DRILL LOG

HOLE NO. B14 SHEET NO. 67 OF 73

PROJECT	KARIAN MULTIPURPOSE DAM CONSTRUCTION			DEPTH	15 m	ELEVATION	28.00 m
SITE	GADEG SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	TS.6
AVERAGE CORE RECOVERY		DATE	FROM Nov. 12 TO Nov. 13 1982	DRILLED	D P M A	LOGGED	*

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL
Nov. 12	3.5	24.50	Top soil		Soft, plastic, grayish brown,	D	▽
	5.6	22.40	Sandy clay		Tuffaceous, fine to medium grained, rather soft, gray to brown		
	8.0	20.00	Sandstone		Tuffaceous, fine to very fine grained, weathered		
Nov. 13	15.0	13.00	Claystone		Tuffaceous, hard, weathered, fractured, intercalated compact white gray tuffaceous claystone (10.5 - 11.5 m), partly sand content, moderate olive brown	CL	
					Diameter 76 mmφ		

CORE RECOVERY (%, cm) | R. Q. D | WATER PRESSURE TEST LUGEON VALUE (10, 20, 30, 40, 50) | DEPTH

89.7

42.4

NO TEST

5.6

HOLE NO. B14

LOG FORM-B

※R.Q.D is Rock Quality Designation. R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total core length) × 100%

※LUGEON VALUE is Lminum moder injection water pressure of 10kg/cm²

※DEPTH and ELEVATION are in meter

* Source : Ref. 5 , modified by JICA team's expert.

DRILL LOG

HOLE NO. BH 1 SHEET NO. 6 OF 7

PROJECT	KARAN MULTIPURPOSE DAM CONSTRUCTION			DEPTH	40m	ELEVATION	209.32m
SITE	QUARRY SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	
AVERAGE CORE RECOVERY		DATE	FROM oct. 9 TO oct. 1683	DRILLED	G. EPSILON	LOGGED	*

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL	CORE RECOVERY %	CORE RECOVERY cm	R. Q. D.	WATER PRESSURE TEST LUGEON VALUE	DEPTH
oct. 9	1.2	208.02	Residual Soil		grayish brown silty							
oct. 10	5		Tuffaceous silty clay		partly contain gravel to cobble (basalt) light olive brown	D						
oct. 11	10 11.0	198.32										
oct. 12	15		Hard weathered basaltic tuff breccia		crack joint rich almost clayey and soft light olive brown	C_L						
oct. 13	17.2	192.02										
	20		weathered basaltic tuff breccia		rather soft vertical joint with clay seam greenish gray	C_M						
	21.8	187.42										
oct. 14	25		Basaltic tuff breccia		medium fresh basaltic tuffy breccia (or part medium hard well cemented partly (27.8 - 29.7m) certain calcite seam greenish gray to dark gray and partly water weathered	C_H ~ B						
oct. 15	30											
	35											
	40	169.42										
					Bit Diameter = 75mm							

LOG FORM-B

HOLE NO. BH 1

*R.Q.D is Rock Quality Designation. R.Q.D = (Total length of cylindric cores longer than 10 cm)/(Total core length) x 100%
#LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm²
+DEPTH and ELEVATION are in meter

* Source : Ref. 6 , modified by JICA team's expert

DRILL LOG

HOLE NO. BG 2 SHEET NO. 6P OF 73

PROJECT	KARIAN MULTIPURPOSE DAM CONSTRUCTION			DEPTH	35m	ELEVATION	172.48m
SITE	QUARRY SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	
AVERAGE CORE RECOVERY		DATE	FROM Oct. 24 TO Oct. 27 '83	DRILLED	A. EPSILON	LOGGED	*

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL	CORE RECOVERY %	CORE RECOVERY cm	R. Q. D	WATER PRESSURE TEST LUGEON VALUE	DEPTH
Oct. 24	0.5	172.18	Top Soil		Brown soft							
	3.0	169.48	Tuffaceous clay		red clay with gray basaltic gravel	D						
	5		Residual soil		weathered basaltic tuff breccia, totally clayey yellow brown							
	6.0	166.48										
Oct. 25	7.4	165.08	Basaltic tuff breccia		Fractured, weathered basaltic tuff breccia with clay seam joint light gray	CL						
	10		Basaltic tuff breccia			CH						
	12.8	159.68			Compact fresh basaltic tuff breccia, medium hard to hard with calcite joint, dark gray	CL						
	15	157.48	Weathered Tuff breccia									
Oct. 26	20		Basaltic tuff breccia		Cracky basaltic tuff breccia, weathered with calcite joint and open joint, medium dark gray	CH ? B						
	22.3	150.18										
	25		Basaltic tuff breccia		Medium hard to hard compact good RQD, partly fractured (16-18m), dark gray							
Oct. 27	30				Soft to rather hard consolidated, partly fractured and weakness, greatly altered by weathering							
	33.0	139.48										
	35	137.48	Basaltic tuff breccia		medium hard to hard compact, with calcite veine dark gray, fresh							
					Bit Diameter = 73mmφ							

HOLE NO. BG. 2

LOG FORM-B

*R.Q.D is Rock Quality Designation, R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total core length) × 100%
#LUGEON VALUE is lt/min/m under injection water pressure of 10kg/cm²
*DEPTH and ELEVATION are in meter

* Source : Ref. 6 , modified by JICA team's expert.

DRILL LOG

HOLE NO. BS 3 SHEET NO. 20 OF 23

PROJECT	KARIAN MULTIPURPOSE DAM CONSTRUCTION			DEPTH	35 m	ELEVATION	163.46 m
SITE	QUARRY SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	
AVERAGE CORE RECOVERY		DATE	FROM 30 Oct. TO 3 Nov. 83	DRILLED	G. EPSILON	LOGGED	*

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL	CORE RECOVERY % / cm	R. Q. D	WATER PRESSURE TEST LUGEON VALUE	DEPTH
Oct. 30	0.8	162.66	Top Soil		grayish brown, sopt						
	5		Residual Soil		weathered granite tuff breccia, loose, soft and clayey altered by weathering, light olive brown	D					
Oct. 31	9.6	153.86									
	10 / 10.3	153.86	basalt		Semi weathered basaltic tuff breccia, soft, cracky fractured, light gray						
Nov. 1	15		Basaltic tuff breccia		medium hard, medium freshness, compact partly (21-22.3m) weathered, fractured with vertical open joint rich	CH					
	20										
Nov. 2	25					CM					
	30				Compact and fractured light gray, medium hardness						
	31.4	132.06									
Nov. 3	34.5	128.96	weathered basaltic tuff breccia			CL					
	35	128.46	clay		Soft, compact, gray						
					Bit diameter 73 mm φ						

HOLE NO. BS 3

LOG FORM-B

*R.Q.D is Rock Quality Designation. R.Q.D= (Total length of cylindric cores longer than 10 cm) / (Total core length) × 100%

*LUGEON VALUE is L/min/m under injection water pressure of 10kg/cm²

*DEPTH and ELEVATION are in meter

* Source : Ref. 6 , modified by JICA team's expert.

DRILL LOG

HOLE NO. B6r.4 SHEET NO. 7/ OF 73

PROJECT	KARIAN MULTIPURPOSE DAM CONSTRUCTION			DEPTH	40 m	ELEVATION	172.26 m
SITE	QUARRY SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	
AVERAGE CORE RECOVERY		DATE	FROM Nov. 5 TO Nov. 11 '83	DRILLED	G. EPSILON	LOGGED	*

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL	CORE RECOVERY % / cm	R. Q. D %	WATER PRESSURE TEST LUGEON VALUE	DEPTH
Nov. 5	1.0	171.26	Top soil		Tuffaceous, mixing black ash, contain basaltic gravel (10 cm φ), brown						
Nov. 6	5		Residual Soil		Tuffaceous, loose, soft, not compact, partly sandy and contain some hard gravel (8 cm φ) yellow brown	D					
	10										
	12.0	161.26			Semi weathered fractured moderate red to olive brown						
Nov. 7	13.0	159.26	Basaltic tuff breccia			CL					
	15				Compact, calcite vein developed, partly (26.5 – 30 m) deep weathered, gray	CH ~ CM					
Nov. 10	20		Basaltic tuff breccia								
Nov. 11	25										
Nov. 12	30					CM ~ CL					
Nov. 13	35										
	40	132.26									
					Bit diameter 73 mm φ						

HOLE NO. B6r.4

LOC FORM-B

*R.Q.D is Rock Quality Designation, R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total core length) x 100%
*LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm²
*DEPTH and ELEVATION are in meter

* Source : Ref. 6 , modified by JICA team's expert.

DRILL LOG

HOLE NO. B&5 SHEET NO. 7 OF 73

PROJECT	KARIAN MULTI PURPOSE DAM CONSTRUCTION			DEPTH	40m	ELEVATION	
SITE	QUARRY SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	TDH
AVERAGE CORE RECOVERY		DATE	FROM Oct. 20 TO 1984	DRILLED	DPMA	LOGGED	M.F

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL	CORE RECOVERY % / cm	R. Q. D	WATER PRESSURE TEST LUGEON VALUE	DEPTH
Nov. 3	0.0		Top Soil		Brown Soft						
	5		Basalt		Olivine basalt, very hard, fractured with clay seam joint. crystalline, black very Sm. R&D.						
	10										
	15					CL					
	20										
	25										
	31.2										
	32.0		Tuff breccia		Fractured, hard, gray						
	35		Basaltic Tuff breccia		compact, dense, rather fresh, moderately hard, exist tight calcite veine, black to dark gray	CH 2 B					
	40										
					Bit diameter 73 mm ϕ						

HOLE NO. B&5

LOG FORM-B

*R.Q.D is Rock Quality Designation. R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total core length) x 100%
*LUGEON VALUE is l/min·m under injection water pressure of 10kg/cm²
*DEPTH and ELEVATION are in meter

DRILL LOG

HOLE NO. BG6 SHEET NO. 23 OF 23

PROJECT	KARIAN MULTIPURPOSE DAM CONSTRUCTION			DEPTH		ELEVATION	
SITE	QUARRY SITE	COORDINATE	: :	INCLINATION	90°	DRILL RIG	TDH
AVERAGE CORE RECOVERY		DATE	FROM TO 1984	DRILLED	DPMA	LOGGED	M.F

DATE	DEPTH	ELEVATION	ROCK TYPE OR FORMATION	COLUMN SECTION	DESCRIPTION	ROCK GRADE	GROUNDWATER LEVEL	CORE RECOVERY (% / cm)	R. Q. D	WATER PRESSURE TEST LUGEON VALUE	DEPTH
	0.3		Top soil		Dark brown	D					
	5 9.2		Basalt	V V V	Fragment of rare olivine basalt with clay seam joint, fractured	CL					
	10 15 20 25 30 32.7		Basalt	V V V	olivine basalt, very hard, fresh, stiff and compact, partly fractured with calcite vein (2mm), black	CH ~ B					
	35 40		Basaltic Tuff Breccia	Δ Δ	Compact, dense, rather fresh, moderately hard exist tight calcite veins, black to dark to dark gray	CH					

Bit diameter 73 mm φ

HOLE NO. BG6

LOG FORM-B

*R.Q.D is Rock Quality Designation. R.Q.D = (Total length of cylindric cores longer than 10 cm)/(Total core length) x 100%
*LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm²
*DEPTH and ELEVATION are in meter

APPENDIX-D

SOIL AND LAND CAPABILITY

APPENDIX-D

SOIL AND LAND CAPABILITY

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APPENDIX-D

SOIL AND LAND CAPABILITY

1. SOILS

1.1 General

K-C-C area of 21,900 ha in gross area is located at about 55 km to the west of Jakarta across the national road from Jakarta to Merak, a ferry port to Sumatra. In 1983, Japan International Cooperation Agency (JICA) carried out soil survey for irrigation development in the K-C-C area. The JICA survey team at that time prepared a soil map and a land capability map for the southern part of the K-C-C area of 11,600 ha bounded by the Kabupaten road connecting Cikande and Babakan.

The present soil survey aims to identify major soil groups and their distributions, and to examine the suitability of irrigation farming for each soil group in the northern part of the K-C-C area of 10,300 ha. The results are incorporated into the results of 1983 soil survey.

In the present soil survey, the following available previous soil information of the K-C-C area is reviewed and fully made use of;

(1) Preliminary soil map in the Banten area (scale: 1/250,000), 1966, Soil Research Institute, Bogor.

(2) Report of land capability survey in the Ciujung watershed and soil map (scale: 1/25,000), 1979, Directorate of Land Use, Jakarta.

The present report deals with (i) survey method, (ii) soil classification, (iii) land capability for the K-C-C area of 21,900 ha. The results of the soil studies are summarized in a soil map (Fig. D-1) and a land capability map (Fig. D-2).

1.2 Survey Area

From a geomorphological viewpoint, the K-C-C area is broadly divided into the following four landforms.

(1) Alluvial plain has flat topography including natural levees and slight depression. The elevation ranges from 0 - 6 m above mean sea level. The land consists of fine textured sediments deeply deposited by the Ciujung, Cidurian, Cibeureum, Cimendaja rivers and their tributaries in the recent formation stage. Almost all the land has been developed as the paddy fields. The alluvial plain in the northern part of K-C-C area, sometimes, suffered from severe floods before reconstruction of dykes for the lower reaches of the Ciujung river.

(2) River terrace, having level to gently undurating topography, extends mainly in the northern part of K-C-C area. The land has a layer of acid tuff and/or lava flow by Mt. Karan upon them. The land is deposited by coarse sand fraction of quartz-like materials. The land of lower terrace is mainly covered with paddy fields. The lands of middle and high terraces have been developed as the mixed farm land.

(3) Depression extends to deeply dissected flat hilly land. The land has fine textured sediments containing relatively high organic matter. The lands are mainly covered with palm, brush and aquatic plants.

(4) Undulating or rolling hills mainly extend over the southern part of the K-C-C area from Jakarta - Merak national road. The land developed on acid tuff and/or lava flow containing significant amount of quartz-like materials. The lands are covered with shrub for the most parts.

In addition, a noteworthy land characteristic of the K-C-C area is marked by white rock called cadas. Cadas is derived from acid tuff. A color of cadas which sometimes contains calcareous materials, is white in the first stage of weathering. Then cadas, as weathering proceedes, turns red and ultimately become brown in color. When cadas experience hydromorphic process, it is easily and strongly weathered

and decomposed. The distribution of cadas approximately coincides with the boundary between middle and high terraces.

1.3 Survey Method

The past survey shows that the soils in the K-C-C area are classified into four Great Soil Groups in conformity with the national soil classification system of Indonesia. The result of present survey fully takes this system into consideration.

Prior to the field survey, the preliminary geomorphological units map of the K-C-C area is prepared using topographic maps on a scale of 1/5,000 as base maps and aerial photographs on a scale of 1/20,000 taken in March, 1980.

The soil profile is surveyed based on the map above-mentioned and 53 soil pits with a density of about 1 pit/400 ha are dug to a depth of about one meter. Profile of each soil pit is described in accordance with the "Guideline for Soil Profile Description" of FAO in 1977. In addition, many observations of opencuts and 88 test boring explorations with a density of about 1 site/250 ha using one meter hand auger or stick are made to confirm boundary of a soil group.

For physico-chemical analyses in laboratory, 53 soil samples are collected at the representative horizons of 16 profiles. Besides, 20 core samples are tested for their moisture retention curves (pF). The soil analyses are made in the Soil Research Institute in Bogor. The items of physico-chemical analyses are (a) pH (H_2O, 1N-KCl), (b) total carbon, (c) total nitrogen, (d) available phosphate, (e) phosphate absorption coefficient, (f) cation exchange capacity, (g) exchangeable cation (Ca, Mg, Na, K), (h) particle size distribution, and (i) pF-moisture curves. The results of soil analyses are shown in Table D-1. Location of each soil pit is given in Fig. D-1.

1.4 Soil Classification

Soil in the K-C-C area are classified into four soil units, i.e. Eutric Fluvisols, Eutric Gleysols, Orthic Acrisols, and Distric Nitosols

according to the FAO/UNESCO soil classification system. These soil units are, furthermore, subdivided into 13 sub-units according to the geomorphological significance to its practical use and management such as the difference in slope and effective soil depth as shown in Table D-2. The principal properties of each soil units and sub-units are outlined as follows:

(1) Eutric Fluvisols (Grayish Brown Alluvial Soils in Indonesian System)

The soils of this soil unit extent on the natural levee along the Cibeureum river to a limited extent. The soils are derived from alluvial deposits and generally immature with no predominant morphological characteristics. In general, the top soils having a weak subangular blocky structure, are slightly sticky and plastic in consistence. The subsoils are brownish gray in color, fine in texture, structureless or massive in structure, sticky and plastic in consistence. As for chemical properties, pH value of the soils shows less than 5.6 throughout the profile. The cation exchange capacity (CEC) ranges from 35 to 43 meq/100 g with more than 80% of the base saturation degree. The soils of this soil unit consists of one sub-unit as shown in the following:

Sub-unit 1: Flat, Deep, Eutric Fluvisols

The relief of the soils of this Phase is nearly level with slope less than 2%. The effective soil depth is deep. The soils are presently under cultivation of upland crops. The soils have generally good agricultural potential. The soils are suitable not only for rice but also for a wide range crops. These soils occupy about 320 ha or 1.5% of the K-C-C area.

(2) Eutric Gleysols (Gray Hydromorphic Soils in Indonesian System)

The soils of this soil unit, typical wet soils are developed on the low land of acid tuff and the valley bottom, and the latter densely dissects the hilly land. The soils are derived from run-off deposits from adjacent elevated areas. The soils have horizon sequence of A-Bg-Cg showing hydromorphic properties within 50 cm of the surface. Their topsoils and subsoils are predominantly gray in color, fine in texture, structureless or massive in structure,

very sticky and very plastic in consistence. In general, the soils are characterized by low chroma less than 2 in soil color which indicates that the soils are under reductive conditions. The pH value ranges from 5.1 to 6.2. The cation exchange capacity is over 20 meq/100 g. The base saturation degree averages more than 75%. The soil units are divided into three sub-units as shown below:

Sub-unit 2: Flat, Deep, Eutric Gleysols

The land covered with the soils of this sub-unit is topographically flat or almost flat. The effective soil depth is deep. At present, the soils are mainly used for the cultivation of rainfed rice in the wet season, and twice a year if the irrigation water is available and not too much in the dry season. The soils of this sub-unit extend over about 7,690 ha or 35.2% of the K-C-C area.

Sub-unit 3: Gently Sloping, Deep, Eutric Gleysols

The soils of this sub-unit developed on the narrow gently sloping valley bottom among the hilly land. The condition of the soil properties, present land use and agricultural potential are almost similar to those of sub-unit 2 explained hereinabove. The areas of this sub-unit are estimated at around 670 ha or 3.1% of the K-C-C area.

Sub-unit 4: Depressed, Deep, Eutric Gleysols

The soils of this sub-unit are poorly drained soils in the lowlying area and/or in depressions. At present, the areas of this sub-unit are mostly covered with palm, brushwood and aquatic plants. This sub-unit covers 400 ha or 1.8% of the K-C-C area.

(3) Orthic Acrisols (Yellowish Brown Podzolic Soils in Indonesian System)

The soils of this soil unit, extending on the hilly land, have a distinct argillic B horizon. The relief is gently undulating with steep slope at its edge. The soils are derived from tuff. Generally, the soils have A-Bt-C in horizon sequence. The topsoils are grayish brown in color, medium in texture, weak subangular blocky in

structure, slightly sticky and slightly plastic in consistence. The subsoils are brownish gray in color, medium to fine in texture, moderate subangular blocky in structure, sticky and plastic in consistence. According to the chemical analysis, pH value ranges from 4.8 to 5.6. The cation exchange capacity is generally low, showing less than 34.2 meq/100 g. The base saturation degree averages about 50%. The soils of this soil unit are, furthermore, subdivided into six sub-unit as follows:

Sub-unit 5: Flat, Deep, Orthic Acrisols

The soils of this sub-unit cover the flat or almost flat hilly land. The effective soil depth is generally deep. The soils are presently used for the cultivation of rainfed rice and upland crops in the wet season. During the dry season, however, the soils are mostly left fallow due to lack of water. The soils are chemically poor, being acid, and lacking in natural fartility. The soils of this sub-unit are estimated at 3,900 ha or 17.8% of the K-C-C area.

Sub-unit 6: Gently, Sloping, Deep, Orthic Acrisols

The soils of this sub-unit extend the undulating land on the hill slopes. The condition of soil properties and present land use are generally same as sub-unit 5. These soils occupy 1,300 ha or 5.9% of the K-C-C area.

Sub-unit 7: Sloping, Deep, Orthic Acrisols

The relief of this sub-unit is steeply dissected to hilly land. The effective soil depth is generally deep. At present, the land of this sub-unit is mainly covered by shrub. The soils represent about 110 ha or 0.5% of the K-C-C area.

Sub-unit 8: Flat, Moderately Deep, Orthic Acrisols

The soils of this sub-unit cover the flat or almost flat hilly land. The effective soil depth is moderately deep. The condition of soil properties and present land use are generally same as sub-unit 5, on the other hand, agricultural potential of this sub-unit is slightly lower than that of sub-unit 5. The soils occupy 220 ha or 1.0% of the K-C-C area.

Sub-unit 9: Gently Sloping, Sha-low, Orthic Acrisols

The soils of this sub-unit are developed on the gently sloping on the hill slopes. The effective soil depth is generally shallow. The soils of this sub-unit include Dystric Regosols, composed of tuffaceous stones and rocks called "cadas". The soils are mainly used for cultivation of rainfed rice in the wet season. The agricultural potential of the soils is generally low. The extent is estimated at about 850 ha or 3.9% of the K-C-C area.

Sub-unit 10: Sloping, Shallow, Orthic Acrisols

The relief of this sub-unit is steeply dissected to hilly land. The erosion hazard of this sub-unit is great. The soils have shallow effective soil depth and are presently left. The agricultural potential is generally low. The area of this sub-unit occupies about 40 ha or 0.2% of the K-C-C area.

(4) Dystic Nitosols (Reddish Latosols in Indonesian System)

The soils of this soil unit are mainly developed on the sloping or undulating hilly land at the higher elevation. The soils are derived from tuff and lava flow, have shinny ped surfaces to a great depth. The soils generally have A-Bt-C horizons. The topsoils are dark reddish brown to brown in color, medium to fine in texture, weak subangular blocky in structure, sticky and slightly plastic in consistence. The subsoils are dark reddish brown to brownish gray in color, fine in texture, medium subangular blocky in structure, sticky and plastic in consistence. The pH value averages 5.3. The cation exchange capacity ranges from 20.9 to 29.0 meq/100 g. The base saturation degree is generally low, showing about 50%. The soils of this soil unit are subdivided into thrre sub-units as shown below:

Sub-unit 11: Flat, Deep, Dystric Nitosols

The soils of this sub-unit develop on the almost flat hilly land. The effective soil depth is generally deep. The area of this sub-unit is mostly used for cultivation of upland crops. The soils have generally high agricultural potential. The soils cover 1,310 ha or 6.0% of the K-C-C area.

Sub-unit 12: Gently Sloping, Deep, Dystric Nitosols

The land covered with the soils of this sub-unit is topographically undulating hilly land. The characteristics of these soils are almost same as the sub-unit 11. The land is mainly covered by upland field and/or shrub occupying about 2,800 ha or 12.8% of the K-C-C area.

Sub-unit 13: Sloping, Deep, Dystric Nitosols

In general, the relief of this sub-unit is deeply dissected. The conditions of the soil properties are almost similar to those of sub-units 11 and 12. The area of this soils is presently put under shrub. The soils are estimated at about 2,260 ha or 10.3% of the K-C-C area.

The typical soil profile of these soil units is shown in Table D-3. The development of the soils classified hereinabove is illustrated on the soil map attached hereto (Fig. D-1).

2. LAND CAPABILITY

2.1 General

Three (3) major land classification systems have been applied for water resource development projects in Indonesia as follows:

(1) USDA land capability classification system: Land Capability Classification, Agricultural Handbook No. 210, 1961, Soil Conservation Services, USDA

(2) USBR land classification system: Bureau of Reclamation Manual Vol. 5 Irrigated Land Use, Part 2: Land Classification, 1953, USBR

(3) FAO land suitability classification system: A framework for Land Evaluation, 1976, FAO

(4) Japanese land classification standard: Outline of Land Classification based on Soil Survey in Japan, 1977, National Institute of Agricultural Science, Tokyo

The USDA system is most widely used, but it does not meet particular requirements for irrigation project. It is mainly used for rainfed agriculture in general. In the USDA system, lands are classified into eight (8) classes and lower four (4) classes from V to VIII are ranked as "not suitable for agricultural production".

The USBR system was devised originally for irrigated land use. However, the basic concept of the USBR system is generally to assess the lands under arid climate and/or assess land productivity for dryland field crops such as wheat, barley, cotton. Some modification of this system is required under Indonesian condition due to the different requirements for irrigated rice cultivation under humid climate. Although several approaches to the modification have been made by various study groups, none of them has been fully authorized at present. The USBR system has six (6) classes, I to III being arable, IV being suitable only for special uses and VI nonarable. Class V reserved for undecided suitability, but in practice this class is often omitted.

The FAO system is more flexible than US systems and can be applied to the full range of environments. It is the system that the Soil Research In-titute in Bogor recommends for use in Indonesia. However, this system does not fulfil the detailed criteria for suitability assessment on the irrigated rice cultivation. The FAO system for land suitability classification is used for assessment of lands in terms of their relative suitability for a specific type of use. In the FAO system, the land suitability classes for each specific utilization type reflect degrees of suitability or of limitation, namely, S1 (highly suitable), S2 (moderately suitable), S3 (marginally suitable), N1 (currently not suitable) and N2 (permanently not suitable).

Considering all these, Japanese land classification standard for rice was applied to the past feasibility study on the K-C-C Irrigation Project and it is conveniently adapted in the present feasibility study by the same reason. The Japanese system is devised originally for rice cultivation and its classification criteria are detailed enough for land capability assessment on a feasibility study level. In the Japanese system, lands are classified into four (4) capability classes, namely, I, II, III and IV. Each class is defined as follows:

Class I : Land has almost no limitation for crop production and/or no risk of soil degradation. It is naturally fertile and has a great potential for crop production without any improvement practices of soils.

Class II : Land has some limitations for crop production and/or some risks of soil degradation, and requires some soil improvement practices for normal crop production.

Class III : Land has many limitations for crop production and/or is likely subject to risks of soil degradation, and fairly intensive improvement practices are required.

Class IV : Land has great natural limitations than these in Class III, but can be utilized for cultivation of some specific crops under very careful management.

The Japanese system, four (4) class classification of arable land, is, therefore, correlative with US systems. And it is considered that the FAO system of suitability classess from S1 to N1 roughly correspond to four (4) classes described in the Japanese system.

In view of consideration shown above, the Japanese system seems to be most suitable for land capability classification for rice fields due to its detailed correlative character with other systems.

2.2 Specification of Land Capability Classification

In the Japanese system, there are 13 factors for assessment of land capability as shown below:

(1) thickness of topsoil
(2) effective soil depth
(3) gravel content in topsoil
(4) easiness of plowing
(5) permeability under submerged condition/1
(6) state of redox potential
(7) wetness of land/2
(8) inherent fertility
(9) content of available nutrient
(10) degree of hazard
(11) frequency of hazard
(12) slope/2
(13) erosion/2

The specification of land capability class are explained as follows:

(1) Thickness of topsoil (code: t)

The topsoil is the first horizon where plant roots can easily penetrate, and generally corresponds to the plowed layer. The classes are grouped according to the thickness of topsoil as follows:

Thiskness of topsoil (cm)	Class		
	Rice	Upland crops	Orchard
more than 25	I	I	I
25 - 15	I	II	I
less than 15	II	III - IV*	III - IV*

Remark: * : When effective soil depth is placed to class IV, this factor also is placed to class IV.

/1 : Factors for rice only
/2 : Factors for upland crops only

(2) Effective soil depth (code: d)

Effective soil depth is the depth up to bedrock, hard pan and gravel layer which plant roots cannot penetrate. The classes are grouped, according to thickness of the effective soil depth, as follows:

Effective soil depth (cm)	Class		
	Rice	Upland crops	Orchard
more than 100	I	I	I
100 - 50	I	II	II
50 - 25	II	III	III
15 - 25	III	III	IV
less than 15	IV	IV	IV

(3) Gravel content in topsoil (code: g)

Gravel contents in topsoil are expressed by the percentage of the exposed surface area of gravel on the soil profile, and are graded into the following classes:

Gravel content (%)	Class		
	Rice	Upland crops	Orchard
less than 5	I	I	I
5 - 10	I	II	I
10 - 20	I - II	II - III	I - II
20 - 50	II - III	III - IV	II - III
more than 50	IV	IV	IV

(4) Easiness of plowing (code: p)

Easiness of plowing largely depends upon the quantity and quality of clay and organic matter and moisture condition. In order to estimate the class of this factor, the following three (3) sub-factors are used.

(a) Soil texture of topsoil (evaluated by clay content): (%)

	content of clay
1. coarse to medium :	less than 15
2. fine :	15 - 25
3. very fine :	more than 25

(b) Stickness of topsoil:

1. none and/or slightly sticky
2. sticky
3. very sticky

(c) Consistence when dry:

1. loose
2. hard
3. very hard

These sub-factors are combined altogether to determine capability classes as follows:

Sub-factors			Class	Criteria
a	b	c		
1	1	(2)	I	Easy to slightly difficult
2	1	1	I	
2	2	1	I	
2	2	2	I - II	Moderately difficult
3	3	2	II - III	
3	3	3	III	Very difficult

(5) Permeability under submerged condition (code: 1)

This factor affects irrigation water requirement, soil temperature, and leaching of the nutrients or development of reduced condition of the soil. This standard factor is evaluated mainly by the combination of soil texture and the presence of compact layer within 50 cm from the surface, as sub-factors:

(a) Soil texture (evaluated by clay content): (%)

		content of clay
1. very fine	:	more than 25
2. fine	:	25 - 15
3. medium to coarse	:	less than 15

(b) Compactness (evaluated by hardness meter): (kg/cm^2)

1. compact	:	more than 14.0
2. medium	:	14.0 - 1.4
3. loose	:	less than 1.4

Sub-factors		Class	Criteria
a	b	Rice	
1	1	I	Poorly to imperfectly permeable
1	2	I	
2	2	I - II	Moderately to well permeable
3	2	II	
3	3	III	Permeable

(6) State of redox potential (code: r)

This factor indicates the risk of root damage owing to the strong reduction of soil, resulting in low rice production. The following sub-factors are used for the evaluation of this factor.

(a) Content of easily decomposable organic matter in topsoil: (NH_4-Nmg/100 g)

1. low	:	less than 10
2. medium	:	10 - 20
3. high	:	more than 20

(b) Content of free iron oxides in topsoil: (%)

1. high	:	more than 1.5 for dry soil
2. medium	:	1.5 - 0.8
3. low	:	less than 0.8

(c) Degree of gleyzation:

1. weak : no gley horizon within 50 cm from the surface
2. medium : gley horizon exist within 50 cm from the surface
3. strong : gley horizon exist throughout profile or exist below plowing layer

Sub-factors			Class	Criteria (risk of root damage)
a	b	c		
1	1	2	I	None to weak
1	3	2	I	
2	1	2	I	
1	1 - 2	3	II	Moderate to strong
1	3	3	II	
2	1 - 2	3	II	
3	1	2	II	
2	3	3	III	Very strong
3	2	2	III	
3	1	3	III	
3	3	2	III	

(7) Wetness of land (code: w ; wet condition, (w) ; dry condition)

This factor is only applied to upland crops and orchard. This factor is used for the estimation of wet or drought injury of upland crops and trees, and is evaluated by the combination of the following three (3) sub-factors:

(a) Permeability:

1. high
2. medium
3. low

(b) Water holding capacity (evaluated by AMC*):

1. high : more than 20
2. medium : 20 - 10
3. low : less than 10

Remark: * : AMC = Field Capacity (pF1.5) - Wilting Point (pF4.2)

(c) Moisture condition:

(2) Dry

1. slightly moist
2. moist
3. wet

Sub-factors			Class	Criteria (risk of drought or wetness)
a	b	c		
1	3	(2)	(IV)	High possibility of drought
1	3	1	(III)	Possibility of drought
1	2	1	(II)	Low possibility of drought
1	1	1	I	None
2	2	2	II	Low possibility of overwetness
1 - 3	1	3	III	Possibility of overwetness
3	2	3	IV	High possibility of overwetness

(8) Inherent fertility (code: f)

Inherent fertility is evaluated by the combination of the following three (3) sub-factors:

(a) Nutrient holding capacity (evaluated by CEC): (meq/100 g)

1. high : more than 20
2. medium : 20 - 6
3. low : less than 6

(b) Nutrient fixation power (evaluated by phosphate absorption coefficient): (P_2O_5 mg/100 g)

1. very low : less than 700
2. low : 700 - 1,500
3. medium : 1,500 - 2,000
4. high : more than 2,000

(c) Base status in soil (evaluated by base saturation degree): (%)

1. good : more than 50
2. medium : 50 - 30
3. poor : less than 30

For rice

Sub-factors			Class	Criteria
a	b	c		
1	1 - 2	2	I	Fertile
2	1 - 2	1	I	
1	1 - 2	3	II	medium
1	3 - 4	2	II	
2	1 - 2	2	II	
3	1	2	II	
2	3 - 4	3	III	Infertile
3	2	2	III	
3	3 - 4	3	III	

For upland crops and orchard

Sub-factors			Class	Criteria
a	b	c		
1	2	1	I	Fertile
2	1	2	I	
1	2	3	II	Medium
1	3	1	II	
1	3	2	II	
2	1	3	II	
2	4	1	II	
1	3	3	III	Infertile
2	4	2	III	
3	1	1	III	

(9) Content of available nutrients (code: n)

Content of available nutrients in soil is closely related to the inherent soil fertility, and are evidently influenced to cultivation practices. The capability class is evaluated by the combination of the following sub-factors:

(a) Content of exchangeable calcium: (meq/100 g)

1. high : more than 7.2
2. medium : 7.2 - 3.4
3. low : less than 3.4

(b) Content of exchangeable magnesium: (meq/100 g)

1. high : more than 1.2
2. medium : 1.2 - 0.5
3. low : less than 0.5

(c) Content of available potassium: (meq/100 g)

1. high : more than 0.3
2. medium : 0.3 - 0.1
3. low : less than 0.1

(d) Content of available phosphate: (P_2O_5 mg/100 g)

1. high : more than 10
2. medium : 10 - 2
3. low : less than 2

(e) Content of available nitrogen: (NH_4-N mg/100 g)

1. high : more than 20
2. medium : 20 - 10
3. low : less than 10

(f) Content of available silica: (SiO_2 mg/100 g)

1. high : more than 15
2. medium : 15 - 5
3. low : less than 5

(g) Content of microelements (evaluated by the risk of deficiency):

1. none and/or weak
2. medium
3. serious

(h) Acidity (evaluated by pH):

Paddy	Upland & Orchard			
1	1	weak	:	more than 6.0
1	2	medium	:	6.0 - 5.0
2	3	strong	:	5.0 - 4.5
3	4	very strong	:	less than 4.5

Class	Criteria
I	High
II	Medium
III	Low

(10) Degree of hazard (code: i)

This factor means limitation caused by the presence (in excess) of substances such as sulphur compounds, soluble salts, heavy metals, etc. Dependent sub-factors are as follows:

(a) Presence of harmful substances:

(i) Harmful sulphur compounds

1. none
2. slightly
3. moderately
4. seriously

(ii) Salts content (evaluated by chlorine content as an indicator) (%)

1. low : less than 0.1
2. medium : 0.1 - 0.3
3. high : more than 0.3

(iii) Heavy metals

1. none
2. slightly
3. moderately
4. seriously

(iv) Irrigation water quality

		Temp. (°C)	pH	Total nitrogen (ppm)	Salts content (ppm)
1.	good	>20	6,0 - 7.5	<1,0	<500
2.	medium	20 - 15	4.0 - 6.0/ 7.5 - 8.5	1.0 - 5,0	500 - 2,000
3-4.	polluted	<15	<4.0 >8.5	>5.0	> 2,000

(b) Physical hazard

Presence of bedrock, pan, compact layer or gravel layer that disturb root development within 50 cm of the surface and difficult of their removal:

1. none
2. slightly difficult
3. very difficult

The class of this factor is decided by the lowest grade among the inter dependent sub-factors.

Class	Criteria
I	None
II	Slightly
III	Moderately
IV	Seriously

(11) Frequency of hazard (code: a)

This factor is mainly influenced by natural environmental condition. The class of this factor is determined by the combination of the following two (2) dependent sub-factors:

(a) Risk of overhead flooding inundation:

1. none and/or rarely : no risk if rainfall with high intensity occurs
2. moderately : even if inundation occurs due to high rainfall intensity, excess water is drained out in a short period
3. frequently : inundation continuous for a long period if rainfall with high intensity occurs

(b) Risk of land creep:

1. none and/or rarely
2. moderately
3. frequently

The class of this factor is determined by the lowest grade of two (2) dependent sub-factors.

Class	Criteria
I	None to rarely
II	Moderately
III	Frequently

(12) Slope (code: s)

This factor is applied to upland and orchard only. The class of this factor is decided by the combination of the following sub-factors:

(a) Natural slope as a main dependent sub-factors: five (5) grades as shown in the following table

(b) Direction of slope

(c) Artificial slope

Steepness of slope (%)	Class	
	Upland crops	Orchard
less than 6	I	I
6 - 14	II	I - II
14 - 28	III	I - III
28 - 47	IV	II - III
more than 47	IV	IV

(13) Erosion (code: e)

The class of this factor is determined by the combination of the following sub-factors:

(a) Occurrence of rill or gully:

	Occurrence of rill	Occurrence of gully
1. none :	none	none
2. rarely :	rarely	none
3. moderately :	sometimes	none
4. frequently :	frequently	exist

(b) Resisting power to water erosion:

1. strong
2. medium
3. weak

(c) Resisting power to wind arosion:

1. strong
2. medium
3. weak

Class	Criteria
I	None or very slightly
II	Slightly
III	Seriously
IV	Very seriously

The specification of Japanese land capability class is summarized in Table D-4.

2.3 Land Capability

The land is evaluated by using the assessment factors mentioned above. The land capability class is determined at the lowest class of the factors. Limitation on suitability of land due to 13 factors are indicated by use of codes like "t", "g", "d" either individually or collectively, as shown in the following example.

	Factor	Code	Paddy	Upland
1.	thickness of topsoil	t	I	III
2.	effective soil depth	d	I	I
3.	gravel content in topsoil	g	I	I
4.	easiness of plowing	p	II (3,3,2)	II (2,2,2)
5.	permeability under submarged condition	l	II (1,3)	-
6.	state of redox potential	r	II (2,1,3)	-
7.	wetness of land	w	-	IV (3,1,3)
8.	inherent fertility	f	I (1,2,2)	III (1,2,3)
9.	content of available	n	II (2,1,1,1, 2,2,2,2)	III (3,3,3,3,3, 3)
10.	degree of hazard	i	I (1,1)	I (1,1)
11.	frequency of hazard	a	I (1,1)	I (1,1)
12.	slope	s	-	I (1,1,1)
13.	erosion	e	-	I (1,1,1)

Land capability class : Paddy ; IIplrn
Upland ; IVw

On the basis of land classification specification defined in Section 2.2, the land in the K-C-C area is graded into four capability classes, i.e. Class I to Class IV. The difinition of each capability class is outlined as follows;

(1) Class I: Arable

The land of Class I having almost no significant limitation is highly suitable for irrigation farming, being capable of producing sustained and high yield of crops at reasonable cost.

(2) Class II: Arable

The land of class II is moderately suitable for the crop cultivation, and relatively high productivity can be expected, However, the land of Class II has some limitations for crop production and more costly to farm.

(3) Class III: Arable

The Class III is of marginally suitable land where the cultivation of crops is fairly productive. But, there are many limitations for crop production. These constraints will increase in cost for improvement.

(4) Class IV: Limited arable

The land of Class IV is distinctly restricted suitable for the cultivation of crops. The land has less productivity than that in Class III because of unfavorable physical conditions. These limitation are difficult to surmount economically.

The correlation between soil units and land capability class is shown in Table D-5 and summarized as follows:

Soil Unit	Capability Class (Rice/Upland Crops)	Area (ha)	Proportional Extent (%)
I. Eutric Fluvisols		320	1.5
Sub-unit 1. Flat, Deep	IIn/IIwfn	320	1.5
II. Eutric Gleysols		8,760	40.1
Sub-unit 2. Flat, Deep	I/IIprw	7,690	35.2
Sub-unit 3. Gently, Sloping, Deep	I/IIprw	670	3.1
Sub-unit 4. Depressed, Deep	IIIra/IVw	400	1.8
III. Orthic Acrisols		6,420	29.3
Sub-unit 5. Flat, Deep	IIfn/IIIn	3,900	17.8
Sub-unit 6. Gently, Sloping, Deep	IIfn/IIIn	1,300	5.9
Sub-unit 7. Sloping, Deep	IIfn/IIIne	110	0.5
Sub-unit 8. Flat, moderately Deep	IIdfn/IIIdn	220	1.0
Sub-unit 9. Gently, Sloping, Shallow	IIId/IIIdn	850	3.9
Sub-unit 10. Sloping, Shallow	IVd/IVtde	40	0.2
IV. Dystric Nitrosols		6,370	29.1
Sub-unit 11. Flat, Deep	IIfn/IIIn	1,310	6.0
Sub-unit 12. Gently, Sloping, Deep	IIfn/IIIn	2,800	12.8
Sub-unit 13. Sloping, Deep	IIfn/IIInse	2,260	10.3
Total		21,870	100.0

The limitations and acreage in each capability class for rice and upland cultivation in the K-C-C area are summarized as follows:

Capability Class	Limitations	Area (ha)	Proportional Extent (%)
1. Rice			
I	none	8,360	38.3
II	medium nutrient fixation power, and medium contents of available phosphate	12,220	55.8
III	shallow effective soil depth, strong degree of gleyzation, and susceptibility to an inundation	1,250	5.7
IV	very shallow effective depth	40	0.2
Total		21,870	100.0
2. Upland crops			
I	none	0	0.0
II	moderately difficulty in plowing, medium degree of gleyzation, medium permeability and medium water holding capacity, medium nutrient fixation power, and medium contents of available phosphate and medium acidity	8,680	39.8
III	shallow effective soil depth, low contents of available phosphate, rolling topography, and serious susceptibility to the soil erosion	12,750	58.2
IV	thin topsoil, very shallow effective soil depth, wet condition, and very serious susceptibility to the soil erosion	440	2.0
Total		21,870	100.0

As described hereinbefore, it is concluded that the arable lands of Class I to III in K-C-C area are suitable for irrigation farming. As for the rice cultivation, the arable lands of Class I to III are estimated at around 21,830 ha in gross and equivalent to about 99.8% of K-C-C area. As to the cultivation of upland crops, the arable lands of Class I to IV extend over 21,430 ha or 98% of K-C-C area. The land capability map for the K-C-C area is prepared as illustrated on Fig. D-2.

In the future when the irrigation systems with drainage improvement will be developed, the arable lands demarcated above can be used intensively for year-round crop cultivation. However, the rice cultivation is quite suitable in the wet season, because of the ground water table comes into the root zone of plants. On the other hand, in the case that the ground water table falls in the dry season, the cultivation of upland crops such as groundnuts and soybean is more profitable for the saving of irrigation water.

Table 1 Result of Soil Analysis (3/3)

Sample No.	Gravel Content (%)	Texture			pH		IN NH_4OAc pH7.0 . Exchangeable Cations (m.eq. per 100 gram soils)				CEC	Base Saturation (%)	Organic Matter			25% HCl		Available P_2O_5 (ppm)	Absorption Coefficient P_2O_5 (mg/100 gram soils)
		Sand (%)	Silt (%)	Clay (%)	H_2O	KCl	Ca	Mg	K	Na			C (%)	N (%)	C/N	P_2O_5 (mg/100 gram soils)	K_2O		
Fluvisols																			
3-1	9.2	4	45	51	5.5	4.3	20.1	8.3	0.4	0.5	35.2	83	1.92	0.23	8	21	21	4	1622
3-2	6.7	3	40	57	5.6	4.0	25.2	9.2	0.3	0.3	41.9	84	0.99	0.12	8	21	19	1	1625
3-3	35.6	1	22	77	5.5	4.1	26.9	9.9	0.2	0.4	43.3	86	0.67	0.10	7	8	16	1	2491
Nitosols																			
5-1	10.1	58	33	9	5.1	4.0	2.4	1.4	0.3	0.2	5.7	75	0.8 3	0.09	9	6	13	2	345
5-2	4.1	44	32	24	5.3	3.9	4.0	2.5	0.2	0.1	10.4	65	0.63	0.08	8	5	13	2	576
5-3	2.9	37	35	28	5.3	3.8	2.8	2.1	0.4	0.1	11.5	47	0.50	0.07	9	4	17	1	597
5-4	2.4	28	27	45	5.0	3.7	4.0	3.1	0.5	0.2	16.6	47	0.43	0.06	7	3	22	1	921
Gleysols																			
7-1	16.6	4	42	54	5.1	3.8	16.6	7.6	0.1	0.4	33.1	75	1.51	0.16	9	12	14	8	1815
7-2	10.7	6	46	48	5.8	4.3	24.0	10.9	0.1	0.7	43.0	83	0.64	0.09	7	13	12	3	1573
7-3	7.2	10	46	44	6.2	4.5	23.6	10.7	0.4	0.9	36.6	97	0.45	0.07	6	26	20	12	1459
Nitosols																			
11-1	3.2	40	25	35	5.3	4.3	8.4	6.7	0.3	0.1	23.5	66	1.79	0.20	9	25	23	7	1192
11-2	3.6	22	17	61	5.2	3.9	8.8	5.7	0.1	0.1	26.1	56	0.75	0.10	8	16	12	1	1255
Acrisols																			
14-1	1.1	51	24	25	4.8	3.6	4.1	2.0	0.3	0.2	12.7	52	0.87	0.10	9	11	10	3	786
14-2	2.2	60	19	21	5.6	4.0	4.6	2.0	0.1	0.1	9.7	70	0.35	0.06	6	10	4	2	642
14-3	4.2	25	17	58	5.5	3.8	13.9	6.3	0.1	0.5	34.2	61	0.37	0.05	7	3	9	1	1356
Gleysols																			
15-1	1.3	41	34	25	5.3	4.1	11.8	4.3	0.1	0.3	20.9	79	0.95	0.10	10	24	9	14	964
15-2	0.2	27	42	31	6.2	4.6	15.2	5.4	0.1	0.7	25.9	83	0.52	0.06	9	10	7	2	1165
15-3	0.6	9	48	43	5.9	4.0	12.5	5.8	0.1	0.9	25.5	76	0.45	0.08	6	16	8	6	1043
Nitosols																			
16-1	0.6	27	33	40	5.0	3.7	4.0	4.4	0.1	0.5	20.9	43	1.36	0.16	9	13	12	4	944
16-2	0.7	16	31	53	5.5	3.7	8.3	8.1	0.3	0.6	29.0	60	0.52	0.07	7	5	16	1	1397

Table D-1 Result of Soil Analysis (2/3)

(pF-moisture content relationships)

Sample No.	Bulk Density (g/cc)	Total Porosity (Vol. %)	Water Capacity (Vol. %)					Drainage Pores (Vol. %)		Available/2 Moisture content (Vol. %)
			10 cm (pF 1)	31 cm/1 (pF 1.5)	100 cm (pF 2)	1/3 atm (pF 2.54)	15 atm (pF 4.2)	Fast	Slow	
Nitosols										
11-1	1.06	60.0	46.6	44.0	41.2	36.3	25.1	18.8	4.9	18.9
11-2	1.03	61.1	52.1	49.5	46.3	42.1	31.3	14.8	4.2	18.2
Nitosols										
12-1	1.28	51.7	38.6	36.5	32.9	28.2	17.7	18.8	4.7	18.8
12-2	1.27	52.1	51.1	49.5	45.9	41.6	30.9	6.2	4.3	18.6
Acrisols										
14-1	1.52	42.6	42.2	40.0	36.7	31.0	19.5	5.9	5.7	20.5
14-2	1.55	41.5	40.2	37.5	33.9	29.4	19.3	7.6	4.5	18.2
14-3	1.46	44.9	43.8	41.0	38.2	34.7	23.3	6.7	3.5	17.7
Nitosols										
20-1	1.37	48.3	36.8	35.0	31.7	26.4	16.7	16.6	5.3	18.3
20-2	1.15	56.6	55.7	53.5	50.5	45.6	34.1	6.1	4.9	19.4
20-3	1.16	56.2	54.6	52.5	49.3	44.9	34.9	6.9	4.4	17.6

Remarks: /1 - The value is estimated graphically

/2 - AMC = (pF 1.5) - (pF 4.2)

Table D-1 Results of Soil Analysis (3/3)

Pit No.	Sample No.	Horizon Name	Depth (cm)	Exchangeable bases (1) Ca	Mg	K	Na	Total	CEC (1)	PBS (2)	Exchangeable Al^{3+} (1)	H^{+} (1)	P.ads. coefficient P_2O_5 (3)	pH H_2O	KCL
33	P-1-1	AP	0- 18	7.3	3.2	0.2	3.7	14.4	20.8	69	1.08	0.55	1167	5.0	3.8
	-2	Bg2	18- 45	4.8	2.2	0.1	0.3	7.4	14.3	52	1.64	0.35	751	4.9	3.7
	-3	Cg	45-100	3.1	1.7	0.1	0.3	5.2	12.8	41	3.72	0.46	721	4.9	3.7
34	P-2-2	A2	0.5- 25	9.7	3.5	0.1	0.6	13.9	17.4	80	0.44	0.15	1046	5.7	4.2
	-3	Bt2	25- 50	11.2	5.7	0.2	1.3	18.4	27.6	67	6.77	0.28	1083	5.2	3.7
	-4	Bt3	50- 72	17.4	9.6	0.1	2.0	29.1	39.5	74	4.82	0.57	1084	5.0	3.8
	-5	C	72-100	14.8	8.0	0.2	17.9	40.9	33.6	122	2.06	0.47	1044	5.1	3.7
35	P-3-1	Ap	0- 6	2.6	0.9	0.3	0.2	4.0	9.3	43	0.36	0.14	298	5.4	4.3
	-4	B22	14-100	2.0	0.5	0.1	0.4	3.0	6.0	50	0.76	0.19	251	5.4	3.9
36	P-4-1	Agp	0- 17	10.7	5.6	0.1	0.9	17.3	22.2	78	0.82	0.27	1042	5.5	4.0
	-2	Bg	17- 35	18.2	10.4	0.3	2.2	31.1	37.0	84	0.24	0.19	1474	5.7	4.4
	-3	Cg	35-100	18.4	13.1	0.3	3.1	34.9	37.2	94	0.50	0.25	1281	5.3	4.0
37	P-5-1	Ap	0- 6	6.0	1.7	0.1	0.2	8.0	15.0	53	0.87	0.19	832	5.4	4.0
	-2	B2	6- 50	6.5	1.7	0.1	0.6	8.9	17.5	51	1.87	0.22	1030	5.3	3.8
	-3	C	50-100	7.5	1.6	0.1	1.0	10.2	17.5	58	1.35	0.27	1060	5.5	3.9
38	P-6-1	Agp	0- 17	4.7	5.5	0.2	0.4	10.8	28.7	38	1.09	0.40	1045	5.1	3.9
	-2	Bgix2	17- 45	15.2	5.4	0.3	0.8	21.7	26.7	81	1.27	0.26	1313	5.4	3.8
	-3	Cg	45-100	20.4	8.1	0.3	1.5	30.3	34.0	89	0.57	0.13	1207	5.4	4.0
39	P-7-1	Ap	0- 10	6.8	4.1	0.4	0.1	11.4	16.1	71	0.03	0.10	862	6.2	5.3
	-2	A3	10- 20	6.5	3.6	0.1	0.0	10.2	16.9	60	1.98	0.31	901	5.0	4.0
	-3	Bt2	20- 47	5.1	3.8	0.3	0.1	9.3	29.7	31	7.94	0.33	1170	5.1	3.7
	-4	Bt3	47- 78	4.5	4.1	0.3	0.2	9.1	35.3	26	16.11	1.08	1504	4.9	3.8
	-5	C	78-100	4.2	4.2	0.3	0.2	8.9	33.5	27	16.73	1.54	1569	5.1	3.8
40	P-8-1	Agp	0- 15	15.7	8.3	0.3	1.1	25.4	37.4	68	2.69	0.46	1551	4.8	3.6
	-2	Ag3	15- 23	19.3	9.8	0.2	1.2	30.5	44.6	68	1.71	0.40	1533	4.8	3.8
	-3	Bg1	23- 45	21.8	11.0	0.3	1.5	34.8	43.1	80	2.92	0.56	1613	4.6	3.7
	-4	Bg2	45- 85	18.2	8.2	0.2	1.6	28.2	42.5	66	9.24	0.49	1356	4.5	3.5
	-5	Cg	85-100	16.5	7.4	0.3	1.4	25.6	41.8	61	11.41	0.56	1543	4.4	3.6
41	P-9-1	Ag	0- 11	4.6	3.0	0.2	0.2	8.0	15.0	53	0.38	0.14	715	5.6	4.8
	-2	B1	11- 30	2.0	1.3	0.1	0.4	3.8	10.8	35	3.82	0.16	533	5.5	3.8
	-3	B2	30- 45	1.4	1.6	0.1	0.3	3.4	12.3	28	5.45	0.31	608	5.4	3.7
	-4	B3	45- 88	1.7	2.0	0.1	0.3	4.1	13.3	31	5.29	0.31	608	5.4	3.7
	-5	R	88-100	2.4	2.7	0.1	0.4	5.6	16.9	33	5.80	0.24	783	5.4	3.8

Unit (1): mg/100g soil, (2): %, (3): mg/100g soil

Table D-2 Soil Classification

Soil Units	Sub-Unit
I. Eutric Fluvisols	1. Flat, Deep
II. Eutric Gleysols	2. Flat, Deep
	3. Gently Sloping, Deep
	4. Depressed, Deep
III. Orthic Acrisols	5. Flat, Deep
	6. Gently Sloping, Deep
	7. Sloping, Deep
	8. Flat, Moderately deep
	9. Gently Sloping, Shallow
	10. Sloping, Shallow
IV. Dystric Nitosols	11. Flat, Deep
	12. Gently Sloping, Deep
	13. Sloping, Deep

Remarks:

Slope (%)

Flat	less than 2
Gently sloping	2 - 6
Sloping	more than 6
Depressed	Swampy Land (including artificially swamp)

Effective soil depth (cm)

Deep	more than 50
Moderately deep	50 - 25
Shallow	less than 25

Table D-3 Soil Profile Description (1/25)

1.	Profile Number (Pit No.)	No.3
2.	Date of Examination	11 November, 1982
3.	Soil Classification	
	1) FAO/UNESCO System	Eutric Fluvisols
	2) Indonesian System	Grayish Brown alluvial Soils
4.	Location	Parakan, Ds. Parakan, Kec. Kopo
5.	Physiography	Flat natural levee
6.	Drainage	Moderately well
7.	Parent Material	Alluvial deposits
8.	Vegetation or Land Use	Dryland field

Horizon	Depth (cm)	Description
Ap	0-15	Brownish black (5YR 3/1), silty clay, weak subangular blocky, slightly sticky and slightly plastic, fine roots, clear smooth boundary, pH 5.5
B_2	15-55	Grayish brown (5YR 4/2), clay, structure-less massive, sticky and plastic, fine roots, clear smooth boundary, pH 5.6
C	55-100(+)	Brownish gray (7.5YR 5/1), clay, few fine distinct orange (5YR 6/8) mottles, struc-tureless massive, sticky and plastic, pH 5.5

Table D-3 Soil Profile Description (2/25)

1.	Profile Number (Pit No.)	No. 15
2.	Date of Examination	18 November, 1982
3.	Soil Classification	
	1) FAO/UNESCO System	Eutric Gleysols
	2) Indonesian System	Grayish Hydromorphic Soils
4.	Location	Junti, Ds. Junti, Kec. Kopo
5.	Physiography	Flat valley bottom
6.	Drainage	Poor
7.	Parent Material	Run-off deposits
8.	Vegetation or Land Use	Rice field

Horizon	Depth (cm)	Description
Ap	0-15	Grayish brown (5YR 5/2), loam, fine medium distinct red (10R 4/6) mottles, structure-less massive, sticky and plastic, fine roots, clear smooth boundary, pH 5.3
Bg2	12-40	Brownish gray (5YR 5/1), clay, common medium distinct reddish black (7.5R 1.7/1) mottles, structureless massive, very sticky and very plastic, fine roots, gradual smooth boundary, pH 6.2
Cg	40-100(+)	Grayish brown (7.5YR 6/2), silty clay, common medium distinct reddish black (7.5R 1.7/1) mottles, structureless massive, very sticky and very plastic, pH 5.9

Table D-3 Soil Profile Description (3/25)

1.	Profile Number (Pit No.)	No. 14
2.	Date of Examination	12 November, 1982
3.	Soil Classification	
	1) FAO/UNESCO System	Orthic Acrisols
	2) Indonesian System	Yellowish Brown Podzoric Soils
4.	Location	Wanasari, Ds. Junti, Kec. Kopo
5.	Physiography	Flat hilly land
6.	Drainage	Moderately well
7.	Parent Material	Tuff
8.	Vegetation or Land Use	Rice field

Horizon	Depth (cm)	Description
Ap	0-20	Grayish brown (7.5Y 6/2), sandy clay, few medium distinct bright brown (2.5YR 5/8) mottles, weak subangular blocky, slightly sticky and slightly plastic, fine roots, clear smooth boundary, pH 4.8
B_1	20-40	Brownish gray (7.5YR 6/1), sandy clay, few fine distinct black (7.5YR 1.7/1) mottles, moderate subangular blocky, slightly sticky and slightly plastic, gradual smooth boundary, pH 5.6
Bt_2	40-100(+)	Brownish gray (5YR 6/1), clay, common fine prominent red (10R 5/8) mottles, structureless massive, sticky and plastic, pH 5.5

Table D-3 Soil Profile Description (4/25)

1.	Profile Number (Pit No.)	No. 16
2.	Date of Examination	23 November, 1982
3.	Soil Classification	
	1) FAO/UNESCO System	Dystric Nitosols
	2) Indonesian System	Reddish Latosols
4.	Location	Pasir Limus, Ds. Pasir Limus, Kec Pamarayan
5.	Physiography	Undulating hilly land
6.	Drainage	Well
7.	Parent Material	Tuff
8.	Vegetation or Land Use	Shrub

Horizon	Depth (cm)	Description
Ap	0-45	Dark reddish brown (5YR 3/4), clay loam, weak subangular blocky, sticky and slightly plastic, medium roots, gradual smooth boundary, pH 5.0
Bt_2	45-100(+)	Brownish gray (7.5YR 6/1), clay, common medium distinct dark reddish brown (2.5YR 3/6) mottles, medium subangular blocky, sticky and plastic, medium roots, pH 5.5

Table D-3 Soil Profile Description (5/25)

1. Profile Number (Pint No.)	No. 33
2. Date of Examination	8 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Tegal Panjang, Ds. Ketos, Kec. Cikande
5. Elevation	8 m
6. Physiography	Shallow valley bottom
7. Topography	Undulating
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Poor
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	Run-off deposits
14. Vegetation or Land Use	Rice field (once a year)

Horizon	Depth(cm)	Description
Ap	0-18	Brownish gray (7.5YR5/1), silty clay, many medium distinct (5YR4/8) reddish brown mottles, structureless massive, sticky and plastic, common fine grass roots, abrupt smooth boundary, moist
Bg2	18-45	Brownish gray (7.5YR5/1), clay, common medium distinct (5YR4/8) reddish brown mottles, structureless massive, sticky and very plastic, few fine grass roots, clear smooth boundary, moist
Cg	45-100(+)	Brownish gray (7.5YR5/1), silty clay, common fine faint (7.5YR5/8) bright brown mottles, structureless massive, sticky and very plastic, very fine few grass roots, moist

Table D-3 Soil Profile Description (6/25)

1. Profile Number (Pit No.)	No. 34
2. Date of Examination	8 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzoric Soils
4. Location	Tritih, Ds. Ketos, Kec. Cikande
5. Elevation	8 m
6. Physiography	Flat hilly land
7. Topography	Undulating
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Moderately well
11. Permeability	Moderately slow
12. Ground Water Level (m)	-----
13. Parent Material	Acid tuff
14. Vegetation or Land Use	Abondoned rice field (grass land)

Horizon	Depth(cm)	Description
A1	0-0.5	Dark reddish brown (5YR3/3), silty clay, no mottles, weak very fine granular, slightly sticky and slightly plastic, firm, common fine grass roots, abrupt smooth boundary, dry
A2	0.5-25	Reddish brown (5YR4/8), silty clay, many fine faint (2.5YR4/8) reddish brown mottles, weak coarse subangular blocky, sticky and very plastic, very firm, common fine grass roots, clear smooth boundary, dry to moist
Bt2	25-50	Grayish brown (7.5YR5/2), clay, many medium distinct (2.5YR4/8) reddish brown mottles, weak coarse subangular blocky, very sticky and very plastic, very firm, few fine grass roots, clear wavy boundary, moist
Bt3	50-72	Dull yellow brown (10YR6/3), clay, many coarse faint (2.5YR4/6) reddish brown mottles, structureless massive, very sticky and very plastic, no roots, clear smooth boundary, moist
C	72-100(+)	Grayish yellow (2.5Y7/2), clay, many coarse faint (10YR 5/1) brownish gray mottles, structureless massive, sticky and very plastic, no roots, moist

Table D-3 Soil Profile Description (7/25)

1. Profile Number (Pit No.)	No. 35
2. Date of Examination	9 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Tegal Panjang, Ds. Ketos, Kec. Cikande
5. Elevation	12 m
6. Physiography	Flat hilly land
7. Topography	Flat
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Moderately well
11. Permeability	Moderately slow
12. Ground Water Level (m)	-----
13. Parent Material	Acid tuff
14. Vegetation or Land Use	Rice field (once a year)

Horizon	Depth(cm)	Description
Ap	0-6	Light gray (10YR7/1), Loam, few fine faint (7.5YR4/6) brown mottles, structureless massive, slightly sticky and slightly plastic, few fine grass roots, clear broken boundary, dry
A2	6-8	Brownish gray (10YR5/1), silty clay, few fine faint (7.5YR4/6) brown mottles, structureless massive, slightly sticky and plastic, few fine grass roots, clear broken boundary, dry to moist
B21 (Bir,mn,)	8-14	Brownish gray (10YR5/1), silty clay, many coarse distinct (7.5YR4/6) brown mottles and common fine distinct (N1.5/0) black mottles, structureless massive, slightly sticky and plastic, few fine grass roots, clear irregular boundary, moist
B22	14-100(+)	Brownish gray (10YR5/1), silty clay, many coarse faint (5YR5/1) bright brown mottles, structureless massive, slightly sticky and plastic, few fine grass roots, moist

Table D-3 Soil Profile Description (8/25)

1. Profile Number (Pit No.)	No. 36
2. Date of Examination	9 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Yellowish brown Podzolic Soils
4. Location	Mendaya, Ds. Binuang, Kec. Carenang
5. Elevation	4 m
6. Physiography	Flat low land
7. Topography	Flat
8. Slope	Flat
9. Erosion	River deposition
10. Drainage	Poor
11. Permeability	Very slow
12. Ground Water Level (m)	1 m
13. Parent Material	Alluvial deposits
14. Vegetation or Land Use	Rice field (1 or 2 times a year)

Horizon	Depth(cm)	Description
Agp	0-17	Gray (10YR5/1), silty clay, many medium distinct (7.5YR 5/6) bright brown mottles, structureless massive, sticky and plastic, common fine grass roots, abrupt smooth boundary, moist
Bg (Bg,mn,ir)	17-35	Grayish yellow brown (10YR4/2), silty clay, many fine distinct (7.5YR2/1) black mottles and many coarse faint (5YR4/6) reddish brown mottles, structureless massive, sticky and plastic, few fine grass roots, clear wavy boundary, moist, few 2-3 mm stones
Cg	35-100(+)	Grayish yellow brown (10YR5/2), silty clay, many medium faint (7.5YR4/6) reddish brown mottles, structureless massive, sticky and plastic, very few fine grass roots, moist to wet

Table D-3 Soil Profile Description (9/25)

1. Profile Number (Pit No.)	No. 37
2. Date of Examination	11 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Patapan, Ds. Blokang, Kec. Pamarayan
5. Elevation	16 m
6. Physiography	Undulating hilly top
7. Topography	Undulating
8. Slope	Flat
9. Erosion	Water erosion
10. Drainage	Well
11. Permeability	Moderate
12. Ground Water Level (m)	-----
13. Parent Material	Acid tuff
14. Vegetation or Land Use	Banana field

Horizon	Depth(cm)	Description
Ap	0-6	Reddish Brown (5YR4/6), silty clay, few fine distinct (7.5YR1.7/1) black mottles, weak fine granular, friable, sticky and very plastic, few fine roots, few fine stones, abrupt smooth boundary, dry
B2	6-50	Dark reddish Brown (2.5YR3/4), clay, common medium distinct (7.5YR1.7/1) black mottles, weak medium subangular blocky, friable, sticky and very plastic, few fine roots, few very fine stones, clear irregular boundary, moist
C	50-100	Brownish gray (7.5YR6/1), clay, few coarse faint (7.5YR 1.7/1) black mottles, and many coarse distinct (5YR4/8) reddish brown mottles, structureless massive, sticky and very plastic, no roots, few to common fine stones, moist

Table D-3 Soil Profile Description (10/25)

1. Profile Number (Pit. No.)	No. 38
2. Date of Examination	11 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Patapan, Ds. Blokang, Kec. Pamarayan
5. Elevation	8 m
6. Physiography	Low terrace
7. Topography	Flat
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Poor
11. Permeability	Slow
12. Ground Water Level (m)	Below 1 m
13. Parent Material	Run-off deposits
14. Vegetation or Land Use	Rice field (twice a year)

Horizon	Depth(cm)	Description
Agp	0-17	Gray (5Y4/1), silty clay, many medium distinct (2.5YR3/4) dark reddish brown mottles, structureless massive, sticky and very plastic, few fine roots, clear smooth boundary, moist
Bgir2	17-45	Brownish gray (5YR5/1), silty clay, many coarse faint (5YR4/8) reddish brown mottles, structureless massive, sticky and very plastic, few fine roots, few fine manganese concretion, abrupt smooth boundary, moist
Cg	45-100(+)	Reddish gray (2.5YR4/1), silty clay, common coarse faint (7.5YR4/6) brown mottles, structureless massive, sticky and plastic, few fine roots, common fine iron and manganese concretion, moist

Table D-3 Soil Profile Description (11/25)

1. Profile Number (Pit. No.)	No. 39
2. Date of Examination	15 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Dystric Nitosols
2) Indonesian System	Reddish Latosols
4. Location	Bontan, Ds. Babakan, Kec. Pamarayan
5. Elevation	23 m
6. Physiography	Flat hilly top
7. Topography	Undulating
8. Slope	Flat
9. Erosion	Water erosion
10. Drainage	Well
11. Permeability	Moderately slow
12. Ground Water Level (m)	-----
13. Parent Material	Tuff and Lava flow
14. Vegetation or Land Use	Banana field

Horizon	Depth(cm)	Description
Ap	0-10	Very dark brown (7.5YR2/3), sandy loam, weak fine subangular blocky, friable, slightly sticky and slightly plastic, common fine roots, many fine stones (quartz-like materials), abrupt smooth boundary, moist
A3	10-20	Dark reddish brown (5YR3/3), sandy clay loam, moderate fine to medium subangular blocky, friable, slightly sticky and plastic, common fine roots, many fine stones (quartz-like materials), clear wavy boundary, moist
Bt2	20-47	Dark reddish brown (2.5YR3/6), sandy clay, moderate medium subangular blocky, firm, sticky and plastic, few fine roots, many fine stones (quartz-like materiatls), partly weathered stones, clear smooth boundary, moist
Bt3	47-78	Brownish gray (5YR5/1), silty clay, many coarse distinct (2.5YR3/4) dark reddish brown mottles, moderate medium subangular blocky, firm, sticky and pistic, few fine roots, many fine stones (quartz-like materials), difuse irregular boundary, moist
C	78-100(+)	Mixed layer of Grayish red (2.5YR5/2), dull yellow (2.5Y 6/3) and red (10R4/6), silty clay to clay, structureless massive, sticky and plastic, very few fine roots, many fine stones (quartz-like materials), moist ***Thislayer is composed of strongly weathered volcanic rocks***

Table D-3 Soil Profile Description (12/25)

1. Profile Number (Pit. No.)	No. 40
2. Date of Examination	15 August, 1984 (Just after cropping)
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Pasir Jambe, Ds. Cijeruk, Kec. Cikande
5. Elevation	7 m
6. Physiography	Valley bottom
7. Topography	Steeply dissected
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Poor
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	Run-off deposit
14. Vegetation or Land Use	Rice field (twice a year)

Horizon	Depth(cm)	Description
Agp	0-15	Gray (N5/0), silty clay to clay, many medium distinct (10R3/4) dark red mottles, structureless massive, very sticky and very plastic, common fine grass roots, clear wavy boundary, moist
Ag3	15-23	Gray (7.5Y5/1), clay, few medium faint (10R3/5) dark red mottles, structureless massive, very sticky and very plastic, common fine grass roots, clear wavy boundary, moist
Bg1	23-45	Reddish gray (7.5R5/1), clay, few fine faint (2.5YR3/6) dark reddish brown mottles and few fine faint (7.5R2/1) reddish black mottles, structureless massive, very sticky and very plastic, few fine grass roots, clear wavy boundary, moist
Bg2	45-85	Dark reddish gray (10R4/1), clay, common medium faint (2.5YR4/6) reddish brown mottles and few to common medium distinct (N3/0) dark gray mottles, structureless massive, very sticky and very plastic, few fine grass roots, gradual irregular boundary, moist
Cg	85-100(+)	Brownish gray (10YR4/1), clay, common fine faint (2.5YR 4/6) reddish brown mottles, structureless massive, very sticky and very plastic, very few fine grass roots, moist to wet

Table D-3 Soil Profile Description (13/25)

1. Profile Number (Pit. No.)	No. 41
2. Date of Examination	16 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Gondel Maja, Ds. Cijeruk, Kec. Cikande
5. Elevation	8 m
6. Physiography	Middle terrace (Undulating)
7. Topography	Undulating
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Well
11. Permeability	Moderately slow
12. Ground Water Level (m)	-----
13. Parent Material	Recent alluvium (Acid tuff)
14. Vegetation or Land Use	Shrub

Horizon	Depth(cm)	Description
A3	0-11	Grayish brown (7.5YR5/2), sandy loam, many fine distinct (7.5YR5/6) bright brown mottles, weak fine granular, very friable, slightly sticky and slightly plastic, many fine grass roots and few tree roots(5-10mm in diameter), abrupt smooth boundary, dry
B1	11-30	Grayish brown (7.5YR5/2), silty clay, many medium faint (7.5YR4/6) brown mottles, moderate medium subangular blocky, friable, slightly sticky and plastic, common fine grass roots and few tree roots(5-10mm in diameter), clear smooth boundary, moist
B2	30-45	Grayish brown (7.5YR5/2), silty clay, many medium faint (5YR4/6) reddish brown mottles and common medium distinct (5YR2/1) brownish black mottles, moderate medium subangular blocky, friable, slightly sticky and plastic, few fine tree roots, gradual wavy boundary, moist
B3	45-88	Light brownish gray (7.5YR7/1), silty clay to clay, many medium faint to distinct (7.5YR4/6) brown mottles and common medium distinct (5YR2/1) brownish black mottles, weak fine subangular blocky, friable, slightly sticky and plastic, very few tree roots, abrupt smooth boundary, moist
R	88-100(+)	Strongly weathered rocks, bright brown (7.5YR5/8) and black (7.5YR1.7/1)

Table D-3 Soil Profile Description (14/25)

1. Profile Number (Pit. No.)	No. 42
2. Date of Examination	21 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Parigi, Ds. Parigi, Kec. Cikande
5. Elevation	20 m
6. Physiography	Undulating hilly top
7. Topography	Undulating
8. Slope	Flat
9. Erosion	Water erosion
10. Drainage	Well
11. Permeability	Moderate
12. Ground Water Level (m)	-----
13. Parent Material	Acid tuff
14. Vegetation or Land Use	Play ground (grass land)

Horizon	Depth(cm)	Description
A1	0-3	Brownish black (7.5YR3/2), sandy loam, moderate fine subangular blocky, friable, non sticky and non plastic, many fine grass roots, many fine stones, abrupt smooth boundary, moist
A2	3-6	Dark brown (7.5YR3/4), sandy loam, moderate very fine subangular blocky, very friable, non sticky and non plastic, common fine grass roots, common fine stones, abrupt smooth boundary, moist
A3	6-23	Dark brown (7.5YR3/4), loam, moderate medium subangular blocky, very friable, non sticky and non plastic, common fine grass roots, and common fine stones, abrupt smooth boundary, moist
B1	23-40	Dark reddish brown (5YR3/4), loam, moderate medium subangular blocky, friable, slightly sticky and slightly plastic, few fine grass roots, common fine stones, clear wavy boundary, moist
Bt2	40-55	Dark reddish brown (5YR3/6), clay loam, many coarse faint (10R3/4) dark red mottles, strong medium to coarse subangular blocky, firm, slightly sticky and plastic, few fine grass roots, few fine stones, clear wavy boundary, moist
Bt3	55-100(+)	Dull reddish brown (5YR4/4), silty clay, many coarse distinct (10R3/4) dark red mottles, strong coarse subangular blocky, firm to very firm, sticky and plastic to very plastic, few fine grass roots, no stones, moist

Table D-3 Soil Profile Description (15/25)

1. Profile Number (Pit. No.)	No. 43
2. Date of Examination	22 August
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Badag, Ds. Gembor Udic, Kec. Cikande
5. Elevation	11 m
6. Physiography	Middle terrace
7. Topography	Undulating
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Well
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	Run-off deposits and tuff
14. Vegetation or Land Use	Unused land (once cultivated as paddy field)

Horizon	Depth(cm)	Description
A1	0-0.5	Brownish black (10YR3/1), silty clay loam, weak fine granular, very friable, slightly sticky and plastic, root mat, few hard stones (2-3mm in diameter), abrupt smooth boundary, moist
A2	0.5-5	Brownish gray (10YR5/1), silty clay loam, few fine faint (5YR4/6) reddish brown mottles, weak very fine subangular blocky, very friable, slightly sticky and plastic, many fine grass roots, many hard stones (3-5mm in diameter), abrupt smooth boundary, moist
Bt1	5-11	Grayish brown (7.5YR4/2), silty clay loam, common medium faint (7.5YR1.7/1) black mottles, moderate fine subangular blocky, friable, slightly sticky and plastic, common fine grass roots, many hard stones (3-5mm in diameter), abrupt smooth boundary, moist
Bt,ir2	11-18	Grayish brown (7.5YR4/2), silty clay, common medium distinct (10R3/6) dark red mottles, weak medium subangular blocky, very friable, sticky and plastic, few fine grass roots, many hard stones (3-5mm in diameter), clear smooth boundary, moist
Bx3	18-100(+)	Reddish gray (2.5YR5/1), silty clay, many fine distinct (10R6/3) dull reddish orange mottles, weak very fine subangular blocky, loose, sticky and plastic, few fine grass roots, common hard stones (3-5mm in diameter), (at the depth of 30 cm, some laterite exists), moist

All stones are moderately weathered and still hard. Their size, shape and color are 3-5mm in diameter, round-shaped and black (7.5YR 1.7/1), respectively.

Table D-3 Soil Profile Description (16/25)

1. Profile Number (Pit. No.)	No. 44
2. Date of Examination	22 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Julang Masjid, Ds. Julang, Kec. Cikande
5. Elevation	11 m
6. Physiography	Middle terrace
7. Topography	Flat
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Moderately well
11. Permeability	Slow
12. Ground Water Level (m)	12 m
13. Parent Material	Acid tuff and terrace materials
14. Vegetation or Land Use	Rubber plantation (abondoned paddy field)

Horizon	Depth(cm)	Description
Ap	0-14	Brownish gray (10YR5/1), silty clay, many medium faint (7.5YR4/6) brown mottles, structureless massive, slightly sticky and plastic, common fine grass roots, few stones (30mm in diameter), clear wavy boundary, moist
B11	14-30	Brownish gray (7.5YR4/1), silty clay loam, many medium faint (7.5YR4/6) brown mottles, weak medium subangular blocky, friable, slightly sticky and plastic, few fine grass roots, common fine stones (quartz-like materials), clear wavy boundary, moist to wet
B12	30-36	Grayish brown (7.5YR4/2), silty clay, many medium distinct (5YR3/4) dark reddish brown mottles, weak fine subangular blocky, friable, slightly sticky and plastic, no roots, many weathered stones (4-5mm in diameter), clear smooth boundary, moist to wet
Bt2	36-100(+)	Brownish gray (7.5YR4/1), clay, no mottles, weak medium subangular blocky, very friable, sticky and very plastic, no roots, common weathered stones (4-5mm in diameter), moist to wet

Table D-3 Soil Profile Description (17/25)

1. Profile Number (Pit. No.)	No. 45
2. Date of Examination	22 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Dystric Nitosols
2) Indonesian System	Reddish Latosols
4. Location	Sumber Hijau, Ds. Leuwi Limus, Kec. Cikande
5. Elevation	26 m
6. Physiography	Flat hilly top
7. Topography	Flat
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Well
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	Volcanic materials
14. Vegetation or Land Use	Upland crop field

Horizon	Depth(cm)	Description
Ap	0-11	Brown (7.5YR4/4), sandy loam, no mottles, weak very fine granular, very friable, non sticky and non plastic, few fine grass roots, many coarse sands (quartz-like materials), abrupt smooth boundary, dry
A3	11-23	Dark reddish brown (5YR3/4), sandy clay loam, structurless massive, sticky and plastic, few grass roots, many coarse sands (quartz-like materials), clear smooth boundary, moist
Bt3	23-84	Dark reddish brown (2.5YR3/4), sandy clay, moderate medium subangular blocky, friable, sticky and plastic to very plastic, few fine grass roots, many coarse sands (quartz-like materials), gradual irregular boundary, moist
C	84-100(+)	Grayish brown (5YR5/2), sandy clay to clay, many medium distinct (10R3/4) dark red mottles, moderate fine subangular blocky, friable, sticky and plastic, friable, few fine grass roots, many coarse sands (quartz-like materials), moist

Table D-3 Soil Profile Description (18/25)

1. Profile Number (Pit. No.)	No. 46
2. Date of Examination	23 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Sasak Nangka, Ds. Parigi, Kec. Cikande
5. Elevation	20 m
6. Physiography	Flat hilly top (high terrace)
7. Topography	Flat
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Well
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	Acid tuff and terrace materials
14. Vegetation or Land Use	Rubber plantation

Horizon	Depth(cm)	Description
A2	0-8	Grayish brown (7.5YR4/2), sandy clay loam, common medium faint (5YR3/6) dark reddish brown mottles, moderate medium subangular blocky, friable, slightly sticky and plastic, many fine grass roots, common coarse sands (quartz-like materials), abrupt smooth boundary, moist
B21	8-23	Brownish gray (7.5YR5/1), sandy clay loam, common medium distinct (5YR3/4) dark reddish brown mottles, weak fine to medium subangular blocky, very friable, slightly sticky and plastic, few fine grass roots, common coarse sands (quartz-like materials), abrupt wavy boundary, moist
Bt,ir22	23-36	Brownish gray (5YR5/1), sandy clay, common to many medium distinct (5YR5/8) bright reddish brown mottles, weak coarse subangular blocky, friable, slightly sticky and plastic to very plastic, very few grass roots, many coarse sands (quartz-like materials), clear irregular boundary, moist
Bt,mn3	36-64	Brownish gray (7.5YR5/1), silty clay, few fine distinct (5YR2/1) brownish black mottles, structureless massive, sticky and very plastic, no roots, few coarse sands (quartz-like materials), clear irregular boundary, moist
c	64-100(+)	Brownish gray (5YR5/1), silty clay, structureless massive, sticky and very plastic, no roots, many stones (4-5mm in diameter), moist

Table D-3 Soil Profile Description (19/25)

1. Profile Number (Pit. No.)	No. 47
2. Date of Examination	23 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Dystric Nitosols
2) Indonesian System	Reddish Latosols
4. Location	Bahbul, Ds.Situ Teratai, Kec. Cikande
5. Elevation	24 m
6. Physiography	Flat hilly top (terrace materials)
7. Topography	Undulating
8. Slope	Flat to undulating
9. Erosion	Water erosion
10. Drainage	Well
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	High terrace materials
14. Vegetation or Land Use	Upland crop field (paddy in rainy season)

Horizon	Depth(cm)	Description
Ap	0-28	Dark reddish brown (5YR3/4), sandy clay loam, moderate medium subangular blocky, firm, slightly sticky and sticky, few to common fine grass roots, many coarse sands (quartz-like materials), gradual irregular boundary, moist
B21	28-60	Brown (7.5YR4/6), sandy clay loam, many coarse faint (5YR3/6) dark reddish brown mottles, moderate medium subangular blocky, firm, slightly sticky and plastic, few fine grass roots, many coarse sands (quartz-like materials), gradual irregular boundary, moist
Bt,ir22	60-100(+)	Dull brown (7.5YR5/3), sandy clay, many medium distinct (10R4/3) reddish brown mottles, moderate medium subangular blocky, friable to firm, sticky and plastic, very few fine grass roots, many coarse sands (quartz-like materials), moist

Table D-3 Soil Profile Description (20/25)

1. Profile Number (Pit. No.)	No. 48
2. Date of Examination	23 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Baluk Besar, Ds. Nambo Udik, Kec. Cikande
5. Elevation	15 m
6. Physiography	Hill foot slope
7. Topography	Sloping
8. Slope	Gently sloping
9. Erosion	Water erosion
10. Drainage	Poor
11. Permeability	Slow
12. Ground Water Level (m)	-----
13. Parent Material	Run-off deposits and tuff
14. Vegetation or Land Use	Wild land (near paddy field)

Horizon	Depth(cm)	Description
A3	0-10	Brownish black (7.5YR3/2), silty clay loam, moderate medium to coarse subangular blocky, firm, sticky and very plastic, many fine grass roots, abrupt wavy boundary, moist
Bt2	10-22	Light yellow (2.5Y7/3), clay, weak medium subangular blocky, friable, very sticky and very plastic, few fine roots, clear irregular boundary, moist
BC	22-47	Gray (7.5Y5/1), clay, structureless massive, sticky to very sticky and very plastic, no roots, clear irregular boundary, moist ***Strongly weathered rock layer, its colors are 2.5Y7/4 (light yellow) and 2.5Y7/2 (grayish yellow). ***
C1	47-80	Pale yellow (7.5Y8/3), clay, structureless, sticky to very sticky and very plastic, no roots, abrupt wavy boundary, moist ***Mixed layer of gravels and clays. The former is dominant.***
C2	80-100(+)	Pale yellow (7.5Y8/3), clay, structureless, sticky and plastic, no roots, moist

Table D-3 Soil Profile Description (21/25)

1. Profile Number (Pit. No.)	No. 49
2. Date of Examination	28 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Graish Hydromorphic Soils
4. Location	Mendaya, Ds. Binuang, Kec. Carenang
5. Elevation	3 m
6. Physiography	River flood plain
7. Topography	Flat
8. Slope	Flat
9. Erosion	River depsition
10. Drainage	Poor
11. Permeability	Slow
12. Ground Water Level (m)	About 1 m
13. Parent Material	Recent alluvium
14. Vegetation or Land Use	Rice field (once a year)

Horizon	Depth(cm)	Description
Ap	0-20	Gray (N4/0) <when wet> and brownish gray (10YR4/1) <when dry>, clay, common medium to coarse prominent (5YR3/4) dark reddish brown mottles, structureless massive, sticky and very plastic, common fine grass roots, abrupt irregular boundary, dry to moist
A3	20-35	Brownish gray (10YR4/1), clay, many medium faint (2.5YR 3/6) dark reddish brown mottles, structureless massive, sticky and very plastic, few fine grass roots, clear wavy boundary, moist
B1	35-43	Brownish black (10YR3/1), clay, common fine faint (5YR4/6) reddish brown mottles, structureless massive, very sticky and very plastic, few fine grass roots, abrupt smooth boundary, moist to wet
B21	43-67	Brownish gray (10YR5/1), sandy clay to silty clay, common coarse faint (10YR4/6) brown mottles and common fine faint to distinct (10YR1.7/1) black mottles, weak medium subangular blocky, friable, slightly sticky and plastic, very few fine grass roots, clear wavy boundary, wet to moist
B22	67-100(+)	Brownish gray (7.5YR5/1), sandy clay to silty clay, many coarse faint (7.5YR5/6) bright brown mottles and common fine faint to distinct (10YR1.7/1) black mottles, weak medium subangular blocky, friable, slightly sticky and plastic, very few fine roots, wet

Table D-3 Soil Profile Description (22/25)

1. Profile Number (Pit. No.)	No. 50
2. Date of Examination	24 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzolic Soils
4. Location	Binuang, Ds. Binuang, Kec. Binuang
5. Elevation	8 m
6. Physiography	Low terrace
7. Topography	Flat
8. Slope	Flat
9. Erosion	No erosion
10. Drainage	Well
11. Permeability	Moderate
12. Ground Water Level (m)	-----
13. Parent Material	Acid tuff (terrace materials)
14. Vegetation or Land Use	Rice field (Once a year)

Horizon	Depth(cm)	Description
Ap	0-13	Grayish yellow brown (10YR6/2), silty clay, common fine faint (7.5YR5/8) bright brown mottles, weak medium subangular blocky, firm, slightly sticky and plastic, many fine grass roots, abrupt smooth boundary, dry
Bt1	13-17	Dull brown (7.5YR5/4), clay, common medium faint to distinct (7.5YR5/8) bright brown mottles, weak fine subangular blocky, firm, sticky and plastic to very plastic, few fine grass roots, clear irregular boundary, moist
Bt21	17-55	Brownish gray (7.5YR4/1), clay, common fine to medium distinct (10R3/6) dark red mottles, moderate fine subangular blocky, firm, sticky and very plastic, very few fine roots, few moderately weathered stones (4-20mm in diameter), gradual wavy boundary, moist
Bt22	55-100(+)	Brownish gray (7.5YR4/1), clay, common fine to medium distinct (10R3/6) dark red, (10YR5/8) yellowish brown and (2.5YR5/1) reddish gray mottles, moderate fine subangular blocky, firm, sticky and very plastic, no roots, moist to wet ***According to the effect of water, the lowest part of this horizon has weakly shiny ped surface.***

Table D-3 Soil Profile Description (23/25)

1. Profile Number (Pit. No.)	No. 51
2. Date of Examination	24 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Kedondong, Ds. Mekar Sari, Kec. Carenang
5. Elevation	0 m
6. Physiography	Recent Alluvial plain
7. Topography	Flat
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Very poor
11. Permeability	Very slow
12. Ground Water Level (m)	-----
13. Parent Material	Recent alluvium
14. Vegetation or Land Use	Rice field (once a year)

Horizon	Depth(cm)	Description
Ap	0-13	Brownish gray (7.5YR4/1), silty clay, many coarse distinct (5YR3/6) bright reddish brown mottles, structureless massive, sticky and very plastic, common fine grass roots, clear wavy boundary, moist
B1	13-35	Brownish gray (7.5YR3/1), clay, many medium faint to distinct (5YR4/8) reddish brown mottles, structureless massive, very sticky and very plastic, few fine grass roots, gradual irregular boundary, moist
B2	35-60	Brownish black (5YR3/1), clay, few fine faint (2.5YR3/1) dark reddish gray and (10YR1.7/1) black mottles, structureless massive, very sticky and very plastic, few fine grass roots, gradual irregular boundary, moist
B3	60-100	Brown (10YR4/6), clay, common medium faint to distinct (7.5YR4/4) brown mottles, structureless massive, very sticky and very plastic, gradual wavy boundary, moist
C	100-110(+)	Brown (10YR4/6), clay, many medium faint (7.5YR4/4) brown and common medium distinct (10R3/6) dark red mottles, structureless massive, very sticky and very plastic, moist

Talbe D-3 Soil Profile Description (24/25)

1. Profile Number (Pit. No.)	No. 52
2. Date of Examination	24 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Kramat, Ds. Peninjoan, Kec. Carenang
5. Elevation	4
6. Physiography	Recent alluvial plain
7. Topography	Flat
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Poor
11. Permeability	Very slow
12. Ground Water Level (m)	-----
13. Parent Material	Terrace materials
14. Vegetation or Land Use	Rice field (once a year)

Horizon	Depth(cm)	Description
Ap	0-10	Brownish gray (10YR4/1), silty clay, many medium faint to distinct (10R3/4) dark red mottles, structureless massive, sticky and plastic, many fine grass roots, few fine stones, clear wavy boundary, moist
B1	10-17	Brownish gray (5YR4/1), clay, common fine distinct (5YR 3/4) dark reddish brown mottles, structureless massive, very sticky and very plastic, common fine roots, few fine stones, clear wavy boundary, moist
Bir,mn2	17-60	Brownish gray (7.5YR4/1), clay, few to common medium distinct (7.5YR1.7/1) black mottles and many coarse faint (5YR3/4) dark reddish brown mottles, structureless massive, very sticky and very plastic, few fine roots, few fine stones, gradual irregular boundary, moist
B3	60-85	Brownish gray (5YR5/1), clay, few fine faint (7.5YR1.7/1) black motlles, structureless massive, very sticky and very plastic, few fine roots, many weathered stones (5-15 mm in diameter), gradual wavy boundary, moist
C	85-100(+)	Reddish gray (2.5YR6/1), clay, many coarse faint to distinct (7.5YR5/6) bright brown mottles, structureless massive, very sticky and very plastic, no roots, few fine stones, moist to wet

Table D-3 Soil Prfile Description (25/25)

1. Profile Number (Pit. No.)	No. 53
2. Date of Examination	29 August, 1984
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Cakung Srewu, Ds. Srewu, Kec. Carenang
5. Elevation	2 m
6. Physiography	Recent alluvial plain
7. Topography	Flat
8. Slope	Flat
9. Erosion	Water deposition
10. Drainage	Very poor
11. Permeability	Very slow
12. Ground Water Level (m)	-----
13. Parent Material	Recent alluvium
14. Vegetation or Land Use	Rice field (once a year)

Horizon	Depth(cm)	Description
Ap	0-10	Brownish gray (10YR4/1), silty clay, common medium distinct (2.5YR4/6) reddish brown mottles, structureless massive, sticky and plastic, few to common fine grass roots, abrupt smooth boundary, moist
A3	10-17	Brownish gray (7.5YR4/1), silty clay to clay, common fine faint (2.5YR4/6) reddish brown mottles and common fine distinct (7.5YR1.7/1) black mottles, structureless massive, sticky and very plastic, few to common fine grass roots, clear wavy boundary, moist
C	17-100(+)	Brownish gray (7.5YR5/1), silty clay, many coarse faint (7.5YR5/8) bright brown, common fine distinct (10R2/3) very dark reddish brown and common fine distinct (7.5YR 3/1) brownish black mottles, structureless massive, sticky and very plastic, very few fine grass roots, moist to wet ***This layer is very difused one. Many kind of mottles show different colors, and their distribution is a ununiform one ***

Table D-4 Summary of Land Classification

Item	Code	Class I			Class II			Class III			Class IV		
		Paddy	Upland	Orchard	Paddy	Upland	Orchard	Paddy	Upland	Orchard	Paddy	Upland	Orchard
1. Thickness of top soil	t	>15 cm	>25 cm	>15 cm	<15 cm	25-15 cm	—	—	<15 cm	—	—	—	
2. Effective depth soil	d	>50 cm	>100 cm		50-25 cm	100-50 cm		25-15 cm	50-15 cm	50-25 cm	<15 cm		<25 cm
3. Gravel content in top soil	g	<20%	<5%	<10%	20-50%	5-20%	10-50%	—	10-50%	20-50%	>50%	>20%	>50%
4. Easiness of plowing	p	Easy to slightly difficult			Moderately difficult			Very difficult			—	—	—
5. Permeability under submerged condition	l	Poorly to imperfectly permeable	—	—	Moderately to well permeable	—	—	Well to excessively permeable	—	—	—	—	—
6. State of redox potentiality (Risk of root damage)	r	None to weak	—	—	Moderate to strong	—	—	Very strong	—	—	—	—	—
7. Wetness of land (Risk of drought or wetness)	Wet: W	—	None		—	Low possibility of over wetness		—	Possibility of over wetness		—	High possibility of over wetness	
	Dry: (W)	—	None		—	Low possibility of drought		—	Possibility of drought		—	High possibility of drought	
8. Inherent fertility	f	Fertile				Medium			Infertile		—	—	—
9. Content of available nutrients	n	High				Medium			Low		—	—	—
10. Degree of hazard	i	None				Slightly			Moderately			Seriously	
11. Frequency of hazard	a	None to rarely				Moderately			Frequently		—	—	—
12. Slope	s	—	<6%	<28%	—	6-14%	14-47%	—	14-28%	28-47%	—	>28%	>47%
13. Erosion	e	None or very slightly				Slightly			Seriously			Very seriously	

Table D-5 Soil Unit and Land Classification Class

Item	Code	Eutric Fluvisols		Eutric Gleysols						Orthic Acrisols												Dystric Nitosols					
		F	D	F	D	G	D	De	D	F	D	G	D	S	D	F	M	G	S	S	S	F	D	G	D	S	D
		R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U
1. Thickness of top soil	t	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	II	II	IV	I	I	I	I	I	I
2. Effective soil depth	d	I	I	I	I	I	I	I	I	I	I	I	I	I	I	II	III	III	III	IV	IV	I	I	I	I	I	I
3. Gravel content in top soil	g	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4. Easiness of plowing	p	I	I	I	II	I	II	I	II	I	I	I	I	I	I	I	II	II	II	II	II	I	I	I	I	I	I
5. Permeability under submerged condition	ƒ	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-
6. State of redox potential	r	I	I	I	II	I	II	III	III	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
7. Wetness of land	w	-	II	-	II	-	II	-	IV	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
8. Inherent fertility	f	I	II	I	I	I	I	I	I	II	II	II	II	II	II	II	II	II	II	II	II	II	II	II	II	II	II
9. Content of available nutrient /1	n	II	II	I	I	I	I	I	I	II	III	II	III	II	III	II	III	II	III	II	III	II	III	II	III	II	III
10 Degree of hazard	i	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
11. Frequency of hazard	a	I	I	I	I	I	I	III	III	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
12. Slope	s	-	I	-	I	-	I	-	I	-	I	-	I	-	II	-	I	-	II	-	II	-	I	-	I	-	III
13. Erosion	e	-	I	-	I	-	I	-	I	-	I	-	II	-	III	-	II	-	III	-	IV	-	I	-	II	-	III
Land classification class		IIn	IIwfn	I/	IIprw	I/	IIprw	IIIra/	IVw	IIfn/	IIIn	IIfn/	IIIn	IIfn/	IIIne	IIdfn/	IIIdne	IIId/	IVtde	IVd/	IIIn	IIfn/	IIIn	IIfn/	IIIn	IIfn/	IIIn

Remarks: F = Flat, D = Deep, G = Gently sloping, S = Shallow, S = Sloping, De = Depressed M = Moderately Deep

R = Rice, U = Unpland crops

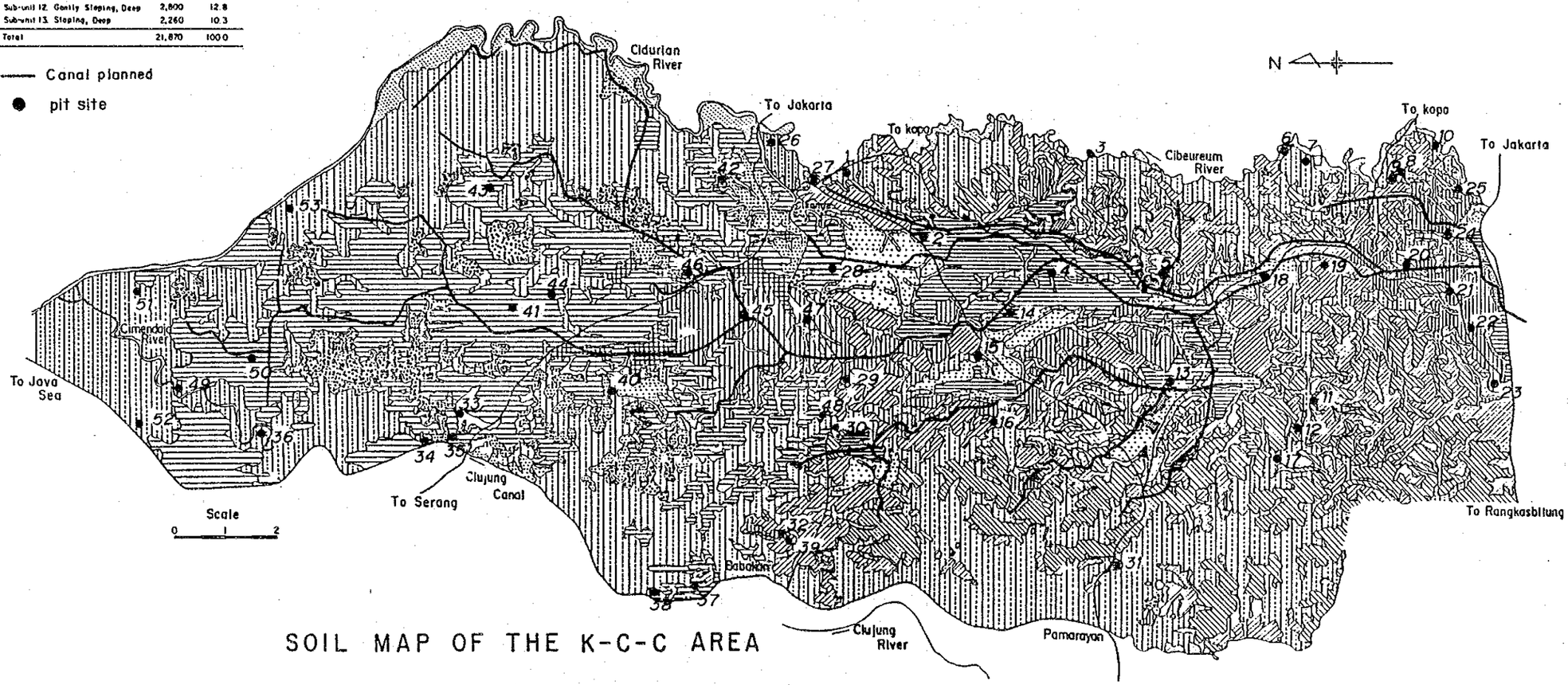
/1: This factor is evaluated by sub-factors except for (e), (f) and (g)

LEGEND

Soil Unit	Area(ha)	Proportional Extent (%)
I. Eutric Fluvisols	320	1 5
Sub-unit 1. Flat, Deep	320	1 5
II. Eutric Gleysols	8,760	40 1
Sub-unit 2. Flat Deep	7,690	35 2
Sub-unit 3 Gently Sloping, Deep	670	3 1
Sub-unit 4 Depressed, Deep	400	1 8
III Orthic Acrisols	6,420	29 3
Sub-unit 5. Flat, Deep	3,900	17 8
Sub-unit 6. Gently Sloping, Deep	1,300	5 9
Sub-unit 7. Sloping, Deep	110	0 5
Sub-unit 8 Flat, Moderately Deep	220	1 0
Sub-unit 9 Gently Sloping, Shallow	850	3 9
Sub-unit 10. Sloping, Shallow	40	0 2
IV Dystric Nitosols	6,370	29 1
Sub-unit 11 Flat, Deep	1,310	6 0
Sub-unit 12. Gently Sloping, Deep	2,800	12 8
Sub-unit 13. Sloping, Deep	2,260	10 3
Total	21,870	100 0

Canal planned

pit site



SOIL MAP OF THE K-C-C AREA

MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT

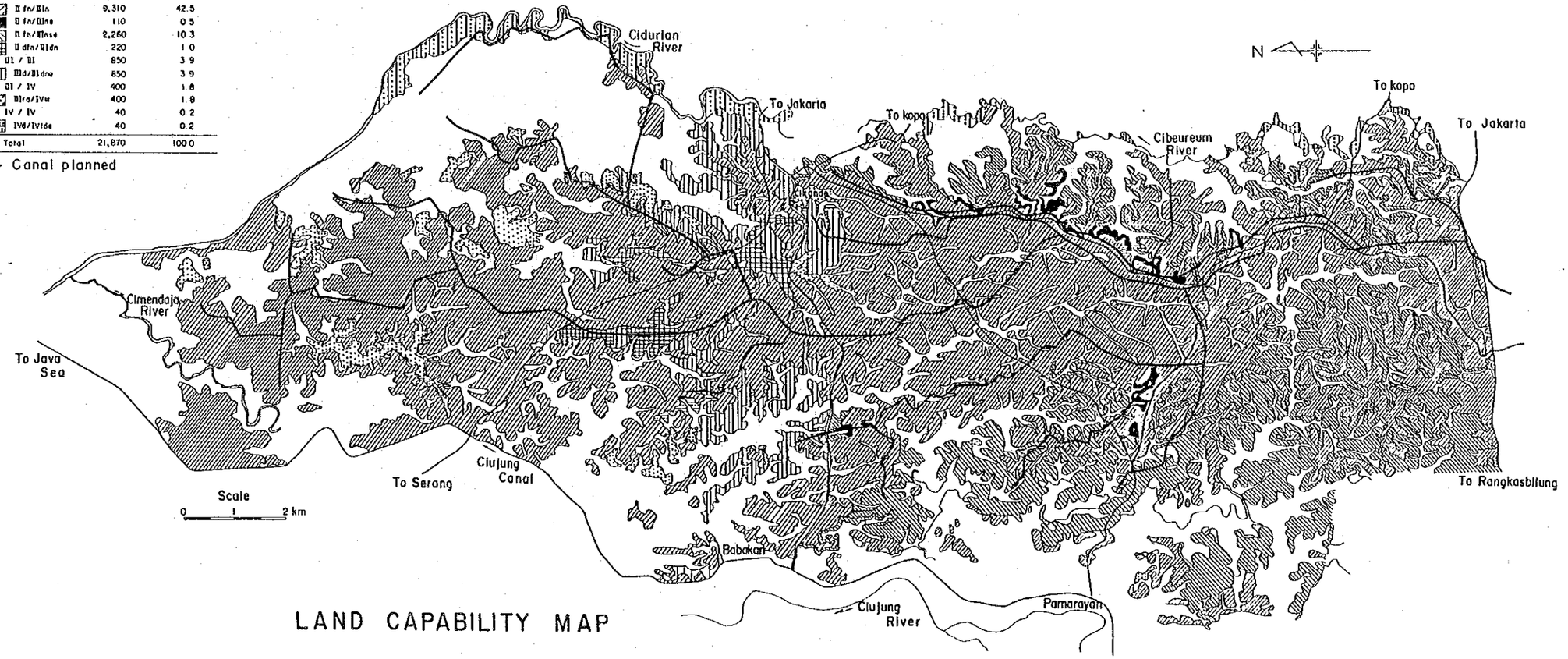
Soil Map of The K-C-C Area

JAPAN INTERNATIONAL COOPERATION AGENCY

LEGEND

	Capability Class (Rice/Upland crops)	Area (ha)	Proportional Extent (%)
1.	I / II	8,360	38.3
	I/II pw	8,360	38.3
2	II / II	320	1.5
	IIn/IIwin	320	1.5
3	II / III	11,900	54.3
	IIfn/IIIn	9,310	42.5
	IIfn/IIIne	110	0.5
	IIfn/IIIse	2,260	10.3
	IIdn/IIIdn	220	1.0
4	III / III	850	3.9
	IIId/IIIdne	850	3.9
5	III / IV	400	1.8
	IIIre/IVw	400	1.8
6	IV / IV	40	0.2
	IVd/IVtde	40	0.2
Total		21,870	100.0

—— Canal planned



LAND CAPABILITY MAP

MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT

Land Capability Map

JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX-E

AGRICULTURE

APPENDIX - E

AGRICULTURE

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AGRICULTURE

1. PRESENT AGRICULTURAL CONDITIONS

1.1 Introduction

The data used for the present study are derived mostly from the government authorities such as

- Central Bureau of Statistics in Jakarta
- Central Research Institute for Agriculture
- Census and Statistic Office for West Java
- Agricultural Office for Kabupaten Serang
- Provincial Office of the Directorate of Agrarian
- Provincial office of the Directorate of Village Development
- Agricultural Extension Office in Kecamatans (WKBPP)
  Kasemen, Ciruas, Kramatwatu, Cilegon, Tirtayasa, Cikande and Kopo
- Camat Offices (Chief of Kecamatan) of Kecamatans Kopo, Pamarayan and Cikande
- PROSIDA Office in Tangerang

The field investigations includifng farmer's interviews and ocular surveys were also carried out in the course of the data collection for the purposes to confirm the information obtained from the said government authorities and to know the farmer's intention to agricultural policies.

1.2 Location

The agricultural study area is located in the northwestern part of the Java Island (North Banten Area). The distance from Jakarta to the eastern border of the study area along the national road (Jakarta - Merak) is about 55 km. The study area extends over the flood-plain of the Cidurian and the Ciujung rivers and belongs to the Kabupatens Serang and Lebak.

There are 14 Kecamatans concerned. The total area of the said 14 Kecamatans concerned is 911 km^2. The list of names of Kecamatans is shown in the following table.

Kecamatans Related to the Project

Kaseman	Kragilan	Carenang	Bojonegara
Kramatwatu	Cikande	Pamarayan	Kopo
Ciruas	Pontang	Cikeusal	
Walantaka	Tirtayasa	Cilegon	

The agricultural condition of the study area is discussed mainly in terms of the 14 Kecamatans concerned.

1.3 Demographic Resources

The total population of Kecamatans concerned was about 592,760 in 1983 based upon the 1983 agricultural census. The population growth rate between 1980 and 1983 is estimated at 1.5% per annum. The population density is about 650 persons/km^2. The number of family in the area was 118,124 in 1983. The average family size is estimated at 5.0 persons/family. About 85% of the total households are agricultural households, of which about 75% of the farms are owner cultivators, 3% are tenant farmers, and 22% are landless farmers. The details of the demographic condition are presented in Table E-1.

1.4 Present Land Use

The present land use survey was made on areas of about 55,600 ha based on the land use map prepared by the Directorate of Agrarian in 1978. The reliability of the map was checked by the field survey and aerial photographs taken in 1978. The lands are classified into 8 categories, namely, residential area, paddy fields, garden, upland fields, forest land, plantation land, grass land, and fishponds. Area of each category is shown below.

Land use Category	Area	Proportional Extent
	(ha)	(%)
Residential areas	2,330	4
Paddy fields	36,700	66
Garden	7,140	13
Upland fields	1,940	4
Porest lands	390	1
Plantation lands	120	-
Grass lands	580	1
Fish ponds	6,370	11
	55,570	100

The survey area is economically utilized to the maximum extent. No idle land is observed in a large scale. The major land use is paddy fields (66%) followed by garden (13%) and fishponds (11%). Upland fields and grass land are very limited. A present land use map is shown in Fig. E-1.

1.5 Present Cropping pattern

The main crop of the study area is lowland rice followed by palawija crops such as maize, chilly, groundnuts, sweet potato and peas. Fruit trees like banana, mango, rambutan, coconuts, etc. are planted around houses.

Cropping patterns differentiate depending upon the soils and topographic conditions, especially, upon availability of irrigation water. Almost all the lowlands are planted with paddy in the wet season. Double or year-round cropping of paddy are prevalent where irrigation water is available. In the Ciujung irrigation scheme, about 59% (14,280 ha) of the land is estimated to be used for second paddy and 2% (480 ha) for the year-round rice cultivation. However, as many as about 30% (7,260 ha) are left fallow after 1st paddy due to lack of irrigation water. About 2,180 ha (9%) are planted with palawija crops and vegetables after wet season paddy. In the Cicinta irrigation scheme, about 93% (1,330 ha) of the land are left fallow in dry season because of irrigation water shortage.

In rainfed paddy fields, major parts of the land are left fallow after wet season paddy. But very limited parts of the fields are devoted to the second paddy making good use of seasonal rainfall distribution. in the K-C-C area, 87% of the rainfed paddy fields are not used in dry season, while 7% are planted with 2nd paddy and 6% are with palawija and vegetables making use of the residual moisture in the ground.

On the uplands, many types of cropping pattern combining different upland crops are distinguished. According to results of a survey on cropping patterns by the Agricultural Office in Serang, the cropping of palawija-palawija-palawija with respective cropping intensity of 97.5%, 61.8% and 8.7% is estimated to be practiced on an average. The details of the cropping sequences in the lowland paddy field are presented in the following table.

Present Cropping Sequences in Lowland Paddy Field

(Unit: %)

Cropping Sequences	K-C-C Area		Cincinta Area	Ciujung Area
	Irrigated Area	Rainfed Area	Irrigated Area	Irrigated Area
A. Paddy-Paddy-Paddy	-	-	-	2
B. Paddy-Paddy-Vegetables	-	-	-	2
C. Paddy-Paddy-Fallow	100	7	7	57
D. Paddy-Palawija-Fallow	-	2	-	1
E. Paddy-Vegetables-Fallow	-	4	-	8
F. Paddy-Fallow	-	87	93	30
Cropping Intensity	200	113	107	173

Source: Agrigultural Office of Kabupaten Serang, 1982
Sample Survey

The first paddy starts at the onset of wet season usually in October to December, and harvested in April to June depending upon a variety used. The second crop starts following the harvest of the 1st crop and ends in September.

1.6 Farming Practices

There are three kinds of paddy cultivations in the study area, namely, wet season paddy, rainfed paddy and dry season paddy cultivations.

The wet season paddy cultivation is adopeted transplanting seedling in the low lands when enough water is available in the fields. If the water is not enough and the transplanting time is limited, the rainfed rice cultivation is applied transplanting seedlings in water-unsaturated fields. Dry season paddy cultivation is carried out in most cases with irrigation.

Land preparation is started 20 to to 30 days before transplanting. Plowing and harrowing are done usually 2 times by carabao or by hand. The prevalence of high-yielding varieties is very high i.e. 90% in area. The main variety is Cisadane variety occupying 37.6% of the lands planted in Kabupaten Serang followed by PB(IR) 36 (17.3%).

Weeding is carried out 2 to 3 times by hand in most cases. The harrowing weeder is adopted in limited areas.

Fertilizer is applied usually 3 times; one day before transplanting, 3 to 4 weeks after transplanting and 7 to 8 weeks after transplanting. In 1983/84 crop season 124 kg of urea and 73 kg of T.S.P. per ha are applied on an average in Kabupaten Serang.

Insect pest control is conducted spraying Diazinon against stem borers and bugs when in most cases symptoms of damage are observed. Zincphosphide is widely used as rodenticide.

Maize is usually planted in upland after rainfed paddy or groundnuts Seeds of 2 or 3 are sown in a hole of 5 cm depth. The planting distance is 110 x 40 cm or 160 x 40 cm. Weeding is carried out 2 times in most cases at 4 and 8 weeks after planting for long matured varieties and 3 to 5 week after planting for short matured varieties. Urea is applied basically at a rate of 100 to 150 kg/ha, sometimes with compost or green manure. Pest controls are conducted when damaged. Major varieties are Metro and Harapan.

Groundnuts are grown in lowlands as well as uplands. In uplands groundnuts are planted after rainfed rice or maize in most cases.

Sometimes groundnuts are intercropped with maize. Planting distance is 40 x 20 cm or 30 x 20 cm. Weedings are carried out 2 time, 3 weeks after sowing and 6 weeks after sowing. Between 4 and 5 weeks after sowing, no weeding is done not to disturb the flowering. Fertilizers are applied at a rate of 25 kg urea/ha on an average as a basal dressing. Harvesting is carried out in 3 to 4 months after sowing.

Soybeans and mung beans are the new crops to the farmer in the study area. Yields are low (0.6 to 0.7 ton/ha) due to the strong soil reaction.

1.7 Crop Production

Table E-2 shows harvested area and production of the main crops in the related 14 Kecamatans from 1979 to 1983.

The most important crop in the area is paddy (53,700 ha in 1983) followed by groundnuts (10,900 ha), chilly (3,600 ha), cassava (2,800 ha). maize (1,600 ha), and sweet potato (1,600 ha) in recent years. The harvested area of paddy did not exceed 75,400 hain recent years, which seemed to show that lands suitable for rice growing have already been fully developed for the rice growing and no substantial increase in the area could not be expected unless additional large irrigation facilities will be built in less suitable areas such as undulating hilling lands. The yield has increased abruptly in 1983 to 4.5 ton/ha from 3.0 ton/ha in previous years. This phenomenon was associtated with decrease in amounts of fertilizer application from 138 kg urea/ha to 124 kg urea/ha. Other factors might have involved. This trend could not be expected to continue in the future. The yield difference by the availability of irrigation water can be assessed by the yield data of Kecamatans having fully irrigated rice field and those having no irrigated rice field. The former case can be found in Kecamatans fully covered by the Ciujung irrigation Scheme and the latter case in Kecamatan Waringin Kurung, as shown in Table E-3. The present paddy yield with irrigation is 3.7 ton/ha and that without irrigation is 2.7 ton/ha. Rice yields in demonstration farms were obtained from the results in Kecamatan Cikande. From the total planted area of about 830 ha, the average yields were 6.6 ton/ha for the wet season growing and also 6.6 ton/ha for the dry season growing.

Serang is the most important groundnut producing area in West Java. The intensive groundnut growing is found in Kecamatan Bojonegara where

well drained sandy soils are developed. The average unit yield of groundnuts is 0.73 ton/ha.

Chilly is the second important palawija crop and source of cash for farmers in the area. The major producing area is the Kecamatan Cikande having 2,025 ha of harvested area in 1983. Cikande has a large area of well drained sandy soils, which is suitable for this crop. The unit yield of the crop was 1.8 ton/ha in 1983.

Onion is a minor crop in Kabupaten Serang. In 1984, 1,616 tons of red onion was havested from 350 ha. The unit yield was 4.6 ton/ha.

1.8 Livestock Production

Chickens, goats, sheep, carabaos and ducks are the main livestock in the study area.

Carabaos are kept for draught work (land preparation), for security in times of financial needs and for milk sources. Goats and sheep are grown for cash source by selling them to the local meat markets. Chickens and ducks are major source of proteins (eggs and meat) and are sold to the market when cash is needed. Numbers of livestock in the related Kecamatans in 1983 are presented in Table E-4.

The average number of livestock per agricultural household is 0.35 heads for carabao, 0.77 heads for goat/sheep and 3.56heads for chicken. The carabao population density is 1.13 heads/ha of paddy field. According to results of socio-economy survey conducted by local governments in 1984, the average livestock production per agricultural household per year was 0.16 heads for carabao, 9.37 heads for goat, 0.12 heads for sheep, 1.9 heads for duck and 3.9 heads for chicken.

2. AGRICULTURAL DEVELOPMENT PLAN

2.1 Basic Concept of Agricultural Development

Agricultural development plans are formulated for the study area taking the economic utilization of natural resources such as land, water and of human resources into consideration in order to improve the living standard of the people in the study area, to supply the staple food for the consumers and to save the foreign exchange spent for imported rice.

The limitation of the full utilization of agricultural potential of land due to the shortage of irrigation water is observed in the Ciujung Irrigation Scheme, K-C-C area and Cicinta Irrigation Scheme. In Ciujung and Cicinta Irrigation Schemes, as many as 34% (8,590 ha) of paddy fields is left fallow in the dry season because of lack of irrigation water in spite of plentiful water resources. In K-C-C area, 8,960 ha (87%) out of potential irrigable area of 10,300 ha is not planted in the dry season, also due to lack of water. Unreliable irrigation water supply in the rainy season and the shortage of the water in the dry season restricts rice yield resulting in low yield, 3.7 ton/ha in with-irrigation, and 2.7 ton/ha without-irrigation conditions. Unreliable water supply constrains the increase in the amount of fertilizer application. At present, no more than 124 kg/ha of urea is given to the paddy.

A large amount of red onion, about 9,000 tons is imported to Serang from outside, majorly from Brebes in Central Java, even though there is some potential to produce onion in the Project area.

The high unemployment rate, i.e. 17% of the economically active population in the area shows a wate of human resources and social unstability.

In the above-mentioned context, the following principles for agricultural development plans are formulated.

I) Introduction of year-round irrigated rice cultivation in K-C-C area, Ciujung and Cincinta Irrigation Schemes.
II) Introduction of onion cultivation to K-C-C and Cicinta areas which have more suitable soil condition having better drainability than Ciujung area.
III) Increase in cropping intensity up to 250% from the 110 to 170% in present conditions.
IV) Increase in amount of fertilizer applications to paddy production

from 124 kg to 200 kg urea per ha and from 73 kg to 100 kg T.S.P per ha.

V) Intensification of agricultural support services such as agricultural extension, agricultural credit, and supply of improved seeds.

2.2 Proposed Land Use

In line with the above-mentioned concept land irrigable by gravity are selected from the K-C-C area to the possible maximum extent for irrigated rice cultivation leaving existing residential area, orchards and area for infrastructure. The land use of Ciujung (24,200 ha) and Cicinta (1,430 ha) Irrigation Schemes are not changed. The difference in land use in K-C-C area by the project is summarized in the following table.

Land Use Change in K-C-C Area by the Project

(Unit: ha)

Land Use	Without-Project	With-Project
Paddy field		
Irrigated	240	10,300
Rainfed	10,260	-
Upland	530	-
Grasslands	140	-
Roads, Canal, Paddy Field Bands	950	1,820
Total	12,120	12,120

2.3 Proposed Cropping Patterns

The future cropping patterns are formulated in due consideration of the following conditions.

1) Cropiing patterns should assure farmers and Project of as larger and more stable benefit as possible.
2) Farming labour requirement should be within the limit of available labour forces.
3) Cropping patterns should be acceptable to farmers as well as government authorities.

Paddy is selected as the main crop for the Project for the following reasons.

1) Paddy is the crop which is most suitable economically and physically to irrigation farming in lowlands which occupy the largest portion (98.3%) of the irrigable area.
2) BUPATI recommends paddy or onion growing in areas where irrigation water is available.
3) Judging from the interviews to farmers in the project area, farmers are thought to prefer paddy growing where irrigation water is available.

Palawija crops will be planted in 10% of the Ciujung area to fill the existing demands. Ten percents of the K-C-C and Cicinta areas is allocated to onion growing to substitute the imported onion.

The canal draingage period is set for canal maintenance from the middle of October to the middle of November. This period is the same as that of Ciujung Irrigation Scheme. A cropping intensity of 250% is proposed in due consideration of BUPATI recommendation in which 250% paddy growing is proposed where irrigable, and of introduction of locally improved late growing varieties which limit the higher intensity. The cropping pattern is given is Fig. E-2.

The proposed cropping patterns have some growing periods when no irrigation water is available in irrigation canals. This situation is experienced in Kecamatan Ciruas in Ciujung Irrigation Scheme. Ciruas has a very intensive paddy growing area of about 470 ha where 5 paddy croppings 2 years are practiced. The water shortage in canal drainage period in this area is met by consuming the stored irrigation water in paddy field stored in advance of canel drainage. The water shortage of this period in the Project will be covered by this method.

2.4 Proposed Farming Practices

The present farming practices for the paddy cultivation in the project area have already reached to the satisfactory technical level except in the amounts of dosage of fertilizers. With the year-round irrigation water supplied by the Project, the amounts of fertilizers to be applied could be increased with less risk to 200 kg/ha for urea, 100 kg/ha for T.S.P. and 50 kg/ha for potasium chloride. With the increase in cropping intensity and fertilizer dosage, pest and disease controls could be intensified. Insecticides and rodenticide will have to be applied at a rate of 2 litres/ha and 0.2 kg/ha, respectively. The major design criteria of proposed farming practices are given below.

Major Design Criteria of Proposed Paddy Farming

Varieties	:	Cisadane and IR36 or IR 50
Growing period	:	Cisadane; 135 -145 days
		IR36; 110 -120 days
		IR50; 102 -111 days
Planting method	:	transplanting
Seed sown	:	25 kg/ha
Nursery period	:	20 days
Planting space	:	25 x 25 cm to 30 x 15 cm
Fertilizer application	:	Urea; 200 kg/ha
		TSP; 100 kg/ha
		KCL; 50 kg/ha
Insecticide	:	2 litres/ha
Rodenticide	:	0.2 kg/ha

Labour requirement for each farming practice in the future is estimated as follows.

Nursery preparation	:	10 man-days/ha
Land preparation	:	60 man-days/ha
Transplanting	:	23 man-days/ha
Weeding	:	23 man-days/ha
Harvesting	:	20 man-days/ha
Post-harvest	:	20 man-days/ha
Others (Chemical spray and water management)	:	30 man-days/ha
Total	:	186 mna-days/ha

Because most of the irrigated area in the beneficial area are now under the World Bank Project, the technical level of the farming in without-project condition is anticipated as that of with-project condition. No major improvements in farming is anticipated in rainfed condition.

The onion cultivation will be carried out more intensively increasing the planting drensity to 8.3 plants/m^2. Major design criteria of onion cultivation are given below.

Major Design Criteria of Onion Cultivation

Variety	:	Bombay
Growing period	:	135 days
Planting method	:	transplanting of sets
Sets transplanted	:	600 kg/ha
Planting space	:	60 cm x 20 cm
Fertilizer application	:	Urea; 150 kg/ha
		TSP; 200 kg/ha
		KCL; 100 kg/ha
Insecticide	:	3 litres/ha
Rodenticides(Zinc phosphide)	:	3 kg/ha

Total labour requirement for onion growing is estimated at 230 man-days as shown below.

Land preparation	:	40 man-days/ha
Planting of onion sets	:	30 man-days/ha
Irrigation	:	40 man-days/ha
Weeding	:	60 man-days/ha
Harvesting	:	20 man-days/ha
Post-harvest	:	10 man-days/ha
Others	:	30 man-days/ha
Total	:	230 man-days/ha

The farming labour balance study is made for the most labour intensive pattern (250% cropping intensity for K-C-C area) to check the adaptability of this pattern to the present labour availability. As illustrated in Fig. E-3, the peak labour requirement of 14.1 man-days/10 days/0.6 ha occurs in the last 10 days of April. This labour requirement is within the available labour force of 20 man-days/10 days/0.6 ha. Accordingly the pattern of 250% cropping intensity for K-C-C area is adaptable in terms of farm labour requirement. The less labour intensive cropping patterns can of course be adaptable from viewpoints of farm family labour requirement.

The draft animal labour requirements is estimated at 45 animal-day/ha for the land preparation. The carabao population density is calculated at 1.1 head/ha of paddy field for 14 related Kecamatans. Therefore the proposed 2 month for land preparation will be enough in terms of animal labour availability.

2.5 Anticipated Crop Production

As stated in the preceding sections, with the introduction of irrigation water supplied by the Project, farmers will be able to diminish the dependence on unreliable rainfall or river flow for paddy growing and be able to increase the farm inputs to the optimum level with less risk. The anticipated paddy yields are estimated at 5.0 ton/ha for both wet and seasons in full development stage of the Project. This unit yield corresponds to 75% of the yield attained in the demonstration fields of the agricultural extension offices. The unit yield of paddy in without-project condition is estimated at 5.0 ton/ha for irrigated paddy and 2.9 ton/ha for rainfed paddy. The unit yield of palawija crops is expected to increase by 15% with irrigation. Groundnut yield, for example, is anticipated at 0.87 ton/ha at the full development stage of the Project. No major improvement in unit yield is expected for palawija crop irrigated in without-project condition. Onion yield is expected to increase to 8.0 ton/ha by doubling the planting density.

The summary of change in unit yields of crops are shown below.

Change in Unit Yields

Cropa	Present	Future	
		Without-Project	With-Project
Irrigated Paddy	3.7	5.0	5.0
Rainfed Paddy	2.7	2.9	-
Onion	4.6	5.0	8.0
Irrigated Palawija crops	0.84	0.87	0.87
Rainfed Palawija crops	0.73	0.76	-

Remark: Yield of palawija crop is estimated in terms of groundnuts.

Following the proposed land use and the cropping patterns, land use, planted area and crops production in the future ofr each area are summarized in the following table.

Land Use, Planted Areas, Cropping Ratio & Production in the Future

	Without-Project				With-Project			
	Ciujung	KCC	Cicinta	Total	Ciujung	KCC	Cicinta	Total
A. Land Use (ha)								
Paddy field(Irrigated)	24,200	240	1,430	25,870	24,200	10,300	1,430	35,930
(rainfed)	-	10,260	-	10,260	-	-	-	-
Uplands	-	530	-	530	-	-	-	-
Grass lands	-	140	-	140	-	-	-	-
Roads, canals, paddy bands	4,270	950	250	5,470	4,270	1,820	250	9,340
Total	28,470	12,120	1,680	42,270	28,470	12,120	1,680	42,270
B. Cropping Ratio (%)								
Paddy field, irrigated								
(paddy)	162	200	107	-	240	240	240	-
(palawija)	11	-	-	-	10	-	-	-
(onion)	-	-	-	-	-	10	10	-
Paddy field, rainfed								
(paddy)	-	107	-	-	-	-	-	-
(palawija)	-	6	-	-	-	-	-	-
Uplands (palawija)	-	168	-	-	-	-	-	-
C. Planted Area (ha)								
Paddy (irrigated)	39,200	480	1,530	41,210	58,080	24,720	3,430	86,230
(rainfed)	-	10,980	-	10,980	-	-	-	-
Palawija (irrigated)	2,660	-	-	2,660	2,420	-	-	-
(rainfed)	-	1,510	-	1,510	-	-	-	-
Onion (irrigated)	-	-	-	-	-	1,030	140	1,170
D. Production (ton)								
Paddy	196,000	34,240	7,650	237,890	290,400	123,600	17,150	431,150
Palawija	2,310	1,150	-	3,460	2,110	-	-	2,110
Onion	-	-	-	-	-	8,240	1,120	9,360

Remarks: Areas can not be planted due to canals, roads, paddy band, etc. are estimated at 15%, 8%, 4% of irrigated paddy area, rainfed paddy area and upland area, respectively. Palawija crops are represented by ground-nuts. Only the incremental portions of onion production from the present condition are enumerated.

Paddy production of 431,150 tons is expected to be produced annually by the Project with the incremental production of 193,260 tons compared with without-project condition. Onion production is also expected to be increased by 9,360 tons annually, which will correspond to almost imported amounts from outside of West Java to Serang. Palawija crop production will decrease by 1,350 tons annually, but this amount might be covered by growing these crops in irrigable areas in K-C-C areas.

Table E-1 DEMOGRAPHIC CONDITION OF THE STUDY AREA IN OCTOBER, 1983

No.	Kecamatan	Popula-tion	Area (km2)	No. of House hold	Popula-tion Density	No. of Agricultural Household
1.	KASEMEN	41,730	60.56	9,324	689	5,919
2.	KRAMATWATU	28,390	48.94	5,942	580	5,127
3.	CIRUAS	33,930	37.62	5,691	902	3,193
4.	WALANTAKA	35,250	47.89	6,532	736	4,320
5.	KRAGILAN	34,820	45.63	6,860	763	4,255
6.	CIKANDE	52,420	82.68	12,230	634	10,550
7.	PONTANG	33,890	74.31	7,176	456	4,508
8.	TIRTAYASA	50,850	90.64	10,343	561	6,273
9.	CARENANG	41,030	54.93	10,158	747	7,497
10.	PAMARAYAN	42,370	73.44	9,070	577	6,530
11.	CIKEUSAL	60,640	98.93	11,395	613	8,170
12.	CILEGON	51,850	42.19	6,818	1,229	3,085
13.	BOJONEGARA	41,350	68.40	8,070	605	6,938
14.	KOPO	44,210	85.18	8,525	519	6,395
	TOTAL :	592,760	911.34	118,134	650	82,760

Source : Agricultural Census in 1983
Agricultural Office of Kabupaten Serang

Table E-2 (1) CROP PRODUCTION IN RELATED KECAMATANS, (1979-1983)

(paddy) (Unit: ha, ton)

No.	Kecamatan	1979 Area Harvested	1979 Production	1980 Area Harvested	1980 Production	1981 Area Harvested	1981 Production	1982 Area Harvested	1982 Production	1983 Area Harvested	1983 Production
1.	Kasemen	5,446	21,401	5,487	23,532	6,102	28,238	3,951	16,081	5,686	31,033
2.	Kramatwatu	3,389	11,430	3,746	13,243	3,828	14,298	2,674	9,947	2,965	15,077
3.	Ciruas	5,099	20,118	4,163	20,092	4,132	20,092	3,390	15,323	5,211	29,330
4.	Walantaka	3,124	13,424	3,098	13,851	2,355	11,983	3,187	14,246	2,911	16,258
5.	Kragilan	2,651	8,545	3,977	13,162	3,441	11,800	3,490	12,773	3,079	15,377
6.	Cikande	5,891	18,065	5,293	17,884	7,228	26,883	4,517	17,074	5,341	27,871
7.	Pontang	4,992	14,521	5,094	16,104	4,934	14,865	4,082	16,614	4,553	22,945
8.	Tirtayasa	5,324	20,368	5,721	17,813	8,057	28,115	2,891	11,390	5,864	31,240
9.	Carenang	3,795	12,528	3,930	13,441	3,877	13,105	3,851	13,170	5,116	26,956
10.	Pamarayan	3,926	12,690	4,840	14,901	3,433	10,392	3,663	12,308	3,541	19,236
11.	Cikeusal	3,738	12,126	3,654	11,021	3,423	11,275	3,956	12,262	3,421	18,209
12.	Cilegon	1,766	4,862	1,757	5,356	1,637	5,128	1,491	4,547	1,204	5,281
13.	Bojonegara	1,706	3,606	1,877	4,224	1,885	4,166	1,900	5,054	1,815	7,812
14.	Kopo	3,242	12,316	3,512	12,644	3,104	11,937	3,115	11,276	2,965	15,699
	Total	54,089	186,000	56,149	197,268	57,436	212,277	46,158	172,065	53,672	282,324
	Unit Yield (ton/ha)	3.4 (2.9)		3.4 (3.0)		3.7 (3.1)		3.7 (3.1)		5.3 (4.5)	

Remarks : Wet unhusked paddy
Figures in parenthesis express unit yield in dry paddy.

Source : Agricultural Office of Kabupaten Serang.

Table E-2 (2) CROP PRODUCTION IN RELATED KECAMATANS
(1979-1983)

(Groundnuts)

No.	Kecamatan	1979		1980		1981		1982		1983	
1.	Kasemen	8	6	5	4	-	-	-	-	-	-
2.	Kramatwatu	436	382	612	551	567	510	954	878	308	286
3.	Ciruas	-	-	16	13	107	86	604	513	-	-
4.	Wilantaka	445	378	593	534	908	817	656	590	786	772
5.	Kragilan	39	33	356	285	299	239	658	566	254	236
6.	Cikande	629	503	975	877	685	616	939	864	266	260
7.	Pontang	-	-	-	-	4	3	328	262	-	-
8.	Tirtayasa	9	6	3	2	15	14	94	76	23	21
9.	Carenang	-	-	5	4	20	16	482	414	98	94
10.	Pamarayan	75	56	362	290	209	167	832	766	265	242
11.	Cikeusal	214	182	900	810	1,438	1,294	2,547	2,420	1,698	1,468
12.	Cilegon	1,822	1,631	2,492	2,243	2,443	2,199	1,833	1,558	1,592	1,445
13.	Bojonegara	9,016	1,613	2,661	2,661	2,643	2,643	4,104	3,283	5,341	4,934
14.	Kopo	64	51	413	370	881	545	561	482	244	262
	Total	12,757	4,841	9,393	8,644	10,019	9,149	14,592	12,672	10,925	10,020
	Unit Yield (ton/ha)	0.38		0.92		0.91		0.87		0.92	

Remark: Dry shelled grains

Table E-2 (3) CROP PRODUCTION IN RELATED KECAMATANS
(1979-1983)

(Cassava)

No.	Kecamatan	1979		1980		1981		1982		1983	
1.	Kasemen	14	98	15	132	8	70	-	-	(28)/1	245
2.	Kramatwatu	37	370	14	123	10	88	9	90	(3)/1	29
3.	Ciruas	95	1,140	120	1,056	113	903	110	968	130	1,849
4.	Walantaka	175	2,450	35	66	38	31	102	938	144	2,102
5.	Kragilan	10	70	213	1,896	292	2,599	398	3,423	385	5,313
6.	Cikande	31	310	320	3,848	120	1,080	75	675	110	1,562
7.	Pontang	-	-	-	-	-	-	-	-	-	-
8.	Tirtayasa	32	224	10	88	4	336	18	144	8	115
9.	Carenang	-	-	-	-	19	156	8	72	29	423
10.	Pamarayan	191	2,292	769	6,767	859	7,559	594	5,227	339	4,814
11.	Cikeusal	700	8,400	907	8,069	324	2,948	444	4,085	735	10,731
12.	Cilegon	41	410	62	552	51	454	34	299	25	360
13.	Bojonegara	197	1,379	248	2,207	374	3,029	380	342	562	8,048
14.	Kopo	285	2,565	184	1,619	187	1,608	141	1,213	305	4,361
	Total	1,808	19,708	2,897	26,423	2,399	20,861	2,313	17,476	2,803	39,952
	Unit Yield (ton/ha)	10.9		9.1		8.7		7.6		14.3	

/1: Estimation by Consultant.

Table E-2 (4) CROP PRODUCTION IN RELATED KECAMATANS
(1979-1983)

(Maize)

No.	Kecamatan	1979		1980		1981		1982		1983	
1.	Kasemen	13	9	23	32	4	3	-	-	7	8
2.	Kramatwatu	53	37	14	21	37	37	18	29	12	57
3.	Ciruas	-	-	-	-	65	65	-	-	-	-
4.	Walantaka	86	69	14	21	21	21	24	38	61	73
5.	Kragilan	5	4	15	19	120	108	63	91	79	89
6.	Cikande	95	66	40	60	115	103	73	106	80	92
7.	Pontang	-	-	5	6	-	-	-	-	-	-
8.	Tirtayasa	2	1	-	-	3	2	4	6	26	31
9.	Carenang	-	-	10	14	7	6	35	52	100	119
10.	Pamarayan	56	39	238	375	208	187	105	166	162	186
11.	Cikeusal	103	82	80	120	346	346	456	730	523	590
12.	Cilegon	32	22	10	14	52	42	-	-	2	2
13.	Bojonegara	80	56	115	172	463	417	409	728	406	436
14.	Kopo	134	94	42	59	170	136	37	54	176	202
	Total	659	479	606	913	1,611	1,473	1,224	2,000	1,634	1,885
	Unit Yield (ton/ha)	0.73		1.51		0.91		1.63		1.15	

Remark: shelled corn.

Table E-2 (5) CROP PRODUCTION IN RELATED KECAMATANS
(1979-1983)

(Sweet Potato)

No.	Kecamatan	1979		1980		1981		1982		1983	
1.	Kasemen	10	115	2	16	-	-	-	-	-	-
2.	Kramatwatu	16	192	69	552	60	468	2	20	29	348
3.	Ciruas	64	890	76	648	-	-	-	-	-	-
4.	Walantaka	70	1,050	80	640	63	504	22	186	84	1,058
5.	Kragilan	12	120	21	168	258	2,012	58	433	74	836
6.	Cikande	71	394	25	210	205	1,681	90	682	115	1,382
7.	Pontang	-	-	275	2,200	-	-	-	-	-	-
8.	Tirtayasa	20	240	-	-	-	-	5	43	-	-
9.	Carenang	-	-	9	72	13	144	20	173	5	65
10.	Pamarayan	96	1,440	135	1,080	258	2,012	205	1,603	295	3,501
11.	Cikeusal	72	1,080	74	592	165	1,419	186	1,582	611	6,937
12.	Cilegon	46	644	78	604	24	192	49	400	-	-
13.	Bojonegara	115	1,725	192	1,596	292	2,336	477	4,293	238	2,588
14.	Kopo	66	990	127	1,016	67	563	45	355	101	1,172
	Total	658	8,880	1,163	9,380	1,405	11,331	1,159	9,770	1,552	17,887
	Unit Yield (ton/ha)	13.5		8.1		8.1		8.4		11.5	

Table E-2 (6) CROP PRODUCTION IN RELATED KECAMATANS
(1983)

(Chilly)

No.	Kecamatan	1983	
1.	Kasemen	10	18
2.	Kramatwatu	237	389
3.	Ciruas	12	19
4.	Walantaka	155	325
5.	Kragilan	181	264
6.	Cikande	2,025	3,535
7.	Pontang	8	13
8.	Tirtayasa	29	46
9.	Carenang	39	37
10.	Pamarayan	161	268
11.	Cikeusal	716	1,490
12.	Cilegon	-	-
13.	Bojonegara	10	17
14.	Kopo	53	84
	Total	3,636	6,505
	Yield (ton/ha)	1.8	

Table E-3 PRESENT UNIT YIELDS OF PADDY WITH IRRIGATION AND WITHOUT IRRIGATION IN THE STUDY AREA

(in wet paddy)

	1981			1982			1983			3-Year Average Yield
	Harvested Area	Production	Unit Yield	Harvested Area	Production	Unit Yield	Harvested Area	Production	Unit Yield	
	(ha)	(ton)	(ton/ha)	(ha)	(ton)	(ton/ha)	(ha)	(ton)	(ton/ha)	(ton/ha)
I. With-irrigation										
Kasemen	6,102	23,238	4.6	3,951	16,081	4.1	5,686	31,033	5.5	4.5
Ciruas	4,132	20,092	4.9	3,390	15,323	4.5	5,211	29,330	5.6	5.1
Tirtayasa	8,057	28,115	3.5	2,891	11,390	3.9	5,864	31,240	5.3	4.2
Total (Average)	18,291	71,445	3.9	10,232	42,794	4.2	16,761	91,603	5.5	4.5
										(3.7)
II. Without-irrigation										
Waringin Kurung	387	1,118	2.9	387	1,126	2.9	378	1,700	4.5	3.4
										(2.7)

Remarks: Source; Agricultural Office of Kabupaten Serang.
Figures in parenthesis express unit yield in dry unhusked paddy in terms of planted area. About 95% of planted areas are estimated to be harvested based on data from kabupaten Serang. The conversion rate from wet paddy to dry paddy is estimated at 0.85.

Table E-4 NUMBER OF LIVESTOCK IN RELATED KECAMATANS, 1983

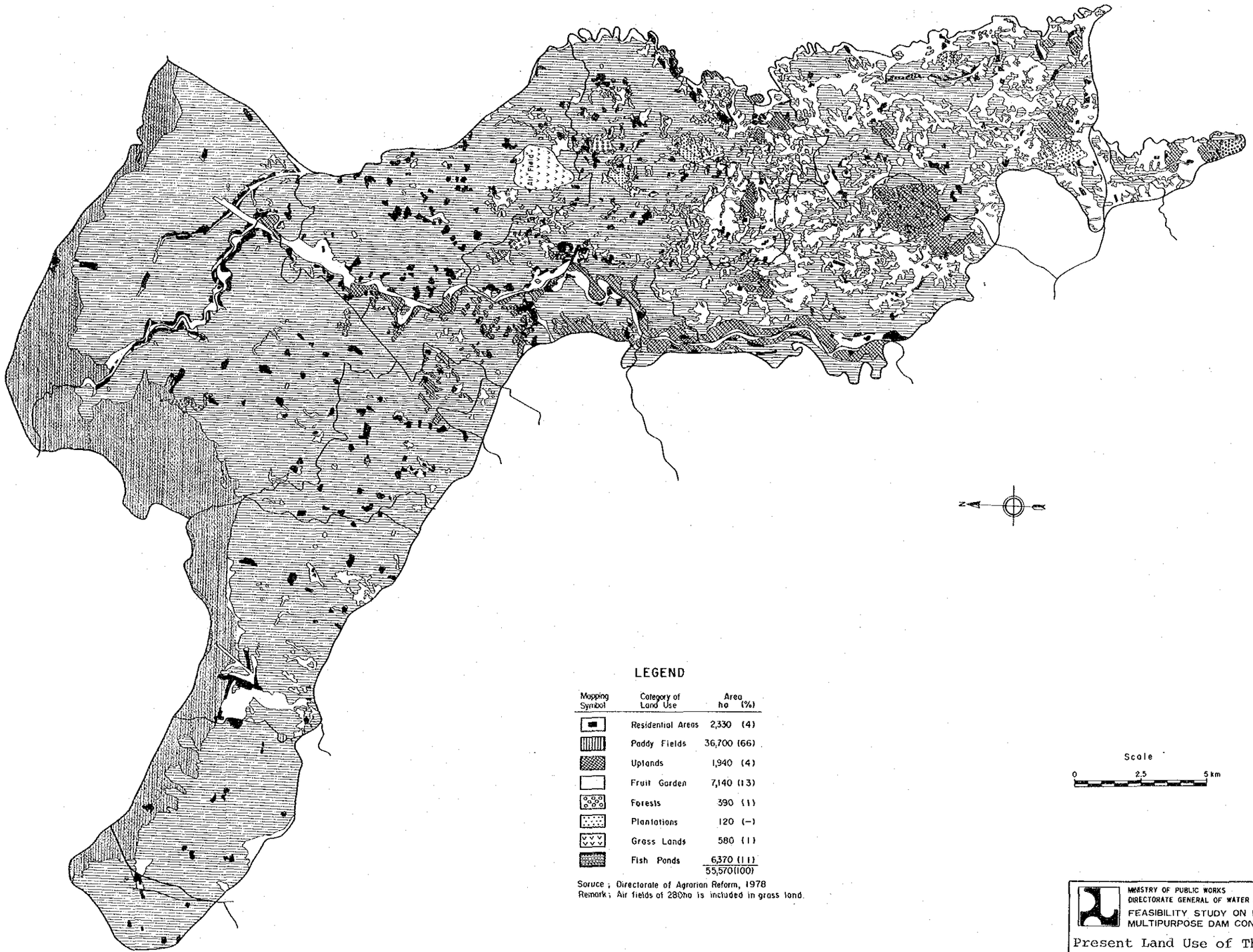
(heads)

No.	Kecamatan	Carabao	Goat and Sheep	Chicken	Paddy Field (ha)
1.	Kasemen	1,726	8,235	26,881	3,085
2.	Kramatwatu	920	4,290	1,407	2,182
3.	Ciruas	709	3,203	12,174	1,974
4.	Walantaka	2,871	4,357	20,021	1,690
5.	Kragilan	2,095	4,355	26,445	1,512
6.	Cikande	6,335	8,375	70,220	3,284
7.	Pontang	1,044	4,562	18,635	2,513
8.	Tirtayasa	1,836	5,197	26,994	3,589
9.	Carenang	3,983	7,497	28,822	3,415
10.	Pamarayan	3,875	5,100	25,520	2,132
11.	Cikeusal	4,230	7,295	52,065	1,931
12.	Cilegon	869	3,852	7,983	1,362
13.	Bojonegara	2,362	9,281	29,037	1,771
14.	Kopo	3,835	3,945	21,720	1,929
	Total	36,690	79,544	367,924	32,369
	Average Number per Agricultural Family	0.35	0.77	3.56	

Source : Agricultural Census in 1983.

Fig.E-1

PRESENT LAND USE OF THE STUDY AREA



LEGEND

Mapping Symbol	Category of Land Use	Area ha (%)
	Residential Areas	2,330 (4)
	Paddy Fields	36,700 (66)
	Uplands	1,940 (4)
	Fruit Garden	7,140 (13)
	Forests	390 (1)
	Plantations	120 (–)
	Grass Lands	580 (1)
	Fish Ponds	6,370 (11)
		55,570(100)

Soruce ; Directorate of Agrarian Reform, 1978
Remark ; Air fields of 280ha is included in grass land.

Scale
0 2.5 5 km

MINISTRY OF PUBLIC WORKS
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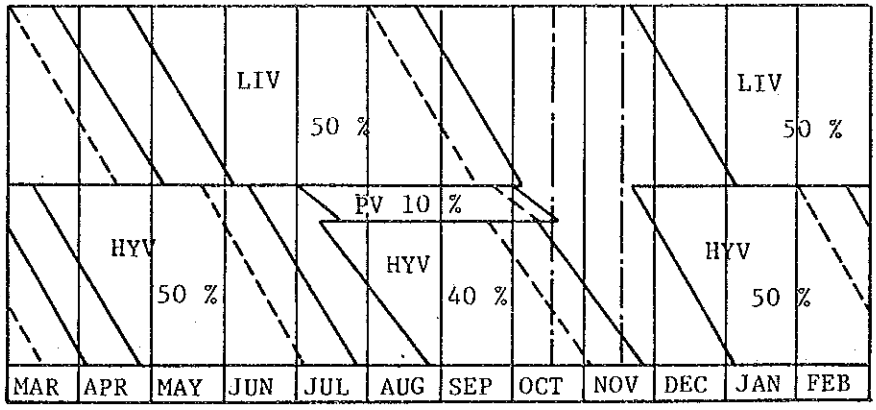
FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

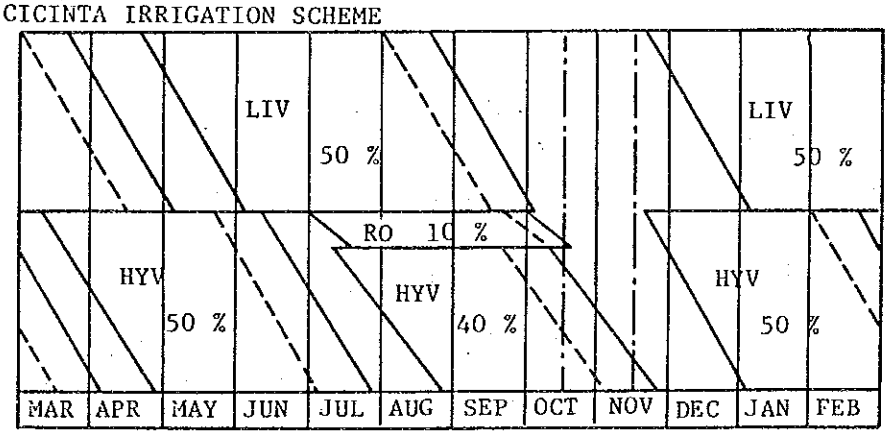
Present Land Use of The Study Area

JAPAN INTERNATIONAL COOPERATION AGENCY

CIUJUNG IRRIGATION SCHEME



K-C-C & CICINTA IRRIGATION SCHEME



Remarks LIV:Locally Improved Variety (Paddy)

HYV:High-Yielding Variety (Paddy)

PV :Palawija or Vegetables

RO :Red Onion

Canal Maintenance Period : middle of Oct.- middle of Nov.

Note : These patterns show the growing period in main fields excluding nursery period. Dotted lines express stoppage of irrigation.

MINISTRY OF PUBLIC WORKS
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FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Proposed Cropping Pattern

JAPAN INTERNATIONAL COOPERATION AGENCY

LABOUR BALANCE STUDY FOR EVERY 10 DAYS OF THE CROPPING PATTER 250% (Farm Size, 0.6 ha)

WORK ITEMS AND LABOUR REQUIREMENT (man/day)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CROPPING PATTERN		Paddy 50%		Harvesting / Nursery / Transplanting			Paddy 50%			Harvesting		Nursery	
		Paddy 50%		Harvesting / Nursery	Transplanting Paddy 50%		Harvesting / Nursery		Onion 10% / Paddy 40%			Harvesting / Nursery	
A. Paddy													
1. Nursery Preparation	10 man-day/ha			0.8	0.8			0.6				0.8	0.8
2. Land Preparation	60	2.6				2.6						2.6	2.6
3. Transplanting or Sowing	23	2.6		3.0				2.4					
4. Weeding	23	1.4				1.4						1.4	1.4
5. Harvesting	20	1.4	0.6		1.4		0.6		1.1			0.6	
6.Post-Harvesting	20	0.9			0.9					0.7		0.9	
7.Others (Chemical application, Water management)	30			1.5		1.5		1.5			1.5	1.2	
				1.0	1.0			1.0		1.0			0.8
								0.5					
TOTAL (man-day)	186												
B. Onion													
1. Land Preparation	40							0.8					
2. Planting	30							0.9					
3. Weeding	60								0.4				
4. Harvesting	20										0.6		
5. Post-harvest	10											0.6	
6. Other	70								0.3				
TOTAL	230	10.0	2.0	7.4	12.7	7.8	6.0	8.6	7.0	4.4	3.5	9.3	12.4
GRAND-TOTAL		2.0	2.0	8.8	12.7	7.0	2.6	10.1	7.0	4.4	3.6	9.3	10.8
		2.0	3.4	10.6	14.1	7.0	6.4	7.6	5.5	4.4	3.3	10.9	10.8
Available Labour Force for 10 days (man-day) (Farm Size 0.6 ha, 2 available farming force)							20						
Balance							+						

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FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT
Labour Balance Study for Every 10-Days of The Cropping Pattern 250%
JAPAN INTERNATIONAL COOPERATION AGENCY