         |
| a. Indonesian system      | Distric Cambisols       |
| b. FAO                    | Distric Cambisols       |
| 3. Location               | 2.5 km West of SKP D DU |
| 4. Physiography           | Terrace                 |
| 5. Slope                  | Gently sloping          |
| 6. Vegetation or Land Use | Primary forest          |
| 7. Drainage Condition     | Moderately well         |
| 8. Groundwater Table      | >1.2 m                  |

9. Profile Description

	Depth (cm)	Description
A <sub>11</sub>	0 - 3	Brownish black (7.5YR3/2) moist; loam; weak fine granular; slightly sticky and slightly plasticity; many fine and medium roots; clear smooth boundary
A <sub>12</sub>	3 - 22	Brown (7.5YR4/4) moist; sandy clay loam; weak fine granular; sticky and slightly plasticity; common medium roots; gradual smooth boundary
B <sub>1</sub>	22 - 46	Yellowish brown (10YR5/6) moist; sandy clay loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; common medium roots; gradual wavy boundary
B <sub>2</sub>	46 - 68	Bright yellowish brown (10YR6/6) wet; sandy clay; moderate medium subangular blocky; sticky and plasticity; few medium roots; diffuse wavy boundary
B <sub>3</sub>	68 - 120	Light yellow (2.5Y7/4) wet; sandy loam; structureless; slightly sticky and non-sticky

Table III-9. SOIL PROFILE DESCRIPTION (34/49)

- |                           |                        |
|---------------------------|------------------------|
| 1. Profile Number         | 35                     |
| 2. Soil Classification    |                        |
| a. Indonesian system      | Distric Cambisols      |
| b. FAO                    | Distric Cambisols      |
| 3. Location               | 1 km North of SKP D DU |
| 4. Physiography           | Terrace                |
| 5. Slope                  | Almost flat            |
| 6. Vegetation or Land Use | Alang-alang            |
| 7. Drainage Condition     | Moderately well        |
| 8. Groundwater Table      | >1.5 m                 |

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 18	Dark brown (10YR3/4) moist; loam; weak fine granular; slightly sticky and slightly plasticity when wet, friable when moist; many medium and fine roots; clear smooth boundary
B <sub>1</sub>	18 - 45	Dull yellow orange (10YR6/4) moist; sandy clay loam; moderate medium blocky; sticky and slightly plasticity when wet, very firm when moist, gradual smooth boundary
B <sub>2</sub>	45 - 120(+)	Bright yellow brown (10YR7/6) moist; sandy clay loam; moderate medium blocky; sticky and slightly plasticity when wet, very firm when moist

Table III-9 SOIL PROFILE DESCRIPTION (35/49)

1. Profile Number 36
2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
3. Location 1.5 km N.E. of SKP C DU
4. Physiography Terrace
5. Slope Gently sloping
6. Vegetation or Land Use Primary forest
7. Drainage Condition Somewhat poorly
8. Groundwater Table 0.7 m

9. Profile Description

	Depth (cm)	Description
0	0 - 9	Organic matter
A <sub>1</sub>	9 - 23	Black (7.5YR1.7/1) wet; sandy loam; weak fine granular slightly sticky and non-plasticity; few medium roots, many fine roots; clear smooth boundary
B <sub>1</sub>	23 - 30	Brownish black (2.5Y3/2) wet; loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; few medium roots, many fine roots; gradual smooth boundary
B <sub>2</sub>	30 - 60	Yellowish brown (10YR5/6) wet; clay loam; moderate medium subangular blocky; sticky and slightly plasticity; few fine roots; gradual wavy boundary
B <sub>3</sub>	60 - 80	Dull orange (7.5YR7/4) wet; clay loam; moderate medium subangular blocky; sticky and slightly plasticity
C	80 +	Grayish yellow (2.5Y7/2) wet; sand; structureless single grain; non-sticky and non-plasticity

Note : Augered below 70 cm

Table III-9 SOIL PROFILE DESCRIPTION (36/49)

1. Profile Number 37
2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
3. Location 1 km N.W. of SKP C DU
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Poorly
8. Groundwater Table 0.2 m

9. Profile Description

	Depth (cm)	Description
0	0 - 15	Organic matter
A <sub>1</sub>	15 - 30	Black (7.5YR1.7/1) wet; clay loam; weak fine subangular blocky; slightly sticky and slightly plasticity; common fine roots; clear smooth boundary
B	30 - 60	Dull yellow orange (10YR6/3) wet; silty clay; moderate medium subangular blocky; sticky and plasticity
BC	60 - 90	Grayish yellow (2.5Y7/2) wet; silty loam; structureless; non-sticky and non-plasticity
C	89 -	Grayish yellow (2.5Y7/2) wet; silty clay; sticky and plasticity

Note: Augered below 20 cm

Table III-9 SOIL PROFILE DESCRIPTION (37/49)

1. Profile Number 38
2. Soil Classification
  - a. Indonesian system Umbric Podzolic Soils
  - b. FAO Humic Acrisols
3. Location 3 km West of SKP C DK II
4. Physiography Terrace
5. Topography Almost flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Moderately well
8. Groundwater Table >0.9 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 12	Brownish black (7.5YR3/2) wet; loam; weak fine granular; slightly sticky and non-plasticity; many medium and fine roots; clear smooth boundary
B <sub>1</sub>	12 - 30	Black (10YR2/1) wet; loam; weak fine angular blocky; slightly sticky and non-plasticity; common medium roots, many fine roots; clear smooth boundary
B <sub>21t</sub>	30 - 65	Bright yellow brown (10YR6/6) wet; clay loam; moderate fine angular blocky; sticky and plasticity; common medium and fine roots; gradual smooth boundary
B <sub>22</sub>	65 - 75	Bright yellow brown (10YR6/6) wet; sandy loam; structureless massive; non-sticky and non-plasticity; clear wavy boundary
C	75 - 90+	Light gray (2.5Y8/2) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (38/49)

1. Profile Number	39
2. Soil Classification	
a. Indonesian system	Umbric Cambisols
b. FAO	Humic Cambisols
3. Location	S.W. of SKP C DK II
4. Physiography	Terrace
5. Slope	Almost flat
6. Vegetation or Land Use	Crop field
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	1.0 m

9. Profile Description

	Depth (cm)	Description
Ap	0 - 15	Dark brown (10YR3/3) wet; loam; structureless; sticky and non-plasticity; many fine and medium roots; clear smooth boundary
B <sub>1</sub>	15 - 35	Black (10YR1.7/1) wet; loam; weak fine granular; slightly sticky and non-plasticity; many medium and fine roots; clear wavy boundary
B <sub>21</sub>	35 - 80	Dull yellow orange (10YR7/3) wet; sandy clay loam; moderate medium subangular blocky; sticky and slightly plasticity; common fine roots; gradual wavy boundary
B <sub>22</sub>	80 - 110	Light brownish gray (7.5YR7/2) wet; sandy clay loam; moderate medium subangular blocky; sticky and slightly plasticity; gradual wavy boundary
C	110 - 120 +	Light gray (2.5Y8/1) wet; sandy clay; structureless massive; sticky and slightly plasticity



Table III-9 SOIL PROFILE DESCRIPTION (39/49)

1. Profile Number 40
2. Soil Classification
  - a. Indonesian system Distric Cambisol
  - b. FAO Distric Cambisols
3. Location 1 km East of SKP C DK III
4. Physiography Terrace
5. Slope Gently sloping
6. Vegetation or Land Use Primary forest
7. Drainage Condition Moderately well
8. Groundwater Table >1.5 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 12	Brown (7.5YR4/4) wet; sandy clay loam; weak medium subangular blocky; sticky and slightly plasticity; many medium and fine roots; clear smooth boundary
B <sub>1</sub>	12 - 35	Brown (10YR4/4) wet; sandy clay loam; weak medium subangular blocky; sticky and slightly plasticity; common medium roots, many fine roots; gradual smooth boundary
B <sub>2</sub>	35 - 110	Yellowish brown (10YR5/6) wet; sandy clay; moderate medium subangular blocky; sticky and slightly plasticity; few medium roots; clear smooth boundary
B <sub>3</sub>	110 - 115	Dull yellow orange (10YR7/4) wet; sandy loam; structureless; non-sticky and non-plasticity; clear smooth boundary
C	115 - 120 +	Light gray (2.5Y/1) wet; sand; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (40/49)

1. Profile Number	41
2. Soil Classification	
a. Indonesian system	Distric Cambisol
b. FAO	Distric Cambisols
3. Location	N.E. of SKP C DK III
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	0.9 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 15	Dull yellowish brown (10YR4/3) wet; loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; many medium and fine roots; gradual smooth boundary
B <sub>1</sub>	15 - 50	Dull yellow orange (10YR6/3) wet; clay loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; common medium and fine roots; gradual smooth boundary
B <sub>2</sub>	50 - 75	Dull yellow (2.5Y6/3) wet; loam; moderate medium subangular blocky; slightly sticky and slightly plasticity; gradual smooth boundary
B	75 - 85	Grayish yellow (2.5Y7/2) wet; silty loam; structureless; non-sticky and non-plasticity; clear smooth boundary
C	85 +	Light gray (2.5Y8/1) wet; sandy loam; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (41/49)

1. Profile Number 42
2. Soil Classification
  - a. Indonesian system Umbric Podzolic Soils
  - b. FAO Humic Acrisols
3. Location 2 km N.E. of SKP C DK IV
4. Physiography Terrace
5. Slope Gently sloping
6. Vegetation or Land Use Primary forest
7. Drainage Condition Somewhat poorly
8. Groundwater Table 1.0 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 20	Brownish black (10YR3/2) wet; clay loam; weak fine subangular blocky; sticky and slightly plasticity; many medium and fine roots; clear smooth boundary
B <sub>1</sub>	20 - 32	Black (10YR2/1) wet; clay loam; weak fine subangular blocky; sticky and slightly plasticity; few medium roots, common fine roots; clear smooth boundary
B <sub>2t</sub>	32 - 52	Dull yellowish brown (10YR5/3) wet; silty clay; moderate fine subangular blocky; sticky and plasticity; few fine roots; gradual smooth boundary
B <sub>3</sub>	52 - 85	Grayish brown (7.5YR5/2) wet; silty clay loam; moderate fine subangular blocky; sticky and plasticity; gradual smooth boundary
C	85 +	Grayish yellow (2.5Y7/2) wet; sandy loam; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (42/49)

1. Profile Number	43
2. Soil Classification	
a. Indonesian system	Distric Cambisols
b. FAO	Distric Cambisols
3. Location	0.5 km North of Sitalus R.
4. Physiography	Terrace
5. Slope	Almost flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Moderately well
8. Groundwater Table	>1.2 m

9. Profile Description

	Depth (cm)	Description
0	0 - 3	Organic matter
A <sub>1</sub>	3 - 9	Brown (7.5YR4/3) wet; loam; moderate fine granular; sticky and plasticity; common medium roots, many fine roots; gradual smooth boundary
B <sub>1</sub>	9 - 21	Dull yellowish brown (10YR4/3) wet; clay loam; moderate fine subangular blocky; sticky and slightly plasticity; common medium roots, many fine roots; gradual wavy boundary
B <sub>21</sub>	21 - 37	Grayish yellow brown (10YR5/2) wet; sandy clay; moderate medium subangular blocky; sticky and plasticity; few medium roots, common fine roots; gradual wavy boundary
B <sub>22</sub>	37 - 75	Dull yellow orange (10YR6/3) wet; sandy clay; moderate medium subangular blocky; sticky and plasticity; few medium root; gradual wavy boundary
B <sub>3</sub>	75 - 100(+)	Grayish yellow (2.5Y7/2) wet; sandy clay; structureless massive; sticky and plasticity

Table III-9 SOIL PROFILE DESCRIPTION (43/49)

1. Profile Number 44
2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
3. Location South of SKP D DK I
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Primary forest
7. Drainage Condition Poorly
8. Groundwater Table 0.5 m
9. Profile Description

	Depth (cm)	Description
O	0 - 5	Organic matter
A <sub>1</sub>	5 - 10	Very dark reddish brown (2.5YR2/3) wet; loam, weak medium granular; slightly sticky and non-plasticity; many medium and fine roots; clear smooth boundary
B <sub>11</sub>	10 - 25	Dark brown (10YR3/3) wet; loam; weak medium granular; slightly sticky and non-plasticity; many medium and fine roots; clear smooth boundary
B <sub>12</sub>	25 - 32	Dull yellowish brown (10YR4/3) wet; loam; structureless; slightly sticky and non-plasticity; common medium roots, many fine roots; gradual smooth boundary
B <sub>21</sub>	32 - 60	Dull yellowish brown (10YR5/4) wet; sandy loam, structureless; non-sticky and non-plasticity; common medium pores; few medium roots
B <sub>22</sub>	60 - 100	Dull yellowish brown (10YR5/3) wet; sandy loam structureless; non-sticky and non-plasticity; common medium pores
C	100 +	Light gray (2.5Y*/2) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Note: Augered below 50 cm

Table III-9 SOIL PROFILE DESCRIPTION (44/49)

1. Profile Number 45
2. Soil Classification
  - a. Indonesian system Umbric Cambisols
  - b. FAO Humic Cambisols
3. Location 1 km N.W. of SKP D DK I
4. Physiography Terrace
5. Slope Flat
6. Vegetation or Land Use Rubber forest
7. Drainage Condition Poorly
8. Groundwater Table 0.5 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 5	Brownish black (7.5YR3/2) wet; loam; moderate fine granular; slightly sticky and slightly plasticity; common fine roots; clear smooth boundary
A <sub>12</sub>	5 - 22	Brownish black (10YR3/2) wet; loam; weak medium angular blocky; slightly sticky and slightly plasticity; common medium and fine roots; clear smooth boundary
B <sub>1</sub>	22 - 42	Brownish black (10YR3/1) wet; loam; weak medium angular blocky; slightly sticky and slightly plasticity; few medium roots; clear smooth boundary
B <sub>2</sub>	42 - 55	Dull yellowish brown (10YR5/3) wet; loam; slightly sticky and slightly plasticity
B <sub>3</sub>	55 - 80	Dull yellow orange (10YR7/4) wet; clay loam; sticky and slightly plasticity
C	80 +	Light gray (2.5Y8/2) wet; loamy sand; non-sticky and non-plasticity

Note: Augered below 50 cm

Table III-9 SOIL PROFILE DESCRIPTION (45/49)

1. Profile Number	46
2. Soil Classification	
a. Indonesian system	Gleyic Alluvial Soils
b. FAO	Distric Fluvisols
3. Location	0.5 km N.W. of SKP D DK II
4. Physiography	Alluvial plain
5. Slope	Almost flat
6. Vegetation or Land Use	Banana
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	>1.2 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 10	Black (10YR2/1) wet; clay loam; moderate fine granular; sticky and plasticity; common medium and fine roots; clear smooth boundary
C <sub>1</sub>	10 - 25	Yellowish brown (10YR5/6) wet; clay; structureless massive; very sticky and very plasticity; few medium roots; clear smooth boundary
C <sub>2</sub>	25 - 40	Yellowish brown (10YR5/6) wet; sandy clay; structureless massive; sticky and slightly plasticity; few medium roots; clear smooth boundary
C <sub>3</sub>	40 - 50	Yellowish brown (10YR5/6) wet; sandy loam; structureless; slightly sticky and non-plasticity; clear smooth boundary
C <sub>4g</sub>	50 - 66	Dull yellowish brown (10YR5/4) wet; clay; structureless massive; very sticky and very plastic; common distinct fine mottlings (5YR5/8); clear smooth boundary
C <sub>5g</sub>	66 - 86	Grayish yellow brown (10YR6/2) wet; loamy sand; structureless; non-sticky and non-plasticity; common distinct medium mottlings (5YR5/8); clear smooth boundary
C <sub>6</sub>	86 - 120 +	Grayish yellow brown (10YR6/2) wet; silty clay; structureless massive; sticky and plasticity; common distinct medium mottlings (5YR5/8)

Table III-9 SOIL PROFILE DESCRIPTION (46/49)

1. Profile Number	47
2. Soil Classification	
a. Indonesian system	Umbric Cambisols
b. FAO	Humic Cambisols
3. Location	SKP D DK II
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Alang-alang
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	1.1 m

9. Profile Description

	<u>Depth (cm)</u>	<u>Description</u>
Ap	0 - 25	Brownish black (10YR2/2) wet; sandy loam; weak fine granular; non-sticky and non-plasticity; many fine roots; abrupt smooth boundary
B <sub>1</sub>	25 - 55	Olive brown (2.5Y4/3) wet; silty clay loam; structureless massive; sticky and plasticity; common fine roots; gradual smooth boundary
B <sub>21</sub>	55 - 85	Grayish brown (7.5YR4/2) wet; silty clay loam; structureless; sticky and plasticity; clear smooth boundary
B <sub>22</sub>	85 - 93	Grayish brown (7.5YR4/2) wet; sandy loam; structureless; slightly sticky and slightly plasticity abrupt wavy boundary
C	93 - 120 +	Light gray (2.5Y8/2) wet; sand; structureless single grain; non-sticky and non-plasticity



Table III-9 SOIL PROFILE DESCRIPTION (47/49)

1. Profile Number	48
2. Soil Classification	
a. Indonesian system	Umbric Cambisols
b. FAO	Humic Cambisols
3. Location	SKP D DK II
4. Physiography	Terrace
5. Slope	Flat
6. Vegetation or Land Use	Alang-alang
7. Drainage Condition	Somewhat poorly
8. Groundwater Table	1.1 m

9. Profile Description

	Depth (cm)	Description
A <sub>11</sub>	0 - 7	Black (10YR2/1) wet; loam; weak fine granular; slightly sticky and non-plasticity; common medium roots, many fine roots; clear smooth boundary
A <sub>12</sub>	7 - 32	Brownish black (10YR2/2) wet; silty loam; weak fine granular; slightly sticky and slightly plasticity; common medium roots, many fine roots; gradual wavy boundary
B <sub>1</sub>	32 - 95	Light yellow (10YR7/3) wet; silty clay loam; moderate medium subangular blocky; sticky and plasticity; few medium and fine roots; gradual wavy boundary
B <sub>2</sub>	95 - 105	Dull yellow orange (10YR6/3) wet; silty loam; structureless; slightly sticky and slightly plasticity; clear wavy boundary
C	105 - 120 +	Light gray (5Y8/2) wet; loamy sand; structureless single grain; non-sticky and non-plasticity

Table III-9 SOIL PROFILE DESCRIPTION (48/49)

1. Profile Number	49
2. Soil Classification	
a. Indonesian system	Distric Cambisol
b. FAO	Distric Cambisols
3. Location	West of SKP D DK I (near IP 29)
4. Physiography	Terrace
5. Slope	Gently sloping
6. Vegetation or Land Use	Alang-alang
7. Drainage Condition	Moderately well
8. Groundwater Table	>1.2 m

9. Profile Description

	Depth (cm)	Description
A <sub>1</sub>	0 - 4	Black (10YR1.7/1) moist; loam; weak fine granular; slightly sticky and slightly plasticity; common medium and fine roots; clear smooth boundary
B <sub>11</sub>	4 - 16	Brown (7.5YR4/4) moist; loam; weak fine subangular blocky; slightly sticky and slightly plasticity when wet, friable when moist; few medium roots, many fine roots; clear smooth boundary
B <sub>12</sub>	16 - 30	Brown (10YR4/4) moist; loam; weak fine subangular blocky; slightly sticky and slightly plasticity when wet, friable when moist; few medium roots, many fine roots; clear smooth boundary
B <sub>2</sub>	30 - 70	Bright yellowish brown (10YR6/6) moist; sandy clay loam; moderate medium subangular blocky; slightly sticky and slightly plasticity when wet; gradual smooth boundary
B <sub>3</sub>	70 - 100	Bright yellowish brown (10YR7/6) moist; sandy clay loam; moderate medium subangular blocky; slightly sticky and slightly plasticity when wet; friable when moist; clear wavy boundary
C	100 - 120 +	Yellow (2.5Y8/6) moist; sand; structureless, very compact; non-sticky and non-plasticity; common prominent coarse mottling (2.5YR4/8)

Table III-9 SOIL PROFILE DESCRIPTION (49/49)

1. Profile Number	50
2. Soil Classification	
a. Indonesian system	Distric Cambisol
b. FAO	Distric Cambisols
3. Location	1 km West of SKP D DK I
4. Physiography	Terrace
5. Slope	Almost flat
6. Vegetation or Land Use	Primary forest
7. Drainage Condition	Moderately well
8. Groundwater Table	>1.2 m

9. Profile Description

	Depth (cm)	Description
0	0 - 5	Organic matter
A <sub>1</sub>	5 - 13	Brown (10YR4/4) wet; clay loam; moderate fine subangular blocky; slightly sticky and plasticity; many medium and fine roots; clear smooth boundary
B <sub>1</sub>	13 - 45	Yellowish brown (10YR5/6) wet; sandy clay loam; weak fine subangular blocky; sticky and plasticity; common medium roots; gradual wavy boundary
B <sub>2</sub>	45 - 70	Bright yellowish brown (10YR6/6) wet; sandy clay loam; weak fine subangular blocky; sticky and plasticity; few medium roots; gradual wavy boundary
B <sub>3</sub>	70 - 105	Dull yellow orange (10YR6/4) wet; loamy sand; structureless; non-sticky and non-plasticity; abrupt wavy boundary
C	105 - 120 +	Grayish yellow (2.5Y7/2) wet; sand; structureless single grain; non-sticky and non-plasticity

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



Fig.III-1 Soil Map

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 BATANG KUMU IRRIGATION PROJECT  
 FEASIBILITY STUDY

**SOIL MAP**

JAPAN INTERNATIONAL COOPERATION AGENCY  
 TOKYO (JICA)

DWG NO.

Legend	Land use	Area (ha)	Proportional extent (%)
	Crop fields	2,600	8.8
	Grass land / Bush	2,800	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

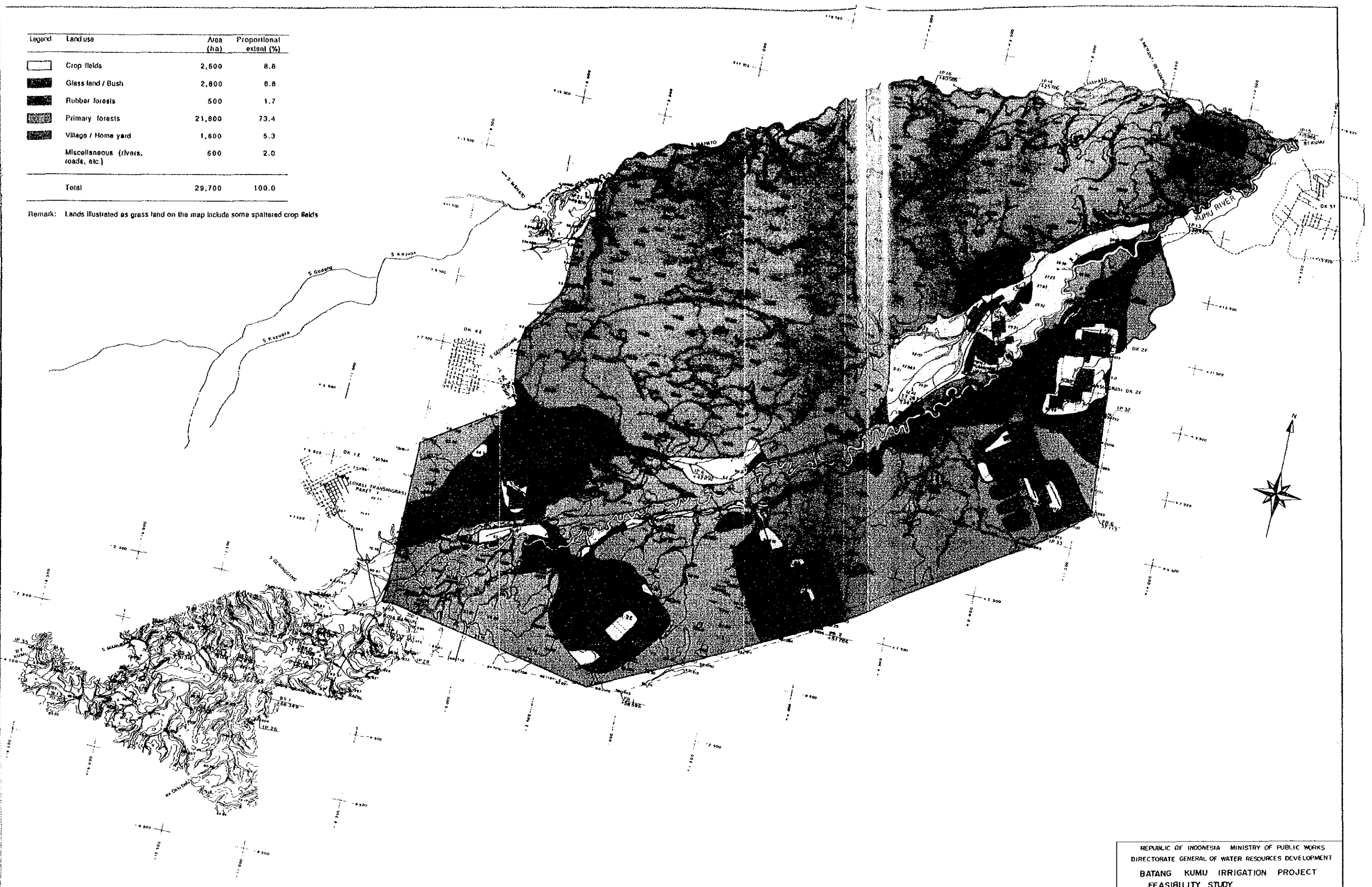
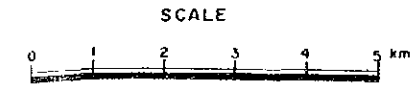


Fig.III-2 Present Land Use Map



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<b>PRESENT LAND USE MAP</b>	
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO (JICA)	DWG. NO. III-83

Legend	Land suitability	Soil mapping unit	(Unit : ha)		
			Right bank	Left bank	Total
	S2ld	1	800	4,000	4,800
	S3l	2, 3, 4	7,900	11,200	19,100
	N1ld	5	1,300	4,500	5,800
Total			10,000	19,700	29,700

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

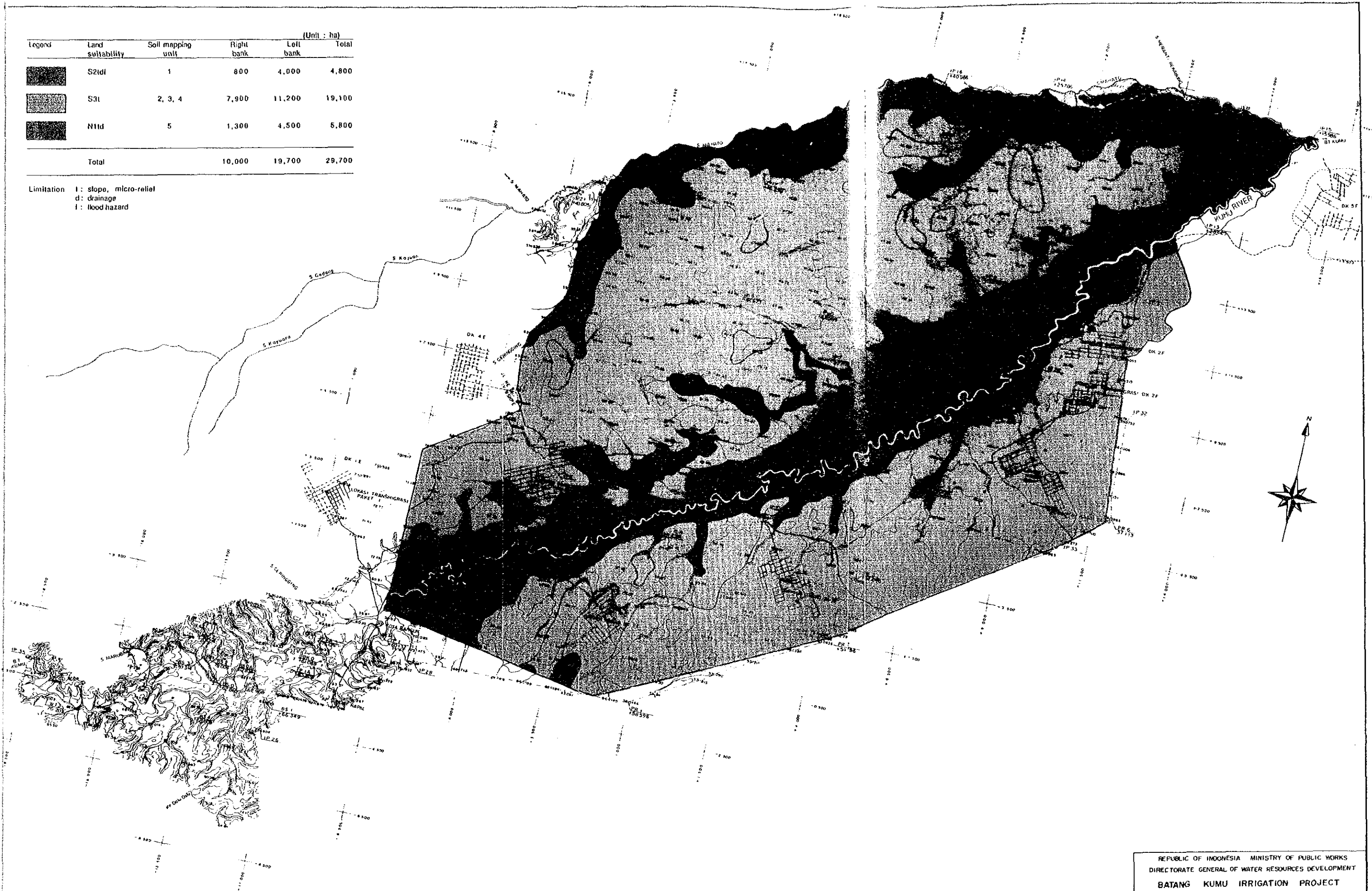
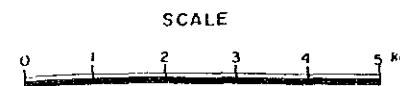


Fig.III-3 Land Suitability Map for Paddy



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

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

Remarks

S3nt  
S3n

Suitability for upland crops  
Suitability for perennial crops

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

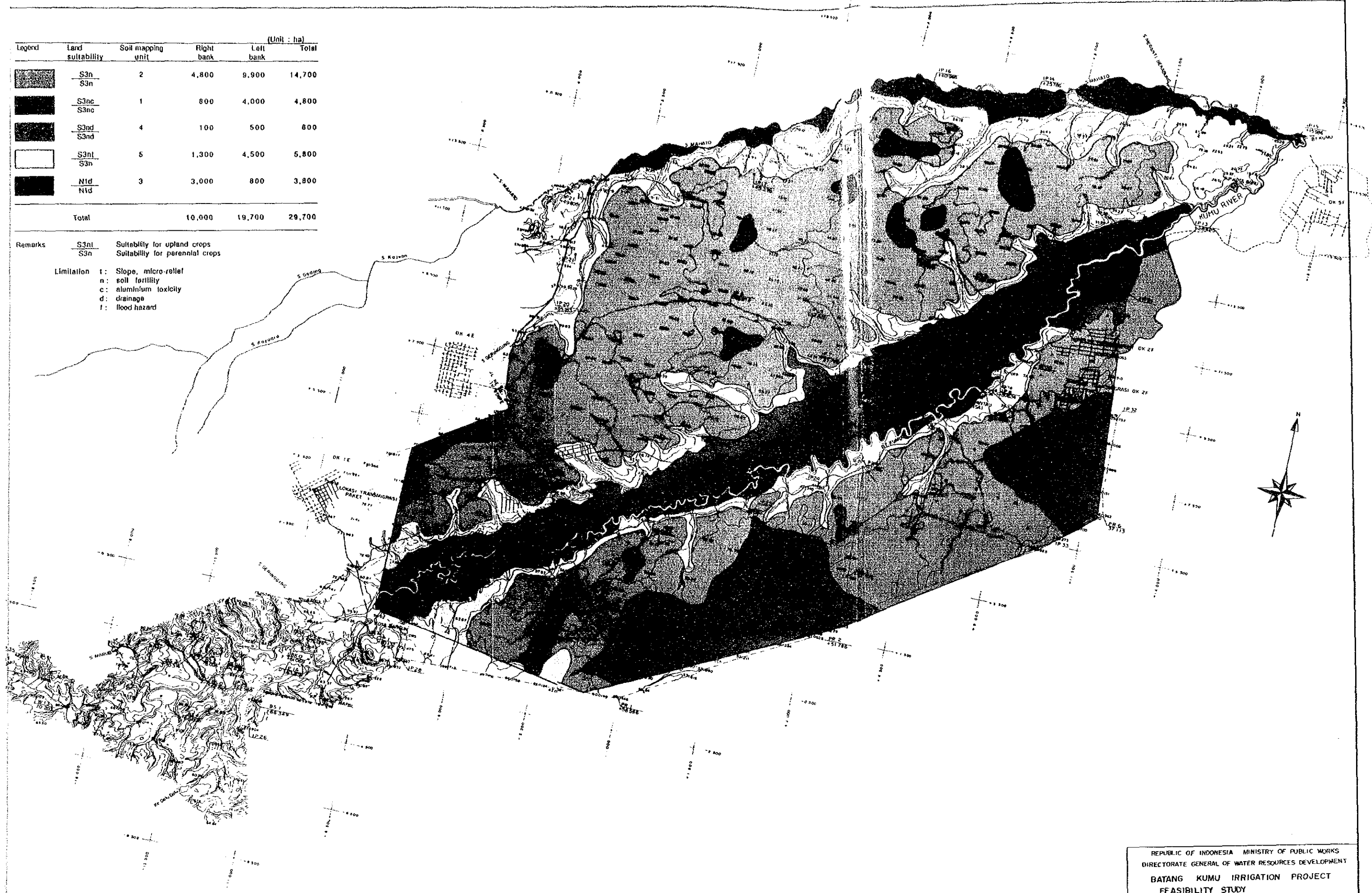
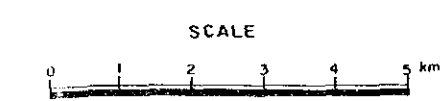


Fig.III-4 Land Suitability Map for Upland and Perennial Crops



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BATANG KUMU IRRIGATION PROJECT  
FEASIBILITY STUDY

LAND SUITABILITY MAP FOR  
UPLAND AND PERENNIAL CROPS

JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO (JICA) DWG NO.

