ANNEX-II SOILS

2.1 GENERAL

The soil survey of the area in South Eastern Sumatra including this Project areas were carried out by FAO/UNDP /1 in 1974. On basis of the soil survey, the reconnaissance soils and land capability map covering about 43,000 km^2 at a scale of 1 : 250,000 were prepared using 1 : 50,000 scale air photographs. However, this reconnaissance soil survey were carried out at a very low intensity with an overall frequency of auger or pit examination of about 1 per 12.5 km^2. Besides, on the Belitang Extension project area having high priority of agriculture development, more detailed reconnaissance soil and land capability survey covering about 160,000 ha were carried out in 1972 under the Land and Water Resources Development Project /2.

The soil survey carried out during this time aims at identifying major soil groups and to delineate their distribution in the project areas, referring to the available data mentioned above.

2.2 PROCEDURE OF SOIL SURVEY

2.2.1 Field Work

The field reconnaissance survey was carried out over the area of about 350,000 ha comprising four project areas. The survey sites were mainly selected on the basis of parent material, land form and relief by the use of topographic map of 1 : 6,000 scale. The soil profiles were observed by pit dug and auger boring at the rate of one site per about 5,000 ha.

/1 Dent F.J. 1974. Land Capability, Land and Water Resources Development in South-Eastern Sumatra, Indonesia FAO/UNDP, AGL: INS/69/518

/2 Nippon Koei Co., Ltd., 1973. Belitang Extension Area Agricultural Development Project, FAO/UNDP AGL: SF/INS/18-1, Annex E.

The profile description were carried out according to the standards defined in "Guidelines for Soil Profile Description" of the Food and Agriculture Organization of the United Nations.

27 pits and 28 auger boring were carried out for profile checking to a depth of about one meter, and 170 soil samples were taken from the representative soil horizons. The soil pit and auger boring sites carried out are shown in Fig. II-1.

2.2.2 Laboratory Work

119 soil samples were sent to Soil Research Institute in Bogor in order to examine chemical and physical properties of the soils. The items of analysis are as follow:

a. Soil particle size distribution
b. Total Carbon
c. Total Nitrogen
d. pH (H_2O, 1 : 2.5), pH (KCl, 1 : 2.5)
e. Cation exchange capacity
f. Exchangeable Cations (Ca, Mg, K, Na)
g. Exchange Acidity
h. Phosphate absorption coefficient
i. Lime requirement by buffer curve

2.3 CHEMICAL AND PHYSICAL PROPERTIES OF SOILS

2.3.1 Chemical Properties

The all samples which were taken from the representative soil horizons at the pit examination site, mainly located in Belitang Extension area, were sent to Soil Research Institute in Bogor, in order to make soil chemical analysis. The soil chemical analysis is underway. The results of analysis so far obtained are shown in Table II-1. Besides, the measurement of pH and EC on the soils which were collected in the whole project area were carried out using portable apparatus.

These chemical analysis data on both the lowlands and upland were respectively summarized in average figure. The results are shown in Table II-2, and Table II-3. The first horizons and second horizons in each profile were defined as the surface soil and subsoil respectively.

Average contents of total nitrogen on surface soil and subsoil are about 0.12% and 0.08% respectively, and these figures in upland and lowland are quite similar. Total carbon content in the surface soil on upland is higher than that of lowland soil. Accordingly the C/N ratio in upland soils shows higher value than that of lowland soils.

The average of soil pH for H_2O and KCl on both soils are in the range of 5.1 to 5.3 and 3.8 to 4.1 respectively, there are no distinct difference between surface soil and subsoil throughout the upland soils and lowland soils. The average pH value on the fresh soils are slightly lower than those on the air dry soils; and the difference between the both pH values are 0.4 to 0.6 pH unit. The EC values are quite low and nearly same value in both soils. The contents of total exchangeable cations in both soils, are very low showing the range of 2.0 to 2.5 (m.e/100 g), cation exchange capacity is also less than 10 (m.e/100 g). Base saturation degree is less than 30% in the surface soils and subsoils of both soils.

From the viewpoints of above chemical properties, upland soils (Cambic Arenosols) and lowland soils (Dystric Fluvisols and Dystric Gleysols) in Belitang Extension area are considered to be leached and poor fertile.

2.3.2 Physical Properties

Three phase distribution, total porosity and bulk density were measured using undisturbed soil sample which were collected from each horizon in Pits. Soil hardness was also measured each horizon using "YAMANAKA" type soil hardness meter. The results are shown in Table II-4 and II-5.

In contrast with chemical properties, the physical properties are different between upland soils and lowland soils. The values of solid ratio on lowland soils and upland soils vary from 42 to 48 % and 39 to 43 % respectively. The values of bulk density on lowland soils and upland soils are in the range of 1.1 to 1.3 (g/cc) and 1.0 to 1.1 (g/cc) respectively.

From these results, it is considered that these soils have a good physical condition at root zone, namely, moderate water permeability, no harm of soil compactness and moderate water holding capacity.

2.4 SOIL CLASSIFICATION

The soil survey in the South Eastern Sumatra including this project areas was carried out by FAO/UNDP. According to the soil and land capability map at 1 : 250,000 scale published by the above, the soils were classified into seven major soil group having 38 soil maping units. In the light of the major profile feature and the results of the laboratory analysis, making reference to above soil map /1 and FAO/UNESCO Soil Map of the World /2, the soils in the project area are classified into seven soil units, by the FAO/UNESCO soil classification system /3.

These soils classified are Dystric Fluvisols, Dystric Histosols, Orthic Acrisols, Ferric Acrisols, Gleyic Acrisols, Cambic Arenosols and Dystric Gleysols. The areas of the major soil units in the project areas described on the attached Soil map (Fig. II-1). The correlations between the Soil map units in FAO/UNDP report/1 and Soil units by the FAO/UNESCO soil classification system /3 are mentioned in Table II-10.

The major soil units with associated soils in the each schemes' area and their acreage and % for the total project area are as follows:

/1 FAO/UNDP 1976 — Land and Water Resources Development in Southeast Sumatra Indonesia
Land, Water and Forestry Resources
AG: DP/INS/69/518 Technical Report 1

/2 FAO/UNESCO — Soil Map of the World, Southeast Asia
(Sheet IX) Edition 1/1976
Compiled by FAO, Rome
Published by UNESCO, Paris, 1976

/3 FAO/UNESCO — Soil Map of the World, 1 : 5000000
Volume 1 Legend UNESCO-Paris 1974

Project Area	Main Soil Unit	Acreage (ha)	Proportion (%)	Associated Soils	Included Soils
Belitang Extension	Cambic Arenosols	49,400	72.0	Dystric Cambisols	Humic Acrisols Dystric Fluvisols
	Dystric Gleysols	15,500	22.6		
	Dystric Fluvisols	1,900	2.8	Dystric Histosols	Dystric Gleysols
	Ferric Acrisols	1,800	2.6	Ferralic Arenosols	Plinthic Acrisols Gleyic Acrisols
Tulangbawang	Dystric Fluvisols	47,400	54.3	Dystric Gleysols	Dystric Cambisols Dystric Regosols Dystric Histosols
	Cambic Arenosols	44,300	45.7	Dystric Cambisols	Humic Acrisols Dystric Fluvisols
Lampung	Dystric Fluvisols	16,100	86.1	Dystric Histosols	Dystric Gleysols
	Gleyic Acrisols	2,600	13.9	-	-
Lower Komering River Basin	Dystric Fluvisols	66,400	60.4	Dystric Histosols	Dystric Gleysols
	Dystric Histosols	25,200	22.8	Humic Gleysols	Regosols Dystric Fluvisols
	Orthic	18,400	16.7	-	Dystric Fluvisols Orthic Ferralsol Ferric Arenosols

2.5 MAIN FEATURE OF MAJOR SOIL UNITS

The features of major soil groups in each area are outlined in this report, more detail consideration will be mentioned in the final report.

2.5.1 Belitang Extension Area

i) Cambic Arenosols

Cambic Arenosols widely extend over the undulating and rolling hilly land in the area. Total area is about 49,000 ha or 72% of the area.

Cambic Arenosols develop from coarse-textured unconsolidated materials, and have cambic B horizon immediately below the A horizon. These soils are lacking lamellae of clay accumulation and ferralic properties.

As for chemical properties, pH (H_2O) value shows the range of 5.0 to 5.5. Cation exchange capacity is about 10 (me/100 g). Base saturation degree shows less than 30%. with regard to physical properties, solid ratio and bulk density shows about 40% and 1.0 (g/cc). Soil texture varies from sandy loam to sandy clay loam depending on location. The typical soil profile is shown below:

No. of soil pit : 45
Location : Petaling Jaya
Land use : Upland field

0 - 20 cm	Dark yellowish brown (10 YR 3/4); sandy loam; fine to moderate subangular blocky structure; slightly plastic; slightly sticky; gradual wavy
20 - 46 cm	Reddish yellow (7.5 YR 6/6); sandy clay; plastic; sticky; gradual irregular
46 cm +	Brownish yellow (10 YR 6/6); sandy clay; very plastic; very sticky

11) Dystric Gleysols

These soils develop over the flat, and imperfectly to poorly drained low lying lands. The total area is about 16,000 ha or 23% of the area.

Dystric Gleysols are soils formed from unconsolidated materials exclusive of recent alluvial deposits, showing hydromorphic properties within 50 cm of the surface. Dystric Gleysols have not any diagnostic horizons other than an ochric A horizon and a cambic B horizon. The base saturation of Dystric Gleysols is less than 50% at least between 20 and 50 cm from the surface.

As for chemical properties, pH (H_2O) value of these soils is about 5.0 ranging from 4.5 to 5.5. Cation exchange capacity shows about 10 (me/100 g). Base saturation degree is less than 25%. The typical soil profile is described below.

No. of soil pit : 15
Location : Saung dadi
Land use : Paddy field

0 - 12 cm Gray (10 YR 5/1); clay; coarse subangular blocky structure; very plastic; very sticky; reddish medium mottling (7.5 YR 6/8); gradual wavy

12 - 30 cm Brownish gray (7.5 YR 5/1); heavy clay; coarse subangular blocky structure; very plastic; very sticky; reddish fine to medium mottling (5 YR 5/8)

30 - 52 cm Dark reddish gray (5 YR 4/2); clay; coarse subangular blocky structure; very plastic; very sticky; reddish fine to medium mottling (7.5 YR 8/8); clear irregular boundary

52 cm + Pinkish gray (5 YR 6/2); loamy sand; medium to coarse subangular blocky; slightly plastic; slightly sticky; reddish medium to coarse mottling (7.5 YR 6/8)

iii) Dystric Fluvisols

Dystric Fluvisols develop mainly over the natural levee of the Komering and Belitang rivers. Total area is about 1,900 ha or 3% of the area.

As for chemical properties, pH (H_2O) value shows about 5.0 throughout the profile. The cation exchange capacity is about 10 (m.e/100 g). Base saturation degree is less than 25%. The typical soil profile is shown below:

No. of soil pit : 8
Location : Sumber Agung
Land use : Paddy field

0 - 11 cm Light gray (10 YR 6/1); clay loam; coarse subangular blocky structure; plastic; sticky; reddish medium mottling (5 YR 5/8) gradual wavy boundary

11 - 39 cm Light yellowish brown (2.5 Y. 6/4); clay loam; medium to coarse subangular blocky structure; very plastic; very sticky; reddish medium mottling (2.5 YR 4/8); gradual wavy

39 - 100 cm Light brownish gray (10 YR 6/2); sandy clay; fine to medium subangular blocky structure; very plastic; very sticky; reddish medium mottling (5 YR 5/8)

iv) Ferric Acrisols

Ferric Acrisols extend over the undulating and rolling hilly land in the Pisang area. Total area is about 1,800 ha or 3% of the area.

Ferric Acrisols have an ochric A horizon and an argillic B horizon with a base saturation of less than 50% in the B horizon. Ferric Acrisols lack hydromorphic properties and plinthite within 50 cm and 125 cm of the surface, respectively.

As for chemical properties, pH (H_2O) value of these soils is

about 5.0. Cation exchange capacity is less than 10 (m.e/100 g). Base saturation degree is less than 35%. The typical soil profile is shown below:

No. of soil pit : 43
Location : Bumiharjo
Land use : Grass land

0 - 9 cm Dark brown (10 YR 3/3); sandy clay loam; fine to medium subangular blocky; slightly plastic; slightly sticky; clear irregular boundary

9 - 24 cm Yellowish brown (10 YR 5/8); clay loam; find to medium subangular blocky structure; very plastic; very sticky; reddish fine to medium mottling (10 YR 7/6); diffuse irregular boundary

24 - 51 cm Yellowish brown (10 YR 5/8); clay loam; fine to medium subangular blocky structure; very plastic; very sticky; reddish fine to medium mottling (5 YR 6/8); gradual irregular boundary

51 - 93 cm Light gray (2.5 Y. 7/2); silty clay; medium to coarse subangular blocky structure; very plastic; very sticky; reddish fine to medium mottling (10 R 4/8); gradual irregular boundary

2.5.2 Tulangbawang Area

i) Dystric Fluvisols

Dystric Fluvisols are extended over the areas below 25 meter S.L. along the Umpu river from Mesir Ilir to Menggala. The total area is about 47,000 ha or 49% of the area. These soils develop from recent alluvial deposits and are immature with no predominant morphological characters, and have a base saturation of less than 50% in the soil between 20 and 50 cm from the surface.

With regard to chemical properties, pH (H_2O) values are in the range of 4.0 to 4.5 and 4.5 to 5.0 for uncultivated soil and

cultivated soil including swampy soil, respectively. The values of EC are in the range of 0.1 to 0.2 (m.moh/cm). The typical soil profile is shown below:

No. of soil pit : 53
Location : Kerta Jaya
Land use : Grass land

0 - 10 cm Dark yellowish brown (10 YR 3/4); sandy loam; fine sub-angular blocky structure; slightly plastic; slightly sticky; clear wavy boundary

10 - 100 cm Light gray (2.5 Y 7/2); light clay; fine to medium sub-angular blocky structure; plastic; sticky

ii) Cambic Arenosols

Cambic Arenosols mainly extend over the hilly lands lying northern parts of the Tulangbawang area. Total area of these soils in the area amounts to about 44,000 ha and 46% of the area. These soils develop from coarse-textured unconsolidated materials, and have cambic B horizon immediately below the A horizon. These soils are lacking lamellae of day accumulation and ferratic properties.

As for chemical properties, pH values in the surface and subsoil shown in the range of 5.0 to 6.0 and 4.5 to 5.0 respectively. EC value are less than 0.2 (m.mho/cm). The typical soil profile is shown below.

No. of soil pit : 48
Location : Gunung Waras
Land use : Grass land

0 - 13 cm Very dark grayish brown (10 YR 3/2) sandy loam; fine to medium subangular blocky; slightly plastic; slightly sticky

13 - 44 cm Yellowish red (5 YR 4/6) sandy clay; fine to medium subangular blocky

44 - 90 cm Red (2.5 YR 5/8) sandy loam; fine to medium subangular blocky

2.5.3 Lampuing Area

I) Dystric Fluvisols

Dystric Fluvisols are extended over in the area along the Macak river and the Lampuing river. The total area of this soils is about 16,000 ha and 86% of the area. These soils develop from recent alluvial deposits, and are immature with no predominant morphological characters. These soils have a base saturation of less than 50 percent in the soil between 20 and 50 cm from the surface. As for chemical properties, pH and EC value shows 5.0 to 5.5 and 0.10 to 0.15 (m.mho/cm), respectively. The typical soil profile is shown below.

No. of soil pit : 55
Location : Bumi Agung 2
Land use : Paddy field

0 - 15 cm Grayish brown (10 YR 5/2); clay loam; medium subangular blocky structure; plastic; sticky

15 - 78 cm Light gray (2.5 Y 7/2);Silty clay; medium subangular blocky structure; very plastic; very sticky; reddish fine mottling (7.5 YR 8/8)

78 cm + Light gray (2.5 Y 7/2);silty clay loam; medium subangular blocky structure; very plastic; very sticky; reddish fine mottling (10 YR 7/4)

II) Gleyic Acrisols

Gleyic Acrisols occupy the hilly land lying northern part in the area. The total area of this soils is about 2,600 ha and 14% for the project area. These soils are Acrisols showing hydromorphic properties within 50 cm of the surface; and are lacking plinthite within 125 cm of the surface. With regard to chemical properties, pH value (H_2O) and EC are in the range of 5.0 to 5.5 and 0.1 to 0.15 (m.moh/cm), respectively. The typical soil profile is shown below.

No. of soil pit : 54
Location : Buml Agung 1
Land use : Grass land

0 - 10 cm Very dark brown (10 YR 2/2);loam; fine to medium subangular blocky structure; slightly plastic; slightly sticky; clear wavy boundary

19 - 47 cm Very pale brown (10 YR 7/4);sandy loam; fine to medium subangular blocky structure; slightly plastic; slightly sticky; reddish medium mottling (7.5 YR 8/8)

47 - 76 cm Very pale brown (10 YR 7/4);loamy sand; fine to medium subangular blocky structure; reddish yellow mottling

2.5.4 Lower Komering River Basin

1) Dystric Fluvisols

Dystric Fluvisols are extended over the area along the lower Komering from Rasuan to Palembang. The total land area is 66,400 ha or 60% of the area. These soils develop from recent alluvial deposits, and are immature with no predominant morphological characters. These soils have a base saturation of less than 50% in the soil between 20 and 50 cm from the surface. As for chemical properties, pH and EC value shows 5.0 to 5.5 and 0.10 to 0.15 (m.mho/cm), respectively. The typical soil profile is shown below.

No. of soil pit : 26
Location : Serdang Menang
Land use : Bush

0 - 15 cm Dark yellowish brown (10 YR 3/4); silty clay; fine subangular blocky structure; very plastic; very sticky; clear smooth boundary

15 - 100 cm Grayish brown (10 YR 5/2); silty clay; medium to coarse subangular blocky structure; very plastic; very sticky

ii) Dystric Histosols

The land covered with Dystric Histosols are distributed the low lying or depressed area along the Komering river. However, concentrated large area can be seen in the central and norther part in the area. Total area is about 25,000 ha and 23% of the area.

Dystric Histosols have an H horizon of 40 cm or more either extending down from the surface or taken cumulatively within the upper 80 cm of the soil. These soils have a pH (H_2O, 1 : 5) of less than 5.5 in some part of the soil between 20 and 50 cm from the surface.

With regard to chemical properties, pH (H_2O) and EC values are in the range of 4.5 to 5.5 and 0.15 to 0.20 (m.mho/cm), respectively. The typical soil profile is shown below.

No. of soil pit : 29
Location : Sungai Pinang
Land use : Paddy field

0 - 7 cm Very dark grayish brown (10 YR 3/2); silty clay; slightly plastic; slightly sticky

7 - 25 cm Black (10 YR 2/1); silty clay; slightly plastic; slightly sticky

25 - 55 cm Dark grayish brown (2.5 Y 4/2); heavy clay; very plastic; very sticky

55 - 82 cm Black (10 YR 1.7/1); clay; very plastic; very sticky

iii) Orthic Acrisols

Orthic Acrisols are scattered all over the hilly land in the area, however concentrated wide area can be seen in the vicinities of Tanjung Lubuk and Rasuan. The total area is about 18,000 or 17% of the area.

Orthic Acrisols have an ochric A horizon, and an argillic B horizon with low organic matter contents and low base saturation of less than 50 percent. As for chemical properties, pH (H_2O) and EC values are in the range of 4.5 to 5.0 and 0.05 to 0.2 (m.mho/cm), respectively. The typical soil profile is shown below:

No. of soil pit : 34
Location : Cempaka
Land use : Forest

0 - 12 cm Dark yellowish brown (10 YR 3/4); sandy clay loam; fine to medium subangular blocky; slightly plastic; slightly sticky; clear smooth boundary

12 - 37 cm Yellowish brown (10 YR 5/6); sandy clay loam; fine to medium subangular blocky; slightly plastic; slightly sticky; clay skin; clear smooth boundary

37 - 63 cm Strong brown (7.5 YR 5/6); sandy clay; fine to medium subangular blocky; plastic; sticky; many stone; clay skin; clear smooth boundary

63 - 99 cm Yellow (2.5 Y 7/6); sandy clay; medium to coarse subangular blocky; very plastic; very sticky; gradual smooth boundary

2.6 LAND SUITABILITY CLASSIFICATION

The land suitability classification in the proposed agricultural development area has been made in reconnsaissance level by FAO/UNDP in 1974, and the land suitability maps for paddy and upland crops have been also prepared in a scale of 1:250,000. Based on this maps and the results of soil survey and its analysis so far obtained, the land suitability classification in the proposed development area were carried out, for which more detailed classification will be made after the data on soil chemical analysis was fully obtained, based on the topographic maps in a scale of 1:5,000 which will be obtained in January 1980. In view of irrigation development of the area the classification is made for particularly paddy and upland crops.

2.6.1 The Standard of Land Suitability Classification

Land suitability classification consists of three orders, namely, Suitable land (S), Conditionally suitable land (CS) and Unsuitable land (N) orders. Furthermore, each order is classified into three classes except unsuitable land according to the suitable degree. Each class is distinguished into subclasses by the nature of the limitation, such as erosion, impeded drainage, salinity and etc. The definitions of the land suitability orders and classes are described below; and also subclasses identified for paddy rice and upland crops in the area are explained in Table II-6 and Table II-7 respectively. The acreage and proportional extent of each class for paddy (wetland) rice and upland crops were calculated from Land Suitability Maps mentioned above. The results are given in Table II-8 and Table II-9.

S - Suitable Land

Land on which sustained use for paddy rice and upland crops is expected to yield benefits that will justify required recurrent inputs without unacceptable risk to land resources on the site or in adjacent area.

S1 - Highly suitable

Land having no significant or only minor limitations to the sustained cultivation of paddy rice and upland crops that will

not significantly reduce production levels.

S2 - Moderately suitable

Land having limitations which in aggregate are moderately severe for the sustained cultivation of paddy rice and upland crops that will reduce production levels.

S3 - Marginally suitable

Land having limitations which in aggregate are severe for the sustained cultivation of paddy rice and upland crops and will so reduce production levels that such expenditure will only be marginally justified.

CS - Conditionally Suitable Land

Land having characteristics which, at present, make it unsuitable for sustained use for paddy rice and upland crops but which, subject to management practices could become suitable.

CS1- Conditionally highly suitable

Land having characteristics which, in general, preclude sustained, economic cultivation of paddy rice and upland crops; type; but which could be used and would be equivalent in suitability to land of Class S1 provided the special management practices defined at class level were implemented.

CS2- Conditionally moderately suitable

Land having characteristics which, in general, preclude sustained, economic cultivation of paddy rice and upland crops. Such land, however, could be used profided the special management practices defined at subclass level were implemented but would only be equivalent in suitability to land of Class S2 as moderately severe limitation indicated by the subclass symbol would remain

CS3- Conditionally marginally suitable

Land having characteristics which, in general, preclude sustained, economic cultivation of paddy rice and upland crops. Such land,

however, could be used provided the special management practices defined at subclass level were implemented; but would only be equivalent in suitability to land of class S3, as severe limitation indicated by the subclass symbol would remain.

N - Unsuitable Land

Land having characteristics which appear to preclude its sustained use for paddy rice and upland crops or which would create production, upkeep and/or conservation problems, requiring a level of recurrent input unacceptable at the time of interpretation.

N1 - Unsuitable

Land having limitation which appear so severe as to preclude any possibility of successful, sustained paddy rice and upland crops cultivation; or having limitations which may be surmountable in time but which cannot be corrected with existing knowledge at presently acceptable cost.

Sub-class

e - erosion Land with an erosion hazard or past erosion damage.

s - soil limitation in the root zone
Land comprising soils with problems such as shallowness, unfavourable texture, stoniness or low fertility that are difficult to correct.

t - unfavourable topography
Land whose relative position or relief limits use for crops and paddy (wetland) rice in particular.

f - flooding Land susceptible to flash flood or prolonged deep flooding, or both, which damage the crops or limit choice of crops.

d - Impeded drainage
Land whose use is limited by excess water due to high water table, slow permeability or slow surface drainage or a combination of all three.

x - salinity Land whose major limitation to use is salinity.

a - soil acidity

Land comprising soils for which extreme acidity, difficult to correct, is the major limitation for crop production.

Table II - 1 THE RESULT OF CHEMICAL ANALYSIS (1)

Pit No.	Sample No.	Location	Depth (Cm)	T - C %	T - N %	C/N	pH (1 : 2.5) H2O	pH (1 : 2.5) KCL	Exchange Acidity m.e/100 g	Exchangeable cations m.e per 100 grams Ca	Mg	K	Na	Sum	Cations Exchange Capacity	Base Saturation %
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.	No. 1	Upland	0 - 7	2.72	0.16	17	5.2	4.2	12.83	0.8	0.3	0.2	0.1	1.4	10.8	13
	2		7 - 25	1.07	0.09	12	5.2	4.1	7.94	0.4	0.1	0.1	0.1	0.7	7.0	10
	3		25 - 60	0.55	0.05	11	5.6	4.2	4.99	0.2	0.1	0.1	0.1	0.5	5.6	9
	4		60 - 120	0.32	0.04	8	5.2	4.1	5.35	0.2	0.1	0.1	0.1	0.3	5.6	6
2.	No. 5	Upland	0 - 12	2.28	0.15	15	5.7	4.6	5.39	1.7	0.3	0.2	0.1	2.3	8.0	29
	6		12 - 25	0.79	0.07	11	5.6	4.4	3.97	0.6	0.3	0.1	0.2	1.2	4.8	25
	7		25 - 65	0.41	0.04	10	5.3	4.2	3.23	0.3	0.1	0.1	0.1	0.5	4.0	13
	8		65 - 120	0.24	0.04	6	5.6	4.2	2.52	0.2	0.3	0.1	0.1	0.6	3.9	15
3.	No. 9	Lowland	0 - 13	1.50	0.15	10	5.3	4.0	11.31	2.2	0.6	0.3	0.2	3.3	13.1	25
	10		13 - 27	0.62	0.08	8	5.6	4.0	8.08	2.0	1.1	0.3	0.2	3.6	11.9	30
	11		27 - 52	0.25	0.05	5	5.5	3.9	6.31	1.4	1.2	0.5	0.2	3.3	11.9	28
	12		52	0.25	0.04	6	5.5	3.9	6.28	1.2	1.2	0.5	0.1	3.0	10.5	29
4.	No. 13	Upland	0 - 10	2.30	0.14	16	4.8	3.9	11.24	1.1	0.4	0.3	0.2	2.0	9.4	21
	14		10 - 36	1.12	0.08	14	4.9	3.9	9.33	0.2	0.1	0.1	0.1	0.5	7.8	6
	15		36 - 72	0.70	0.05	14	4.8	3.9	6.36	0.1	0.0	0.1	0.1	0.2	7.6	3
5.	No. 16	Upland	0 - 21	2.44	0.16	15	5.5	4.4	8.05	1.8	0.3	0.1	0.1	2.2	7.1	31
	17		21 - 50	1.53	0.11	14	5.4	4.3	8.79	1.4	0.2	0.1	0.1	1.8	6.2	29
	18		50 - 71	0.70	0.06	12	5.4	4.2	6.74	0.5	0.2	0.0	0.1	0.8	4.1	20
	19		71 - 135	0.66	0.05	13	5.2	4.1	6.23	0.7	0.1	0.1	0.0	0.8	4.8	17
6.	No. 20	Lowland	0 - 10	0.83	0.06	14	4.9	4.0	2.99	0.8	0.2	0.1	0.1	1.2	3.6	33
	21		10 - 23	0.54	0.04	14	5.2	3.9	3.26	0.8	0.2	0.0	0.1	1.0	4.3	23
	22		23 - 46	0.49	0.04	12	5.2	3.8	6.32	0.5	0.3	0.1	0.1	1.0	6.2	16
7.	No. 23	Upland	0 - 13	1.58	0.10	16	5.4	4.2	5.34	1.0	0.4	0.1	0.1	1.6	5.7	28
	24		13 - 38	0.68	0.05	14	5.4	4.1	6.52	0.2	0.2	0.1	0.2	0.7	6.0	12
	25		38 - 82	0.49	0.03	16	5.1	4.1	7.21	0.0	0.2	0.1	0.1	0.4	7.3	5

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
8.	No. 26	Lowland	0 - 11	1.54	0.12	13	4.8	3.7	11.27	0.9	0.4	0.1	0.1	1.5	11.5	13
	27		11 - 39	0.79	0.07	11	5.0	3.8	10.54	0.9	0.3	0.1	0.1	0.6	9.4	6
	28		39 - 100	0.67	0.06	11	4.7	3.7	9.79	0.8	0.2	0.1	0.1	1.2	10.0	12
9.	No. 29	Upland	0 - 5	1.01	0.09	11	5.2	3.7	8.14	2.6	1.1	0.3	0.3	4.3	11.8	36
	30		5 - 16	0.80	0.06	13	5.5	3.6	9.26	2.2	2.3	0.5	0.3	5.3	15.2	35
	31		16 - 82	0.35	0.04	9	5.1	3.4	14.56	1.2	4.4	0.7	0.7	7.0	23.0	30
10.	No. 32	Upland	0 - 14	2.35	0.13	18	5.3	4.1	8.44	1.2	0.6	0.3	0.5	2.6	7.6	34
	33		14 - 33	0.95	0.06	16	4.9	3.9	6.81	0.8	0.4	0.1	0.1	1.4	6.3	22
	34		33 - 72	0.52	0.04	13	4.8	3.8	8.51	0.3	0.2	0.1	0.1	0.7	6.3	11
11.	No. 35	Upland	0 - 11	1.84	0.15	12	5.3	3.9	7.77	3.5	0.7	0.2	0.2	4.6	10.1	46
	36		11 - 28	0.72	0.06	12	5.5	3.6	7.91	3.0	1.3	0.4	0.4	5.1	12.8	40
	37		28 - 67	0.54	0.06	9	5.7	3.7	9.10	2.6	1.7	0.6	0.5	5.4	12.8	42
12.	No. 38	Lowland	0 - 9	1.21	0.11	11	5.5	3.8	6.78	1.2	0.7	0.1	0.2	2.2	7.3	30
	39		9 - 23	0.35	0.03	12	5.8	3.7	5.47	0.6	1.2	0.5	0.4	2.7	8.6	31
	40		23 - 63	0.16	0.02	8	5.8	3.6	7.66	0.7	2.1	0.8	0.8	4.4	12.9	34
13.	No. 41	Upland	0 - 15	2.16	0.20	11	5.8	4.6	9.23	4.1	0.5	0.4	0.1	5.1	12.0	43
	42		15 - 42	0.98	0.10	10	6.0	4.8	8.14	2.9	0.4	0.2	0.1	3.6	9.2	39
	43		42 - 72	0.61	0.06	10	5.7	4.2	9.56	2.1	0.6	0.3	0.2	3.2	12.5	26
	44		72 - 120	0.43	0.05	9	5.5	4.1	8.78	1.7	0.5	0.1	0.2	2.5	12.6	20
14.	No. 45	Upland	0 - 32	0.56	0.05	11	5.2	4.0	10.07	0.6	0.1	0.0	0.2	0.9	8.0	11
	46		32 - 64	0.49	0.05	10	5.2	4.1	8.44	0.1	0.0	0.0	0.1	0.2	8.6	2
15.	No. 47	LOwland	0 - 12	1.69	0.14	12	5.2	3.8	11.81	2.5	0.4	0.2	0.2	3.3	13.5	24
	48		12 - 30	1.55	0.12	13	5.1	3.7	11.65	1.9	0.3	0.1	0.1	2.4	12.6	19
	49		30 - 52	1.00	0.08	13	4.7	3.4	16.90	0.7	0.2	0.1	0.3	1.3	17.6	7
16.	No. 50	Upland	0 - 21	0.56	0.05	11	5.0	3.8	6.45	0.1	0.1	0.1	0.2	0.4	7.5	5
	51		21 - 40	0.59	0.04	15	5.2	3.9	8.19	0.2	0.0	0.1	0.1	0.3	8.2	4
	52		40 - 55	0.60	0.04	15	4.7	3.9	8.03	0.2	0.0	0.0	0.2	0.4	8.0	5
	53		55 - 81	0.45	0.04	11	5.1	3.8	9.67	0.2	0.0	0.1	0.1	0.4	10.8	4

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
17.	No. 54	Lowland	0 - 10	0.96	0.08	12	5.4	4.0	9.80	1.8	0.9	0.3	0.2	3.2	10.9	29
	55		10 - 24	0.99	0.09	11	5.5	4.1	8.61	0.9	0.8	0.5	0.2	2.4	9.5	25
	56		24 - 49	0.14	0.02	7	6.0	3.9	5.92	0.7	0.4	0.1	0.3	1.4	7.9	18
18.	No. 57		0 - 10	2.14	0.20	11	4.9	3.7	11.60	1.2	0.1	0.1	0.2	1.6	12.5	13
	58		10 - 20	1.49	0.14	11	5.0	3.6	11.34	0.6	0.1	0.1	0.3	1.1	12.4	9
	59		20 - 77	0.95	0.06	16	5.4	3.6	11.05	0.1	0.2	0.4	0.3	1.0	12.0	8

Table II.2 Average values of chemical Analysis on the Soils classified into lowland and upland .

	Lowland Soils		Upland Soils	
	Surface soil	Subsoil	Surface soil	Subsoil
T - N (%)	0.12	0.08	0.13	0.07
T - C (%)	1.41	0.90	1.80	0.88
C/N	11.8	11.3	13.8	12.6
pH (1:2.5) H_2O	5.1	5.3	5.3	5.3
pH (1:2.5) KCl	3.9	3.8	4.1	4.1
Exchange Acidity (m.e/100g)	9.4	8.4	8.4	7.7
Exchangeable cations (m.e/100g)				
Ca	1.5	1.0	1.7	1.1
Mg	0.5	0.6	0.4	0.5
K	0.2	0.2	0.2	0.2
Na	0.2	0.2	0.2	0.2
Total	2.4	2.0	2.5	2.0
C.E.C (m.e/100g)	10.3	9.8	8.9	8.4
Base Saturation (%)	23.3	20.4	28.1	23.8

Table. II-3 The Results of pH and EC Measurement on the Fresh Soils Classified into Lowland and Upland.(1)

Lowland soils						Upland soils					
Surface soil			Sub soil			Surface soil			Sub soil		
Sample No.	pH (H_2O)	EC (m.mho)	Sample No.	pH (H_2O)	EC (m.mho)	Sample No.	pH (H_2O)	EC (m.mho)	Sample No.	pH (H_2O)	EC (m.mho)
9	4.8	0.14	10	4.8	0.17	1	4.5	0.20	2	4.8	0.19
20	4.5	0.19	21	4.6	0.17	5	5.2	0.19	6	4.8	0.14
26	4.6	0.17	27	4.4	0.16	13	4.7	0.20	14	4.3	0.13
38	4.6	0.15	39	4.9	0.17	16	5.2	0.17	17	4.9	0.14
47	4.5	0.18	48	4.5	0.20	23	5.0	0.18	24	4.5	0.13
54	4.9	0.13	55	5.0	0.12	29	4.5	0.20	30	4.8	0.19
57	4.5	0.18	58	4.9	0.19	32	4.9	0.17	33	4.5	0.15
60	5.4	0.18	61	5.6	0.17	35	4.7	0.22	36	4.6	0.19
63	4.0	0.20	64	4.3	0.13	41	5.4	0.18	42	5.4	0.13
69	5.0	0.17	70	5.4	0.16	45	4.7	0.09	46	4.7	0.09
75	4.8	0.12	76	4.9	0.13	50	4.3	0.15	51	4.3	0.13
79	5.1	0.19	80	4.8	0.18	66	4.5	0.11	67	4.6	0.09
81	5.1	0.16	82	5.0	0.15	72	4.7	0.10	73	4.7	0.08
84	5.3	0.17	85	4.8	0.17	77	5.1	0.16	78	5.2	0.12
91	6.0	0.19	92	5.2	0.14	88	5.7	0.26	89	5.4	0.16
93	5.7	0.19	94	5.5	0.17	99	4.4	0.18	100	4.4	0.14
97	5.3	0.18	98	6.0	0.16	110	4.6	0.14	111	4.5	0.16
104	6.0	0.20	105	6.0	0.18	119	4.8	0.15	120	4.5	0.17
107	5.7	0.19	108	5.2	0.20	127	4.4	0.15	128	4.6	0.10
113	4.8	0.14	114	4.7	0.13	131	5.1	0.18	132	4.7	0.13
116	5.0	0.15	117	4.8	0.13	138	4.8	0.11	139	4.6	0.14
124	5.0	0.15	125	5.1	0.14	141	6.6	0.20	142	5.2	0.12
135	4.7	0.13	136	4.5	0.12	148	5.8	0.17	149	4.8	0.10
145	4.7	0.19	146	5.0	0.17	154	4.9	0.14	155	4.3	0.36

to be continued

Table II-3 The Results of pH and EC Measurement on the Fresh Soils Classified into Lowland and Upland (2)

151	4.4	0.21	152	5.3	0.16	165	5.5	0.15	166	4.8	0.11
157	5.3	0.17	158	4.7	0.12						
161	4.4	0.14	162	4.4	0.15						
163	4.5	0.21	164	4.3	0.14						
168	4.8	0.20	169	5.0	0.16						
Average	5.0	0.17		4.9	0.16		5.0	0.17		4.7	0.14

Table II-4 The Results of Physical Analysis (1).

Pit No.	Sample No.	Location	Depth (cm)	Solid ratio (%)	Water ratio (%)	Air ratio (%)	Total porosity (%)	Bulk Density (g/cc)	Soil hardness (Reading figure)
1	1		0- 7	36.3	25.8	37.9	63.7	0.94	-
	2	Upland	7-25	42.7	28.4	28.9	57.3	1.11	-
	3		25-60	40.7	27.2	32.1	59.3	1.06	-
	4		60-120	44.1	32.0	23.9	55.9	1.15	-
	5		0-12	48.2	25.0	51.8	51.8	1.25	17
2	6	Upland	12-25	49.1	26.4	24.5	50.9	1.28	16
	7		25-65	44.4	23.2	32.4	55.6	1.15	18
	8		65-120	48.4	27.4	24.2	51.6	1.26	18
	9		0-13	37.2	39.8	23.0	62.8	0.97	16
3	10	Lowland	13-27	46.4	38.2	15.4	53.6	1.21	20
	11		27-52	35.2	33.0	31.8	64.8	0.92	20
	12		52-	45.2	37.8	17.0	54.8	1.18	20
	13		0-10	38.1	24.0	37.9	61.9	0.99	25
4	14	Upland	10-36	41.3	29.8	28.9	58.7	1.07	25
	15		36-72	41.5	32.4	26.1	58.5	1.08	22
	16		0-21	39.8	16.4	43.8	60.2	1.04	23
5	17	Upland	21-50	41.2	22.0	36.8	58.8	1.07	23
	18		50-71	41.1	21.8	37.1	58.9	1.07	22
	19		71-135	30.4	16.0	53.6	69.6	0.79	16
	20		0-10	56.5	26.8	16.7	43.5	1.47	15
6	21	Lowland	10-23	54.9	27.6	17.5	45.1	1.43	16
	22		23-46	47.2	26.8	26.0	52.8	1.23	18

to be continued

Table II-4 The results of physical analysis (2)

	23		0-13	42.3	21.4	36.3	57.7	1.10	19
7	24	Upland	13-38	41.2	24.0	34.8	58.8	1.07	23
	25		38-82	43.8	30.6	25.6	56.2	1.14	24
	26		0-11	37.2	30.8	32.0	62.8	0.97	17
8	27	Lowland	11-39	54.6	40.0	5.4	45.4	1.42	20
	28		39-100	37.9	29.8	32.3	62.1	0.99	22
	29		0- 5	34.6	29.8	35.6	65.4	0.90	14
9	30	Upland	5-16	45.3	40.8	13.9	54.7	1.18	19
	31		16-82	39.2	38.6	22.2	60.8	1.02	23
	32		0-14	43.1	23.2	33.7	56.9	1.12	27
10	33	Upland	14-33	46.4	26.6	27.0	53.6	1.21	24
	34		33-72	44.6	26.6	28.8	55.4	1.16	23
	35		0-11	31.9	42.0	26.1	68.1	0.83	12
11	36	Upland	11-28	46.8	44.0	9.2	53.2	1.22	17
	37		28-67	43.6	52.0	4.4	56.4	1.13	18
	38		0- 9	45.8	36.2	18.0	54.2	1.19	23
12	39	Lowland	9-23	57.1	38.0	4.9	42.9	1.48	28
	40		23-63	46.4	41.0	12.6	53.6	1.21	25
	41		0- 5	35.5	19.8	44.7	54.5	0.92	25
13	42	Upland	15-42	37.5	25.4	37.1	62.5	0.98	24
	43		42-72	39.5	32.6	27.9	60.5	1.03	23
	44		72-120	39.9	35.8	24.3	60.1	1.04	23
14	45	Upland	0-32	37.9	23.6	38.5	62.1	0.99	28
	46		32-64	38.1	29.0	32.9	61.9	0.99	27

to be continued

Table II-4 The Results of Physical Analysis (3)

	47		0-12	40.9	35.2	23.9	59.1	1.06	15
15	48	Lowland	12-30	41.9	44.4	13.7	58.1	1.09	13
	49		39-52	39.5	39.2	21.3	60.5	1.03	25
	50		0-21	42.4	23.0	34.6	57.6	1.10	22
16	51	Upland	21-40	43.4	27.0	29.6	56.6	1.13	22
	52		40-55	45.5	23.6	30.9	54.5	1.18	22
	53		55-81	40.5	27.8	31.7	59.5	1.05	24
	54		0-10	44.4	39.4	16.2	55.6	1.16	11
17	55	Lowland	10-24	43.8	41.6	14.6	56.2	1.14	13
	56		24-49	47.0	46.0	7.0	53.0	1.22	15
	57		0-10	34.6	25.0	40.4	65.4	0.90	24
18	58	Lowland	10-20	38.6	28.8	32.6	61.4	1.00	25
	59		20-77	47.0	28.2	24.8	53.0	1.22	30
	99		0-12	36.8	23.8	39.4	63.2	0.96	15
34	100	Upland	12-37	35.3	21.4	43.3	64.7	0.92	18
	101		37-63	42.8	20.6	36.6	57.2	1.11	23
	102		63-94	39.7	28.4	31.9	60.3	1.03	27
	103		94-	45.6	29.0	25.4	54.4	1.19	28
	127		0-19	44.3	16.6	39.1	55.7	1.15	22
42	128	Upland	19-40	43.8	16.4	39.8	56.2	1.14	24
	129		40-63	40.2	16.8	43.0	59.8	1.04	25
	130		63-105	47.8	26.2	26.0	52.2	1.24	25
	131		0- 9	34.7	26.8	38.5	65.3	0.90	18
43	132	Upland	9-24	37.6	23.8	38.6	62.4	0.98	25
	133		24-51	37.7	25.6	36.7	62.3	0.98	23
	134		51-93	39.2	30.2	30.6	60.8	1.02	22
	138		0-20	36.7	22.4	40.9	63.3	0.95	17
45	139	Upland	20-46	47.9	22.2	29.9	52.1	1.25	21
	140		46-	43.5	24.0	32.5	56.5	1.13	24

Table II-5 Average Values of Physical Analysis on the Soils Classified into Lowland and Upland .

	Lowland soils		Upland soils	
	Surface soil	Sub soil	Surface soil	Sub soil
Solid ratio (%)	42.4	48.2	38.8	42.5
Total porosity(%)	57.6	51.8	61.2	57.5
Bulk density (g/cc)	1.10	1.25	1.01	1.11
Soil hardness (Reading figure)	17	19	20	22

Table II-6 THE DEFINITIONS OF THE LAND SUITABILITY SUBCLASES IDENTIFIED FOR PADDY RICE IN THE AREA

Class	Sub-class	Land feature	Soil depth	Soil texture	Drainage	Permeability in subsoil	Water holding capacity in subsoil	Main limitation
S2 Moderately suitable	S2f	Level	Deep	Clayey to loamy	Poorly to very poorly	Slowly	High	Excessive flooding, moderately severe soil acidity
	S2a	Level	Deep	Clayey to loamy	Poorly to very poorly	Slowly	High	Very strong acidity
	S2s	Level	Deep	Clayey to loamy	Poorly to very poorly	Slowly	High	Low fertility, very strong acidity
S3 Marginally suitable	S3a	Level	Deep	Clayey or loamy	Poorly to very poorly	Slowly	High	Extreme acidity
	S3s	Level to nearly level	Deep	-	Poorly to very poorly	Moderately	-	Poor workability, low fertility very strong acidity
CS2 Conditionally moderate suitable	CS2a	-	-	-	-	-	-	Deep, prolonged flooding, permanent inundation
CS3 Conditionally marginally suitable	CS3x	Tidal swamps	-	-	-	-	-	Salinity
	CS3s	-	Deep	-	Poorly	-	-	Poor workability, very strong acidity, low fertility
N1 Unsuitable	N1s	Undulating terrain	Deep	Sandy	Excessively drainage	-	-	Unfavourable sand texture, low organic matter content, low water holding capacity
	N1t	Undulating rolling hilly or mountainous	-	-	-	-	-	Unfavourable topography

Table II-7 THE DEFINITIONS OF THE LAND SUITABILITY SUBCLASES IDENTIFIED FOR UPLAND CROPS IN THE AREA (1)

Class	Sub-class	Land feature	Soil depth	Soil texture	Drainage	Permeability in subsoil	Water holding capacity in subsoil	Main limitation
S2 Moderately suitable	S2f	Levee and river channels	Deep	Loamy and clayey	Moderately well to somewhat poorly	Moderate	Moderate to high	Flash flooding
	S2s	Undulating to rolling	Deep to moderately deep	Clayey or loamy	Well	Moderate	Moderate	Stoniness, moderately poor soil workability, slight susceptibility to erosion
	S2e	Predominantly rolling	Deep to moderately deep	Clayey or loamy	Well	Moderate	Moderate	Moderate susceptibility to erosion, moderately poor workability
S3 Marginally suitable	S3d	Level or nearly level	Deep	Clayey or loamy	Poorly to somewhat poorly	Moderate to slowly	-	Impeded drainage, poor workability
	S3s	Undulating to hilly	Shallow, moderately deep, deep	Loamy or clayey	Well to excessively	Moderately to slowly	Moderate to low	Shallowness, stoniness
	S3e	Hilly or mountainous terrain	Shallow to deep	-	Well to excessively	-	-	Very severe susceptibility to erosion, stoniness
CS2 Conditionally moderately suitable	CS2s	-	-	-	-	-	-	Wetness, poor workability, unfavourable texture
	CS2a	-	-	-	-	-	-	Wetness, moderately severe soil acidity
CS3 Conditionally marginally suitable	CS3a	-	-	-	-	-	-	Wetness, severe soil acidity

Table II-7 THE DEFINITIONS OF THE LAND SUITABILITY SUBCLASES IDENTIFIED FOR UPLAND CROPS IN THE AREA (2) continued

Class	Sub-class	Land feature	Soil depth	Soil texture	Drainage	Permeability in subsoil	Water holding capacity in subsoil	Main Limitation
NI Unsuitable land	NIf	Level	Deep	Clayey to loamy	Very poorly	-	-	Flooding
	NIs	Undulating, rolling and hilly terrain	Deep to moderately deep	Gravelly, stony and sandy	Well to excessively	-	Low or high	High gravel and stone content, unfavourable sand content
	NIe	Hilly terrain	Shallow to deep	-	Well to excessively	-	-	Very severe susceptibility to erosion

Table II - 8 ACREAGE AND ITS PROPORTIONAL EXTENT OF EACH SUITABLE CLASS FOR PADDY (WETLAND) RICE.

Sub class	Belitang Extension Acreage (ha)	proportion (%)	Tulang Bawang Acreage (ha)	Proportion (%)	Lempuing Acreage (ha)	proportion (%)	Lower Komering River Basin Avreage (ha)	proportion (%)
S1	10,400	15.2	1,300	1.3	3,200	17.1	17,800	16.2
S1/S2a	-	-	6,200	6.4	-		2,300	2.1
S1/S2a/N1s	3,900	5.7	-	-	-		25,900	23.6
S1/S2s/N1s	10,500	15.3	-	-	12,400	66.3	-	-
S1/S2a+f/ CS3s	800	1.2	13,100	13.5	-		15,100	13.7
S1/S2a+f/ CS2a/CS3s	-	-	-	-	3,100	16.6	-	-
S2a + s	39,800	58.0	-	-			14,900	13.5
S2a + f	-	-	33,700	34.8	-	-	-	-
S2s/S3a	3,000	4.4	-	-		-	21,700	19.8
S3s/CS2a/ CS3s	-	-	-	-	-	-	5,000	4.5
N1t	200	0.3	42,600	44.0	-	-	7,300	6.6
T O T A L	68,600	100	96,900	100	18,700	100	110,000	100

Table II - 9 ACREAGE AND ITS PROPORTIONAL EXTENT OF EACH SUITABLE CLASS FOR UPLAND CROPS.

Sub class	Belitang Acreage (ha)	Extension proportion (%)	Tulang Acreage (ha)	Bawang Proportion (%)	Lempuing Acreage (ha)	Lempuing proportion (%)	Lower Komering River Basin Acreage (ha)	Lower Komering River Basin proportion (%)
S1/CS2a+s	17,700	25.7	-	-	-	-	22,100	20.1
S2s	11,700	17.1	75,300	77.7	-	-	5,700	5.2
S2f/CS1	5,400	7.9	-	-	-	-	7,300	6.6
S2e/S2s	16,300	23.7	-	-	-	-	-	-
S3a/CS2s	-	-	2,500	2.6	-	-	28,000	25.5
CS2s	2,600	3.8	-	-	5,600	29.9	600	0.5
CS2a+s	-	-	19,100	19.7	2,900	15.5	-	-
CS2a/CS2s	-	-	-	-	-	-	32,600	29.6
CS2s/CS3a	2,100	3.1	-	-	-	-	13,700	12.5
CS2s/N1s	12,800	18.7	-	-	10,200	54.6	-	-
T O T A L	68,600	100	96,900	100	18,700	100	110,000	100

Table II-10 SOIL CLASSIFICATION

Soil Mapping Units	Slope %	Description*	FAO/UNESCO Units/ Soil Map of the World
I. ALLUVIAL SOILS	<2	Hydromorphic Alluvial Soils of the Coastal Plains. Marine Clay Deposits	Gleyic Solonchake & Eutric Fluvisols
	<2	Hydromorphic Soils of the Present River Banks - Recent Alluvium	Dystric Fluvisols & Dystric Gleysols
	2 or less	Brown Alluvial Soils of Hydromorphic Alluvial	Estric Gleysol & Eutric Cumbisols
	2 or less	Association of Brown Alluvial and Hydromorphic Alluvial Soils - Recent Alluvium	Eutric Gleysols & Eutric Cumbisols
	2 or less	Association of Greyish Brown Alluvial and Hydromorphic Soils of the Present River Banks Recent Alluvium	Dystric Fluvisols and Dystric Gleysols
	< 2	Association of Yellowish Brown Alluvial Soils of the Present River Banks and Hydromorphic Soils Recent Alluvium	Eutric Fluvisols, Dystric Fluvisols & Dystric Gleysols
	< 2	Hydromorphic Alluvial Soils, Humic Gley Soils and Organic Soils Developed from River Alluvium	Dystric & Thionic Fluvisols, Dystric Gleysols & Dystric Histosol
II. GLEY SOILS	<2	Complex of Hydromorphic Alluvial Soils, Humic Gley Soils and Low Humic Gley Soils - Recent Alluvium	Thionic & Dystric Fluvisols, Dystric Gleysols & Humic Gleysols
	<2	Humic Gley Soils of the Lebak Dalam - Recent Alluvium	Thionic & Dystric Fluvisols & Humic Gleysols
	2 or less	Humic Gley and Organic Soils - Recent Alluvium	Thionic & Dystric Fluvisols & Humic Gleysols
	1 - 2	Grey Hydromorphic Soils Semi Recent Alluvium	Gleyic Acrisols

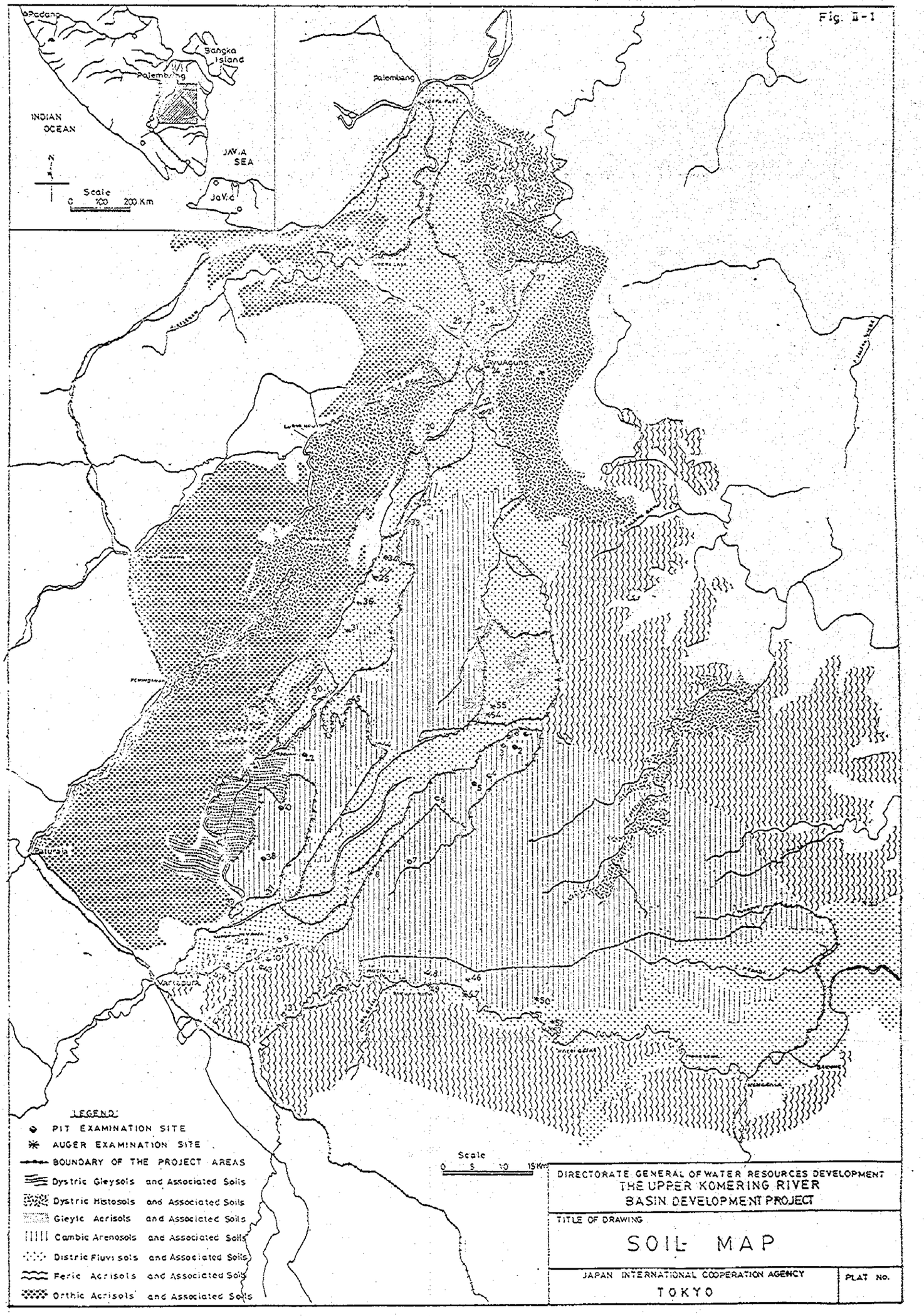
*Refers to Soil Sub-Group described in Sistim Klasifikasi Tanah di Balai Penyelidikan Tanah, M.Soepraptohardjo, Bogor 1961

Soil Mapping Units	Slope %	Description*	FAO/UNESCO Units/ Soil Map of the World
III. REGOSOLS	2-4	Deep, Light Grey Regosols - Aeolian Sand	Dystric Regosols
	2 or less	Grey Regosols, Grey Hydromorphic Soils and Low Humic Gley Soils Semi Recent Alluvium	Dystric Regosols, Dystric Fluvisols Dystric Gleysols & Gleyic Acrisols
	4	Brown Regosols and Gray Hydromorphic Soils Residium from Sandy Tuffs and Semi Recent Alluvium	Eutric Combisols Gleyic Acrisols
IV. RENDZINAS	8-30	Very Shallow, Rendzina Soils of the Rolling to Hilly Area - Residium from limestones	Rendzinos
V. ANDOSOL	16-30	Dark Brown Andosols of Mountain Lands unconsolidated Volcanic Material	Ochroic Andosols
VI. LATOSOL	8 - 30	Brown Latosol Developed from intermediate Tuff	Humic Acrisols
	16-30	Deep Brown Latosols Developed and Eroded Phase of the some Igneous Rocks	Humic Acrisols
	10-16	Reddish Brown Latosols of variable depth from Acid and intermediate Tuffs and Igneous Rocks	Dystric Nitosols
	8-30	Reddish Brown Latosols of Variable Depth from Acid Tuffs and Igneous Rocks	Dystric Nitosols
	8-30	Reddish Brown Latosols of Variable Depth from Intermediate Tuff	Orthic Acrisols
	10-30	Reddish Brown Latosols Developed from Igneous Rock	Dystric Nitosols

Soil Mapping Units	Slope %	Description*	FAO/UNESCO Units/ Soil Map of the World
	8-30	Reddish Brown Latosols and Yellowish Red of Variable Depth Developed from intermediate Tuffs	Dystric & Humic Nitosols
	8-30	Moderate deep to deep, Reddish Brown Latosols and Yellowish Brown Podzolic Soils	Orthic & Ferric Acrisol
VII. PODZOLIC SOILS	1-8	Moderately Deep to Deep, Yellowish Brown and Brown Podzolic Soils Developed from Acid Sandstones	Ferric & Humic Acrisols
	2-16	Deep Yellowish Brown Podzolic Soils and Moderately Deep Yellowish Red Podzolic Soils Developed from Acid Tuffs	Ferric, Orthic & Plinthic Acrisols
	1-8	Yellowish Brown Podzolic Soils and Grey Hydromorphic Soil Developed from Acid Sandstone and Semi Recent Alluvium	Ferric Acrisols & Gleyic Acrisols
	1-8	Moderately Deep to Deep Yellowish Brown and Yellowish Red Podzolic Soils Developed from sandy Tuffs	Ferric & Orthic Acrisols
	1-8	Moderately Deep to Deep, Yellowish Brown and Yellowish Red Podzolic soils Developed from Acid Sandstone	Ferric & Orthic Acrisols
	2-16	Moderately Deep, Yellowish Brown and Yellowish Red Podzolic Soils Developed from Acid Sandstones	Ferric & Orthic Acrisols
	2-16	Moderately Deep to Deep, Yellowish Brown and Yellowish Red Podzolic Soils formed from Acid Claystone.	Ferric, Orthic Plionthit Acrisols

Soil Mapping Units	Slope %	Description	FAO/UNESCO Units/ Soil Map of the World
	8-30	Moderately Deep, Yellowish Brown and Yellowish Red Podzolic Soil Developed from Acid Sandstone	Ferric & Orthic Acrisols
	1-8	Deep Brown Podzolic Soil and Brown Regosols formed from Acid Tuffs;	Humic Acrisol & Humic Andozols
	16+	Brown Regosols and Eroded Phase of the Some Developed from Acid Plutonic Rocks	Humic & Vitric Andozols
	8-16	Moderately Deep to Deep, Yellowish Brown and Yellowish Red Podzolic Soils Developed from Clay sediments	Ferric & Orthic Acrisols
	2-18	Moderately Deep to Deep, Yellowish Brown Reddish Brown Podzolic Soils Developed from Sandy Tuffs	Orthic & Humic Acrisols

Fig. II-1


Padang
Bangka Island
Palembang
INDIAN OCEAN
JAVA SEA
Jakarta
Scale
0 100 200 Km
Palembang
Kayuagung
Baturaja
Martapura
LEGEND
PIT EXAMINATION SITE
AUGER EXAMINATION SITE
BOUNDARY OF THE PROJECT AREAS
Dystric Gleysols and Associated Soils
Dystric Histosols and Associated Soils
Gleyic Acrisols and Associated Soils
Cambic Arenosols and Associated Soils
Distric Fluvisols and Associated Soils
Feric Acrisols and Associated Soils
Orthic Acrisols and Associated Soils
Scale
0 5 10 15Km
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
THE UPPER KOMERING RIVER
BASIN DEVELOPMENT PROJECT
TITLE OF DRAWING
SOIL MAP
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO
PLAT No.

ANNEX-III AGRICULTURE AND AGRO- SOCIO ECONOMY

3.1 PRESENT CONDITION

3.1.1 General

1) Population

The population of Indonesia was estimated at about 141 million corresponding to 74 persons/km^2 in 1978 according to the Central Bureau of Statistics. The following Tables III-1 and III-2 shows the population of Indonesia, South Sumatra and Lampung Provinces as well as Kabupatens OKU and North Lampung where the Project area is situated, in recent six (6) years.

Table III-1 Population from 1973 to 1978

Unit : 1,000

	1973	1974	1975	1976	1977	1978
Indonesia	126,088	129,083	132,110	135,190	138,342	141,579
South Sumatra Pro.	3,688	3,795	3,905	4,018	4,135	4,257
Lampung Pro.	2,949	3,163	3,308	3,646	3,707	3,990
Kab. OKU	560	572	599	622	635	671
Kab. North Lampung	497	567	592	644	673	714

Source: Central Bureau of Statistics, 1971-1981
Kantor Sensus & Statistik, Lampung 1977, 1978
Kantor Sensus & Statistik, Palembang 1977, 1978

Table III-2 Population Density and Growth Rate

	Area (km^2)	Density (Person/km^2)	Growth Rate (%)
Indonesia	1,904,569	74	2.34
South Sumatra Prov.	103,688	41	2.93
Lampung Prov.	33,307	119	6.23
Kab. OKU	11,133	62	3.68
Kab. North Lampung	19,368	37	7.51

Source: Central Bureau of Statistics, 1971-1981
Kantor Sensus & Statistik, Palembang & OKU, 1978
Kantor Sensus & Statistik, Lampung & North Lampung, 1978

As seen in above table, the population growth rate in the outer islands has been increased rapidly, particularly in Lampung Province as compared with the national growth rate. The trans-migration from the densely populated islands, Java and Bali, to the Lampung area and OKU Kabupaten area have been remarkable.

With respect to the Economically Active Population, about 70% of South Sumatra Province and about 80% of Lampung Province of the working pupulation are now engaged in agriculture sector, followed by service sectors such as trade, restaurant and hotel and community services as shown in Table III-3. In particular, the rate of agricultural sector is relatively higher than that of the whole Indonesia, and one of the particular characteristics in South Sumatra province are comparatively high in mining sector.

Table III-3 Economically Active Population (1978)

Sector	Indonesia		South Sumatra		Lampung	
	Person (1000)	%	Person (1000)	%	Person (1000)	%
Agriculture	35,259	66.0	1,127	69.3	1,038	81.0
Mining	44	-	35	2.2	1	-
Manufacturing	3,560	6.7	56	3.4	16	1.3
Electricity, Gas & Water	34	-	1	-	1	-
Construction	1,098	2.1	31	1.9	12	0.9
Trade, Restaurant & Hotels	6,253	11.7	128	7.9	69	5.2
Transport, Storage & Communication	1,112	2.1	40	2.5	14	1.1
Finance and Insurance	74	0.2	3	0.2	1	-
Community Service	5,157	9.6	121	7.4	83	6.4
Others	853	1.6	84	5.2	53	4.1
Total	53,444	100.0	1,626	100.0	1,287	100.0

Data Source: 1) Central Bureau of Statistic, Indonesia
2) Kantor Sensus & Statistik, Palembang
3) Depnaker Propinsi Lampung

ii) Gross Regional Products

Table III-4 shows the Gross Regional Products in both South Sumatra and Lampung Provinces comparing with DGP of the whole Indonesia in 1977. The primary sectors of agriculture and mining occupied about 37% and about 57% of the total gross regional products in South Sumatra Province and Lampung Province respectively, while those of the whole Indonesia showed about 50%.

Gross regional products in both South Sumatra and Lampung Provinces were Rp.1,157 million and Rp.344 million respectively, which corresponded to Rp.280,000 and Rp.93,000 per capita respectively. Such high gross regional products in South Sumatra Province was distinctly attributable to the products from the mining sector.

Table III-4 Gross Regional Product of South Sumatra and Lampung Province in 1977

Item	Indonesia Amount		South Sumatra Prov. Amount		Lampung Prov./1 Amount	
	($Rp.10^9$)	%	($Rp.10^9$)	%	($Rp.10^9$)	%
Agriculture, Forestry and Fishery	5,968	31.3	201.4	17.4	195.0	56.7
i) Farm food crops	3,549	18.6	69.7	6.0	86.1	25.0
ii) Non-farm food crops	777	4.1	89.3	7.7	*	-
iii) Estate crops	372	2.0	0.7	0.1	72.2	21.0
iv) Livestock	412	2.2	15.1	1.3	24.8	7.2
v) Forestry	602	3.2	11.2	1.0	4.8	1.4
vi) Fishery	256	1.3	15.4	1.3	7.2	2.1
Mining	3,694	19.4	227.3	19.6	0	0
Manufacturing	1,810	9.5	175.9	15.2	25.1	7.3
Electric, Gas and Water Supply	122	0.6	2.6	0.2	0.4	0.1
Construction	912	4.8	16.6	1.4	3.4	1.0
Commerce	3,066	16.1	408.8	35.3	57.4	16.7
Trans. and Information	827	4.3	44.6	3.9	14.1	4.1
Finance	263	1.4	8.0	0.7	2.7	0.8
Immovable property	371	1.9	6.8	0.6	23.4	6.5
Governmental Service	1,397	7.3	41.2	3.6	15.8	4.6
Other Service	617	3.2	23.8	2.1	7.6	2.2
Total	19,047	100.0	1,157.0	100.0	344.0	100.0
Per capita G.R.P.($Rp10^3$)	137.3		279.8		92.8	

Data Source: 1) Central Bureau of Statistic, Indonesia, 1977
2) Dalam Angka, Lampung, 1976
3) Dalam Angka, South Sumatra, 1977

* No data available.

/1 Because of no data obtained, the figures in 1977 was tentatively estimated based on GRP 1976 applying an increase rate of GDP from 1976 to 1977 in the whole Indonesia.

iii) Rice Demand and Supply

Production of paddy and supply of rice in both South Sumatra and Lampung Provinces in the past nine (9) years are tabulated in Table III-5. The production of paddy in Lampung Province has been remarkably increased, namely, 7.82% per annum on an average, while that in South Sumatra Province has shown 3.06% per annum. Although the rate of production increase in Lampung Province is higher than that of the demand, more than 70,000 tons of rice of shortage occured in 1978 in both Lampung and South Sumatra Provinces.

Table III-5 Rice Demand and Supply in South Sumatra and Lampung Province

	South Sumatra Province				Lampung Province			
	Paddy Production (tons)	Rice Supply (tons)	Rice Demand (tons)	Balance (tons)	Paddy Production (tons)	Rice Supply (tons)	Rice Demand (tons)	Balance (tons)
1970	549,800	376,180	427,300	- 51,120	309,900	210,110	320,775	-110,662
1971	582,920	398,840	444,710	- 45,870	364,240	246,950	333,083	- 86,131
1972	490,030	335,280	457,960	-122,680	374,020	253,590	341,793	- 88,205
1973	550,920	376,940	471,380	- 94,440	391,650	265,540	353,943	- 88,407
1974	622,630	426,010	485,070	- 59,060	395,440	268,110	379,560	-111,453
1975	672,490	460,120	510,860	- 50,740	456,940	309,810	397,060	- 87,253
1976	613,750	419,930	525,670	-105,740	462,500	313,570	437,527	-123,956
1977	625,020	427,650	540,990	-113,340	534,730	362,540	444,878	- 82,334
1978	699,640	478,700	556,900	- 78,200	565,910	383,690	458,457	- 74,767
Increase Rate %	3.06		3.37		7.82		4.60	
Per-capita (kg)		112	131			96	120	

Source: Census & Statistics Offices in South Sumatra and Agricultural Office in Lampung Provinces in 1978

3.1.2 Present Land Use

The present land use in the Project area is classified by the data obtained from three Kabupaten Offices, OKU, OKI and North Lampung. Table III-6 shows the present land use in the Project area in each Kecamatan basis as of 1977 and 1978.

i) Belitang Area

The Belitang area has been much developed for agriculture in the South Sumatra Province. Total paddy land cultivated in the Belitang area was about 44,000 ha, 12.1% of total land of the area, which correspond to about 79% of total paddy land in Kabupaten OKU. About 20,000 ha out of the total paddy lands are equiped with the perennial irrigation system and the remainings are still rain-fed conditions.

About 37,000 ha of upland in the Belitang area occupying about 35% of the total upland in OKU, are mainly cultivated with upland paddy, maize, cassava, peanuts, soybeans, etc. under the rain-fed conditions. As the perennial cash crops, coffee, fruits and rubber are planted in the levee land of the Komering river and the hilly land.

The grass land (alang-alang), one of the potential cultivable lands, occupies about 12% of the gross area and are still non-productive. Forest lands are mainly covered by secondary forests, which occupy about 56% of the gross area. Shifting cultivation is commonly practiced in the forest area.

ii) Tulangbawang Area

Table III-6 shows the land use pictures in three Kecamatans located along the Tulangbawang river. Only 0.4% of paddy land and 1.8% of upland crop farm land are cultivated in three Kecamatans. The areas cultivated with paddy in the left bank of the Tulangbawang area (area within the Project area) are negligible small. Estate crops, coffee, pepper, fruits, etc. are mostly in the levee land of the Tulangbawang river and some elevated lands.

Virtually, the most of the Tulangbawang area is still covered with primary and secondary forests, which correspond to about 75% of the total land. Recently, about 2,500 families of transmigrants have been settled by the Government program in

the eastern part of area which will be extended to receive about 4,500 families by the end of 1979, but their farming is still practiced under rainfed conditions.

ii) Lempuing Area

The Lempuing area has been rapidly developed for settlement of the transmigrants from the densely populated Islands recently. Because of rather flatness of the area, the substantial areas have been cultivated with upland crops due to no source irrigation water by gravity is made so far available. Upland paddy, maize, cassava, peanuts etc. are predominantly cultivated in the area.

Table III-6 Present Land Use

Unit : ha

Kec. Concerned	Sawah	Upland	Yard	Estate	Alang-Alang	Forest[1]	Others	Total
Belitang Area								
Martapura	1,720	12,050	530	2,610	11,070	27,710	10	55,700
Buay Madang	15,510	13,190	3,200	560	9,500	68,910	2,470	113,340
Belitang	4,390	4,200	3,900	100	11,950	15,700	1,250	41,490
Cempaka	20,560	4,350	2,660	12,280	0	70,620	100	110,570
Bahuga/Lampung	1,610	3,110	2,040	760	10,960	19,220	1,710	39,410
Total	43,790	36,900	12,330	16,310	43,480	202,160	5,540	360,510
Proportion (%)	12.1	10.2	3.4	4.5	12.1	56.1	1.5	100
Kab. OKU	55,300	104,140	15,070	72,750	77,190	811,490	16,790	1,152,730
Lempuing Area								
Padamaran	1,690	330	520	930	0	108,470	2,420	114,630
Proportion (%)	1.7	0.3	0.5	1.0	0	94.6	2.1	100
Kab. OKI	68,390	13,920	7,590	44,290	10,840	2011,420	22,960	2,179,410
Tulang Bawang Area								
Pakuan Ratu	80	3,380	530	320	7,800	164,530	1,700	178,340
Menggala	970	1,430	1,000	3,610	2,900	200,260	29,710	239,880
T.B. Tengah	1,320	4,720	1,420	350	0	33,950	71,240	113,000
Total	2,370	9,530	2,950	4,280	10,700	398,740	102,650	531,220
Proportion (%)	0.4	1.8	0.6	0.8	2.0	75.1	19.3	100
Kab.N.Lampung	20,280	82,060	9,030	43,450	45,350	1,104,470	251,020	1,555,660

Data Source: 1) Sub-department of Land Use, South Sumatra and Lampung Provinces, 1973, 1977
2) Kab. OKU and North Lampung Agricultural Office, 1978

/1 : Including shifting culture land for upland crops

3.1.3 Present Cropping Pattern

Present cropping pattern prevailing in the proposed development area is shown in Fig. III-1, III-2 and III-3 according to the data obtained from the Agricultural offices in both Kabupatens OKU and North Lampung and Irrigation Office in Belitang.

Type I pattern is predominant in the flat lowland in the Belitang area except for the Belitang proper area of about 20,000 ha. Rainfed paddy is planted from the onset of rainy season, normally middle of October. The planting period ranges about three months depending on the rainfall pattern which varies from year to year. The harvesting paddy lasts about three (3) months from March to May. Dry season paddy is practiced after the harvesting of rainy season paddy but very limited at where stream flow for irrigation is made available. Upland paddy is planted also during the rainy season. Upland crops such as maize, peanuts, soybeans, cassava, etc. are planted from the end of rainy season in general and harvested from August to September depending on the variety of crops. Land holding of farmer in the area is rather small at about 1.0 ha per household.

Type II pattern mostly prevails in rather undulated lands and recently transmigrated lands in the Belitang and the Lampuing areas. Out of 1.75 ha of farm land for each transmigrant about 1.5 ha are planted with rainy season paddy, upland paddy and upland secondary crops in the rainfed conditions. The rainy season paddy (sawah) is basically cultivated as large as possible if water available in the lowland. About 0.25 ha is planted with perennial cash crops such as rubber coffee, clove and pepper.

Type III pattern is predominant in the newly settled transmigration area under the Government program and spontaneous in the Tulangbawang area. The farmer cultivate upland crops and some perennial tree crops at only 10 to 20% of the total lands provided by the Government. Large parts of the land are still covered by the forest or grass lands.

3.1.4 Present Farming Practices

The present farming practices in the Project area are still conventional resulting in rather low yield of crops. Rainfed cultivation prevails in all over the proposed development area.

Pembongkar, Bongkar Putih, Bongkar Utang, Lampung, etc. of paddy varieties are the prevailing traditional variety throughout the project areas, at present. I.R. varieties such as P.8-5, -8, -26, -28, -32, etc. have been introduced in the low land area in the recent years. Growing period of traditional variety is about 150 to 170 days and high yielding variety is about 115 to 135 days respectively. Fertilizer application in the project area is relatively low at present, ranging from 10 to 20 kg per hectare of area and 5 to 10 kg per hectare of triple super phosphate, a little amount of agrochemical is used in the project area, spraying of about 1 time as the amount of 1 liters per hectare, as shown in Table III-7. In recent years the rainy season paddy has been suffered serious damages by insects as leaf hoppers, and rats in the entire project area.

Farming in the project area is comparatively labor intensive from the transplanting to the harvest though animal power such as buffaloes or cattles is used for land preparation. "Ani-ani" system is also the prevailing method of harvesting except for improved varieties.

Upland crops such as maize, soybeans, peanuts, sweet potatoes are cultivated either alternately or in rotating pattern so as to minimize yield decrease due to disease and insects. Weeding is commonly practiced by manual labor. Neither fertilizer nor chemicals is applied for the upland crops.

Perennial cash crops such as rubber, coffee, clove and orchard are mainly planted in either river levee lands or some elevated lands where natural soil characteristics and its drainability are favourable for the three crops. No fertilizer and chemicals are commonly used. The weeding is carried out manually.

Table III-7 Amounts of Farm Inputs at Present

Description	Unit	Lowland Paddy Rainy Season	Lowland Paddy Dry Season	Upland Paddy	Maize	Cassava	Soybean	Peanut	Rubber	Coffee
Seed	(kg/ha)	35	35	40	15	10,000/1	25	70	625/2	1,600/2
Fertilizer	(kg/ha)									
Urea		20	10	10						
T.S.P.		10	5							
Agro-chemical	(lit/ha)									
Insecticide (Diazinon)		1	1	1						

/1: Unit; stalk

/2: Unit; No. of seedling

Source: 1) Agricultural Office in Kab. OKU and North Lampung
2) Farm economy survey in each project area

3.1.5 Crop Yield and Production

Yield of paddy varies substantially with the variety of rice, quantity and time of irrigation water and density of farm inputs, ranging from 1.1 to 2.5 t/ha in the proposed agricultural development area. Under the BIMAS, the yield from the improved varieties ranges usually from 3.0 to 4.5 t/ha in the irrigated Belitang Proper area.

Yields of upland crops are also very substantially with the variety, soil fertility, rainfall distribution and density of farm inputs. Particularly in the hilly lands the crops often encounter with severe drought and lack of nutrient and fertility, resulting a considerable low yield. Table III-8 shows the present average crop yields and production for paddy and upland crops estimated according to the data obtained from the Agricultural Offices in Kab. OKU and Kab. North Lampung.

For reference, Table III-9 shows the paddy harvested area and production in Kab. OKU and North Lampung, for past 3 years, and Table III-10, III-11 and III-12 show the major crops production in Kab. OKU, OKI and North Lampung, for past 5 years.

3.1.6 Livestock

Various kinds of livestock are raised in the Project area. They are cattle, buffalo, goat, pig, chicken, duck and to a lesser extent, sheep, as shown in Table III-13. Table III-14 shows a number of livestock in Kabupatens OKU, and North Lampung in recent years.

Cattle and buffalo are playing an important role in the land preparation for farming and to some extent in the transportation purpose as well as in meat. The numbers of cattle and buffalo are about 55,000 ha heads corresponding to only about 0.4 head/ha of the cultivated lands in the Belitang area, which is insufficient to plow the land within the limited period of land preparation even though those numbers share more than 50% of the total numbers in Kabupaten OKU. In the Lempuing and Tulangbawang area, number of livestock, particularly cattle and buffalo is extremely few. Buffalo increased substantially at about 36% in the Belitang area in recent three years, while decreased in the North Lampung Kabupaten at about 25% in the same period.

The other livestock such as goat, pig, chicken and duck raised in the area are mainly for home consumption and to some extent in local marketing. Chicken and duck has increased remarkably in both the Kabupatens OKU and North Lampung in recent years.

Table III-15 shows the number of slaughter of livestock in the Belitang region and Tulangbawang region in 1977. The number of slaughter was extremely small particularly in cattle as compared with the present number of cattle. It seems that the certain numbers die of disease and some are sold to others.

3.1.7 Agricultural Support Services

Agricultural support services are one of the most important sectors for the agricultural development, in particular, rapid increase of crop production and subsequently increase of farm income as well as improvement of the farmers' living standard.

1) Agricultural extension services

According to the data and information obtained from both the Kabupaten OKU and North Lampung Agricultural Offices, on PPM (Extension Supervisior) in BPP (Rural Extension Center) commands at least 10 PPL (Field Extension Worker) and covers about 10 Wilud (Wilayah Unit Desa commanding 3 to 4 Desa) on an average. The area covered by one PPL varies substantially from the area to area ranging from about 660 ha to 12,500 ha of farm land in case of the Belitang region as shown in Table III-16. One PPL has to provide his service for the farmers as large as about 2,240 ha on an average, and give the guidance on improved farming technics and knowledge to the farmers either directly or through the Kontak-tani who are selected from each Desa. One Kontak-tani covers approximately 100 farmers.

In view of such limited number of PPL, it is desired to equip with better communication facilities such as jeep, motor cycle etc. so as to enlarge his activities as large as possible. Further more the number of PPL is to be strengthened and increased so as to be able to give more intensive guidance to the farmers.

For reference, Fig. III-4 shows the extension organization in South Sumatra Province, at present.

II) Research Works

The agricultural research works in the South Sumatra Province are carried out within the centralized network activities under the direction of the Central Research Institute of Agriculture, Bogor (C.R.I.A.).

Two Branch Offices of C.R.I.A. at Purbolinggo in Lampung Province and at Lahat in South Sumatra Province are conducting application tests of high yielding and local varieties suitable, fertilizers test, test for control of pests and diseases, same upland crops tests, etc.

Tegineneng center, where is located in the near Tanjungkarang in the Lampung Province, has played one of the most important role on improvement of agriculture in Lampung area since 1972. The major works of this center is selection tests of suitable varieties for paddy and upland crops, application tests of fertilizer, control tests of pests and diseases, seed multiplication of paddy and upland crops, training for PPL and farmers, farm economy survey, etc. This center has 84 staff in total, under the close cooperation among Japanese and Indonesian engineers.

In South Sumatra Province, the main research work carried out by the provincial government is the field test on the trial plots. The main items of the tests carried out in the past few years were:

1) paddy and upland paddy variety test,
2) fertilizer test for paddy,
3) protection test for plant disease,
4) second crop variety test and fertilizer test, etc.

The test works under the detailed farming and measuring plan directed by C.R.I.A. are carried out mostly by the students of the Agricultural Faculty, Sriwidjaja University in Palembang, they are hired as seasonal workers, and these data are analysed by C.R.I.A.

III) Seed Multiplication and Distribution

One of the most important factors of the agricultural inputs for production increase is the introduction of improved seeds of crops. The Government of Indonesia has placed particular emphasis

on the improvement of rice since the beginning of BIMAS programme in 1964.

A seed center in the South Sumatra with 10 ha of paddy land is located at the Belitang Project site in the Kabupaten OKU, which was established in 1969 (see Fig.III-5). Foundation seeds are supplied from C.R.I.A. to this seed center through the Agricultural Extension Service in the South Sumatra Province.

The paddy stock seeds produced at the Belitang seed center are supplied to same seed growers whose list is shown in Table III-17 in the Kabupaten OKU, North Lampung, etc. In addition to above some uncertificated seed growers in each Kabupaten are also supplied the seeds from this seed center. The seed produced at seed growers farm are distributed to BUUD/KUD for the BIMAS farmers and directly to common farmers, as extension seed.

However, the amount of seed produced in these field are still limited, as shown in Table III-17. Further efforts are required for distributing the improved seeds smoothly in as wide area as possible.

iv) BIMAS and INMAS Credits

Since 1970, when BIMAS National was started in Indonesia, BIMAS credit has been issued by B.R.I. directly to farmers. Before that, farmers had to obtain loans and necessary requisites through the representatives of the farmers' group who had to travel to distant B.R.I. brach offices as well as the warehouses owned by fertilizer distributors. Under the new system, B.R.I. officers are either stationed at the villages or visit those places as a member of mobile bank.

There are two types of BIMAS credit system. One is the ordinary BIMAS (BIMAS Biasa) under which high yield local varieties are introduced. The other is called the new BIMAS (BIMAS Baru) under which improved new varieties such as PB-5, PB-8, IR-34, IR-36, IR-38, etc. requiring more fertilizer than the ordinary ones are introduced. Credit for BIMAS Program in 1979 was Rp.44,940 per ha for BIMAS Baru and Rp.25,940 per ha for BIMAS Biasa in South Sumatra Province.

The past records on this area served by the BIMAS program are given in Table III-18. The annual average of the area under the program is about 8,000 ha for rainy season paddy and 1,600 ha for dry season paddy in Kabupaten OKU, about 3,600 ha for rainy season paddy and 500 ha for dry season paddy in Kabupaten North Lampung respectively. The area under BIMAS programs covers only 14% of that of Kabupaten OKU and only 10% of Kabupaten North Lampung respectively. These figures are very low in comparison with about 30% of that in the whole Indonesia, especially more than 50% in Java Island. The main reason for these small coverages are due to the fact that there is a few technical irrigation system in the area.

Table III-19 shows the records on total amount of credit provided for the farmers and its repayment in this area. The average are about 16,600 Rp./ha in Kabupaten OKU about 16,400 Rp./ha in Kabupaten North Lampung respectively. As seen in the Table, the repayment of the credit was relatively low, ranging between 39% and 83% in Kabupaten OKU and between 11% and 65% in Kabupaten North Lampung respectively. The repayment time usually comes immediately after the harvest when the price of rice is at the lowest. Consideration should be given to this fact with improvement of the farmers' credit.

Under BIMAS program, the activities of the Bank have been considerably strengthened to offer the special short term credit for paddy cultivation. In both the Kabupaten OKU and the North Lampung, however, the number of unit BRI is as low as about 4% of that of total Desa, which shows that further improvement of the credit activities are required. (See table III-20)

v) Cooperatives

The existing farmers cooperatives in both the Belitang and Tulangbawang area are shown in Table III-20. BUUD/KUD (Badan Usaha Unit Desa/Koperasi Unit Desa) play an important role in providing various services for the farmers to achieve levelling-up of their standard mainly through the increase of their farm income.

The BUUD/KUD, farmers organizations or village-level organization, is the fore-runner of the KUD, and purchase products directly from farmers and re-sell those to Government food purchasing agencies (DOLOG). The other activities of such BUUD/KUD are the supply of necessary farm inputs such as improved seeds, fertilizers, agro-chemicals, some farming instruments, etc. and marketing of farm products. As seen in Table III-20, KUD established to the total Desa in the Kabupaten OKU and the Belitang area is less than 4% and about 7%, respectively. No BUUD/KUD exists in Kecamatan Pakuan Ratu and 6% of Kabupaten North Lampung. The activity is accordingly quite insufficient to provide necessary services for each villages.
KIOS is supplying farm inputs and small farming equipment under the control of BUUD/KUD.

3.1.8 Market and Prices

The seasonal fluctuations in farm gate price of the products are relatively large due to the inadequate marketing system, transportation and storage facilities and the lack of market information. The farmers usually sell their farm products to the millers in the neighbourhood, to the millers agents, or to itinerant grain buyers immediately after the harvest.

In an attempt to stabilize the prices of rice, governmental agency (Badan Urusan Logistic = BULOG) functions in the marketing. This agency was primarily organized for the purpose of military logistics in 1965, with Depot Logistic (DOLOG) in provincial level, etc. BULOG's function was shifted from the securing food for the armed forces to the rice stabilization in 1968.

BULOG purchased the dry paddy at Rp.100/kg from the farmers through KUD and Rp.98/kg without through KUD in 1979. The share of marketing of paddy through BUUD/KUD is, however, limited due to the shortage of storage facilities. In addition, the storage facilities of farmers themselves are very limited to store their products in good conditions. Accordingly the farmers are often compeled to sell those products immediately after the harvest, resulting in selling those at unforeseen low farm gate price to the itinerant merchants. Augmentation of the storage facilities is very essential.

There are two ways of rice marketing, one through BULOG and the other through the merchants at present. In order to stabilize the market price of rice, the Government is controlling its price fluctuation through BULOG. Fig.III-6 shows the prevailing flow channel of marketing of rice.

The farm gate prices of the products and the price of farm inputs are estimated based on the data obtained from the Agricultural Offices in both Kabupatens OKU and North Lampung as well as the supplemental field investigations as shown in Table III-21 and Table III-22 respectively.

3.1.9 Farm Budget

Table III-23 shows the tentative present farm budget of typical farmer in the Belitang area. In cases of Type I and Type II the main source of income depends on rice, while upland crops in case of Type III is predominant. Income from the livestock is still insignificant. The farmer raise mainly those chicken and ducks as a home consumption. The average annual farm income is still low as compared with that in whole Indonesia. Recently, the living expenses of family increased substantially due to upgrading of living standard. Surplus of their budget is accordingly rather small. Further detail survey will be made in the future stage in view of the tentative estimation.

3.1.10 Transmigration

Transmigration from the densely populated islands, Java, Bali, etc. to the Sumatra was initiated in 1905. In the Belitang area, the settlement activities have been progressively carried out since 1942. In particular, the transmigration policy has been promoted under Pelita I and Pelita II.

Accordingly to the Transmigration Offices in both South Sumatra Province and Lampung Province, the total number of migrants during 28 years from 1950 to 1978 were about 34,000 and about 73,000 families respectively. Table III-24 and Table III-25 show the lists of settled families under the Government program in both Kabupatens OKU and North Lampung from 1950 to date. More than 95% of total numbers of transmigrants in OKU were settled in the Belitang area. In the Tulangbawang area, about 2,500 families were settled in the north of Menggala from 1977 to 1978.

In Repelita III the Government places also particular emphasis on the transmigration program as shown in Table III-26, in which 500,000 of families in total are planned to be settled during the five years. Table III-27 and Table III-28 show the transmigration program for Kab. OKU and North Lampung during Repelita III.

In order to implement successfully the settlement the Government will provide 1.25 ha of land preparation, certain quantities of infra-

structures and living accommodation to the imigrants as well as commodities such as food, clothes, cooking utensils and farm inputs needed such as seed, seedling, fertilizer, etc. to the new settler. Table III-29 and Table III-30 show the facilities to be provided and the materials as well as goods to be supplied by the Government to the settlers.

Table III-8 Present Crop Production

Crops	Area (ha)	Unit Yield (ton/ha)	Production (tons)
1) Belitang Area (1 ha)			
Rainy season paddy	8,450	2.5	21,350
Dry season paddy	850	2.0	1,700
Upland paddy	3,660	1.1	4,030
Total paddy			27,080
Cassava	1,500	6.0	9,000
Maize	860	0.9	770
Peanut	750	0.8	600
Soybean	550	0.7	390
2) Belitang Transmigration Area (1.75 ha)			
Rainy season paddy	480	2.5	1,200
Upland paddy	720	1.1	800
Total paddy			2,000
Cassava	250	6.0	1,500
Maize	140	0.9	160
Peanut	120	0.8	100
Soybean	90	0.7	60
Rubber	280	0.5	140
Coffee	20	0.6	10
3) Lempuing Area (1.75 ha)			
Rainy season paddy	530	2.5	1,330
Upland paddy	780	1.1	860
Total paddy			2,190
Cassava	280	6.0	1,680
Maize	150	0.9	140
Peanut	140	0.8	110
Soybean	100	0.7	70
Rubber	410	0.5	210
Coffee	30	0.6	20
4) Tulang Bawang Area			
Upland paddy	1,250	1.1	1,380
Cassava	950	6.0	5,700
Maize	250	0.9	230

Crops	Area (ha)	Unit Yield (ton/ha)	Production (tons)
Peanut	50	0.8	40
Soybean	0		0
Rubber	300	0.5	150
Coffee	460	0.6	280

Table III-9 Paddy Harvested Area and Production in Kab. OKU and North Lampung

Description	1976 Harvested Area	1976 Production	1977 Harvested Area	1977 Production	1978 Harvested Area	1978 Production	Average Harvested Area	Average Production
Kab. OKU								
Rainy season paddy*	35,700	125,700	35,990	130,830	36,090	130,450	35,930	128,990
Dry season paddy*	3,020	9,170	1,840	5,420	2,700	9,180	2,520	7,920
Swamp paddy*	9,510	14,020	7,810	13,860	8,500	19,550	8,610	15,810
Sub-total	48,230	148,890	45,640	150,110	47,290	159,180	47,060	152,720
Upland paddy*	27,110	25,250	27,600	28,880	26,450	33,160	27,050	29,100
Total	75,340	174,140	73,240	178,990	73,740	192,340	74,110	181,820
Kab. North Lampung								
Rainy season paddy*	10,120	27,950	12,590	41,440	11,950	39,100	11,550	36,160
Dry season paddy*	1,140	2,010	910	1,610	770	1,900	940	1,840
Sub-total	11,260	29,960	13,500	43,050	12,720	41,000	12,490	38,000
Upland paddy*	39,060	65,590	43,700	75,960	49,700	83,050	44,150	76,200
Total	50,320	99,550	57,200	119,010	62,420	124,050	56,640	114,200

Data Source: Laporan Dinas Pertanian in Kab. OKU and North Lampung

* Dry stalk paddy

Table III-10 Major Crop Production in Kab. OKU

	1974		1975		1976		1977		1978	
	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons
Paddy* (sawah)	47,840	156,550	49,050	164,520	48,230	148,890	45,640	150,110	47,290	159,180
Paddy* (upland)	27,480	23,730	27,500	23,060	27,110	25,250	27,600	28,880	26,450	33,160
Paddy total	75,320	180,280	76,550	187,580	75,340	174,140	73,240	178,990	73,740	192,340
Maize	2,150	1,590	2,450	1,930	2,240	1,410	1,950	1,420	2,390	1,780
Cassava	2,170	19,570	2,300	17,940	3,770	27,480	3,820	28,710	3,910	29,050
Peanut	630	440	650	510	760	550	850	630	1,220	1,030
Soybean	300	200	690	530	1,070	810	890	720	870	850
Rubber	42,940	14,700	42,950	17,640	42,350	13,500	41,560	14,770	41,560	14,760
Coffee	32,530	14,850	32,680	18,790	32,700	19,010	31,830	17,600	31,900	17,620
Coconut	3,050	910	3,150	1,180	3,230	990	3,230	990	3,230	990
Pepper	260	140	370	120	370	100	370	100	370	100
Clove	220	0.05	500	0.11	590	0.12	850	0.70	1,030	0.6

Note: * Dry stalk paddy

Data Source: 1) Agricultural Office in Kab. OKU
2) Estate Office in Kab. OKU

Table III-11 Major Crop Production in Kab. North Lampung

	1974		1975		1976		1977		1978	
	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)	Planted or Harvested Area (ha)	Production (tons)
Paddy* (sawah)	10,640	36,170	10,790	37,400	10,120	35,420	12,490	41,380	13,010	39,100
Paddy* (upland)	42,700	72,610	36,490	48,400	38,380	68,970	43,740	79,010	50,260	73,320
Paddy total	53,340	108,780	47,280	85,800	48,500	104,390	56,230	120,390	63,270	112,420
Maize	10,880	7,330	5,520	3,590	6,490	4,590	5,340	5,140	6,230	5,410
Cassava	7,070	119,090	10,090	173,040	10,860	145,590	16,140	269,140	15,000	243,440
Peanut	1,260	800	1,550	1,420	1,230	1,230	1,480	1,220	2,580	2,140
Soybean	610	350	690	450	320	250	480	260	300	240
Rubber	9,890	3,350	9,890	3,460	10,800	4,970	11,050	4,700	11,780	5,550
Coffee	17,580	8,660	23,920	8,100	25,530	12,230	28,100	14,300	29,660	19,800
Coconut	16,180	6,220	16,180	1,820	19,300	7,740	19,700	8,100	20,140	8,100
Pepper	23,330	13,150	23,780	10,150	24,050	11,120	25,200	13,200	24,680	19,080
Clove	5,720	930	6,050	670	7,390	1,920	7,500	2,300	10,380	860

* Dry stalk paddy.

Data Source : 1) Agricultural Office in Kab. North Lampung
2) Estate Office in Kab. North Lampung

Table III-12 Major Crop Production In Kab. OKI

	1974		1975		1976	
	Harvested Area (ha)	Production (tons)	Harvested Area (ha)	Production (tons)	Harvested Area (ha)	Production (tons)
Paddy* (sawah)/1	70,240	157,820	61,770	173,380	61,010	115,050
Paddy* (upland)	12,870	14,190	13,270	13,930	9,000	9,510
Paddy total	83,110	172,010	75,040	187,310	70,010	124,560
Maize	530	300	470	350	410	210
Cassava	3,260	15,600	3,410	16,900	3,260	14,520
Peanut	230	170	220	170	260	150
Soybean	15	10	45	30	50	35
Rubber/2					49,380	18,740
Coffee/2					120	30
Coconut/2					2,280	620
Clove/2					230	-

Data Source: 1) Kabupaten OKI Agricultural Office
2) Kabupaten OKI Statistic Office

/1 : Including Lebak, swamp and rainfed area
/2 : Figures in 1977

*Dry stalk paddy

Table III-13 Number of Livestock (1977)

Kecamatan	Cattle (head)	Buffalo (head)	Goat (head)	Sheep (head)	Pig (head)	Chicken (head)	Duck (head)
Belitang Area							
Martapura	2,100	80	480	-	190	24,480	5,850
Buay Madang	10,780	3,290	4,760	1,850	7,180	105,340	26,880
Belitang	8,880	920	3,010	820	4,690	89,520	16,240
Cempaka	3,750	100	2,570	810	2,760	54,660	5,160
Bahuga Lampung	230	180	1,600	-	240	30,370	600
(1) Sub-total	25,740	4,570	9,710	3,480	15,060	304,370	54,730
(2) Kab. OKU	39,590	15,150	17,360	5,980	15,140	441,040	72,480
(1)/(2) in %	65.0	30.2	55.9	58.2	99.5	69.0	75.5
Lempuing Area							
(1) Pedamaran	788	721	821	500	0	11,938	4,734
(2) Kab. OKI	18,241	7,007	7,655	2,598	187	200,693	138,360
(1)/(2) in %	4.3	10.3	10.7	19.2	0	5.9	3.4
Tulangbawang Area							
(1) Pakuan Ratu	700	350	700	-	-	5,000	550
(2) Kab. North Lampung	10,720	6,240	20,650	1,860	750	363,080	9,600
(1)/(2) in %	6.5	5.6	3.4	0	0	1.4	5.7

Data Source: 1) Livestock Offices in Kab. OKU, and North Lampung
2) Statistic Office in Kab. OKI

Table III-14 Number of Livestock in Recent Years

	Cattle	Buffalo	Goat	Sheep	Pig	Chicken	Duck
Kab. OKU							
1974	38,560	11,140	14,450	4,400	11,100	211,500	27,190
1975	40,820	12,330	16,040	4,810	13,330	302,740	61,920
1976	37,530	12,460	17,780	5,500	13,880	406,420	65,660
1977	35,590	15,190	17,360	5,980	15,140	441,040	72,480
1977/1974 %	2.7	36.4	20.1	35.9	36.4	208.5	266.6
Kab. North Lampung							
1974	9,320	8,320	12,020	2,090	880	140,480	8,250
1975	9,790	10,250	17,840	2,030	1,250	164,750	8,640
1976	8,500	5,710	17,710	1,620	1,320	289,610	9,100
1977	9,120	5,950	19,340	1,790	1,480	326,280	9,800
1978	10,720	6,240	20,650	1,860	750	363,080	9,600
1978/1974 (%)	15.0	(-)25.0	71.8	(-)11.0	(-)15.0	258.5	16.4

Data Source: Livestock Office in Kab. OKU and North Lampung

Table III-15 Slaughter of Livestock (1977)

	Number of Slaughter/1					Egg
	Cattle (head)	Buffalo (head)	Goat (head)	Sheep (head)	Pig (head)	(Piece)
Belitang Area						
Martapura		5				
Buay Madang	27		136			442,820
Belitang	84		621			279,500
Cempaka	10		79		3	111,570
Bahuga Lampung			35			8,200
(1) Sub-total	121	5	871		3	842,090
(2) Kab. OKU	423	142	836		144	993,890
(1)/(2) in %	28.6	3.5	100.0		2.0	84.7
Tulangbawang Area						
(1) Pakuan Ratu	10	5	30	0	0	11,270
(2) Kab. North Lampung	110	60	950	0	10	818,200
(1)/(2) in %	9.1	8.3	3.2	0	0	1.4

Data Source: 1) Livestock Office in Kab. OKU and North Lampung
2) Dalam Angka 1968-1977, Statistic Office in Kab. OKU

/1: No data on chicken was obtained

Table III - 16 STAFFING OF AGRICULTURAL EXTENSION SERVICES.*

Kec. Concerned	No. of Desa	Wilud /1	P.P.S /2	P.P.M /3	P.P.L /4	Contak tani /5	Desa/I.P.P.L	Ha/I.P.P.L /6	Contak tani/I.P.P.L
Belitang Area									
Martapura	22	7			4	60	6	3,440	15
Buay Madang	58	16	1	1	13	23	5	2,210	2
Belitang	51	16		1	13	165	4	660	13
Cempaka	40	9		1	2	23	20	12,460	11
Bahuga Lampung	14	2			4	**	5	1.180	
Sub - Total (1)	185	50	1	3	36	271	5	2.240	8
Kab. OKU (2)	455	110	2	5	63	804	7	2,530	13
(1)/(2) (1)	40.6	45.5	50.0	60.0	57.1	33.7			
Tulang Bawang Area									
Pakuan Ratu (1)	15	0	0	0	0	**			
Kab.North Lampung (2)	454	35	2	4	64	787	7	1,600	12
(1)/(2) (1)	3.3								

Note : * Kab. OKI and Kecamatan Menggala and T.B Tengah in Kab.North Lampung are no available data
** no available data.

/1 : Wilayah unit Desa which covers 3 - 4 Desa.
/2 : Penyuluh Pertanian Specialist.
/3 : Penyuluh Pertanian Madia (Chief of rural extension center B.P.P)
/4 : Penyuluh Pertanian Lapangan (Field Extension Worker)
/5 : Key farmers in each Desa.
/6 : ha means Sawah + Tegal.

Data Source : 1) Agricultural office in Kab. OKU, 1978.
2) Agricultural office in Kab.North Lampung, 1978.

Table III - 17 LIST OF SEED CENTER AND SEED GROWER.

Name of Seed Center Seed Grower	Location	Sawah (ha)	Paddy Seed Production (Kg)	Distribution Paddy Seed (Kg)	No. of Stuff (persons)	No. of houses	Remarks
Kab. OKU							
Abusahie	Belitang	0.36	750	750	1		Seed Grower Certificated
Asnawi	Belitang	1.20	3,000	3,000	1		,,
K.B.S /1	Belitang	10.0	20,000	20,000	26	11	
Kab.North Lampung							
B.B. Wonomerto	Kotabumi	10	*	*	1	1	Seed Grower Certificated
K.B. Tj.Iman	Tj. Iman	11 /2	*	*	1	1	,,
K.B. Sekincau	Sekincau	7 /2	*	*	1	1	,,
Tegineneng Center /3	Tegineneng	(5 (22.5 (Tegal)			84	10	

/1 : National seed center.

/2 : Upland with polowijo seed.

/3 : Tegineneng center is located in the South Lampung, but seed produced is also distributed to farmers in the Kab. North Lampung.

* : No available data.

Data Source : 1) Kab.OKU Agricultural office and Agricultural extension office in Lampung Province.

2) K . B . S in Belitang.

3) Tegineneng Center.

Table III - 18 AREA UNDER BIMAS PROGRAM IN KAB.OKU AND KAB.NORTH LAMPUNG.

	Cropping season	BIMAS Program Area Rainy season paddy (ha)	Dry season paddy (ha)	Swamp paddy (ha)	Sub - Total	Upland paddy (ha)	T o t a l paddy (ha)	Kab. Total paddy area (ha)	Total BIMAS area	Total paddy area (%)
Kab.OKU	1974		2,330		2,330		2,330	75,310		8.5
	1974/75	4,070			4,070		4,070			
	1975		2,900	2,180	5,080		5,080	76,530		18.5
	1975/76	8,030			8,080	1,070	9,100			
	1976		1,200	5,030	6,230	430	6,660	75,340		17.1
	1976/77	5,670			5,670	530	6,200			
	1977		190		190		190	73,240		9.9
	1977/78	6,620			6,620	420	7,040			
	1978		1,550	2,210	3,760	550	4,310	73,740		15.0
	1978/79	5,950			5,950	830	6,780			
	Average	6,070	1,630	1,880	9,580	770	10,350	74,830		13.8
Kab.North Lampung.	1974		620		620		620	53,340		11.2
	1974/75	4,980			4,980	1,970	6,950			
	1975/		820		820		820	50,320		10.9
	1975/76	3,260			3,260	1,380	4,640			
	1976		430		430		430	57,200		13.0
	1976/77	5,310			5,310	1,710	7,020			
	1977		430		430		430	62,420		10.1
	1977/78	4,510			4,510	1,350	5,860			
	1978		170		170		170	63,270		0.4
	1978/79	10			10	60	70			
	Average	3,610	500		4,110	1,290	5,400	57,310		9.4

Data Source : Kabupaten OKU and North Lampung Agricultural offices.

Table III - 19 CREDIT AND REPAYMENT OF BIMAS PROGRAM.

Kab. OKU	Cropping Season	Credit (1,000 Rp)	Repayment (1,000 Rp)	Outstanding (1,000 Rp)	Repayment percent (%)
	1974	24,527	20,065	4,463	81.8
	1974/75	69,024	52,938	16,086	76,7
	1975	76,543	56,045	20,498	73.2
	1975/76	121,971	86,828	35,143	71.2
	1976	92,069	42,006	50,063	45.6
	1976/77	87,568	58,963	28,605	67.3
	1977	3,302	2,750	552	83.3
	1977/78	116,982	71,082	45,900	60.8
	1978	92,281	35,928	56,353	38.9
	1978/79	174,305	68,421	105,884	39.3
Total or Average		858,572	495,025	363,547	57,7
Kab.North Lampung.					
	1974	6,760	4,431	2,329	65.5
	1974/75	98,062	51,135	46,927	52.1
	1975	10,095	5,984	4,111	59.3
	1975/76	84,581	39,372	45,209	46.5
	1976	7,198	2,638	4,560	36.6
	1976/77	128,074	44,783	83,291	35.0
	1977	7,512	853	6,659	11.3
Total or Average		342,282	149,196	193,086	43.6

Data Source : 1) B.R.I (Bank Rakyat Indonesia) office in Kab. OKU.

2) Laporan Tahunan, Dinas Pertanian, Lampung Province 1977.

Table III - 20 COOPERATIVES.

Belitang Area	Kec.Concerned	No. of Desa	BUUD	KUD	Kioa	Rice Mill	Unit B.R.I
	Martapura	22		0	1	32	1
	Buay Madang	58		5	8	77	5
	Belitang	51		5	10	42	4
	Cempaka	40		2	3	36	2
	Bahuga Lampung	14		1	0	5	1
	Sub - Total	185		13	22	192	13
	Kab. OKU	455		16	30	589	19
Tulang Bawang Area.							
	Pakuan Ratu	15	0	0	0	0	0
	Kab.North Lampung	454	27		19	257	17

Data Source : 1) Cooperative office in Kab. OKU, 1978

2) Cooperative office in Kab. North Lampung, 1978

N o t e : Establishment of BUUD and KUD in South Sumatera and lampung Province is commenced in 1977.

Table III - 21 FARM GATE PRICE OF FARM PRODUCTS.

Item	Price (Rp/Kg or seedling)	Remarks
Rice	170	
Dry paddy	95	
Maize	100	
Cassava	15	
Soy bean	240	
Peanuts	330	
Rubber	280	
Coffee	600	
Clove	4,000	
Pepper	770	
Coconut	50	1 Piece
Cattle	60,000	1 Head (young)
Cattle	160,000	1 Head (adult)
Buffalo	300,000	1 Head (adult)
Pig	20,000	,,
Sheep	20,000	,,
Goat	20,000	,,
Chicken	1,200	,,
Duck	1,100	,,
Meat	2,000	
Egg	50	1 Piece

Data Source : 1) Agricultural office in Kab.OKU and Kab.North Lampung.

2) Farm economic survey in the Belitang and Tulang Bawang Area.

3) Local market survey in Martapura.

Table III - 22 PRICE OF FARM INPUTS.

	Item	Price (Rp/Kg lit, person, etc)	Remarks
Seed	Paddy	125	
	Maize	130	
	Soy Bean	280	
	Peanut	370	
	Coffee	30	1 Seedling
	Rubber	135	,,
	Clove	150	,,
	Pepper	100	,,
Fertilizer	Urea	70	
	T.S.P	70	
Agro - Chemical (Insecticide)			
	Diathion	1,230	
	Sumithion	1,230	
	Sevin	1,230	
(Rodenticide)			
	Zink - phosphide	2,500	
Agro - Equipment			
	Plow	17,000	
	Harrow	5,000	
	Winnower	10,000	
	Sprayer	36,000	
	Rotary weeder	5,000	
	Tradle thresher	30,000	
	Cangkol	2,000	
	Sickle	500	
Hired labor	(light)	300	
	(heavy)	400	

Data Source : 1) Agricultural office in Kab.OKU and Kab.North Lampung
2) Farm economic survey in the Belitang and Tulang Bawang area.
3) Local market survey in Kartapura.

Table III - 23 PRESENT TYPICAL FARM BUDGET.

Cropping pattern	Type I		Type II		Type III	
Family size		6.0		6.0		5.5
Farm size		1.0		1.75		1.75
1) Gross Income						
Farm income		255,300		262,900		172,300
P a d d y	210,900		157,700		52,300	
Upland crops	44,400		70,200		45,000	
Perennial crops	0		35,000		75,000	
Livestock income		38,000		30,000		20,000
Miscellaneous		50,000				
T o t a l		343,300		322,900		202,300
2) Out go						
Farming expenses		50,960		49,320		28,930
P a d d y	46,660		40,240		17,900	
Upland crops	4,030		5,350		2,310	
Perennial crops	0		3,730		8,720	
Livestock expenses		3,800		3,500		1,000
IPEDA tax, etc		6,700		1,300		1,000
Family living expenses		279,800		268,000		171,000
T o t a l		341,260		322,120		201,930
3) Balance Capacity to pay		2,040		780		370
		(US $ 3.3)		(US $ 1.2)		(US $ 0.6)

N o t e : 1) Conversion rate ; US $ 1 = Rp. 625,-

2) Application Area.

Type I ; Belitang low land area.

Type II ; Transmigration area in Belitang and Lemputing area.

Type II ; Tulang Bawang area.

Table III - 24 PROGRESS OF TRANSMIGRATION IN KAB. OKU.

Year	Main Location	No. of family	No. of Persons
1950	Belitang	7	13
1951	Belitang	108	341
1952	Belitang	216	1,080
1953	Belitang	4,644	21,071
1954	Belitang, B. Madang	1,223	5,150
1955	Belitang, B. Madang	2,317	10,378
1956	Buay Madang	763	3,342
1957	Bahuga	804	2,170
1958	Buay Madang	871	4,439
1959	Bahuga	846	4,169
1961	Belitang	627	3,409
1963	Belitang	419	1,863
1964	Belitang	343	1,718
1965	Belitang	1,609	7,476
1967	Belitang	201	862
1968	Belitang	128	906
1969	Belitang	38	187
1970	Belitang, B. Madang	127	456
1971	Belitang	673	2,535
1972	Belitang	936	3,724
1973	Belitang	1,122	4,715
1974	Buay Madang	822	4,057
1976	Baturaja - Martapura	406	1,724
1977	Baturaja - Martapura	244	1,109
1978	Baturaja - Martapura	650	2,828
T o t a l		20,144	89,702

Data Source : Transmigration office in Kab. OKU, 1978

Table III - 25 PROGRESS OF TRANSMIGRATION IN KAB. NORTH LAMPUNG.

	Location/Project Area	No. of Family	No. of Person
Before 1970		1,669	9,897
1970	Way Abung I	636	2,450
	Way Abung II	800	3,922
1971	Way Abung I	1,399	6,925
	Way Abung II	671	3,438
1972	Way Abung I	500	2,400
	Way Abung II	1,416	6,132
1973	Banjit	616	2,764
	Way Abung I	686	2,576
	Way Abung II	6,785	29,579
1974	Way Abung III	1,290	5,629
1975	Way Abung III	950	4,369
1976	Tulang Bawang I	500	2,253
1977	Tulang Bawang I	2,000	8,588
1978	Tulang Bawang	1,040*	*
T o t a l		20,958	90,922

Data Source : Kab. North Lampung Transmigration office in Kotabumi.
* on going.

Table III - 26 PROGRAM OF TRANSMIGRATION IN PELITA III.

	Unit	1979/80	1980/81	1981/82	1982/83	1983/84	Total
Family	1,000	50	75	100	125	150	500
No. of Settle land		25	38	50	62	75	250
(Coastal or Swamp area)		(12)	(8)	(8)	(8)	(8)	(44)
(Upland)		(13)	(30)	(42)	(54)	(67)	(206)
Access road	Km	260	600	840	1,080	1,340	4,120
Village road	Km	1,000	1,500	2,000	2,480	3,000	10,000
Forest road	Km	1,500	2,280	3,000	3,720	4,500	15,000
Farm road	Km	1,500	2,280	3,000	3,720	4,500	15,000
Total road	Km	4,260	6,680	8,840	11,000	13,340	44,120
Farm land + home yard	Ha	62,500	93,750	125,000	156,250	187,500	625,000
No. of farm house	1,000	50	75	100	125	150	500

Data Source : Pelita III

Table III - 27 PROGRAM OF TRANSMIGRATION IN PELITA III IN KAB. OKU AND SOUTH SUMATERA PROVINCE.

Location		1979/80 NPS	1979/80 PS	1980/81 NPS	1980/81 PS	1981/82 NPS	1981/82 PS	1982/83 NPS	1982/83 PS	1983/84 NPS	1983/84 PS	Total
South Sumatera Province (1)		7,000	8,500	10,000	8,000	11,200	10,000	10,300	10,300	13,500	0	89,800
Kab. OKU	Baturaja	1,000										1,000
	Martapura					300						300
	Sungai Liat											0
	Tanjung							300				300
	Pandang			2,000								2,000
	Kelingi II					1,000		1,000		2,000		4,000
Sub - Total (2)		1,000	0	2,000	0	1,300	0	1,300	0	2,000		7,600
(2)/(1) (%)		6.5		11.1		6.0		6.3		11.8		8.5

Data Source : 1) Transmigration office in South Sumatera Province.

2) Transmigration office in Kab. OKU

N o t e : NPS ; Upland area.

PS ; Lowland area.

Unit : Family.

Table III - 28 PROGRAM OF TRANSMIGRATION IN POLITA III IN KAB. NORTH LAMPUNG AND LAMPUNG PROVINCE.

	Location	1979/80	1980/81	1981/82	1982/83	1983/84	T o t a l	A r e a (ha)
Lampung Province	(1)	500	3,000	2,500	2,500	5,000	13,500	175,000
Kab.North Lampung	Tulang Bawang Area II	500					500	8,000
	Pakuan Ratu I & II		1,500				1,500	24,000
	Giham Kawat		1,000				1,000	20,000
	Giham Kasui		500				500	7,500
	Way Tuba			500			500	15,000
	Negeri Ujung Karang				500		500	10,000
	Mesuji				1,000	1,000	2,000	40,000
	Krui Selatan				500	1,000	1,500	30,000
	Blambangan Umpu					2,000	2,000	15,000
	Sub - Total (2)	500	3,000	500	2,000	4,000	10,000	169,500
	(2)/(1) (%)	100.0	100.0	20.0	80.0	80.0	74.1	96.9

Data Source : 1) Transmigration office in Lampung Province.

2) Transmigration office in Kab. North Lampung.

3) BAPPEDA office in Lampung Province.

Note: Unit : Family

Table III - 29 PUBLIC FACILITIES TO BE PROVIDED BY GOVERNMENT FOR ONE UNIT[1] TRANSMIGRATION AREA.

Facilities	No.	Building (m^2)	Yard (ha)
Office	1	60	0.25 ha.
Village house	500	30 - 34	0.25 ha.
Store house			
Official residence	1	42	0.25 ha.
Pos Box			
Clinic	1	60	0.25 ha.
Religious building	2	36	0.25 + 0.25 ha.
School	1 (S.D)	540	0.50 - 1.00 ha.
Market			
Cemetary	1		2.00 ha.
House of official	6	42	0.25 ha.

Data Source : Transmigration office in South Sumatera Province.

[1] : More than 1,000 ha or 500 family.

Table III - 30 SUPPLY MATERIALS PER FAMILY PER MONTH.

Materials		Amount
1) Food.	Rice	50 Kg.
	Sugar	3 Kg.
	Salt	2 Kg.
	Fuel	8 Lit.
	Frying oil	3 Kg.
	Soap	1 Kg.
	Salt fish	5 Kg.

2) Clothes. Transmigrant received from Government of origin area such as 1 (one) set Uniform (1 shirt + 1 trousers).

3) Cooking utensils such as cooking pot, frying pan, kettle

4) Agricultural Equipment such as broad hoe, chopping knife, crow bar.

5) Agricultural input materials

Paddy seed	25 Kg	(in 2 - 3 years)
Fertilizer	Urea	70 Kg.
	DAP	75 Kg.
Insecticide	2 Lit.	
Rodenticide	100 gram as zinc phosphate	

Rp. 5,000 for other seeds to be purchased (coconuts, rubber, clove, etc) these input materials are provided by Agricultural Extension Offices concerned with the project areas since this year.

Data Source : Transmigration office in South Sumatera Province.

Fig.III.1 Present Cropping Pattern Type I (1.0 Ha)

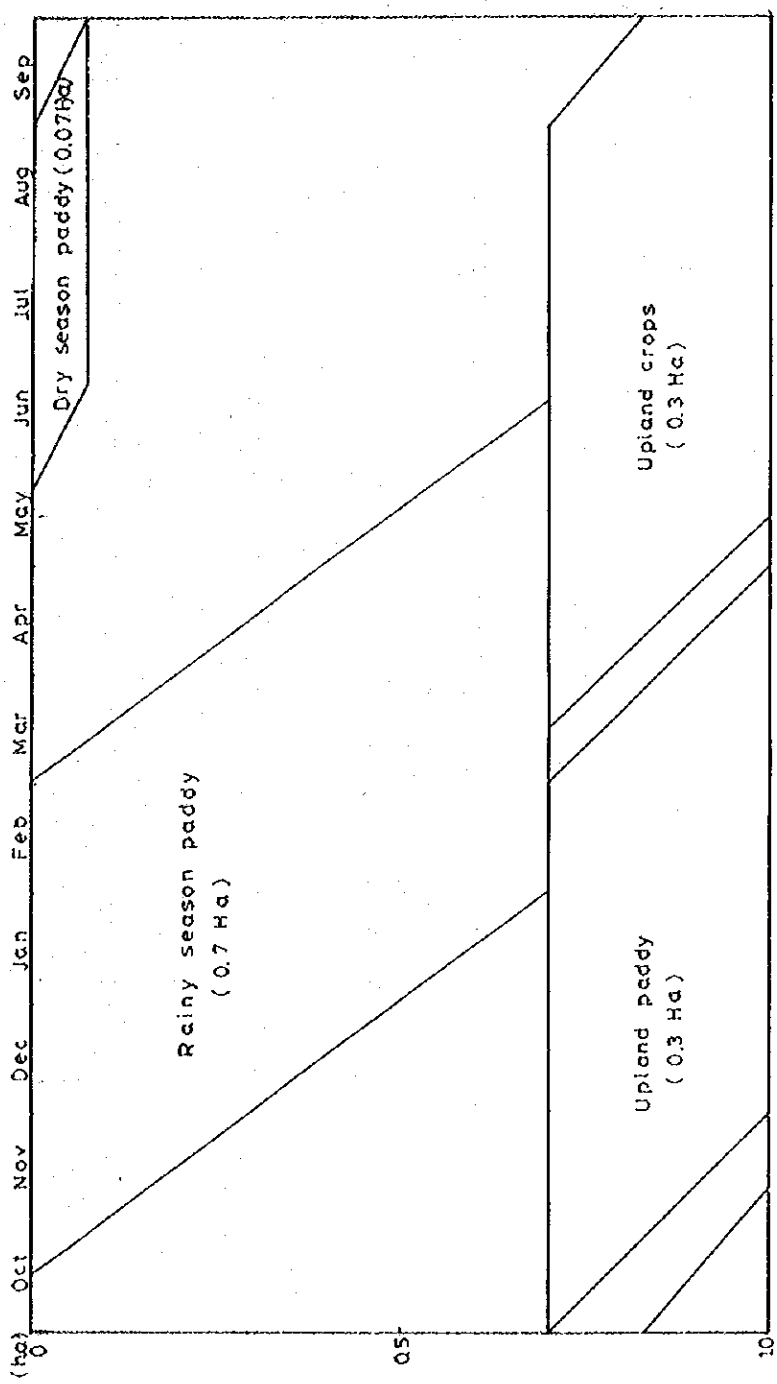
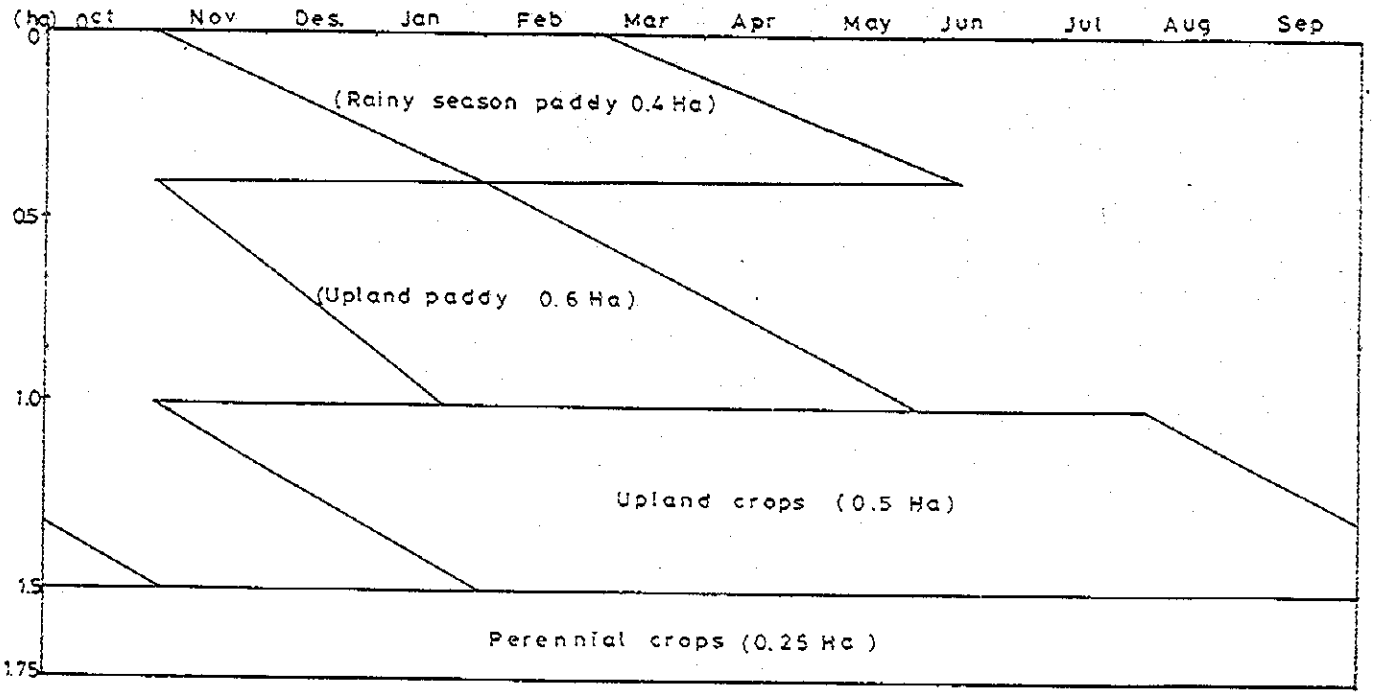
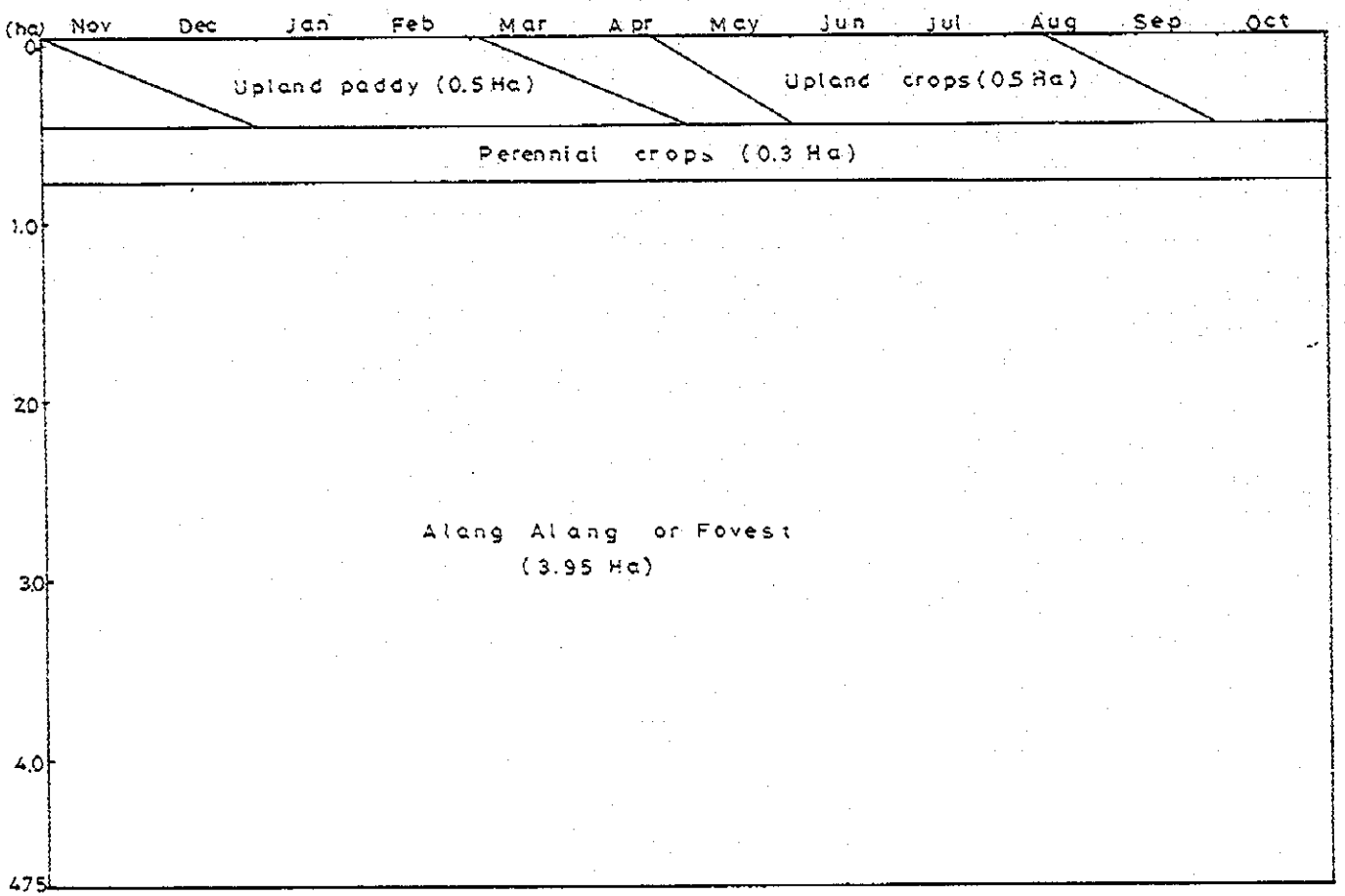


Fig.III. 2 Present Cropping Pattern Type II (1.75 Ha)



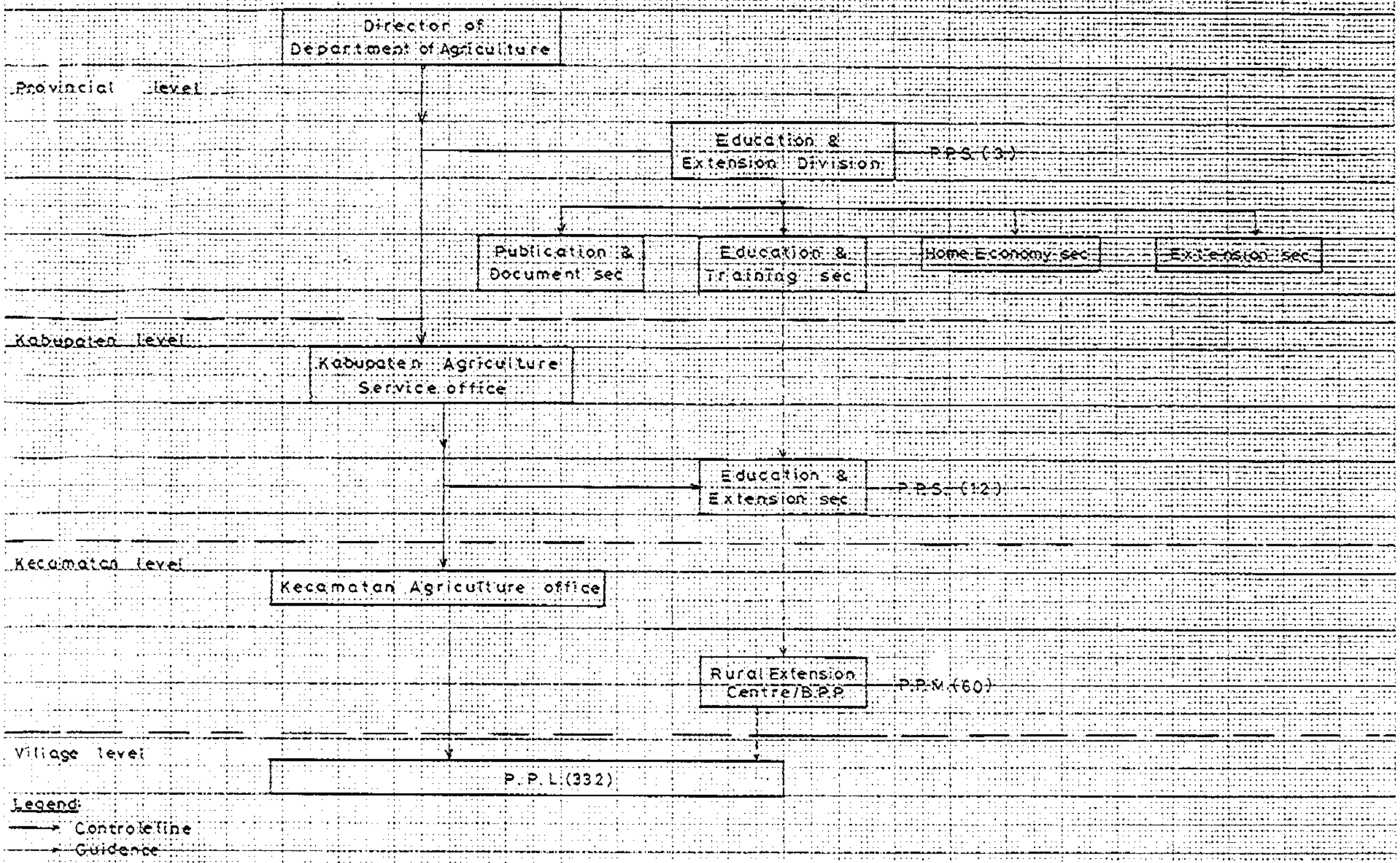
Crop intensity: 1.00

Fig.III-3 Present Cropping Pattern Type III (4.75 Ha)



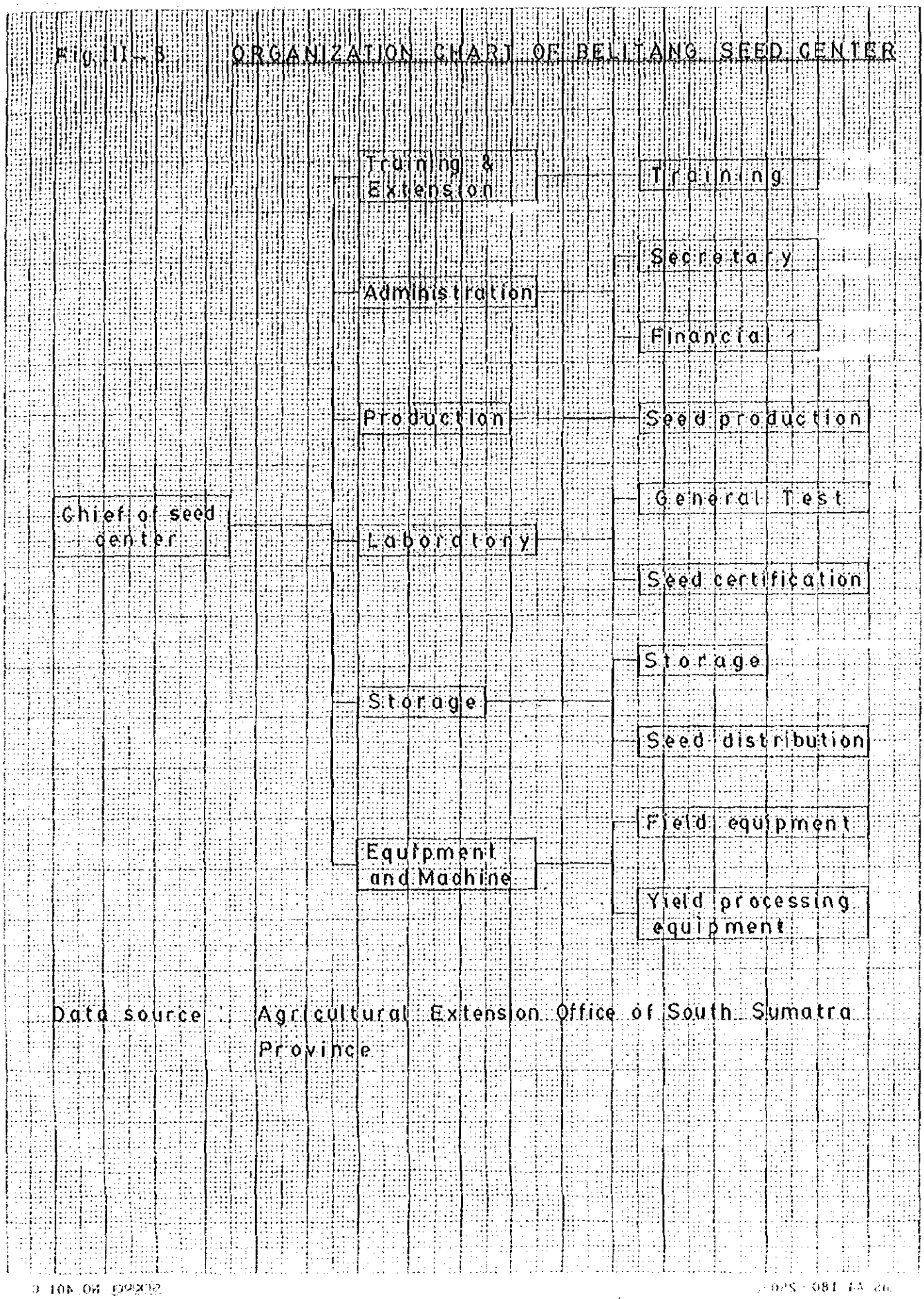
Crop intensity: 0.32

Fig.III-4 EXTENSION ORGANIZATION CHART IN SOUTH SUMATRA PROVINCE



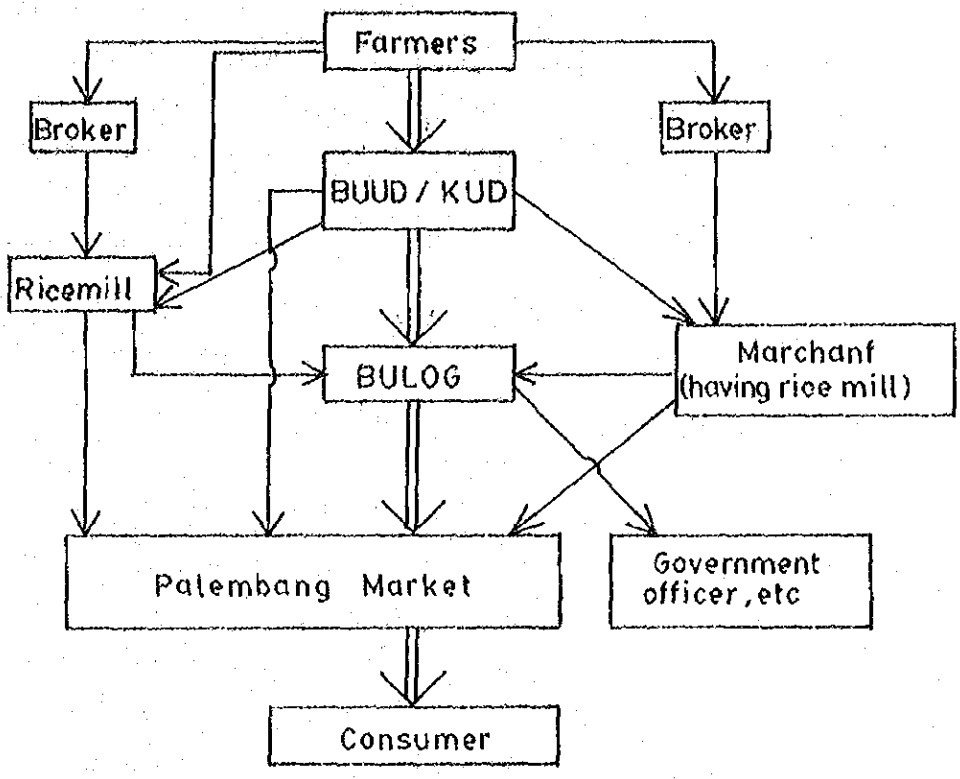
Source Agriculture Extension office of South Sumatra Province

Fig. III - 8 ORGANIZATION CHART OF BELITANG SEED CENTER



Data source : Agricultural Extension Office of South Sumatra Province

Fig. III.6 Marketing System of Rice



3.2 AGRICULTURAL DEVELOPMENT PLAN

3.2.1 Basic Concept for Development

At present the production of foodstuff in Indonesia is still insufficient for the domestic demands which are increasing proportionally to the population growth and the increase of percapita income. The same thing can be said in the South Sumatra and Lampung provinces. The Government's specific objective in the agricultural sector is the achievement of self-sufficiency in food grains. For this the Government has laid the agricultural targets in Pelita-III as shown in Table III-31. Along this line, the agricultural development plan of this project should be established.

Under this situation, the following basic concepts are taken into consideration in this study.

1) Increase and stabilization of crop yield and production through proper irrigation and drainage improvement and introduction of improved farming practices.

2) Increase in production of staple food crops by introducing double cropping with main emphasis on paddy cultivation under year-round irrigation, and by introducing high-yield varieties and improved farming technics.

3) Increase of crop production by reclaiming new farmlands in the areas which have favorable physical conditions for agricultural development.

3.2.2 Proposed Cropping Patterns

Paddy is taken up as the main crop in the project area. In establishing the proposed cropping patterns, the considerations are paid to the climate, soil characteristics, topography, availability of water resources, drainage, agronomic characteristics and crops, availability of labor forces, farmers' desire and the national policy.

Fig III-7 through III-12 show the proposed cropping patterns. In these patterns, the cultivation of dry season paddy is limited to some extent because of insufficient water resources in dry season, then, semi-double cropping with high yield varieties of paddy is intended in this study. Among these patterns, the pattern II-(2) (Fig.III-9) and the

pattern III-(2) (Fig.III,11) are alternative ones for the pattern II-(1) (Fig. III,8) and the pattern III-(1) (Fig.III,10). The calculation of water requirements and the following studies are made for the patterns I, II-(1), III-(1) and IV.

Each cropping pattern is mainly introduced into the following respective areas:

Cropping pattern I;	Lowland area in the Belitang Extension Area where land holding size of one farm family is around 1 ha on an average.
Cropping pattern II-(1);	Recently transmigrated area where land holding size of one farm family is around 2 ha on an average including 0.25 ha of house yard.
Cropping pattern III-(1);	Transmigration area under the Government's plan where 5 ha of lands including 0.25 ha of house yard are to be given to each transmigrant.
Cropping pattern IV;	Lebak area where land holding size of one farm family is around 1.2 ha on an average.

In all the proposed cropping patterns, the duration of transplanting of paddy except for the dry season paddy under the cropping patterns II-(1) and IV is prolonged to 2 months to decrease the requirements of labor forces in peak time. Under the cropping patterns I and II-(1), the transplanting of rainy season paddy will be started from mid-October in the earliest place and terminated by mid-December in the latest place. The harvesting period would be between late-January and late-March. In the Tulangbawang area, the transplanting of rainy season paddy will be done during the period from mid-November to mid-January, and harvesting time would be from late-February to late-April. As for the Lebak area, the duration of transplanting is one month from early-December to early-January, and the harvesting time will be from mid-March to mid-April.

The dry season paddy under the cropping pattern I will be transplanted in the period from early-March to early-May and harvested from mid-June to mid-August. Under the cropping pattern II-(1), the transplanting of the dry season paddy will be commenced from early-March and completed by early-April. After 95 to 100 days from the transplanting, i.e. mid-June, the harvesting will be started and completed by mid-July. The dry season paddy in the cropping pattern III-(1) will be transplanted in early-April in the earliest area and completed by early-June in the latest area. The harvesting will be started in the earliest area from mid-July and finished by mid-September. As for the Lebak paddy in the cropping-pattern IV, the transplanting will be started after descent of stagnant water level in the paddy fields, i.e. from early-April in higher lands and from early-July in lower lands. The harvesting will be commenced from early-September and completed by the end of November.

Cultivation of Polowijo crops such as peanuts, soybeans and maize will also be introduced after harvesting the paddy crops under every cropping pattern. Particularly in the cropping patterns II-(1), the cultivation of perennial crops such as rubber and coffee are also intended considering the topography there and farmers' desire.

In addition to the above proposal, it also recommended to cultivate green manure in the fallow period for the purpose of soil conservation and of supply livestock as feed.

The successful introduction of these cropping patterns to these areas requires strong agricultural supporting services such as agricultural extension services, seed multiplication and distribution system, cooperatives and water users' groups and good transportation network.

The above study is still on the preliminary basis. Before the start of the implementation, further detailed studies are needed.

3.2.3 Proposed Farming Practices

Together with the introduction of modernized irrigation and drainage system, the improved farming practices will be introduced to the area to maintain the crop productivity high. These are use of high yield variety, proper fertilizer application, pest and disease control, agro-mechanization, proper management of irrigation water, etc.

The followings are the suggestions for the farming practices suitable for the project area.

(1) Paddy

Varieties of paddy being cultivated in the project area are PB-5, PB-8, IR-24, IR-26, Lampung, Pembongkar, Gati, Bongkar Putih, Bongkar Utang, Jambu, Pelita I/1, Pelita I/2, C4-64, etc. These are being cultivated under rainfed conditions with a little orwithout agricultural inputs such as fertilizers and agro-chemicals. Thus, yield of paddy in the project area is comparatively lower than the yields in other areas. The present yields in the area are around 2.5 tons/ha of rainy season paddy, 2.0 tons/ha of dry season paddy and 1.1 tons/ha of upland paddy on an average.

For the increase of yields, distribution of good quality of seeds from the seeds center to the farmers is essential as well as introduction of high yield varieties.
Although the recommedation on the varieties of paddy to be introduced to this Project area requires further study, IR series such as IR-26, 34, 36 and 38 and the improved local varieties like B series may be recommended from the plant physiology and productivity.

Table III-32 shows the standard cultivation method of irrigated paddy. According to this standard, the proper amount of seed is about 25 kg per hectare of main paddy field. The required amount of fertilizers for nursery bed of 400 m^2, which is required for 1 ha of main paddy field, is around 1.5 kg of urea and 1.0 kg of T.S.P., respectively.

Land preparation for transplanting area will be started about 10 days before the transplanting time in general. Two times of rough plowing drawn by the cattles or buffaloes will be made and paddling will be done at the time of 1 to 2 days before transplanting of seedlings.

At the time of transplanting, the attention should be given to that the seedling is not transplanted too deep and the number of seedling per hill is 3 to 4. The optimum planting spaces will be 20 - 25 cm x 20 - 25 cm, corresponding to about 20 - 25 hills per m^2.

With regard to the basal fertilizer application for paddy field, it is better to apply fertilizers at the time of about 5 to 7 days berofe transplanting and a dose of fertilizer per ha is at about 50 kg of urea, and about 90 kg of T.S.P., respectively. Additional fertilizer application will be carried out 2 to 3 times, i.e. about 15 days after transplanting, at the time when the young panicle formation starts. The amount of fertilizer to be applied per ha is about 60 to 70 kg of urea for each dressing time.

After transplanting, weed control in the paddy field will be carried out 2 or 3 times according to the condition of weed growth. Insect and disease control for paddy cultivation will also be carried out without delay from the proper time. Recommendable agro-chemicals for insects are sumithion, diazinon, etc. and for disease control, kasumin and kitazin are recommended. The amount of dose of rate damage, rodenticides like zink-phosphate is applied at the rate of about 0.2 kg per ha.

The amount and timing of irrigation in the growing period of paddy should properly be controlled according to the growth stages as follows: shallow irrigation is about for 30 days after transplanting, and after that the field is drained for 10 to 15 days. In the young panicle formation stage, deep irrigation is maintained at the water depth of 5 to 10 cm.

After the completion of heading, intermittent irrigation is made for 10 to 15 days, after that, the field is dried up completely until harvest.

The growth duration of the high yield varieties such as IR-26, -34, -36, -38, Asahan, Citarum, B-series, etc. is around 110 ~ 120 days from sowing to harvest. In the new harvesting system, it is recommended that straws be cut from the bottom by using a sickle instead of the present Ani-Ani system.

Thus, the target yields of paddy; about 4.0 tons/ha of rainy season paddy and 4.5 tons/ha of dry season paddy would be achieved at the end of build-up period.

(2) Other major crops

For major food crops other than paddy, such as maize, peanuts and soybeans, standard cultivation methods are shown in Table III-33 through III-35.

3.2.4 Anticipated Yield and Production

(1) Crop yields

The anticipated crop yields are estimated on the basis of the data on recent achievement obtained from the well-irrigated fields in and around the project area and with reference to the results of crop experiment in the Central Research Institute for Agriculture, Bogor (CRIA).

Table III-36 shows the potential grain yields for both the rainy and dry season paddies at various stations in Java. In this table it is observed that at every station the yield of dry season paddy is higher than rainy season paddy by around 12% on an average ranging from 3% to 28%.

Fig. III-13 shows the relationship between rice grain yields and the nitrogen levels (N-level) at 5 different places. This figure indicates that the unit yield of paddy increase when the N-level increases, but the yield may not increase much or may decrease when N-level is more than 180 kg/ha.

The Table III-37 through III-39 show the paddy yields by varieties at the Belitang Seed Center, the effect of irrigation on paddy yield and the results of sample survey on paddy yields in

the Belitang Proper Area where irrigation water is available throughout the year. These tables show the difference in yield from variety to variety and importance of irrigation particularly in the dry season.

Judging from the abovementioned various data, the yields of 4.0 tons/ha of dry season paddy can, at least, be expected under the irrigated conditions and with proper agricultural practices.

As for the yields of polowijo corps, the target yields are forecasted as shown in Table III-40. In this forecase, the data listed up in the same table are fully referred.

The target yields thus forecasted can not be attained immediately after the completion of irrigation and drainage facilities and setting up of the agricultural supporting services. The yields will gradually increase and reach the target yield after 5 to 10 years from the completion of the project; some 5 years in the built-up area like the lowland area of the Belitang Extension Area and some 10 years in the newly opened area like the Tulangbawang Area where the farmers are not habituated to modernized irrigation farming. Table III-41 shows the year-by-year increase of yield and the built-up period of the target yield of each crop in respective development area.

(2) Production

Based on the proposed cropping patterns mentioned in Section 3.2.2 hereof, the proposed irrigable area and the target yields of the crops, the total crop production with project is estimated as shown in Table III-42. Furthermore, the increase of each crop production after the project is also estimated as shown in Table III-43.

Table III - 31 AGRICULTURAL TARGET BY PELITA III.

	1979	1983	Increase rate (1983/1979)	Remarks
South Sumatera Province.				
Paddy (ha)	404,092	477,751	1.18	
(tons)	755,200	923,978	1.22	as dry paddy
Maize (ha)	7,115	10,250	1.44	
(tons)	5,659	9,137	1.62	as grain
Soybean (ha)	4,301	8,053	1.87	
(tons)	3,553	7,196	2.03	as grain
Peanut (ha)	7,621	11,524	1.51	
(tons)	6,558	10,695	1.63	as grain
Cassava (ha)	25,744	36,352	1.41	
(tons)	193,489	275,921	1.43	as fresh roof
Lampung Province.				
Paddy (ha)	307,823	336,610	1.09	
(tons)	567,890	689,440	1.21	as dry paddy
Maize (ha)	57,367	86,835	1.51	
(tons)	97,184	162,923	1.67	as grain
Soybean (ha)	76,711	98,527	1.28	
(tons)	60,907	81,246	1.33	as Grain
Peanut (ha)	8,983	11,039	1.23	
(tons)	5,136	6,355	1.24	as grain
Cassava (ha)	86,824	104,003	1.20	
(tons)	1,013,896	1,277,607	1.26	as grain

Data Source : 1) Agricultural offices in South Sumatera and Lampung Provinces.

2) BAPPEDA offices in South Sumatera and Lampung Provinces.

Table III - 32 STANDARD CULTIVATION METHOD FOR IRRIGATED PADDY.

Days	Managements (Preparation of Nursery)	Amount of Implements
- 3	Seed selection	Salt solution for seed selection 10 liters of water + 2 Kg of nacf.
- 3	Seed disinfection	Berlate - T[1](200 - 400 X, 6 - 12 hours) or homai (200 - 400 X, 6 - 12 hours)
- 2	Seed soaking	24 hours.
- 2	Hastening of germination	36 hours
- 1	Application of fertilizer	Urea 1.5 Kg/400 m^2. T.S.P 1.0 Kg/100 m^2.
0	S o w i n g	Acreage 400 m^2/ha, Seed 25 Kg/ 100 m^2/ to ha.
15	Control ofdiseases and insects damage	Diazinon 30 - 50 cc in 1,000 liters of water 300 - 500 lit/400 m^2 spraying.
	Nursery period : 25 days. (After transplanting) preparation of paddy field.	
- 5	Basal manuring	Urea 50 Kg/ha, TSP 90 Kg/ha.
0	Transplanting	Spacing 20 - 25 Cm x 20 - 25 Cm 3 - 4 seedling/per hill, 25 days/seedling.
10	W e e d i n g (Ist)	Hand rotary weeding.
13	Control of disease and insect damage (Ist)	Diazinon 1 lit/ha, Kasumin 1 lit/ha.
15	Application of fertilizer (Ist)	Urea 60 Kg/ha.
30	W e e d i n g (2 nd)	Hand rotary weeding.
40	Control of disease of insect damage (2 nd)	Sumithion 1 lit/ha, Kasumin 1 lit/ha.

Days	Managements (Preparation of Nursery)	Amount of Implements
60	(Paniclo initiation period)	
63	Application of fertilizer (2 nd)	Urea 70 Kg/ha.
70	(Booting period)	
73	Control of disease and insect damage	Diazinon 1 Lit/ha.
80	(Heading period)	
105	Harvesting	Use of sickle.

N o t e : 1) This table compiled on the basis of the published data by Central Research Institute for Agriculture, Bogor.

2) For the introduction of new varieties, much attention should be paid to their resistance power against diseases and insects for this, IR - 26, - 34, - 36, - 38 and B - series may be recommended.

/1 : To rice seedling disease, rice blast, rice leaf spot etc.

Table III - 33 STANDARD CULTIVATION METHOD FOR MAIZE.

Days	Managements (Preparation of field)	Amount of Implements
0	S o w i n g	20 Kg/ha, Spacing 50 x 100 Cm.
15	Application of fertilizer (Ist)	Urea 50 Kg/ha, TSP 30 Kg/ha.
17	Intertillage and weeding (Ist)	Hoe and hand.
30	Control of inseot damage (Ist)	Sumithion 1 Lit/ha.
40	Application of fertilizer (2 nd)	Urea 30 Kg/ha.
43	Intertillage and weeding	Hoe and hand
95	Harvesting	
100	Drying	
105	Cleaning	

N o t e : 1) High yielding varieties : Harapan baru, H - 68, H - 159

2) This table is compiled on the basis of the data published by Central Research Institute for Agriculture, Bogor.

Table III - 34 STANDARD CULTIVATION METHOD FOR PEANUTS.

Days	Managements	Amount of Implements
	(Preparation of field)	Lime 300 Kg/ha.
0	S o w i n g	Seed 40 Kg/ha, Spacing 25 x 25 Cm.
17	Application of fertilizer (Ist)	Urea 20 Kg/ha, TSP 40 Kg/ha.
20	Intertillage and weeding	Hoe and hand.
35	Control insect damage (Ist)	Spraying of Sumithion 1 Lit/ha.
45	Application of fertilizer (2 nd)	Urea 10 Kg/ha.
47	Intertillage and weeding (2 nd)	Hoe and hand
100	Harvesting	
105	D r y i n g	
110	C l e a n i n g	

N o t e : 1) High yielding varieties : Gajah, Banteng, Gajah Campur, Kidang, Macan.

2) This table is compiled on the basis of the published data by Central Research Institute for Agriculture, Bogor.

Table III - 35 STANDARD CULTIVATION METHOD FOR SOYBEANS.

Days	Managements	Amount of Impremente.
	(Preparation of field)	Lime 300 Kg/ha.
0	S o w i n g	Seed 60 Kg/ha, Spacing 30 x 50 Cm.
15	Application of fertilizer (Ist)	Urea 10 Kg/ha, TSP 40 Kg/ha.
17	Intertillage and weeding (Ist)	Hoe and hand
30	Control of insect damage (Ist)	Spraying of Sumithion 1 Lit/ha.
40	Application of fertilizer (2 nd)	Urea 10 Kg/ha.
45	Intertillage and weeding (2 nd)	Hoe and hand.
90	Harvesting	
95	D r y i n g	
100	C l e a n i n g	

N o t e : 1) High yielding varieties : Orba, Kucir, Mas.

2) This table is compiled on the basis of the published data by Central Research Institute for Agriculture, Bogor.

Table . III - 36 POTENTIAL GRAIN YIELD AT VARIOUS STATIONS IN JAVA IN WET AND DRY SEASON.

Location	Longitude	Latitude	Elevation	Yield /1 (ton/ha) Dry Season	Wet Season
M u a r a	106° 45'E	6° 40'S	260 m	8.00	6.45
M o j o s a r i	112° 30'E	7° 30'S	30	8.85	6.90
S i n g a m e r t a	106° 15'E	6° 10'S	0	7.00	6.80
G e n t e n g	114° E	8° 20'S	171	7.75	7.20
N g a l e	111° 10'E	7° 20'S	55	7.15	6.50
K u n i n g a n	108° 24'E	6° 58'S	559	7.85	7.50
Kendalpayak	112° 20'E	8° 05'S	450	8.05	7.40
Pusakanegara	107° 45'E	6° 18'S	7	7.80	7.20
A v e r a g e				7.81	6.99

Data Source : C.R.I.A, Bogor No. 30 1977.

/1 : Grain yield as 14 % moisture content.

Table III - 37 PADDY YIELD AT SEED CENTER BY VARIETY.

Variety	Plot No.	Paddy yield (ton/ha)	Mean (ton/ha)
PB - 5	1	4.13	
	2	4.13	
	3	4.28	
			4.18
Pelita I/1	1	4.13	
	2	4.28	
	3	4.28	
			4.23
CH - 63	1	3.84	
	2	3.69	
	3	3.54	
			3.69
Dewi Ratih	1	4.43	
	2	4.57	
	3	3.94	
			4.18
T o t a l M e a n			4.27

Data Source : Belitang seed center, 1972

N o t e : Fertilizer application

N	:	P_2O_5	:	K_2O
53	:	44	:	0

Urea ; 115 Kg/ha.

T.S.P ; 95 Kg/ha.

Table III - 38 VARIETAL TRIAL NO. 1 ON RICE.

- Effect of irrigation on the yield of grain (ton/ha)

B e l i t a n g

1972 1973

V a r i e t y	Wet Season	Dry Season	Average
PB - 5	5.7	2.8	4.3
Pelita I/1	5.1	3.2	4.2
Pelita I/2	6.7	3.0	4.9
IR - 20	5.3	3.3	4.3
IR - 22	4.5	1.8	3.2
Katek Jumadi	5.0	1.6	3.3
P u t i h	5.2	2.1	3.7
Sri makmur	5.2	1.5	3.4
Pelita I/2 *	6.7		6.7

* Belitang FAO,

N o t e : Low yield of dry season paddy caused by lack of irrigation water.

Table III - 39 SAMPLE SURVEY OF SUFFICIENT IRRIGATION WATER AREA.

Kec. Concerned	Variety	Unit yield (ton/ha) Rainy season paddy	Dry season paddy
Buay Madang	PB - 5	4.9	
	IR - 32	4.8	4.7
	Pelita I/1	4.9	
	P,U.T.W	4.4	
	IR - 36		5.5
	P u t i h		5.3
	Pempunghar		5.8
Belitang	PB - 5	5.3	5.1
	IR - 32	4.7	
	IR - 36	5.1	5.2
	Pempunghar		5.6
	R a t i h		5.3
A v e r a g e		4.8	5.3

Data Source : Belitang Sub - Seksi office, 1978, 1979.

N o t e : Dry paddy.

Table III - 40 TARGET OF YIELD FOR MAJOR CROPS.

Crops	Yield (ton/ha)	Remarks
Rainy season paddy	4.0	Dry paddy
Dry season paddy	4.5	Dry paddy
M a i z e	2.0	
P e a n u t	1.2	
S o y B e a n	1.3	
R u b b e r	1.0	
C o f f e e	1.0	

Reference data,

1) Belitang Extension Area Agricultural Development Project Annex, FAO / UNDP, 1974

2) Statistic of Agriculture in Kab. OKU and North Lampung, 1978.

3) Farm Economy Survey in the project Area (Belitang and Tulang Bawang) 1979.

4) Sub Seksi office in Belitang, 1976, 1977, 1978.

5) B.P.P (Agricultural Extension Office) in Kecamatan Belitang.

6) Annual Report of C.R.I.A (LP_3), Bogor, 1976, 1977.

7) Report of Japan - Indonesia Joint Food Crop Research Program. 1975, J.I.C.A.

Table III - 41 BUILD - UP PERIOD OF TARGET YIELD OF EACH CROP.

(Lowland Area of Belitang Extension Area)

Crops	Existing Condition	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	6 th Year	7 th Year	8 th Year	9 th Year	10 th Year
Rainy season paddy	2.5	2.8	3.3	3.7	3.9	4.0					
Dry season paddy	2.0	2.7	3.4	3.9	4.3	4.5					
Peanuts	0.8	0.9	1.0	1.1	1.2	1.2					

(Transmigration Area of Belitang Extension Area and the Lemguing Area)

Rainy season paddy	2.5	2.8	3.1	3.4	3.6	3.8	3.9	4.0			
Dry season paddy	2.0	2.6	3.1	3.5	3.9	4.2	4.4	4.5			
Soybean	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3			
Coffee	0.6	0.7	0.8	0.9	1.0	1.0	1.0	1.0			

(Tulang Bawang Area)

Rainy season paddy	2.5	2.7	3.0	3.2	3.4	3.5	3.6	3.7	3.8	3.9	4.0
Dry season paddy	2.0	2.5	2.9	3.2	3.5	3.8	4.0	4.2	4.3	4.4	4.5
Maize	0.9	1.1	1.3	1.5	1.7	1.8	1.9	2.0	2.0	2.0	2.0
Coffee	0.6	0.7	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rubber	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0

Table III - 42 FUTURE CROP PRODUCTION IN THE PROJECT AREA.

Lowland Area of the Belitang Extension Area.

Crops	Area (ha)	Unit yield (ton/ha)	Production (ton)
Rainy season paddy	21,700	4.0	86,800
Dry season paddy	21,700	4.5	97,650
Paddy Total			184,450
P e a n u t	10,850	1.2	13,020

Transmigration Area of Belitang Extension Area.

Rainy season paddy	18,780	4.0	75,120
Dry season paddy	9,760	4.5	43,920
Paddy Total			119,040
S o y b e a n	9,010	1.3	11,710
C o f f e e	7,520	1.0	7,520

Lemguing Area.

Rainy season paddy	9,350	4.0	37,400
Dry season paddy	4,890	4.5	21,820
Paddy Total			59,220
S o y b e a n	4,480	1.3	5,820
C o f f e e	3,739	1.0	3,739

Tuiang Rawang Area.

Rainy season paddy	18,730	4.0	74,920
Dry season paddy	12,480	4.5	56,160
Paddy Total			131,080
M a i z e	15,570	2.0	31,140
R u b b e r	12,450	1.0	12,450
C o f f e e	12,450	1.0	12,450

Table III - 43 INCREASE OF CROP PRODUCTION IN THE PROJECT AREA.

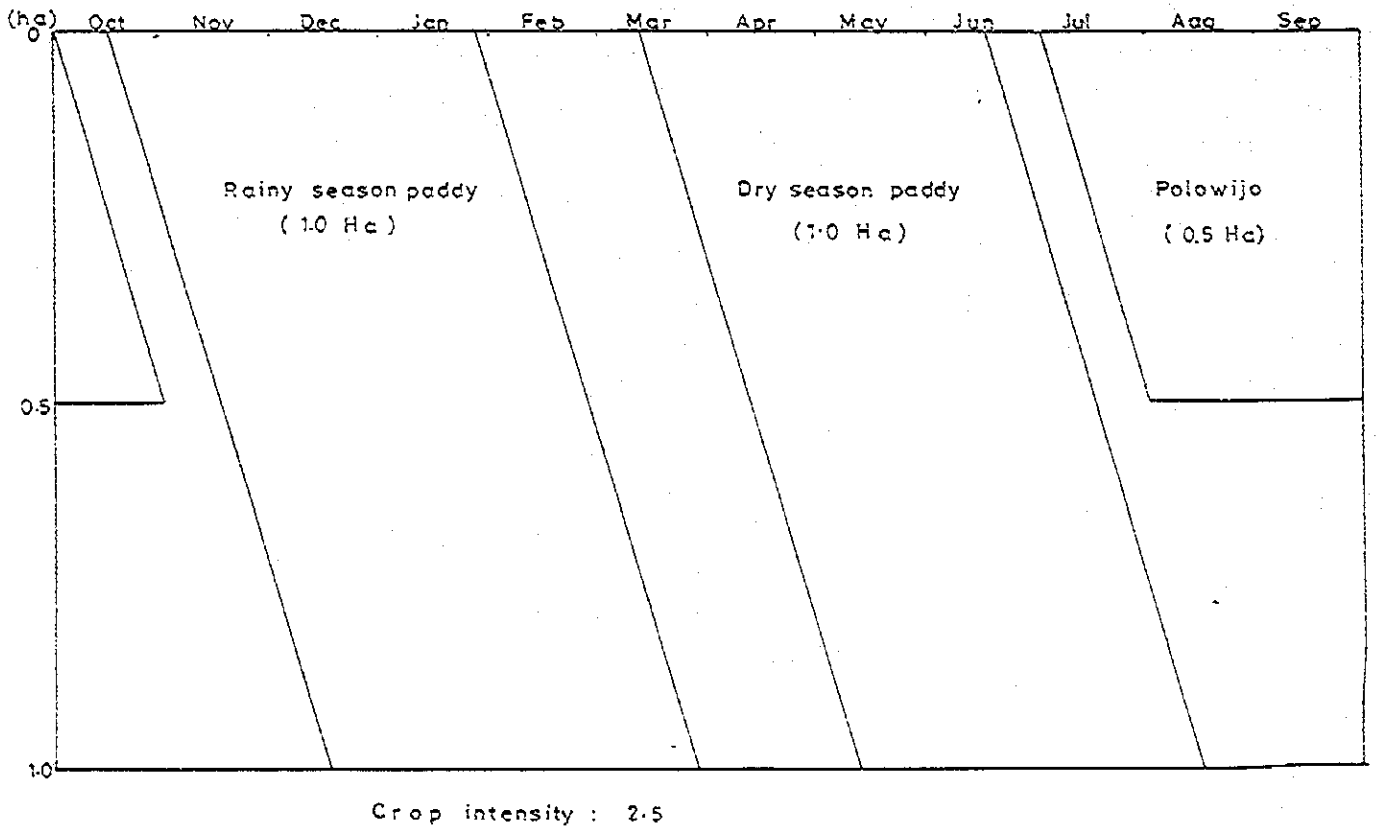
Crops	Present (tons)	Crop production with Project (tons)	Increase (tons)
Lowland Area of Belitang Extension Area.			
Rainy season paddy	21,350	86,800	65,450
Dry season paddy	1,700	97,650	95,950
Upland paddy	4,030		- 4,030
Total Paddy	27,080	184,450	157,370
C a s s a v a	9,000		- 9,000
M a i z e	770		- 770
P e a n u t	600	13,020	12,420
S o y b e a n	390		- 390
Transmigration Area of Belitang Extension Area.			
Rainy season paddy	2,100	75,120	73,020
Dry season paddy		43,920	43,920
Upland paddy	800		- 800
Total paddy	2,000	119,040	117,040
C a s s a v a	1,500		- 1,500
M a i z e	160		- 160
P e a n u t	100		- 100
S o y b e a n	60	11,710	11,650
R u b b e r	140		- 140
C o f f e e	10	7,520	7,510

(to be continued)

Crop	Present (tons)	Crop production With Project (tons)	Increase (tons)
Lampung Area.			
Rainy season paddy	1,330	37,400	36,070
Dry season paddy		21,820	21,820
Upland paddy	860		- 860
Total Paddy	2,190	59,220	57,030
C a s s a v a	1,680		- 1,680
M a i z e	140		- 140
P e a n u t	110		- 110
S o y b e a n	70	5,820	5,750
R u b b e r	210		- 210
C o f f e e	20	3,730	3,710
Tulang Bawang Area.			
Rainy season paddy		74,920	74,920
Dry season paddy		56,160	56,160
Upland paddy	1,380		- 1,380
Total Paddy	1,380	131,080	129,700
M a i z e	230	31,140	30,910
C a s s a v a	5,700		- 5,700
P e a n u t	40		- 40
R u b b e r	150	12,450	12,300
C o f f e e	280	12,450	12,170

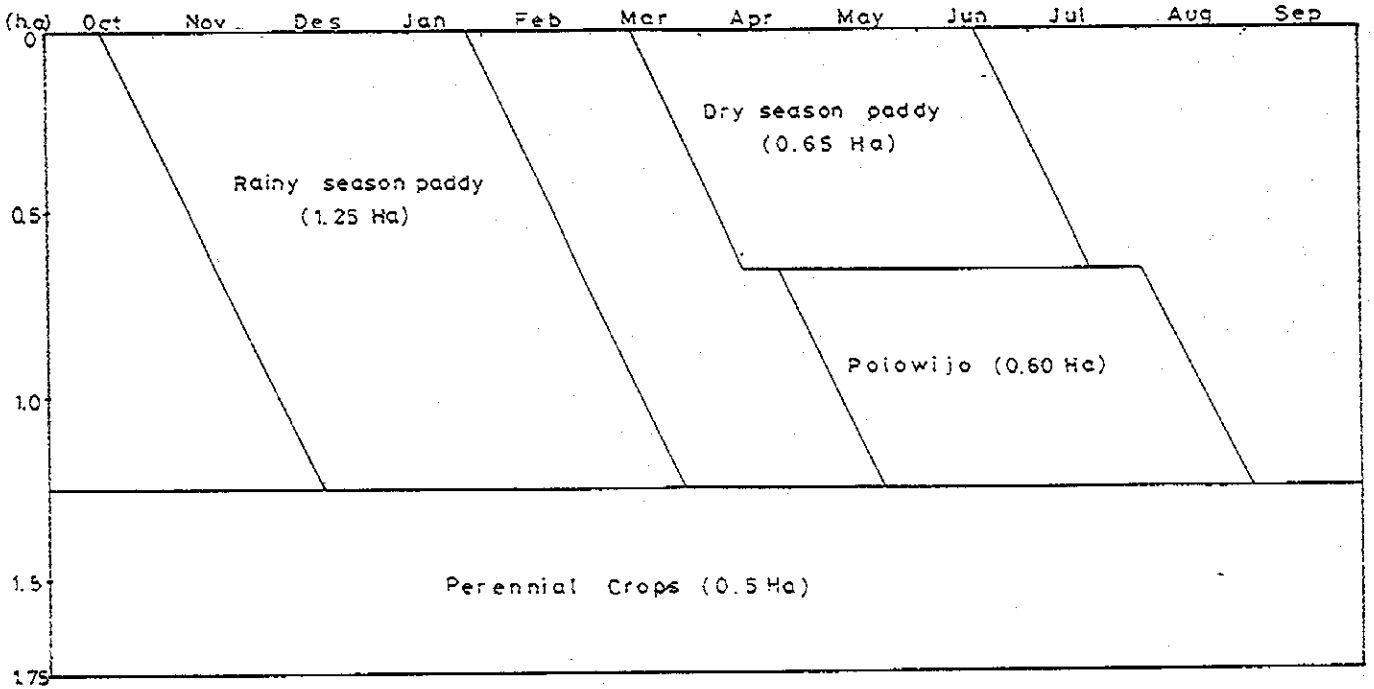
N o t e : Paddy is as dry paddy.

Fig. III. 7 Proposed Cropping Pattern Type I (1.0 Ha)



Crop intensity : 2.5

Fig.III.8 Proposed Cropping Pattern Type II-(1)(1.75 Ha)



Crop intensity: 1.71

Fig.III.9 Proposed Cropping Pattern TypeII-(2) (1.75Ha)

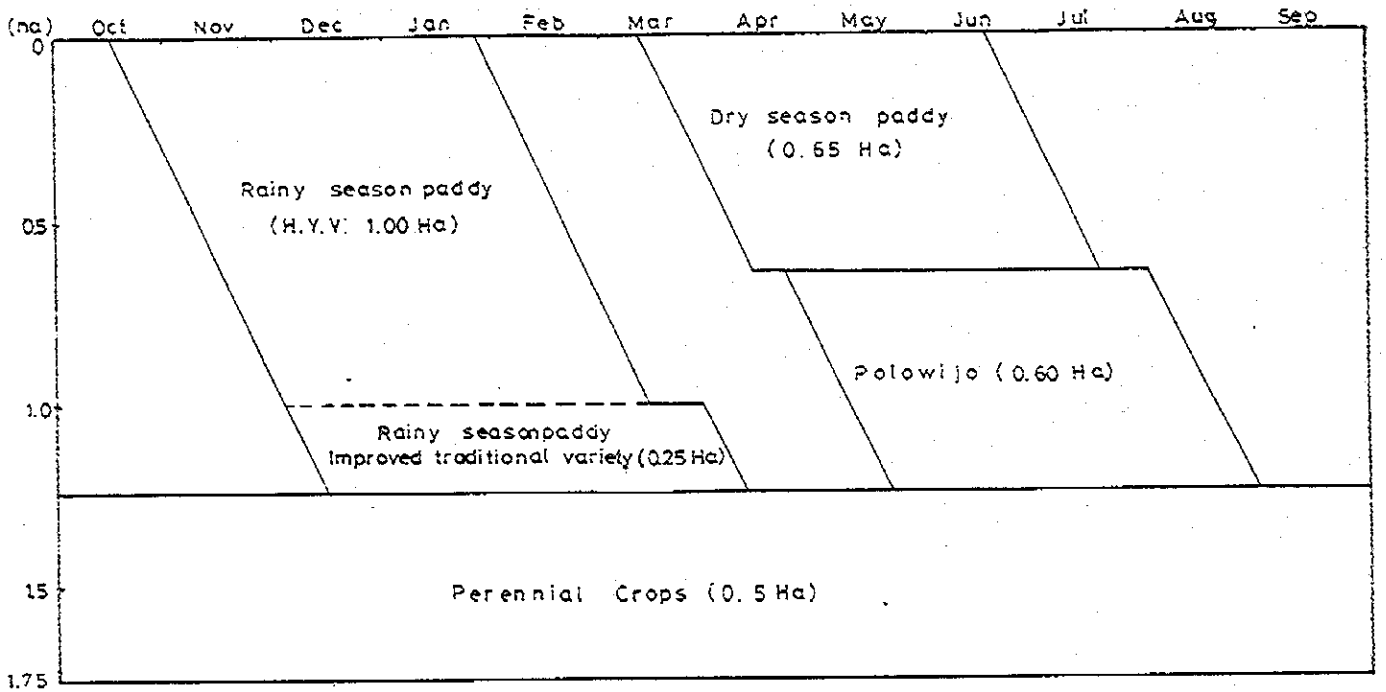
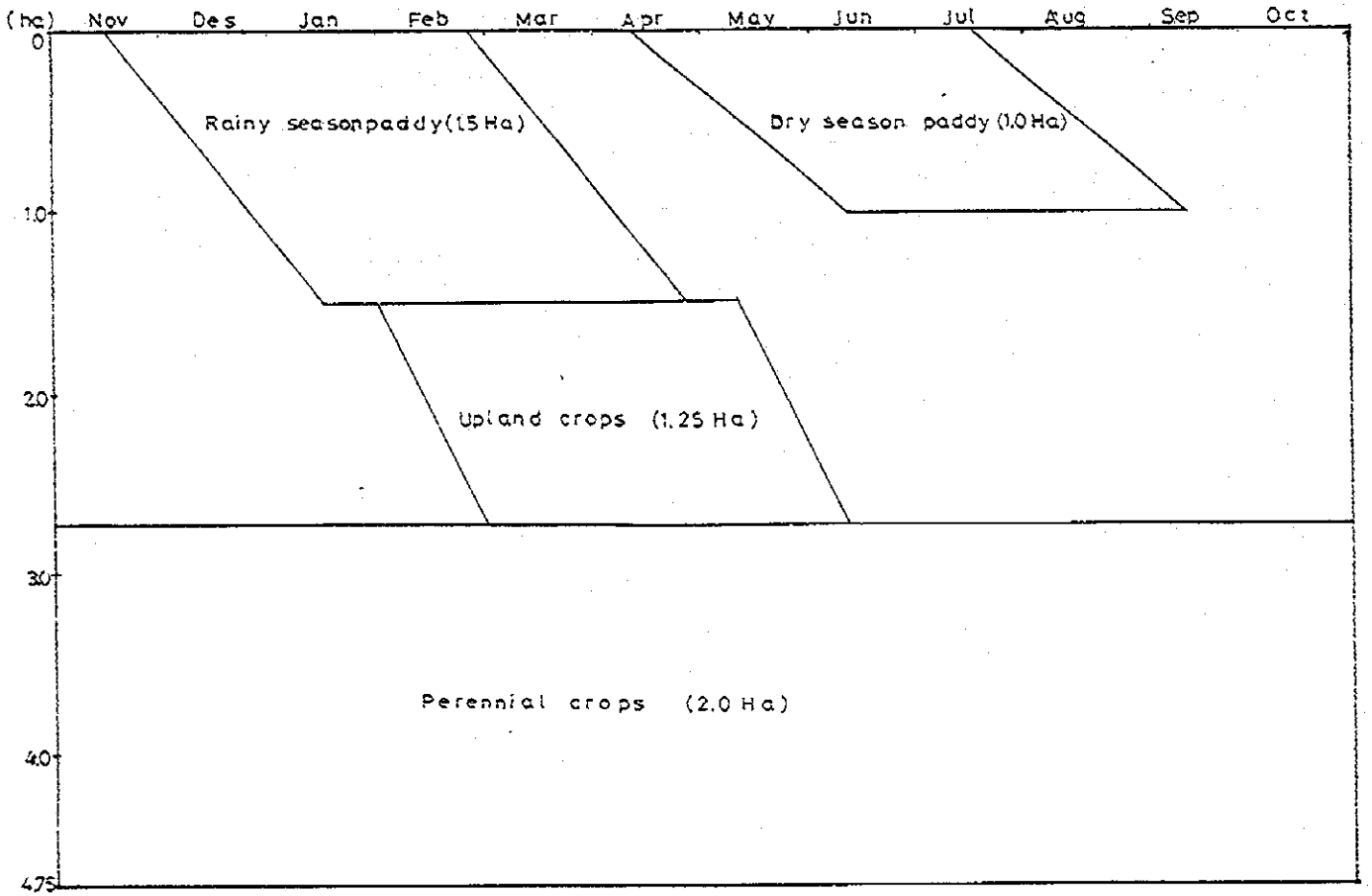


Fig.III.10 Proposed Cropping Pattern Type III-(1) (4.75Ha)



Crop intensity : 1.21

Fig.III.11 Proposed Cropping Pattern Type III–(2) (4.75 Ha)

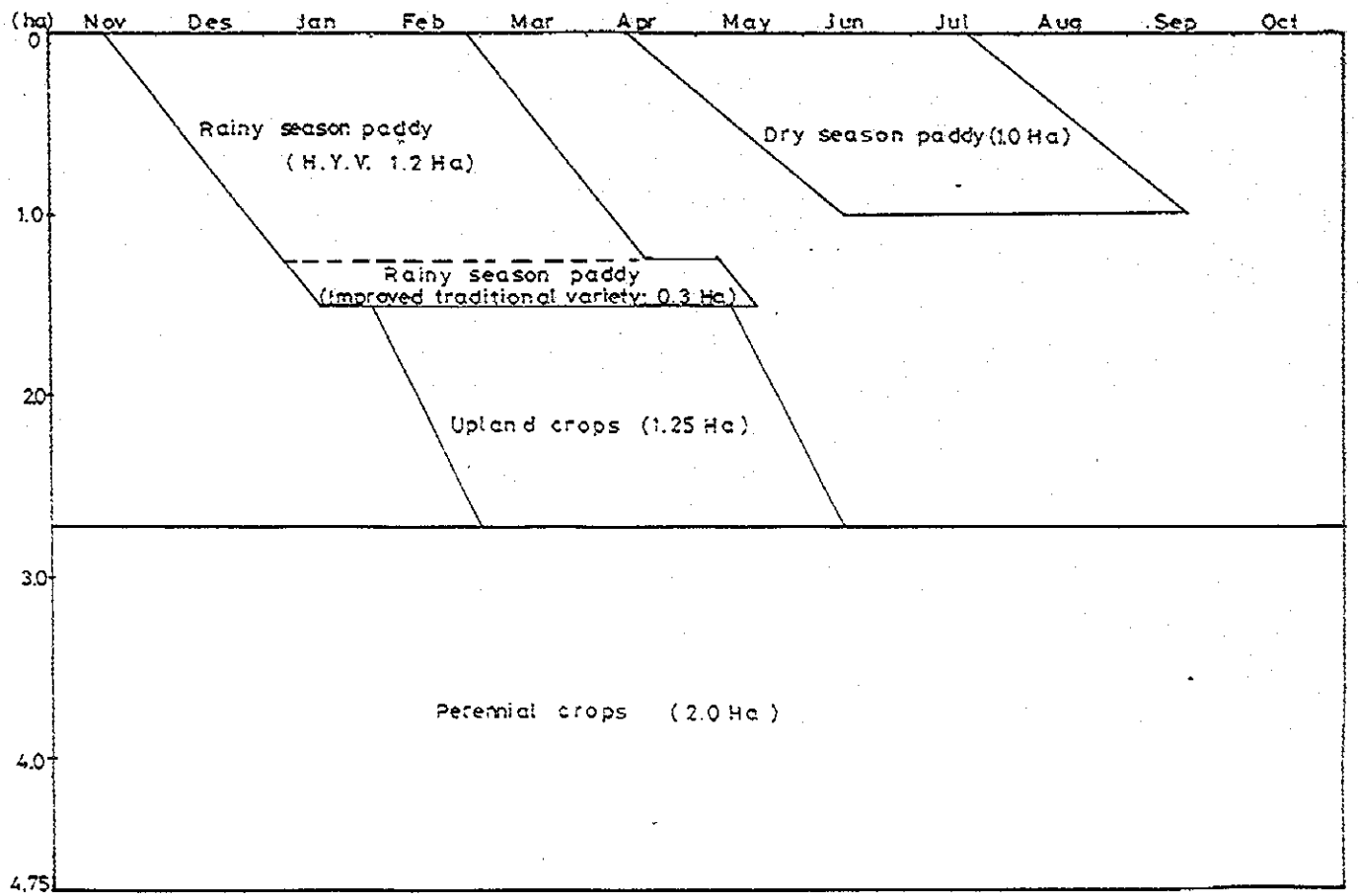
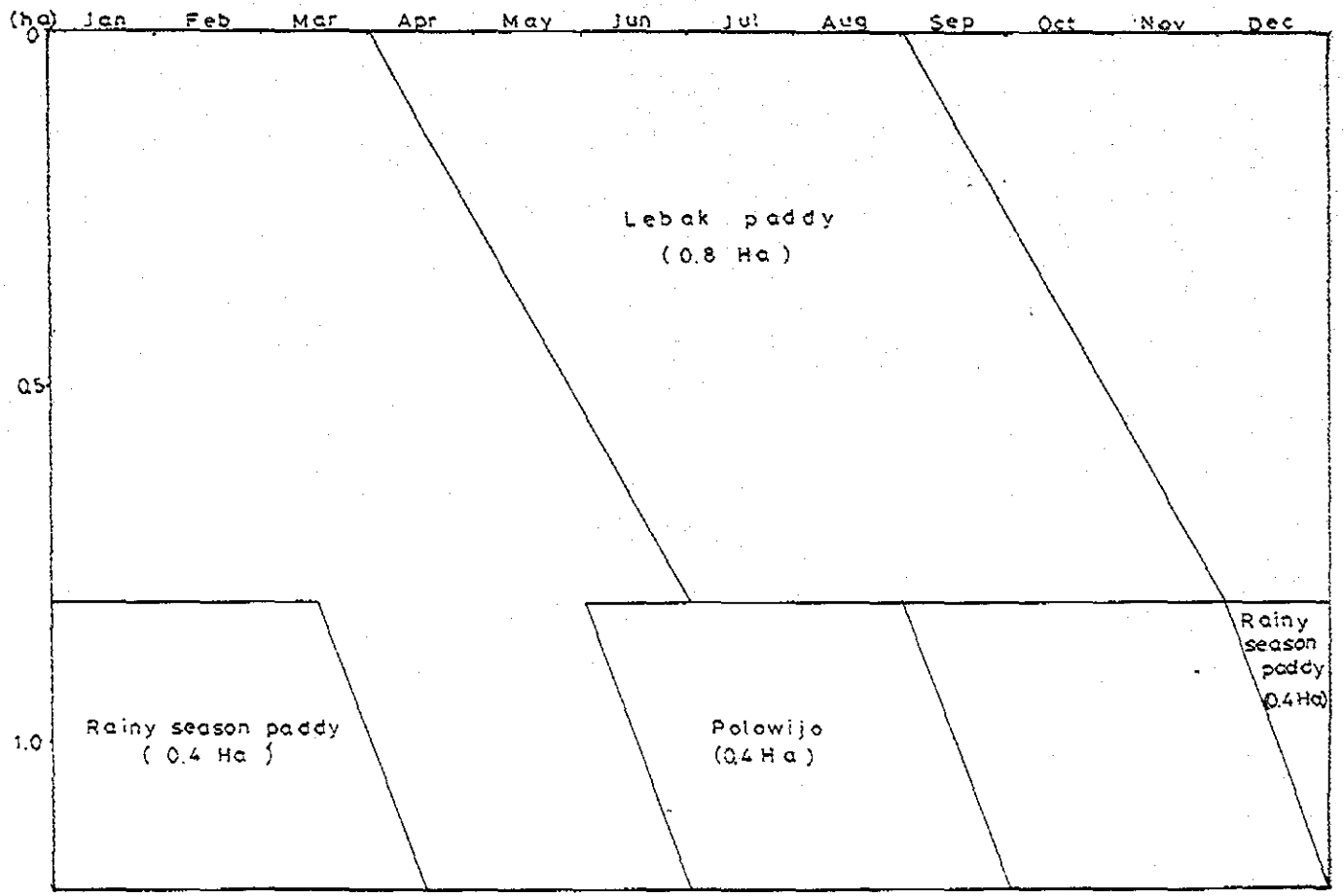
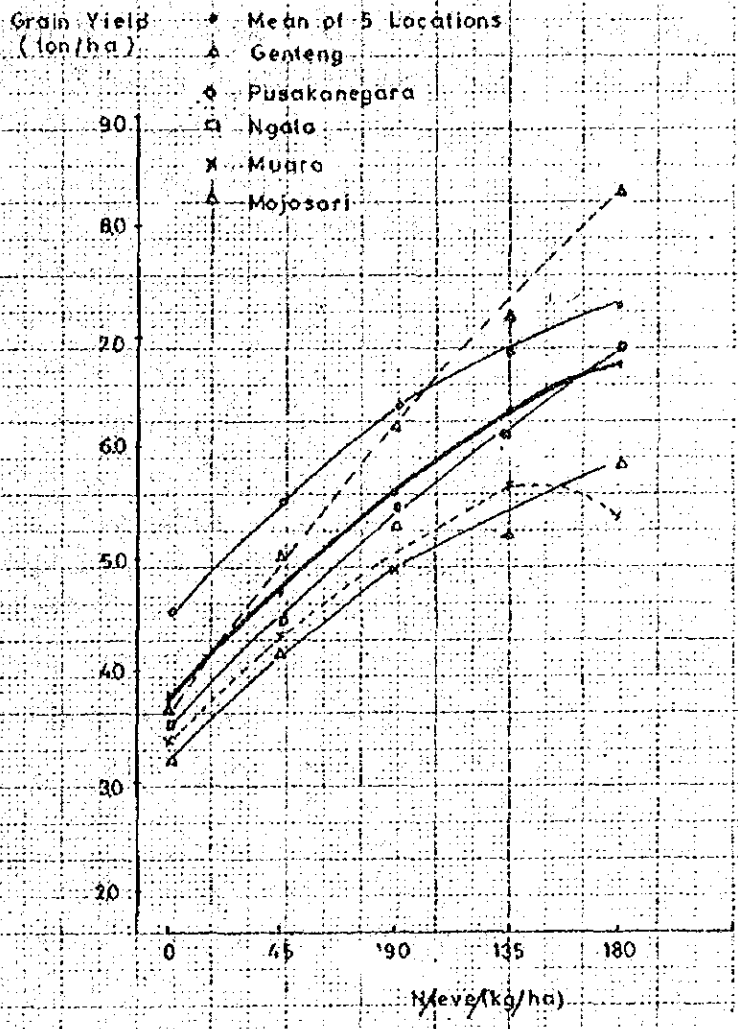


Fig.III.12 Proposed Cropping Pattern Type IV (1.20 Ha)



C. I : 1. 33.

Fig. III.13 Relation between rice grain yield and increasing rates of nitrogen application at 5 different locations



Data Source :
- Report on Japan-Indonesia Joint Food Crop Research Program, JICA, 1975

ANNEX-IV IRRIGATION AND DRAINAGE

4.1 IRRIGATION WATER REQUIREMENTS

4.1.1 General

In planning of irrigation project, a full knowledge of irrigation water requirements of crops from time of seeding until harvest is needed. It is also necessary to know the total amount of water required in each season to produce optimum yields for the climate and soils involved in order to make a water balance study in the basin.

Peak water requirement by crop must be known in order to determine the capacity of irrigation system. It is also important to check whether the peak use periods for different crops in the study area occur at the same time or at different months. This can be a very important consideration where water resources are limited compared with the magnitude of irrigable area.

Since field measurement of consumptive use of water by crops was not carried out in this study period because of shortage of time, the study was made mainly depending on the field measurement results prepared by FAO/UNDP in 1974 for the "Belitang Extension Area, Agricultural Development Project". The empirical and theoretical formulas developed in the past by various experts were also used in this study.

In this study, the Lebak Area of around 76,000 ha shown in Fig.IV-5 is also included for the purpose of water balance study.

4.1.2 Consumptive Use of Water by Crops

Practically the consumptive use of water by crops is obtained by multiplying the class-A pan evaporation or potential evapotranspiration by the crop coefficient.

(1) Potential Evapotranspiration

In the study area, the evaporation data are available at Belitang (1971-1979), Palembang (1976-1978) and at Menggala (1972-1977), but these data were not used in this study, because

there found some disturbances in these data, i.e. extremely high and low values and many blanks in the daily data. Instead, the potential evapotranspiration calculated using the Modified Penman Formula is used in the study. In the selection of formula among the various empirical and theoretical formulas, the latitudinal and altitudinal location of the study area and availability of meteorological data are fully taken into consideration.

The followings are calculated results using the meteorological data at Belitang and Palembang (for the meteorological data vide ANNEX-I).

(Unit : mm/month)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
At Belitang	146	132	152	147	146	138	149	151	159	167	150	143	1,782
At Palembang	152	137	164	150	149	141	144	149	168	174	150	149	1,827

In the values calculated above, the potential evapotranspiration at Belitang is used for the calculation of consumptive use of water for the Belitang Extension Area, Tulangbawang Area and Lampung Area. Whereas, the average values of those at Belitang and Palembang are used for the approximation of consumptive use of water for the Lebak Area which is located between the two places.

(2) Crop Coefficients, kc

The crop coefficient of paddy is referred to the kc-curve mentioned in the ANNEX VIII of the Reconnaissance Planning Report on "Belitang Extension Area, Agricultural Development Project" prepared by FAO/UNDP in 1974. This curve is also shown in Fig. IV-1. As for the kc-values for maize, soybeans and peanuts, the curves shown in the Technical Release No.21 published by USDA in 1967 are used in the calculation. These curves are shown

in Fig. IV-2 through IV-4. The kc-values for coffee is taken to be 0.9 throughout the year as recommended by FAO in the FAO Series No.24, "Irrigation and Drainage Paper".

(3) Results of Calculations

The results of calculations of the consumptive use of water by each crop in respective cropping pattern are shown in Table IV.1-1 through IV.1-14.

4.1.3 Farm Requirements

After knowing the consumptive use of water, the farm requirements are calculated by the following equation.

$$FR = CU + PL + NW + PW - ER + FL$$

where, FR ; Farm requirements
CU ; Consumptive use of water
PL ; Percolation loss (for paddy field only)
NW ; Nursery water requirement (for paddy field only)
PW ; Puddling water requirement (for paddy field only)
ER ; Effective rainfall
FL ; Farm application losses (for upland field only)

(1) Percolation Loss

Since the data of percolation rate in paddy field are not available, the same values as mentioned in Appendix VIII of the Reconnaissance Planning Report on "Belitang Extension Area, Agricultural Development Project" prepared by FAO/UNDP in 1974 are adopted in the calculation, i.e. 1 mm/day in the dry season (June-September) and nil in the rainy season (October-May).

Horizontal percolation through the paddy fields in terraceland will come out in the lower adjacent paddy fields and this percolation is not deemed to be loss. Therefore, such percolation is not taken as a loss in the overall irrigation requirements.

(2) Nursery Water Requirement

The nursery water requirement is estimated for the following assumptions.

(a) Area required for nursery bed:
- 1/20 of main field

(b) Nursery period:
- 20 days

(c) Water required for the 20 days period:

- Preparation of nursery bed,	120 mm
- Evapotranspirtation,	100 mm
- Percolation loss,	20 mm
Total	240 mm

(equivalent to 12 mm against the area of main field)

(3) Puddling Water Requirement

The quantity of water required for puddling works is theoretically assessed for the soil depth to be puddled and porosity, which vary relatively from place to place. In this study, the following formula and assumptions are adopted for the approximation.

a) Formula

$$PW = DS + WS$$

where, PW; puddling water requirement in mm
DS; required water depth above soil surface after puddling in mm
WS; difference in soil moisture contents before and after puddling in mm

b) Assumptions

i) Water depth above soil surface after puddling is 50 mm.
ii) Porosity is 50% in both surface soil (20 cm depth) and sub-soil (10 cm depth).
iii) Vapor phase in soils after the puddling is 5%.
iv) Soil moisture before irrigation is 14% in volume which corresponds approximately to the permanent wilting point.

The calculated results is as follows:

$$PW = 50 + 300 \times (1 - 0.05) \times 0.5 - 0.14 \times 300$$

$$\fallingdotseq 150 \text{ mm}$$

(4) Effective Rainfall

The monthly rainfall data have been collected from the following eleven stations:

i) Belitang (1956-1979)
ii) Kurungannyawa (1971-1974, 1978-1979)
iii) Jelabat (BK IX) (1971-1974, 1978-1979)
iv) Petanggan (BK XVII) (1977-1979)
v) Menggala (1972-1979)
vi) Palembang Air Port (1971-1979)
vii) Branch Office of Meteorological Institute in Palembang (1976-1979)
viii) Kayuagung (1963-1965, 1969-1978)
ix) Pedamaran (1972-1978)
x) Tanjung Lubuk (1972-1978)
xi) Cempaka (1972-1978)

Among them, the data at Belitang were used for the estimation of effective rainfall in the Belitang Extension Area, Tulangbawang and the Lempuing Area, and the data at Kayuagung were used for the Lebak Area, because of their long observation periods and suitable locations for the estimation.

In the estimation of effective rainfall, the annual rainfall with a 80% probability of exceedance of the draught year is estimated using the probability paper. The rainfall thus estimated is distributed to each month at the same ratio as that of the average monthly rainfall. The following table shows the estimated monthly rainfall with a 80% probability.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
At Belltang												
283	223	285	230	158	87	71	85	91	163	248	306	2,230
At Kayuagung												
239	217	262	211	161	91	71	67	110	116	209	273	2,030

For the estimation of the effective rainfall, the table developed by the US Bureau of Reclamation is applied. The results thus obtained are understood to be the first approximation. The more detailed estimation using the daily balance method will be presented in the final draft report.

The estimated results of the effective rainfall are shown in Table IV.1-1 through IV.1-14.

(5) Farm Application Losses

Farm application losses in upland irrigation include deep percolation, surface run-off, etc. Taking into account the soil characteristics, topography, climate, irrigation practice and experience, etc. the application efficiency is assumed to be 70% of (CU - ER) on an average over the whole study area.

4.1.4 Diversion Requirements

The canal conveyance and operation losses can not be avoided in any case, and therefore these losses should be included in the irrigation water requirements at the head of canal. Such diversion water requirements are obtained by dividing the farm requirements obtained in Section 3 hereof by the canal conveyance and operation efficiencies. In this study, the canal conveyance efficiency is estimated to be 85% and canal operation efficiency to be 80% of the diversion requirements.

The calculated unit diversion requirements for each crop are shown in Table IV.1-1 through IV.1-14 and the unit diversion requirements for respective cropping pattern are shown in Table IV.2. The Table IV.3 shows the diversion requirements in each development area.

4.2 DRAINAGE REQUIREMENTS

It is essential to maintain soil moisture in an adequate condition to keep land productivity high. If the lands can not be drained well within a feasible range, the productivity will go down and, in the worst case, the lands have to be abandoned.

In general, the criteria for the calculation of unit drainage requirement defines the rainfall intensity with certain probability and a drain period necessary for removal of excess water to an allowable extent. In the on-going irrigation projects in Indonesia, drainage requirements have been estimated by applying their own ways considering the natural and physical conditions prevailing over the project area.

In this study, the drainage requirements are estimated on the basis of following assumptions and procedures:

(1) The daily rainfall data at Belitang (1956-1979) and Kayuagung (1972-1978) are used. The data of each station are applied to the following development area/1.
- Data at Belitang; To Belitang Extension, Tulangbawang and Lempuing Areas
- Data at Kayuagung; To Lebak Area (for reference)

(2) Design rainfall is estimated to be 245 mm of 3 days rainfall at Belitang and 190 mm at Kayuagung taking a 10-year return period.

(3) Based on the average rainfall distribution pattern, the distribution percentage of the design daily rainfall is estimated as follows:

	Distribution Percentage	
Day	Belitang	Kayuagung
1st day	33	30
2nd day	31	36
3rd day	36	34

/1: This study will further be reinforced by the data from Menggala and Cempaka, if available.

(4) Relationship between rainfall and runoff distribution is assumed as follows:

Relationship between cumulative rainfall and total runoff

Cumulative rainfall (mm)	Runoff coefficient (f)
less than 10	0
10 - 30	0.1
30 - 50	0.3
50 - 100	0.5
100 - 300	0.8

Relationship between rainfall and runoff distribution

Rainfall (mm)	1st day (%)	2nd day (%)	3rd day (%)	4th day (%)
less than 30	100	-	-	-
30 - 50	70	30	-	-
50 - 100	60	30	10	-
more than 100	50	30	15	5

(5) Based on the above assumptions, the drainage requirements are estimated as follows:

At Belitang

Design Rainfall (mm)	Cumulative Rainfall (mm)	f	Runoff (mm) 1st day	2nd day	3rd day	4th day	5th day
81	81	0.5	24.3	12.1	4.1	-	-
76	157	0.8	-	36.5	18.2	6.1	-
88	245	0.8	-	-	42.2	21.1	7.0
Total			24.3	48.6	64.5	27.2	7.0
lit/sec/ha			2.8	5.6	7.5	3.1	0.8

At Kayuagung

57	57	0.5	17.1	8.6	2.9	-	-
68	125	0.8	-	32.6	16.3	5.4	-
65	190	0.8	-	-	31.2	15.6	5.2
Total			17.1	41.2	50.4	21.0	5.2
lit/sec/ha			2.0	4.8	5.8	2.4	0.6

Table IV. 1.1 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - I (for 1 ha Area)
- Wet Season paddy -

Description	SEP	OCT			NOV			DEC			JAN			FEB			MAR	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping pattern		Nursery Stage											Ripening Stage					
A. Cropping intensity to unit area			1/12	1/4	5/12	7/12	3/4	11/12	1	1	11/12	3/4	7/12	5/12	1/4	1/12		
B. Consumptive use of water																		
1. Crop coefficient, kc			0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46							
				0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46						
					0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46					
						0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46				
							0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46			
								0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46		
2. Average, kc			0.76	0.77	0.84	0.92	1.00	1.07	1.13	1.15	1.12	1.12	1.07	0.96	0.75	0.46		
3. Potential evapotranspiration(mm)			58.0	59.4	50.0	50.0	50.0	46.0	46.0	50.6	47.0	47.0	51.7	48.0	48.0	38.4		
4. Consumptive use of water (mm)			41	46	42	46	50	49	52	58	53	53	55	46	36	18		
C. Per colation loss (mm)			10	11	0	0	0	0	0	0	0	0	0	0	0	0		
D. Effective rainfall (mm)			32	35	41	41	41	40	40	44	40	40	44	36	36	29		
E. Sub - Total,(4 + C - D)x A (mm)			2	6	1	3	7	8	12	14	12	10	6	4	0	0		
F. Nursery Water requirement (mm)	2	2	2	2	2	2												
G. Puddling water requirement (mm)		25	25	25	25	25	25											
H. Farm requirements, E + F + G (mm)	2	27	29	33	28	30	32	8	12	14	12	10	6	4	0	0		
I. Diversion requirements H/Ei (mm)	3	40	43	49	41	44	47	12	18	21	18	15	9	6	0	0		
J. Equivalent continuous flow(lit/sec/ ha).	0.03	0.46	0.50	0.52	0.47	0.51	0.54	0.14	0.21	0.22	0.21	0.17	0.09	0.07	0	0		

N o t e : Ei ; Canal conveyance and operation efficiencies, 68 %.

Table IV. 1.2 UNIT DIVERSION REQUIREMENTS

Crooping pattern, Type - I (for 1 ha Area)
- Dry Season paddy.-

Description	FEB	MAR			APR			MAY			JUN			JUL			AUG	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping pattern	Nursery Stage												Ripening Stage					
A. Cropping intensity to unit area			1/12	1/4	5/12	7/12	3/4	11/12	1	1	11/12	3/4	7/12	5/12	1/4	1/12		
B. Consumptive use of water																		
1. Crop coefficient, kc			0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46							
				0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46						
					0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46					
						0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46				
							0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46			
								0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46		
2. Average, kc			0.76	0.77	0.84	0.92	1.00	1.07	1.13	1.15	1.12	1.12	1.07	0.96	0.75	0.46		
3. Potential evapotranspiration(mm)			49.0	53.9	49.0	49.0	49.0	47.0	47.0	51.7	46.0	46.0	46.0	48.0	48.0	52.8		
4. Consumptive use of water (mm)			37	42	41	45	49	50	53	59	52	52	49	46	36	24		
C. Percolation loss (mm)			0	0	0	0	0	10	10	11	10	10	10	10	10	10		
D. Effective rainfall (mm)			38	42	40	40	40	33	33	36	20	20	20	15	15	17		
E. Sub - Total,(4 + C - D)xA (mm)			0	0	1	3	7	25	30	34	39	32	23	17	8	1		
F. Nursery water requirement (mm)	2	2	2	2	2	2												
G. Puddling water requirement (mm)		25	25	25	25	25	25											
H. Farm requirement, E + F + G (mm)	2	27	27	27	28	30	32	25	30	34	39	32	23	17	8	1		
I. Diversion requirements, H/Ei (mm)	3	40	40	40	41	44	47	37	44	50	57	47	34	25	12	1		
J. Equivalent continuous flow (lit/ sec/ha)	0.04	0.46	0.46	0.42	0.47	0.51	0.54	0.43	0.51	0.53	0.66	0.54	0.39	0.29	0.14	0.01		

Note : Ei; Canal conveyance and operation efficiencies, 68 %.

Table IV.1.3 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - I (for 1 ha Area)

- P e a n u t s -

D e s c r i p t i o n	JUL			AUG			SEP			OCT		
	1	2	3	1	2	3	1	2	3	1	2	3
Cropping pattern												
A. Cropping intensity to unit area	1/6	1/2	5/6	1	1	1	1	1	1	5/6	1/2	1/6
B. Consumptive use of water												
1. Crop coefficient, kc	0.30	0.36	0.51	0.75	0.93	0.98	0.97	0.91	0.80	0.64		
		0.30	0.36	0.51	0.75	0.93	0.98	0.97	0.91	0.80	0.64	
			0.30	0.36	0.51	0.75	0.93	0.98	0.97	0.91	0.80	0.64
2. Average, kc	0.30	0.34	0.41	0.54	0.73	0.89	0.96	0.95	0.89	0.81	0.75	0.64
3. Potential evapotranspiration (mm)	48.0	48.0	52.8	51.0	51.0	56.1	53.0	53.0	53.0	54.0	54.0	59.4
4. Consumptive use of water (mm)	14	16	22	28	37	50	51	50	47	44	41	38
C. Effective rainfall (mm)	13	13	14	20	20	22	23	23	23	32	32	35
D. Sub - Total, (4 - C) x A (mm)	1	2	7	8	17	28	28	27	24	10	5	1
E. Farm requirements D/Ef (mm)	1	3	10	11	24	40	40	39	34	14	7	1
F. Diversion requirements, E/Ei (mm)	1	4	15	16	35	59	59	57	50	21	10	1
G. Equivalent continuous flow (lit/sec/ha)	0.01	0.05	0.16	0.19	0.41	0.62	0.68	0.66	0.58	0.24	0.11	0.01

N o t e : Ef ; Field application efficiency, 70 %

Ei ; Canal conveyance and operation efficiencies, 68 %.

Table IV. 1.4 UNIT DIVERSION REQUIREMENTS.

Cropping patterm, Type - II (for 2 ha Area)
- Wet Season paddy -

Description	SEP	OTC			NOV			DEC			JAN			FEB			MAR	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping Pattern	Nursery Stage												Ripening Stage					
A. Cropping intensity to unit area			1/12	1/4	5/12	7/12	3/4	11/12	1	1	11/12	3/4	7/12	5/12	1/4	1/12		
B. Consumptive use of water																		
1. Crop coefficient, kc			0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46							
				0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46						
					0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46					
						0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46				
							0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46			
								0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46		
2. Average, kc			0.76	0.77	0.84	0.92	1.00	1.07	1.13	1.15	1.12	1.12	1.07	0.96	0.75	0.46		
3. Potential evapotranspiration(mm)			54.0	59.4	50.0	50.0	50.0	46.0	46.0	50.6	47.0	47.0	51.7	48.0	48.0	38.4		
4. Consumptive use of water (mm)			41	46	42	46	50	49	52	58	53	53	55	46	36	18		
C. Percolation loss (mm)			10	11	0	0	0	0	0	0	0	0	0	0	0	0		
D. Effective rainfall (mm)			32	35	41	41	41	40	40	44	40	40	44	36	36	29		
E. Sub - Total, (B + C - D) x A (mm)			2	6	1	3	7	8	12	14	12	10	6	4	0	0		
F. Nursery water requirement (mm)	2	2	2	2	2	2												
G. Puddling water requirement (mm)		25	25	25	25	25	25											
H. Farm requirement, E + F + G (mm)	2	27	29	33	28	30	32	8	12	14	12	10	6	4	0	0		
I. Diversion requirements, H/Ei (mm)	3	40	43	49	41	44	47	12	18	21	18	15	9	6	0	0		
J. Equivalent continuous flow(lit/ sec/ha).	0.03	0.46	0.50	0.52	0.47	0.51	0.54	0.14	0.21	0.22	0.21	0.17	0.09	0.07	0	0		

Note : Ei ; Canal conveyance and operation efficiencies, 68 %

Table IV. 1.5 UNIT DIVERSION REQUIREMENTS.

Cropping patterm, Type - II (for 2 ha Area)

- Dry Season paddy -

Description	FEB	MAR			APR			MAY			JUN			JUL	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping patterm	Nursery Stage										Ripening Stage				
A. Cropping intensity to unit area			1/6	1/2	5/6	1	1	1	1	1	5/6	1/2	1/6		
B. Consumptive use of water															
1. Crop coefficient, kc			0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46				
				0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46			
					0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46		
2. Average, kc			0.76	0.77	0.84	0.94	1.12	1.26	1.31	1.17	0.96	0.75	0.46		
3. Potential evapotranspiratiom (mm)			49.0	53.9	49.0	49.0	49.0	47.0	47.0	51.7	46.0	46.0	46.0		
4. Consumptive use of water (mm)			37	42	41	46	55	59	62	60	44	35	21		
C. Percolation loss (mm)			0	0	0	0	0	10	10	11	10	10	10		
D. Effective rainfall (mm)			32	35	41	41	41	35	35	39	18	18	18		
E. Sub - Total,(4 + C - D() x A (mm)			1	4	0	5	14	34	39	32	30	14	2		
F. Nursery water requirement (mm)	4	4	4												
G. Puddling water requirement (mm)		50	50	50											
H. Farm requirements, E + F + G (mm)	4	54	55	54	0	5	14	34	37	32	30	14	2		
I. Diversion requirements, H/Ei (mm)	6	79	81	79	0	7	21	50	54	47	44	21	3		
J. Equivalent continuous flow (lit/sec/ha)	0.09	0.91	0.94	0.83	0	0.08	0.24	0.58	0.62	0.49	0.51	0.24	0.03		

N o t e : Ei ; Canal conveyance and operation efficiencies, 68 %.

Table IV. 1.6 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - II (for 2 ha Area)

- S o y b e a n s -

Description	APR			MAY			JUN			JUL			AUG		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Cropping pattern															
A. Cropping intensity to unit area			1/6	1/2	5/6	1	1	1	1	1	1	1	5/6	1/2	1/6
B. Consumptive use of water															
1. Crop coefficient, kc			0.22	0.29	0.36	0.44	0.57	0.73	0.91	1.01	0.98	0.82	0.72		
				0.22	0.29	0.36	0.44	0.57	0.73	0.91	1.01	0.98	0.82	0.72	
					0.22	0.29	0.36	0.44	0.57	0.73	0.91	1.01	0.98	0.82	0.72
2. Average, kc			0.22	0.28	0.30	0.36	0.46	0.58	0.74	0.88	0.97	0.94	0.86	0.79	0.72
3. Potential evapotranspiration (mm)			49.0	47.0	47.0	51.7	46.0	46.0	46.0	48.0	48.0	52.8	51.0	51.0	56.1
4. Consumptive use of water (mm)			11	13	14	19	21	27	34	42	47	50.0	44.0	40	40
C. Effective rainfall (mm)			11	16	16	18	17	17	17	17	17	19	22	22	24
D. Sub - Total, (4 - C) x A (mm)			0	0	0	1	4	10	17	25	30	31	18	9	3
E. Farm requirements, D/Ef (mm)			0	0	0	1	6	14	24	36	43	44	26	13	4
F. Diversion requirements, E/Ei (mm)			0	0	0	1	9	21	35	53	63	65	38	19	6
G. Equivalent continuous flow (lit/sec/ ha)			0	0	0	0.01	0.10	0.24	0.41	0.61	0.73	0.68	0.44	0.22	0.06

N o t e : Ef ; Field application efficiency, 70 %

Ei ; Canal conveyance and operation efficiencies, 68 %.

Table IV 1.7 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - II (for 2 ha Area)

- C o f f e e -

D e s c r i p t i o n	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. Cropping intensity to unit area	1	1	1	1	1	1	1	1	1	1	1	1
B. Consumptive use of water												
1. Crop coefficient, kc	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2. Potential evapotranspiration (mm)	146	134	152	147	146	138	149	158	159	167	150	143
3. Consumptive use of water (mm)	131	121	137	132	131	124	134	142	143	150	135	129
C. Effective rainfall (mm)	138	135	139	138	113	67	50	70	70	121	138	135
D. Sub - Total,(3 - C) (mm)	0	0	0	0	18	57	84	72	73	29	0	0
E. Farm requirements, D/Ef (mm)	0	0	0	0	26	81	120	103	104	41	0	0
F. Diversion requirements, E/Ei (mm)	0	0	0	0	38	119	176	151	153	60	0	0
G. Equivalent continuous flow (lit/sec/ha)	0	0	0	0	0.14	0.46	0.66	0.56	0.59	0.22	0	0

N o t e : Ef ; Field application efficiency, 70 %

Ei ; Canal conveyance and operation efficiencies, 68 %.

Table IV. 1.8 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - III (for 5 ha Area)

- Wet Season paddy -

Description	OCT	NOV			DEC			JAN			FEB			MAR			APR	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping pattern	Nursery Stage												Ripening Stage					
A. Cropping intensity to unit area			1/12	1/4	5/12	7/12	3/4	11/12	1	1	11/12	3/4	7/12	5/12	1/4	1/12		
B. Consumptive use of water																		
1. Crop coefficient, kc			0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46							
				0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46						
					0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46					
						0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46				
							0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46			
								0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46		
2. Average, kc			0.76	0.77	0.84	0.92	1.00	1.07	1.13	1.15	1.12	1.12	1.07	0.96	0.75	0.46		
3. Potential evapotranspiration(mm)			50.0	50.0	46.0	46.0	50.6	47.0	47.0	51.7	48.0	48.0	38.4	49.0	49.0	53.9		
4. Consumtive use of water (mm)			38	39	39	42	51	50	53	59	54	54	41	47	37	25		
C. Percolation loss (mm)			0	0	0	0	0	0	0	0	0	0	0	0	0	0		
D. Effective rainfall (mm)			38	38	40	40	44	41	41	45	44	44	35	35	35	39		
E. Sub - Total, (4 + C - D)x A (mm)			0	1	0	1	5	9	12	14	10	10	6	12	2	0		
F. Nursery water requirement (mm)	2	2	2	2	2	2												
G. Puddling water requirement (mm)		25	25	25	25	25												
H. Farm requirements, E + F + G (mm)	2	27	27	28	27	28	5	9	12	14	10	10	6	12	2	0		
I. Diversion requirements, H/Ei (mm)	3	40	40	41	40	41	7	13	18	21	15	15	9	18	3	0		
J. Equivalent continuous flow (lit/sec/ha)	0.03	0.46	0.46	0.47	0.46	0.47	0.07	0.15	0.21	0.30	0.17	0.17	0.09	0.21	0.03	0		

Note : Ei; Canal conveyance and operation efficiencies, 68 %.

Table IV. 1.9 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - III (for 5 ha Area)

- Dry Season paddy -

Description	MAR	APR			MAY			JUN			JUL			AUG			SEP	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping pattern		Nursery Stage											Ripening Stage					
A. Cropping intensity to unit area			1/12	1/4	5/12	7/12	3/4	11/12	1	1	11/12	3/4	7/12	5/12	1/4	1/12		
B. Consumptive use of water																		
1. Crop coefficient, kc			0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46							
				0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46						
					0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46					
						0.76	0.78	0.93	1.12	1.31	1.35	1.27	0.90	0.46				
							0.76	0.78	0.93	1.12	1.13	1.35	1.27	0.90	0.46			
								0.76	0.78	0.93	1.12	1.13	1.35	1.27	0.90	0.46		
2. Average, kc			0.76	0.77	0.84	0.92	1.00	1.07	1.13	1.13	1.12	1.12	1.07	0.96	0.75	0.46		
3. Potential evapotranspiration (mm)			49.0	49.0	47.0	47.0	51.7	46.0	46.0	46.0	48.0	48.0	52.8	51.0	51.0	56.1		
4. Consumptive use of water(Mmm)			37	38	39	43	52	49	52	53	54	54	56	49	38	26		
C. Percolation loss (mm)			0	0	10	10	11	10	10	10	10	10	10	10	10	10		
D. Effective rainfall (mm)			38	38	31	31	34	20	20	20	18	18	20	19	19	21		
E. Sub - Total, (B + C - D) x A (mm)			0	0	8	13	22	36	42	43	42	35	27	17	7	1		
F. Nursery water requirement (mm)	2	2	2	2	2	2												
G. Puddling water requirement (mm)		25	25	25	25	25	25											
H. Farm requirements E + F + G (mm)	2	27	27	27	35	40	47	36	42	43	42	35	27	17	7	1		
I. Diversion requirements H/Ei (mm)	3	40	40	40	51	59	69	53	62	63	62	51	40	25	10	1		
J. Equivalent continuous flow (lit/sec/ha)	0.03	0.46	0.46	0.42	0.59	0.68	0.73	0.61	0.72	0.73	0.72	0.59	0.42	0.29	0.12	0.01		

Note : Ei; Canal conveyance and operation efficiencies, 68 %.

Table IV.1.10 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - III (for 5 ha Area)

- M a i z e -

Description	FEB			MAR			APR			MAY		
	1	2	3	1	2	3	1	2	3	1	2	3
Cropping pattern												
A. Cropping intensity to unit area	1/6	1/2	5/6	1	1	1	1	1	1	5/6	1/2	1/6
B. Consumptive use of water												
1. Crop coefficient, kc	0.44	0.50	0.60	0.71	0.90	1.03	1.07	1.07	1.04	1.00		
		0.44	0.50	0.60	0.71	0.90	1.03	1.07	1.07	1.04	1.00	
			0.44	0.50	0.60	0.71	0.90	0.03	0.07	1.07	1.04	1.00
2. Average, kc	0.44	0.48	0.53	0.60	0.74	0.88	1.00	1.06	1.06	1.04	1.03	1.00
3. Potential evapotranspiration (mm)	48.0	48.0	38.4	49.0	49.0	53.9	49.0	49.0	49.0	47.0	47.0	51.7
4. Consumtive use of water (mm)	21	23	20	29	36	47	49	52	52	49	48	52
C. Effective rainfall (mm)	23	23	18	36	36	40	44	44	44	36	36	40
D. Sub - Total, (4 - C) x A (mm)	0	0	2	0	0	7	5	8	8	11	6	2
E. Farm requirements, D/Ef (mm)	0	0	3	0	0	10	7	11	11	16	9	3
F. Diversion requirements, E/Ei (mm)	0	0	4	0	0	15	10	16	16	24	13	4
G. Equivalent continuous flow (lit/sec/ha)	0	0	0.06	0	0	0.16	0.12	0.19	0.19	0.28	0.15	0.04

N o t e : Ef ; Farm application efficiency, 70 %

Ei ; Canal conveyance and operation efficiencies, 68 %

Table IV. 1.11 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - III (for 5 ha Area)

- C o f f e e -

D e s c r i p t i o n	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. Cropping intensity to unit area	1	1	1	1	1	1	1	1	1	1	1	1
B. Consumptive use of water												
1. Crop coefficient, kc	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2. Potential evapotranspiration (mm)	146	134	152	147	146	138	149	158	159	167	150	143
3. Consumptive use of water (mm)	131	121	137	132	131	124	134	142	143	150	135	129
C. Effective rainfall (mm)	138	135	139	138	113	67	50	70	70	121	138	135
D. Sub - Total,(3 - C) (mm)	0	0	0	0	18	57	84	72	73	29	0	0
E. Farm requirements, D/Ef (mm)	0	0	0	0	26	81	120	103	104	41	0	0
F. Diversion requirements, E/Ei (mm)	0	0	0	0	38	119	176	151	153	60	0	0
G. Equivalent continuous flow (lit/sec/ha)	0	0	0	0	0.14	0.46	0.66	0.56	0.59	0.22	0	0

N o t e : Ef ; Field application efficiency, 70 %

Ei ; Canal conveyance and operation efficiencies, 68 %

Table IV 1.12 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - IV (for Lebak Area)

- Lebak paddy -

Description	MAR		APR			MAY			JUN			JUL			AUG			SEP			OCT			NOV		
	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Cropping pattern	Nursery stage																	Ripening stage								
A. Cropping intensity to unit area			1/18	1/6	5/18	7/18	1/2	11/18	13/18	5/6	17/18	1	1	1	1	17/18	5/6	13/18	11/18	1/2	7/18	5/18	1/6	1/18		
B. Consumptive use of water																										
1. Crop coefficient, kc			0.76	0.76	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37										
				0.76	0.76	0.77	1.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37									
					0.76	0.76	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37								
						0.76	0.76	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37							
							0.76	0.76	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37						
								0.76	0.76	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37					
									0.76	0076	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37				
										0.76	0.76	0.77	0.88	1.04	1.16	1.29	1.36	1.36	1.31	1.17	0.92	0.65	0.37			
2. Average, kc			0.76	0.76	0.76	0.80	0.85	0.91	0.97	1.02	1.06	1.10	1.14	1.17	1.14	1.11	1.10	1.07	1.02	0.94	0.84	0.70	0.56	0.37		
3. Potential evapotranspiration(mm)			50	50	50	48	48	53	47	47	47	46	46	51	48	48	53	56	56	56	56	56	62	50		
4. Consumptive use of water			38	38	38	38	41	48	46	48	50	51	52	60	55	53	58	60	57	53	47	39	35	19		
C. Percolation loss (mm)			0	0	0	10	10	11	10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10		
D. Effective rainfall (mm)			38	38	38	33	33	36	22	22	22	17	17	19	17	17	19	57	57	57	24	24	27	19		
E. Sub - Total, (4 + C - D) x A (mm)			0	0	0	6	9	14	25	30	38	44	45	60	48	43	42	13	9	3	13	7	3	1		
F. Nursery water requirement (mm)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3																	
G. Puddling water requirement (mm)		17	17	17	17	17	17	17	17	17																
H. Farm requirements, E + F + G (mm)	1	18	18	18	18	24	27	32	43	47	38	44	45	60	48	43	42	13	9	3	13	7	3	1		
I. Diversion requirements, H/Ei (mm)	2	26	26	26	26	35	40	47	63	69	56	65	66	88	71	63	62	19	13	4	19	10	4	1		
J. Equivalent continuous flow (lit/ sec/ha)	0.02	0.27	0.31	0.31	0.31	0.41	0.46	0.49	0.73	0.80	0.65	0.75	0.76	0.93	0.82	0.73	0.65	0.22	0.15	0.05	0.22	0.12	0.04	0.01		

Note: Ei ; Canal conveyance and operation efficiencies, 68%

Table IV. 1.13 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - IV (for Lebak Area)
- Wet Season paddy -

Description	NOV		DEC			JAN			FEB			MAR			APR	
	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Cropping pattern	Nursery Stage													Ripenig Stage		
A. Cropping intensive to unit area			1/6	1/2	5/6	1	1	1	1	1	1	5/6	1/2	1/6		
B. Consumptive use of water																
1. Crop coefficient, kc			0.76	0.77	0.89	1.10	1.28	1.36	1.32	1.16	0.81	0.40				
				0.76	0.77	0.89	1.10	1.28	1.36	1.32	1.16	0.81	0.40			
					0.76	0.77	0.89	1.10	1.28	1.36	1.32	1.16	0.81	0.40		
2. Average, kc			0.76	0.77	0.82	0.92	1.09	1.25	1.32	1.28	1.10	0.87	0.67	0.40		
3. Potential evapotranspiration (mm)			47	47	52	48	48	53	49	49	39	51	51	56		
4. Consumptive use of water (mm)			36	36	43	44	52	66	65	63	43	44	34	22		
C. Percolation loss (mm)			0	0	0	0	0	0	0	0	0	0	0	0		
D. Effective rainfall (mm)			37	37	41	41	41	45	43	43	34	32	32	35		
E. Sub - Total, (4 + C - D)x A (mm)			0	0	2	3	11	21	22	20	9	12	2	0		
F. Nursery water requirement (mm)	4	4	4													
G. Puddling water requirement (mm)		50	50	50												
H. Farm requirement, E + F + G (mm)	4	54	54	50	2	3	11	21	22	20	9	12	2	0		
I. Diversion requirements, H/Ei (mm)	6	79	79	73	3	4	16	31	32	29	13	18	3	0		
J. Equivalent continuous flow (lit/sec/ha)	0.07	0.91	0.91	0.84	0.03	0.05	0.19	0.33	0.37	0.34	0.14	0.21	0.03	0		

N o t e : Ei ; Canal conveyance and operation efficiencies, 68 %

Table IV. 1.14 UNIT DIVERSION REQUIREMENTS.

Cropping pattern, Type - IV (for Lebak Area)

- M a i z e -

D e s c r i p t i o n	JUN			JUL			AUG			SEP		
	1	2	3	1	2	3	1	2	3	1	2	3
Cropping pattern												
A. Cropping intensity to unit area	1/6	1/2	5/6	1	1	1	1	1	1	5/6	1/2	1/6
B. Consumptive use of water												
1. Crop coefficient, kc	0.44	0.50	0.60	0.71	0.90	1.03	1.07	1.07	1.04	1.00		
		0.44	0.50	0.60	0.71	0.91	1.03	1.07	1.07	1.04	1.00	
			0.44	0.50	0.60	0.71	0.91	1.03	1.07	1.07	1.04	1.00
2. Average, kc	0.44	0.48	0.53	0.60	0.74	0.88	1.00	1.06	1.06	1.04	1.03	1.00
3. Potential evapotranspiration (mm)	47	47	47	46	46	51	48	48	53	56	56	56
4. Consumptive use of water (mm)	21	21	25	28	34	45	48	51	56	58	58	56
C. Effective rainfall (mm)	19	19	19	17	17	19	15	15	17	26	26	26
D. Sub - Total,(4) - C) x A (mm)	1	1	5	11	17	26	33	36	39	27	16	5
E. Farm requirements D/Ef (mm)	1	1	7	16	24	37	47	51	56	39	23	7
F. Diversion requirements, E/Ei (mm)	2	2	10	24	35	54	69	75	82	57	34	10
G. Equivalent continuous flow (lit/sec/ha)	0.02	0.02	0.12	0.28	0.41	0.57	0.80	0.87	0.96	0.66	0.39	0.12

N o t e : Ef ; Farm application efficiency, 70 %

Ei ; Canal conveyance and operation efficiencies, 68 %

Table IV. 2 UNIT DIVERSION REQUIREMENTS.

Crops	Cropped Area (% to Unit) Area.	JAN 1	2	3	FEB 1	2	3	MAR 1	2	3	APR 1	2	3	MAY 1	2	3	JUN 1	2	3	JUL 1	2	3	AUG 1	2	3	SEP 1	2	3	1
A. Cropping pattern, Type - I																													
- Wet Season paddy	100,0	0.21	0.17	0.09	0.07	0	0																					0.03	0.1
- Dry Season paddy	100.0						0.04	0.46	0.46	0.42	0.47	0.51	0.54	0.43	0.51	0.53	0.66	0.54	0.39	0.29	0.14	0.01							
- Peanuts	50.0																			0.01	0.03	0.08	0.10	0.21	0.31	0.34	0.33	0.29	0.1
TOTAL		0.21	0.17	0.09	0.07	0	0.04	0.46	0.46	0.42	0.47	0.51	0.54	0.43	0.51	0.53	0.66	0.54	0.39	0.30	0.17	0.09	0.10	0.21	0.31	0.34	0.33	0.32	0.5
B. Cropping pattern, Type - II.																													
- Wet Season paddy	62.5	0.13	0.11	0.06	0.05	0	0																					0.02	0.2
- Dry Season paddy	32.5						0.03	0.30	0.31	0.27	0	0.03	0.08	0.19	0.20	0.16	0.17	0.08	0.01										
- Soybeans	30.0												0	0	0	0.01	0.03	0.07	0.12	0.18	0.22	0.20	0.13	0.07	0.02				
- Coffee	25.0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0.04	0.04	0.12	0.12	0.12	0.17	0.17	0.17	0.14	0.14	0.14	0.15	0.15	0.15	0.0
TOTAL		0.13	0.11	0.06	0.05	0	0.03	0.30	0.31	0.27	0	0.03	0.08	0.23	0.24	0.21	0.32	0.27	0.25	0.35	0.39	0.37	0.27	0.21	0.16	0.15	0.15	0.17	0.3
C. Cropping pattern, Type - III																													
- Wet Season paddy.	30.0	0.05	0.06	0.09	0.05	0.05	0.03	0.06	0.01																				
- Dry Season paddy	20.0									0.01	0.09	0.09	0.08	0.12	0.14	0.15	0.12	0.14	0.15	0.14	0.12	0.08	0.06	0.02	0.01				
- Maize	25.0				0	0	0.02	0	0	0.04	0.03	0.05	0.05	0.07	0.04	0.01													
- Coffee	40.0	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0.06	0.06	0.18	0.18	0.18	0.26	0.26	0.26	0.22	0.22	0.22	0.24	0.24	0.24	0.0
TOTAL		0.05	0.06	0.09	0.05	0.05	0.05	0.06	0.01	0.05	0.12	0.14	0.13	0.25	0.24	0.22	0.30	0.32	0.33	0.40	0.38	0.34	0.28	0.24	0.23	0.24	0.24	0.24	0.0
D. Cropping pattern, Type - IV.																													
- Lebak paddy	67 %								0.01	0.18	0.21	0.21	0.21	0.27	0.31	0.33	0.49	0.54	0.44	0.50	0.51	0.62	0.55	0.49	0.44	0.15	0.10	0.03	0.1
- Wet Season paddy	33 %	0.02	0.06	0.11	0.12	0.11	0.05	0.07	0.01	0																			
- Maize	33 %																0.01	0.01	0.04	0.09	0.14	0.19	0.26	0.29	0.28	0.22	0.13	0.04	
TOTAL		0.02	0.06	0.11	0.12	0.11	0.05	0.07	0.02	0.18	0.21	0.21	0.21	0.27	0.31	0.33	0.50	0.55	0.48	0.59	0.65	0.81	0.81	0.78	0.72	0.37	0.23	0.07	0.1

Table IV. 2 . UNIT DIVERSION REQUIREMENTS.

	JAN			FEB			MAR			APR			MAY			JUN			JUL			AUG			SEP			OCT			NOV			DEC		
	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	0.21	0.17	0.09	0.07	0	0																					0.03	0.46	0.50	0.52	0.47	0.51	0.54	0.14	0.21	0.22
						0.04	0.46	0.46	0.42	0.47	0.52	0.54	0.43	0.51	0.53	0.66	0.54	0.39	0.29	0.14	0.01																
																			0.01	0.03	0.08	0.10	0.21	0.31	0.34	0.33	0.29	0.12	0.06	0.01						
	0.21	0.17	0.09	0.07	0	0.04	0.46	0.46	0.42	0.47	0.51	0.54	0.43	0.51	0.53	0.66	0.54	0.39	0.30	0.17	0.09	0.10	0.21	0.31	0.34	0.33	0.32	0.58	0.56	0.53	0.47	0.51	0.54	0.14	0.21	0.22
	0.13	0.11	0.06	0.05	0	0																					0.02	0.29	0.31	0.33	0.29	0.32	0.34	0.09	0.13	0.14
						0.03	0.30	0.31	0.27	0	0.03	0.08	0.19	0.20	0.16	0.17	0.08	0.01																		
												0	0	0	0.01	0.03	0.07	0.12	0.18	0.22	0.20	0.13	0.07	0.02												
	0	0	0	0	0	0	0	0	0	0	0	0.04	0.04	0.04	0.12	0.12	0.12	0.17	0.17	0.17	0.14	0.14	0.14	0.15	0.15	0.15	0.06	0.06	0.06	0	0	0	0	0	0
	0.13	0.11	0.06	0.05	0	0.03	0.30	0.31	0.27	0	0.03	0.08	0.23	0.24	0.21	0.32	0.27	0.25	0.35	0.39	0.37	0.27	0.21	0.16	0.15	0.15	0.17	0.35	0.37	0.39	0.29	0.32	0.34	0.09	0.13	0.14
	0.05	0.06	0.09	0.05	0.05	0.03	0.06	0.01																						0.01	0.14	0.14	0.14	0.14	0.14	0.02
									0.01	0.09	0.09	0.08	0.12	0.14	0.15	0.12	0.14	0.15	0.14	0.12	0.08	0.06	0.02	0.01												
					0	0	0.02	0	0	0.04	0.03	0.05	0.05	0.07	0.04	0.01																					
	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0.06	0.06	0.18	0.18	0.18	0.26	0.26	0.26	0.22	0.22	0.22	0.24	0.24	0.24	0.09	0.09	0.09	0	0	0	0	0	0
	0.05	0.06	0.09	0.05	0.05	0.05	0.06	0.01	0.05	0.12	0.14	0.13	0.25	0.24	0.22	0.30	0.32	0.33	0.40	0.38	0.34	0.28	0.24	0.23	0.24	0.24	0.24	0.09	0.09	0.10	0.14	0.14	0.14	0.14	0.14	0.02
									0.01	0.18	0.21	0.21	0.21	0.27	0.31	0.33	0.49	0.54	0.44	0.50	0.51	0.62	0.55	0.49	0.44	0.15	0.10	0.03	0.15	0.08	0.03	0.01	0.02	0.30	0.30	0.28	0.01
	0.02	0.06	0.11	0.12	0.11	0.05	0.07	0.01	0																											
																0.01	0.01	0.04	0.09	0.14	0.19	0.26	0.29	0.28	0.22	0.13	0.04									
	0.02	0.06	0.11	0.12	0.11	0.05	0.07	0.02	0.18	0.21	0.21	0.21	0.27	0.31	0.33	0.50	0.55	0.48	0.59	0.65	0.81	0.81	0.78	0.72	0.37	0.23	0.07	0.15	0.08	0.03	0.01	0.04	0.60	0.60	0.56	0.02

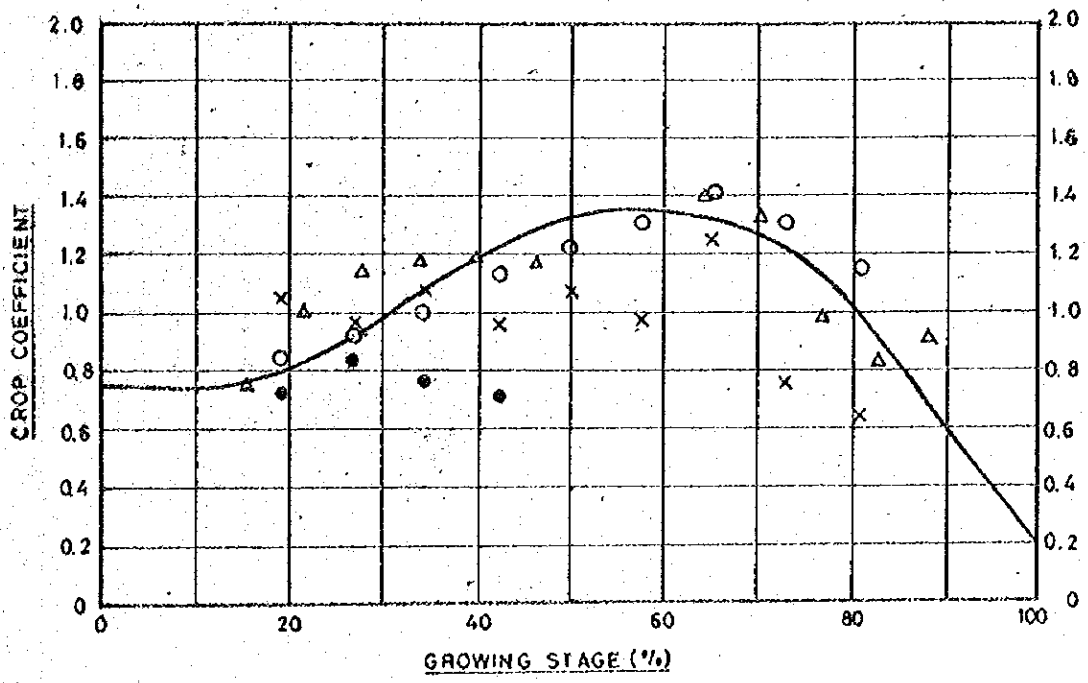
Table IV-3 DIVERSION REQUIREMENTS OF EACH DEVELOPMENT AREA

(Unit : m^3/sec)

Month		Belitang Proper Area C.P.-I Area 20,600 ha	Belitang Extension Area C.P.-I Area 21,700 ha C.P.-II Area 26,300 ha	Tulang-bawang Area C.P.-III Area 59,300 ha	Lempuing Area C.P.-II Area 13,100 ha	Lebak Area C.P.-IV Area 76,000 ha	Total
Jan.	E	4.33	7.98	2.97	1.70	1.52	18.50
	M	3.50	6.58	3.56	1.44	4.56	19.64
	L	1.85	3.53	5.34	0.79	8.36	19.87
Feb.	E	1.44	2.83	2.97	0.66	9.12	17.02
	M	0	0	2.97	0	8.36	11.33
	L	0.82	1.66	2.97	0.39	3.80	9.64
Mar.	E	9.48	17.87	3.56	3.93	5.32	40.16
	M	9.48	18.14	0.59	4.06	1.52	33.79
	L	8.65	16.22	2.97	3.54	13.68	45.06
Apr.	E	9.68	10.20	7.12	0	15.96	42.96
	M	10.51	11.86	8.30	0.39	15.96	47.02
	L	11.12	13.82	7.71	1.05	15.96	49.66
May	E	8.86	15.38	14.83	3.01	20.52	62.60
	M	10.51	17.38	14.23	3.14	23.56	68.82
	L	10.92	17.02	13.05	2.75	25.08	68.82
Jun.	E	13.60	22.74	17.79	4.19	38.00	96.32
	M	11.12	18.82	13.98	3.54	41.80	94.26
	L	8.03	15.04	19.57	3.28	36.48	82.40
Jul.	E	6.18	15.72	23.72	4.59	44.84	95.05
	M	3.50	13.95	22.53	5.11	49.40	94.49
	L	1.85	11.68	20.16	4.85	61.56	100.10
Aug.	E	2.06	9.27	16.60	3.54	61.56	93.03
	M	4.33	10.08	14.23	2.75	59.28	90.67
	L	6.39	10.94	13.64	2.10	54.72	87.79
Sep.	E	7.00	11.32	14.23	1.97	28.12	62.64
	M	6.80	11.11	14.23	1.97	17.48	51.59
	L	6.59	11.42	14.23	2.23	5.32	39.79
Oct	E	11.95	21.79	5.34	4.59	11.40	55.07
	M	11.54	21.88	5.34	4.85	6.08	49.69
	L	10.92	21.76	5.93	5.11	2.28	46.00
Nov	E	9.68	17.83	8.30	3.80	0.76	40.37
	M	10.51	19.48	8.30	4.19	3.04	45.52
	L	11.12	20.66	8.30	4.45	45.60	90.13
Dec	E	2.88	5.41	8.30	1.18	45.60	63.37
	M	4.33	7.98	8.30	1.70	42.56	64.87
	L	4.53	8.46	1.19	1.83	1.52	17.53

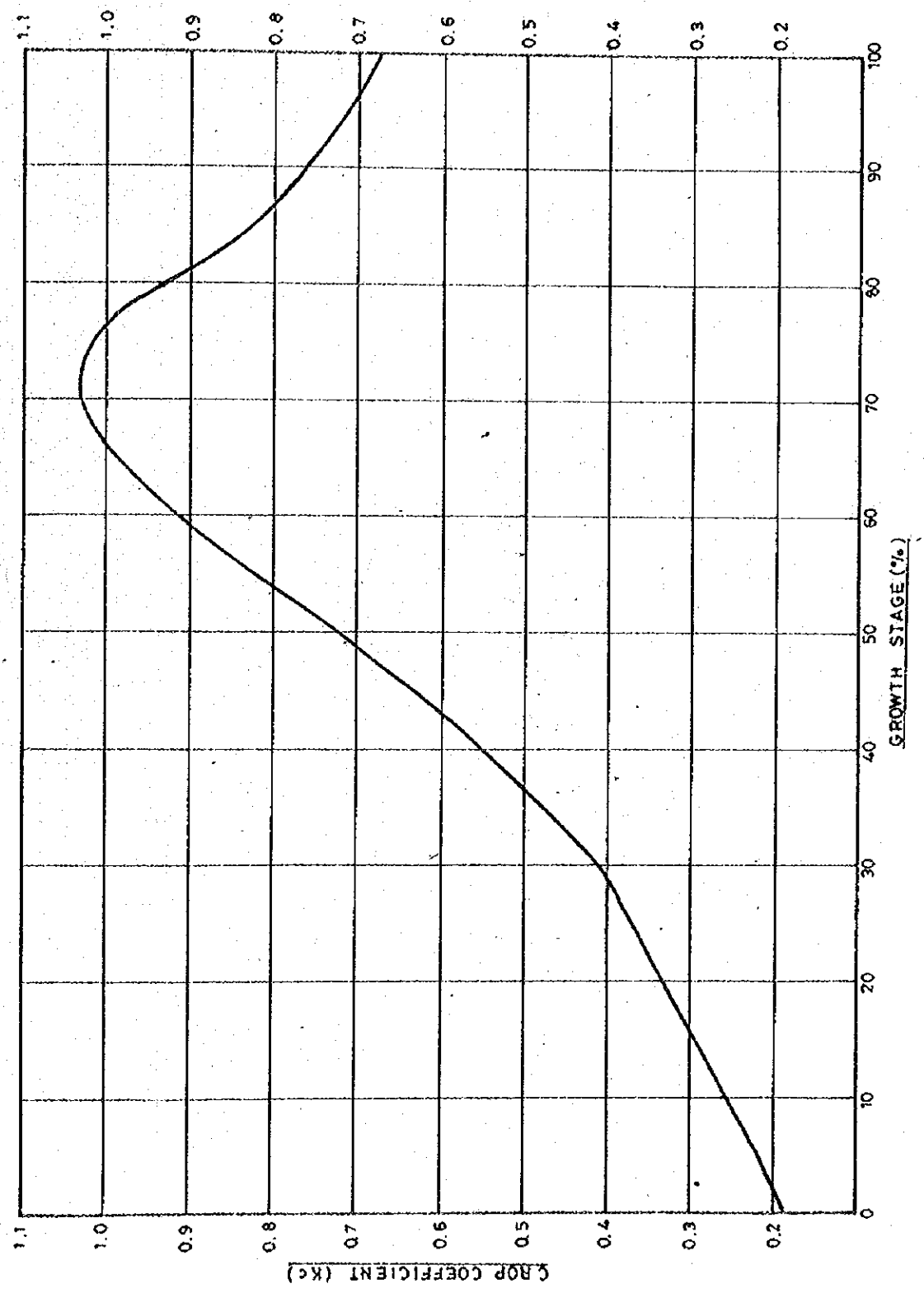
Note : C.P. is the abbreviation of Cropping Pattern.

Fig.IV-1 CROP COEFFICIENT CURVE FOR PADDY



× Observed at Cintamanis (Wet season)
• —— do —— (Dry season)
○ Observed at Belitang (Wet season)
△ —— do —— (Dry season)

Fig.IV-2 CROP COEFFICIENT CURVE FOR SOYBEANS



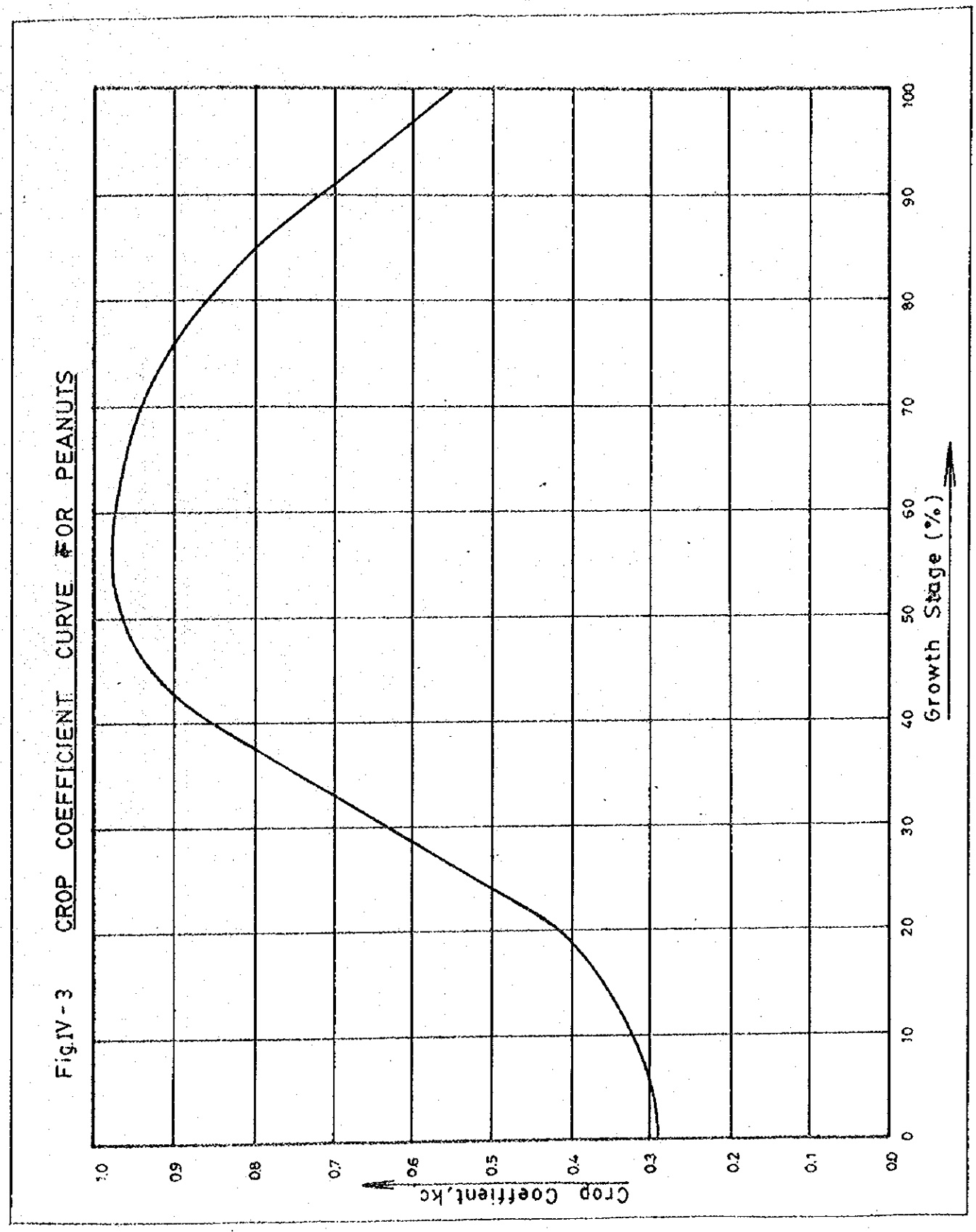
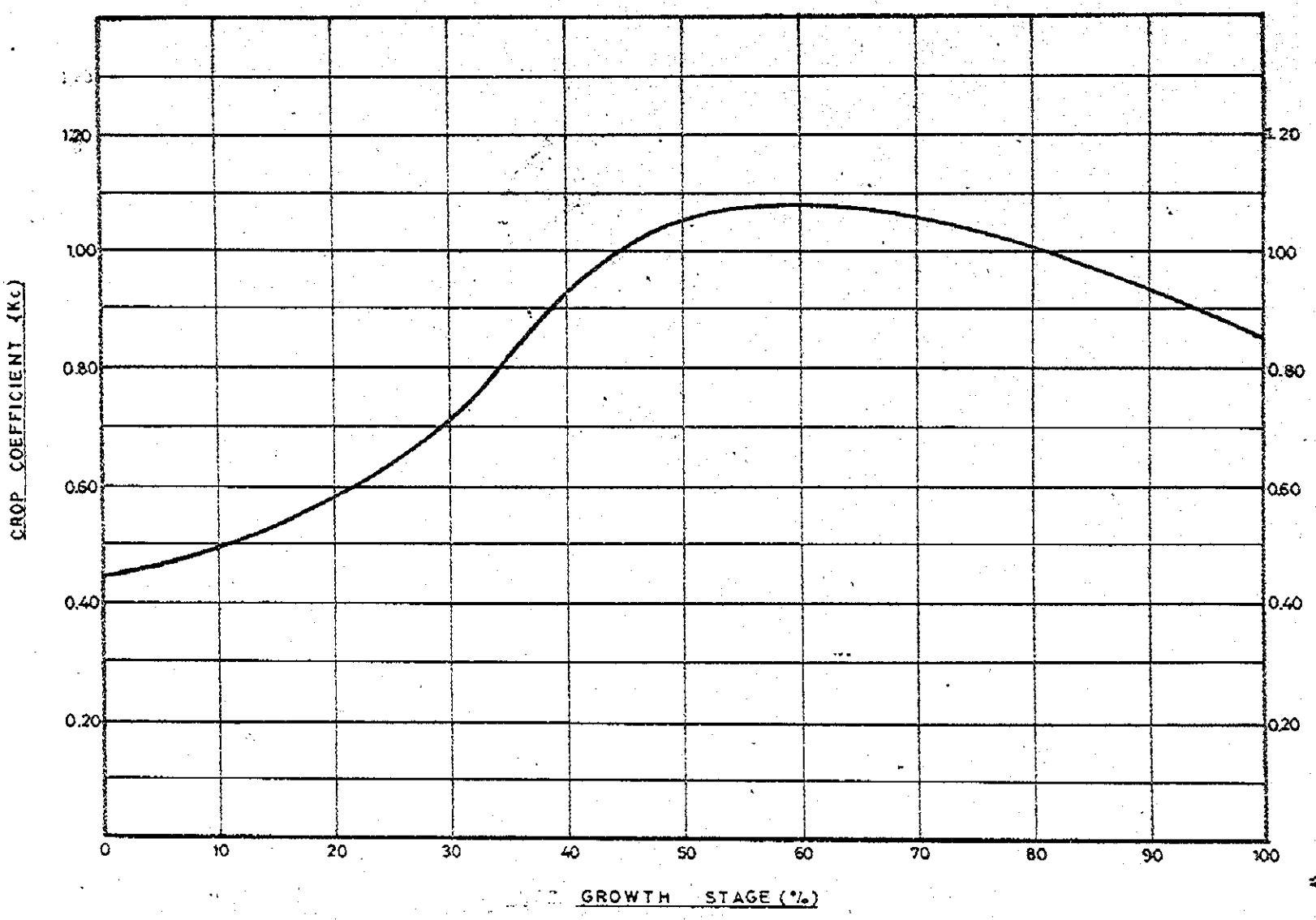
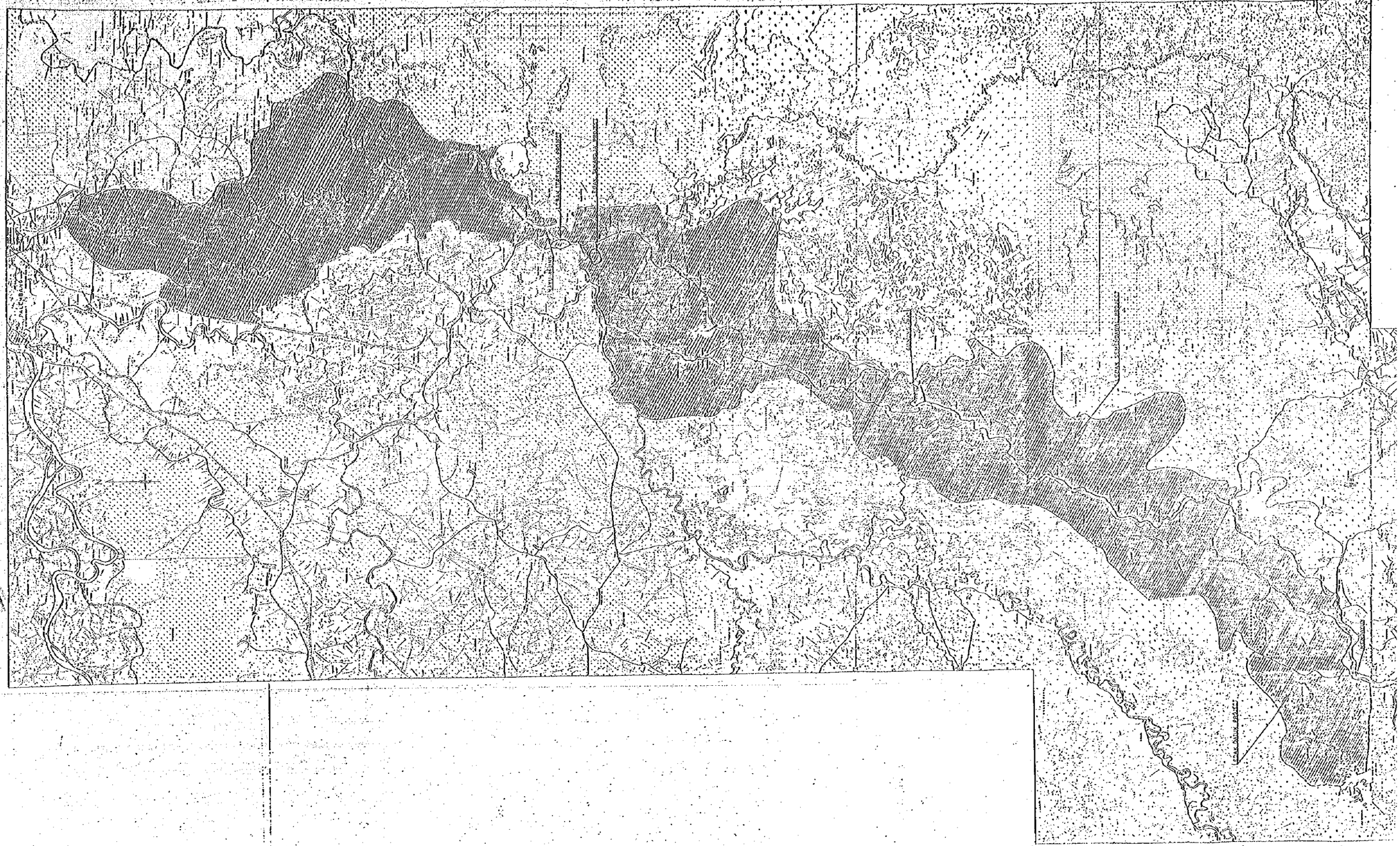


Fig.IV-3 CROP COEFFICIENT CURVE FOR PEANUTS
Crop Coefficient, kc
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
Growth Stage (%)

Fig.IV-4 CROP COEFFICIENT FOR MAIZE





DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
THE UPPER KOMERING RIVER
BASIN DEVELOPMENT PROJECT

TITLE OF DRAWING
LOCATION MAP OF LESAK
DEVELOPMENT AREA

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

Fig.IV-5

ANNEX V HYDROPOWER DEVELOPMENT

5.1 GENERAL

The Upper Komering River involves a significant potential of hydropower development in its basin. It drains the north-eastern slopes of southern part of the Bukit Barisan running along the whole length of Sumatra Island where the annual rainfall is reported more than 2,500 mm and runs down on a considerably steep slope resulting in many cascades and rapids on its course. The drops along the Upper Komering from the Lake Ranau, which water level is situated at El. 542 m, to the Muaradua damsite are about 420 m in the total. The catchment area is measured as 2,866 km^2 at the Muaradua site and the run-off is estimated as 4,100 million m^3 per annum. The Lake Ranau situated in the upmost of the river has an area of 127 km^2 at the water surface and regulates the runoff from the basin of 508 km^2 throughout the year.

The first objective of development of the Upper Komering is planned to enhance the agricultural products in Belitang Extension Area of 48,000 ha and Tulang Bawang Area of 33,000 ha in South Sumatra and Lampung Provinces by irrigation. The plan of hydropower development at the Muaradua is worked out with a consideration that the first priority of available water is given to the agricultural sector.

Regarding the power market, it is envisaged to supply the power generated to such cities and towns over the South Sumatra and Lampung Provinces as Palembang, Tanjung Karang, Batu Raja, Kotabumi etc. where almost all of the power are generated now with petroleum.

The first study on the hydropower development of the basin was made by FAO Team and published as "Reconnaissance Planning Report, Belitang Extension Area Agricultural Development Project" in 1974. The Report has proposed 6 hydropower schemes of 142.8 MW in total between the Lake Ranau and the Muaradua site, on the basis of topographical maps in a scale of 1/100,000 when it was available.

5.2 FIELD ACTIVITY

The field activity carried out by the expert during a period from 5 October to 2 November 1979 could be classified into two in the nature:

I. Data collection and
II. Field reconnaissance and survey.

The records and information of electric power supply and distribution systems including development plans in South Sumatra and Lampung Provinces were collected mainly from PLN Wilayah IV Office and its Lampung branch.

The field reconnaissance has been carried out for 14 days in October. The expert looked in general aspects over the whole project area including farm land, and proceeded with the survey on the Upper Komering (named locally Way Selabung).

The survey carried out this time included cross-section survey along proposed dam axis on 5 sites and very rough leveling. The results of the cross sectional survey are compiled as seen in the attached Figs-V-1 to V-5, and the leveling is reflected to Fig.V-6 "Profile of the Selabung River".

So far the expert looked in, the following were felt by him:

I. The valley in the reaches from about 3 Km to 37 Km downstream of the Lake Ranau forms narrow, deep gorges. Fig.V-3 shows a typical shape of the gorge. The gorge in general seems too narrow to accommodate an above-ground power house at the bottom of the canyon.

II. In view of the geology mainly consisting of ignimbrite and tuff and the topography of the gorge, concrete dam would be suitable more than other types and the height would be limited to 60 - 70 m, as well as from the economical view-point.

III. In such conditions, the hydropower development would be better to be a dam and conduit type.

The objective of present survey was to collect more accurate and, recent data and information and review the previous study upon the findings obtained. The works have been planned to include the following:

i. To collect topographical and geological maps at damsite, so far as available,

ii. To make field reconnaissance over all promising sites proposed in FAO Report, so far accessible and

iii. To collect data and information of power demands and supply capacity in both the South Sumatra and Lampung Provinces and revise the forecast on the basis of recent data collected.

5.3 PRELIMINARY STUDY ON HYDROPOWER DEVELOPMENT

Taken into consideration the findings from the survey and reconnaissance mentioned in the previous sub-section and the topographical maps of 1/50,000, the FAO's proposal is reviewed. As the results of hydrological investigation were not presented yet, the available discharges for the schemes are appropriated from the FAO Report.

Remarkable discrepancy between the FAO's and this study is found in the reservoir capacity on the No.1 damsite. The study based upon the maps of 1/50,000 scale indicates 170 million m^3 in the gross storage below the HWL of El.430 m as shown in Fig.V-7. The high waterlevel of the reservoir here is set at El.430 m so as to avoid inundation of the coffee plantation extending above the said elevation. This results a reduction in the firm discharge by some amount.

Similar discrepancy, though not so big as above, happens in the Muaradua reservoir as seen in Fig.V-8, and the necessary capacity of about 400 million m^3 here is ensured by heightening the hight waterlevel by 3 m from the FAO's.

The skeleton of the hydropower development schemes envisaged this time is shown on the attached Fig.V-9. As seen in Fig.V-9, 4 schemes are worked out and brief descriptions of each scheme are given in turn from the upstream as follows:

i. Ranau Powerstation: Regulation weir will be provided at about 2 Km downstream of the outlet of the Lake, H.W.L. 542 m. Powerhouse will be constructed underground on the right bank and the outlet of the tailrace will be provided about 8 Km downstream of the weir site, T.W.L. 430 m. Total length of water way will be about 9.0 Km.

ii. Komering No.1 Powerstation: Dam will be built at about 200 m downsteam of the confluence of the W. Selabung with the Air Baru and the height will be about 80 m, H.W.L. 430 m and L.W.L. 410 m. Powerhouse will be located underground on the left bank and the outlet of the tailrace will be provided about 7 Km from

The Komering No.1 Dam, T.W.L. El.270 m. Total length of waterway will be about 7.5 Km.

iii. Komering No.2 Powerstation: Damsite is selected at about 4 Km upstream of Sukabumi Village and the height will be about 70 m. The H.W.L. is set at El.270 m so as to protect the coffee plantation from inundation. The powerstation will be located underground on the right bank. The tailrace outlet will be provided about 4 Km of the dam. T.W.L. El.175 m. The total length of waterway will be about 3.5 Km.

iv. Muaradua Powerstation: Dam will be built accross the Komering at about 300 m downstream of the confluence with the Saka river and on the low ridge between the Komering and the Saka in the left abutment. H.W.L. 142 m. The height of dam will be about 30 m. The powerstation will be constructed at the foot of the dam. T.W.L. El.115 m.

Due to the revision in the effective capacity of Komering No.1 reservoir as stated above, the firm discharge is reduced to 34.8 m^3/sec at the Komering No.1 Powerstation, while the FAO's is taken at 41.3 m^3/sec. The reduction in the firm discharge by 6.5 m^3/sec is done at the powerstations downstream.

Principal features of the hydropower development schemes taken up this time are summarized in the attached Table V-1. Generating capacity together with 4 proposed schemes amounts to 158.2 MW in the installed capacity, 150.4 MW in the dependable peak capacity and 1,084 GWh of energy a year, while those by the FAO's are 142.4 MW, 127.9 MW and 904 GWh respectively.

5.4 POWER MARKET STUDY

5.4.1 Present Power Situation

Power supplied in South Sumatra at present is limited to cities and town. No public power supply system exists in village level, but some few powers are privately supplied in the evening in the limited area. The following table shows power generating capacities installed by PLN (Perusahaan Umum Listrik Negara) as of March 1979 and the private enterprises as of September 1976 respectively in major cities in both South Sumatra and Lampung Provinces. The data were mainly obtained from the report titled "Implomentation Program of Palembang Electric Power System Project" prepared by PLN and PLN Exploitasi II in Palembang and Tanjung Karang.

Power Installed Capacities in South Sumatra and Lampung Provinces

Name of City	PLN[1]			Private[2]		Remarks
	Unit	Inst. Capacity (KW)	Max. Available Capacity (KW)	No. of Owner	Inst. Capacity (KW)	
South Sumatra						
Palembang	7	71,100	51,900	1	33,600	Pertamina
"				1	38,600	P.T.Pusri
"				18	11,575	
Baturaja	8	1,600		3	937	
Kayuagung	4	786				
Sekayu		436				
Lubuklinggau		1,664		2	50	
Lahat		550		1	1,600	
Muara Enim		No data		1	184	
Pagar Alam		936				
Tanjung Enim				1	19,072	P.N.Taba
Prabumulih				1	8,090	Pertamina
Sub-Total		77,072		29	113,708	

Lampung					
Tanjung Karang	8	16,368	14,750	34	4,049
Kotabumi	4	1,016		7	1,326
Metro	4	1,372		9	577
Lampung Selatan				30	5,600
Sub-Total		18,766		80	11,552

/1 As of Mar. 1979
/2 As of Sept. 1976

Some towns and private enterprice are provided with own generating facilities and is not interconnected each other yet. Accordingly, the power generated in each district has been supplying to the customers in the respective area only through 70 kV transmission lines, 20 kV, 12 kV or 7 kV distribution lines.

The annual energy consumption provided by PLN in 1978 in the major cities are shown in the followings and tabulated in detail in Table 5.2, Table 5.3 and Table 5.4.

City	Energy Generated (10^3KWH)	Energy Sold (10^3KWH)	Peak Load (KW)	House-hold (10^3Nos)	Custo-mer (10^3Nos)	Elect. Ratio (%)
Palembang	136,248	81,168	26,000	144.1	36.8	25.6
Baturaja	2,525	2,012	480	11.9	1.6	13.5
Kayuagung	1,527	963	290	9.2	1.0	10.6
Sekayu	371	282	70	20.4	0.4	2.1
Lubuk Linggau	2,894	2,315	550	10.6	1.5	13.9
Lahat	3,068	2,690	530	12.0	2.2	18.8
Muara Enim	1,234	1,172	240	7.8	1.2	15.0
Pagar Alam	533	382	110	14.7	0.8	5.4
Tanjung Karang	36,948	25,492	7,890	41.0	11.5	30.0
Metro	2,600	1,670	730	16.3	0.9	5.3
Kotabumi	3,199	2,056	755	14.2	1.1	7.7
Total	191,147	120,102	37,645	302.2	59.0	19.5

As seen in above Table, the electrification ratio in South Sumatra excluding rural villages was about 20% in 1978, which is considered to be far below from the actual demands in those area. Palembang had a majority in power generated at about 71% of the total and occupied about 62% of total customers in PLN and followed by Tanjung Karang.

As shown in Table V-2, the losses of transmission and distribution in Palembang and some other towns were very large i.e. 20% to 35% which is attributable to less maintenance activities as well as deterioration of the equipment.

The present power rates charged by PLN in 1979 are shown in the following table.

Category	Description	Rate (Rp./KWH)
A1	Household ≦200 VA	22.7
A2	Social purpose (mosque, school etc.)	24.1
B1	Household ≧250 VA	31.5
B2	Commercial purpose (lighting) ≧250 VA	42.4
C1	Industry ≧13,500 VA	36.5
C2	Municipal purpose (Government) 250 VA	27.7
D	Street lighting	23.1
E	More than 100 KVA	30.9
F	Incidental	70.8

5.4.2 Forecast of Future Power Demand

As shown in Fig. V-10 and Fig. V-12, the quantities of energy sold in Palembang and Tanjung Karang have increased at an average annual rate of about 11% and 10% respectively for the past five years from 1973 to 1978, which corresponds to the period of the Second Five Year Development Plan (Pelita II).

From very low electrification ratio even in the city areas so far, the power demand of waiting consumers will be inevitably increased.

In addition, it is expected that large power consumers except for Pertamina now having their own power facilities of about 72,018 KW in total in South Sumatra Province and about 11,500 KW in total in Lampung Province, will gradually switch their sources of power supply to the PLN system after their facilities depreciated.

From the above circumstances, it is considered that the power demand in these areas will increase rapidly with improvement of the living standard of the people which results in increasing of electrification ratio and industrialization of urban area as well as rural electrification in the village level under the Third Stage Five Year Development Plan, 1979/1980 to 1983/1984. An annual increase of the power demand during the above period is estimated by PLN to be 22 percent.

To cope with anticipated increase of the power demand, PLN prepared plans to reinforce and improve the power supply facilities including transmission and distribution lines in Palembang, Tanjung Karang and other areas.

From the many consideration as well as mentioned above, the annual average increase rate of 15% is tentatively estimated in this report for the period of the Third Stage Five Year Development Plan and the rate of 22% is assumed for the period after the Third Stage Development Plan.

Tables V-5 and V-6 and Figures V-10 to V-13 show the future power and energy demand till 1988 based on the above estimation. The annual power and energy demand in Palembang, Tanjung Karang and other areas in 1983 and 1988 are estimated as follows:

	1983		1988	
	Energy Demand (10^3 kWh)	Peak Load (kW)	Energy Demand (10^3 kWh)	Peak Load (kW)
Palembang	163,258	50,887	441,239	137,533
Tanjung Karang	47,780	14,824	129,135	40,065
Other areas	67,000	22,000	184,000	60,000
Total	278,038	87,711	754,374	237,598

In order to meet the power demand increase in the future and in order to save consumption of expensive, irrecoverable fossil fuel, development of hydroelectric power in the upper basin of the Komering river including the Lake Ranau and construction of transmission and distribution network had better be promoted at the early convenience.

Table - V-1 Principal Features of Hydro-Power Scheme

		Ranau	Komering		Muaradua	Total
			No.1	No.2		
Catchment area	(Km^2)	508	1,056	1,169	2,866	
Reservoir						
HWL	(El.m)	542	430	270	142	
LWL	(El.m)	539.5	410	268	230	
Capacity	($10^6 m^3$)	270	118	-	260	
Discharge						
maximum	(m^3/sec)	32.2	58.0	59.2	119.8	
Firm	(")	19.3	34.8	35.5	71.9	
Head						
TWL	(El.m)	430	270	215	115	
Effective	(m)	97	139	88	21.5	
Output						
Installed capacity	(kW)	26,000	67,200	43,400	21,500	158,100
Firm	(")	16,800	42,900	27,000	12,800	99,500
Dependable Peak power	(kW)	25,800	64,000	43,100	17,500	150,400
Annual energy	(10^6 kWh)	136.5	473.1	320.7	153.3	1,083.6
Primary "	(")	136.5	375.8	236.5	112.1	860.9
Secondary "	(")	-	97.3	84.2	41.2	222.7

Table V-2: POWER GENERATED AND SOLD IN SOUTH SUMATRA PRO. (1)

Year	Generated 10^3 KWH	St.Service 10^3KWH	Delivered to T/L 10^3 KWH	Trans. Losses 10^3KWH	Trans. Losses %	Delivered to D/L 10^3 KWH	Dist.Losses 10^3KWH	Dist.Losses %	Sold 10^3KWH
1) Palembang									
1970	54,130								
1971	60,273	1,002				59,270	12,585		46,685
1972	61,726	969	60,757			60,757	13,938	22.94	46,819
1973	62,718	849				61,869	13,483	22.27	48,086
1974	86,198	4,174	79,023	396	1.48	78,628	22,844	29.05	55,784
1975	104,159	12,221	91,938	1,505	1.64	90,433	28,129	30.59	62,306
1976	114,432	12,230	102,162	1,497	1.44	100,685	34,105	33.38	66,580
1977	126,116	11,717	112,509	1,911	1.68	111,597	42,207	37.82	69,372
1978	136,248	12,893	123,354	2,700	2.19	120,720	39,551	32.84	81,168
1979	71,159 /1	5,312	65,945	2,298	3.48	63,645	16,573	26.0	47,074

Note: /1 From January to June
T/L Transmission Losses
D/L Distribution Losses

Table V-2: POWER GENERATED AND SOLD IN SOUTH SUMATRA PRO. (2) continued

Year	Generated 10^3 KWH	Station Use 10^3 KWH	Delivered to 10^3 T/L 10^3 KWH	Transmission Losses 10^3KWH	%	Delivered to 10^3 D/L 10^3 KWH	Distribution Losses 10^3KWH	%	Sold 10^3KWH
2) Baturaja									
1974	1,501	115				1,373	133	9.71	1,247
1975	1,671	129				1,543	210	13.6	1,333
1976	1,859	146				1,713	238	13.9	1,476
1977	2,104	152				1,927	249	15.3	1,633
1978	2,525	167				2,370	358	15.1	2,012
1979	1,387	87				1,301	189		1,112
3) Kayu Agung									
1974	562	6.6				556	66.7	14.3	489
1975	602	6.8				596	86.9	14.6	509
1976	675	7.1				668	154	23.0	514
1977	1,364	31.0				1,253	540	43.1	712
1978	1,527	89.9				1,438	476	33.09	963

Table V-2: POWER GENERATED AND SOLD IN SOUTH SUMATRA PRO. (3) continued

Year	Generated 10^3 KWH	Station Use 10^3 KWH	Delivered to T/L 10^3 KWH	Transmission Losses 10^3KWH	Transmission Losses %	Delivered to D/L 10^3 KWH	Distribution Losses 10^3KWH	Distribution Losses %	Sold 10^3KWH
4) Sekayu									
1976	69.6 /1	5.6				64.0	13.5	21.07	50.5
1977	237.7	14.0				223.7	50.1	22.4	173.6
1978	371.3	35.2				336.1	53.9	16.0	282.2
5) Lubuk Linggau									
1973	1,013	12				1,091	89	8.14	1,002
1974	1,224	24				1,200	87	7.26	1,113
1975	1,266	41				1,225	65	5.35	1,160
1976	1,324	32				1,305	116	8.92	1,188
1977	1,583	49				1,535	138	9.03	1,397
1978	2,894	266				2,628	312	11.87	2,315
1979	1,937 /1	156				1,780	304	17.08	1,476

/1 Started from June

/ January through June

Table V-2: POWER GENERATED AND SOLD IN SOUTH SUMATRA PRO. (4) continued

Year	Generated 10^3 KWH	St. Service 10^3 KWH	Delivered to T/L 10^3 KWH	Transmission Losses 10^3KWH	Transmission Losses %	Delivered to D/L 10^3 KWH	Distribution Losses 10^3KWH	Distribution Losses %	Sold 10^3KWH
6) Lahat									
1973	1,059					1,059	40	5.10	1,044
1974	1,698					1,698	51	3.01	1,649
1975	2,332					2,332	245	10.53	2,086
1976	2,684					2,684	361	13.46	2,321
1977	2,597	0.6				2,971	397	13.36	2,574
1978	3,068	63				3,002	311	10.36	2,690
1979	2,085 /1	124				1,963	287	14.62	1,675
7) Muara Enim									
1974	907					907	22	2.49	885
1975	962	4				958	13	13.42	925
1976	1,057					1,057	38	3.62	1,019
1977	1,187					1,187	70	1.65	1,167
1978	1,234					1,234	62	5.02	1,172
8) Pager Alam									
1977	309	3				106	4	4.19	106
1978	533	125				412	34	8.40	382
1979	440 /1	45				395	18	4.55	378

/1 January through June

/ From January through June

Table V-3 POWER DEMAND IN PALEMBANG CITY AREA

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Average Increase Rate
Peak load (KW)	9,200	9,250	9,300	-	-	-	-	-	-	-	25,300	
Increase rate (%)	-	+0.54	+0.54	-	-	-	-	-	-	-	-	10.65%
Energy (10^3KWh)												
Generated	48,801	53,230	54,130	60,272	61,726	62,718	86,198	104,159	114,432	126,116	136,248	
Sold	36,970	40,052	40,822	46,685	46,819	48,086	55,784	62,306	66,580	69,372	81,168	
Increase rate (%)	-	+8.34	+1.92	+14.36	+0.29	+2.71	+16.01	+11.69	+6.86	+4.19	+17.00	8.18%
Annual load factor (%)	60.44	65.69	63.91	-	-	-	-	-	-	-	61.48	
Energy loss factor (%)	24.24	24.76	21.60	22.54	24.15	23.33	35.28	40.18	41.82	44.99	40.43	
No. of household	-	109,312	112,591	117,793	121,300	124,855	128,483	132,201	136,032	139,998	144,113	
No. of customer	20,398	20,585	21,122	-	-	23,586	24,802	26,438	27,999	29,703	36,322	
Increase rate (%)	-	+0.92	+2.61	-	-	-	+5.16	+6.60	+5.90	+6.09	+22.28	5.94%
Electrification ratio (%)	-	18.83	18.76	-	-	18.89	19.30	20.00	20.58	21.22	25.20	
Peak load/No. of customer (KW)	0.451	0.449	0.440	-	-	-	-	-	-	-	0.697	

Table V-4 POWER DEMAND IN TANJUNG KARANG CITY AREA

	1974	1975	1976	1977	1978	Average Increase Rate
Peak load (KW)	3,780	4,280	4,530	5,630	7,370	
Increase rate (%)	-	+13.23	+5.84	+24.28	+30.91	18.17%
Energy (10^3 KWh)						
Generated	-	23,034	24,546	28,138	33,914	
Sold	-	18,036	19,280	21,390	23,755	
Increase rate (%)	-	-	+6.90	+10.94	+11.06	9.62%
Annual load factor (%)	-	61.44	61.86	57.05	52.53	
Energy loss factor (%)		21.702	21.45	23.98	29.96	
No. of household	-	-	-	-	41,000	
No. of customer	8,730	9,049	9,450	10,260	11,467	
Increase rate (%)	-	+3.65	+4.43	+8.57	+26.08	10.33%
Electrification ratio (%)	-	-	-	-	30.0	
Peak load/No. of customer (KW)	0.433	0.473	0.479	0.549	0.570	

Table V-5 ESTIMATE OF ANNUAL ENERGY AND PEAK DEMAND
(Palembang City Area)

Year	Annual energy sold (MWh)	Peak (KW)	Annual growth rate (%)	Remarks
1966	36,616	7,700	-	
1967	32,804	5,400	-29.87	
1968	36,970	9,200	70.37	
1969	40,052	9,250	0.54	
1970	40,822	9,300	0.54	
1971	46,685			Actual data
1972	46,819			
1973	48,086			
1974	55,784			
1975	62,306			2nd stage five year development (74/75 to 78/79)
1976	66,580			
1977	69,372			
1978	81,168	25,300		
1977	93,343	29,095	15.0	
1980	107,345	33,459	"	3rd stage five year development (79/80 to 83/84)
1981	123,446	38,478	"	
1982	141,963	44,250	"	
1983	163,258	50,887	"	
1984	199,175	62,082	22.0	
1985	242,993	75,740	"	
1986	296,452	92,403	"	
1987	361,671	112,732	"	
1988	441,239	137,533	"	

Table V-6 ESTIMATE OF ANNUAL ENERGY AND PEAK DEMAND
(Tanjung Karang City Area)

Year	Annual energy sold (MWh)	Peak (KW)	Annual growth rate (%)	Remarks
1974	-	3,780	-	2nd stage five year development (74/75 ro 78/79)
1975	18,036	4,280	13.23	
1976	19,280	4,530	5.84	
1977	21,390	5,630	24.28	Actual data
1978	23,755	7,370	30.91	
1979	27,318	8,476	15.0	
1980	31,416	9,747	"	3rd stage five year development (79/80 to 83/84)
1981	36,128	11,209	"	
1982	41,548	12,890	"	
1983	47,780	14,2824	"	
1984	58,292	18,085	22.0	
1985	71,116	22,064	"	
1986	86,761	26,918	"	
1987	105,849	32,840	"	
1988	129,135	40,065	"	

Fig V - 1 RIVER CROSS SECTION OF RANAU REGULATING DAM SITE.

Scale: 1 / 1.000

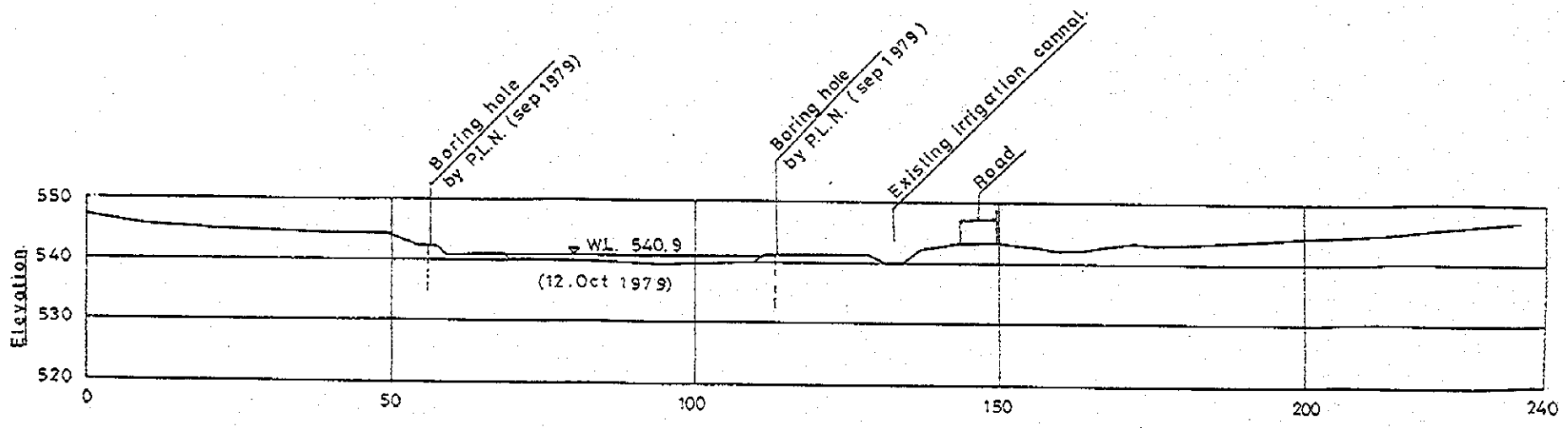


Fig V - 2 RIVER CROSS SECTION OF KOMERING NO.1 DAM SITE

Scale : 1 / 1.000

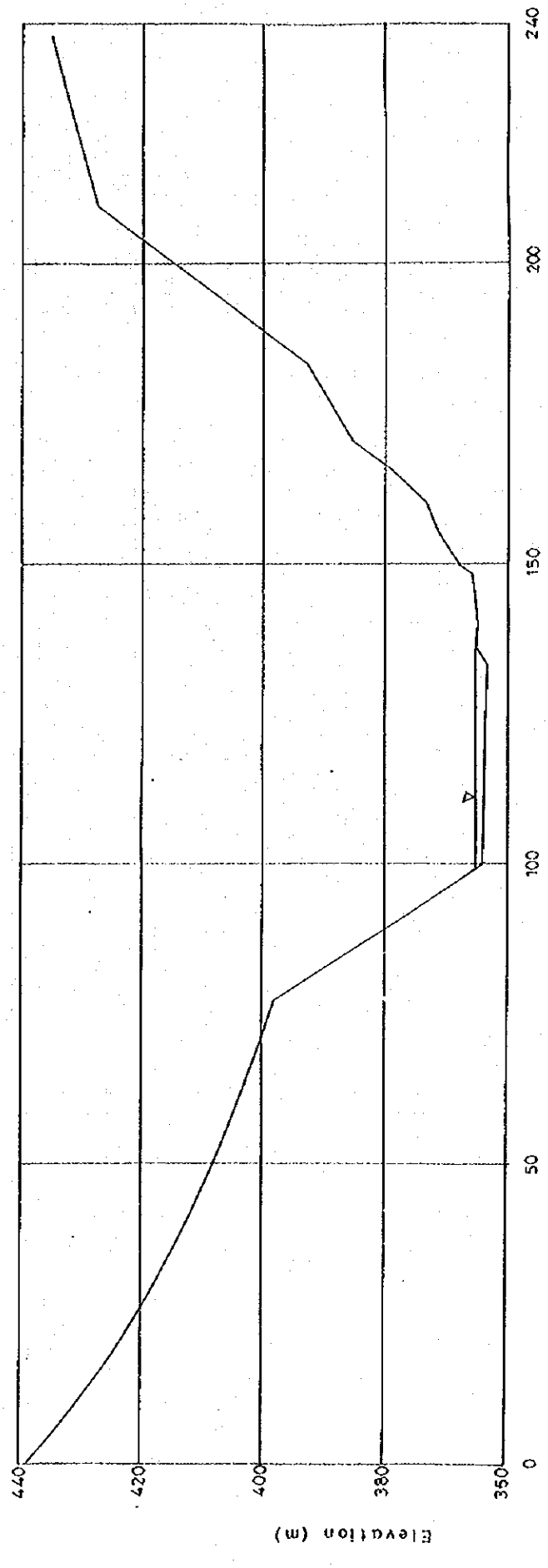


Fig.V - 3 RIVER CROSS SECTION OF KOMERING NO.2 DAM SITE.

Scale : 1 / 1.000

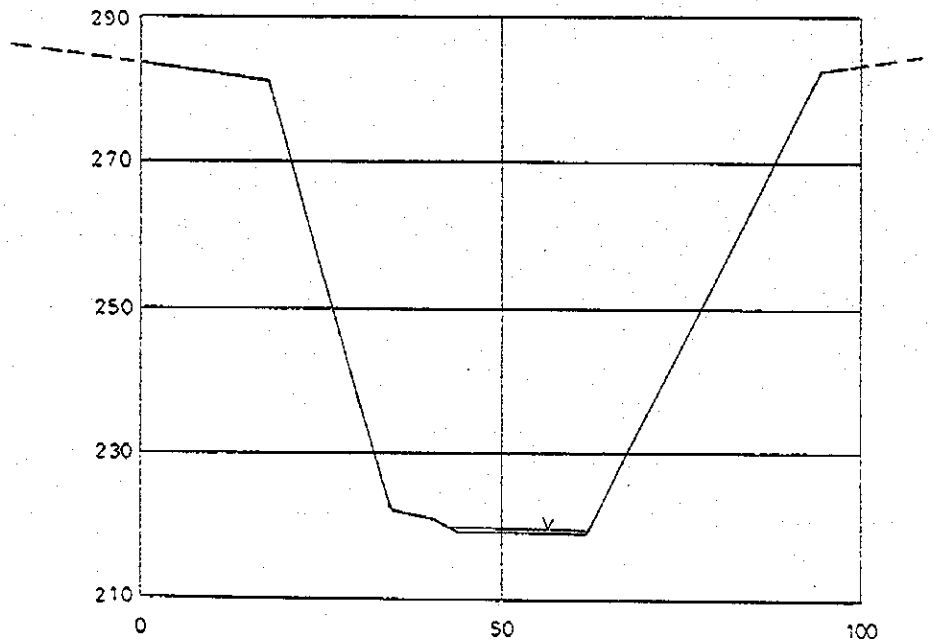


Fig. V - 5 RIVER CROSS SECTION OF MUARADUA DAM SITE.

Scale: V : 1 / 1.000
H : 1 / 2.000

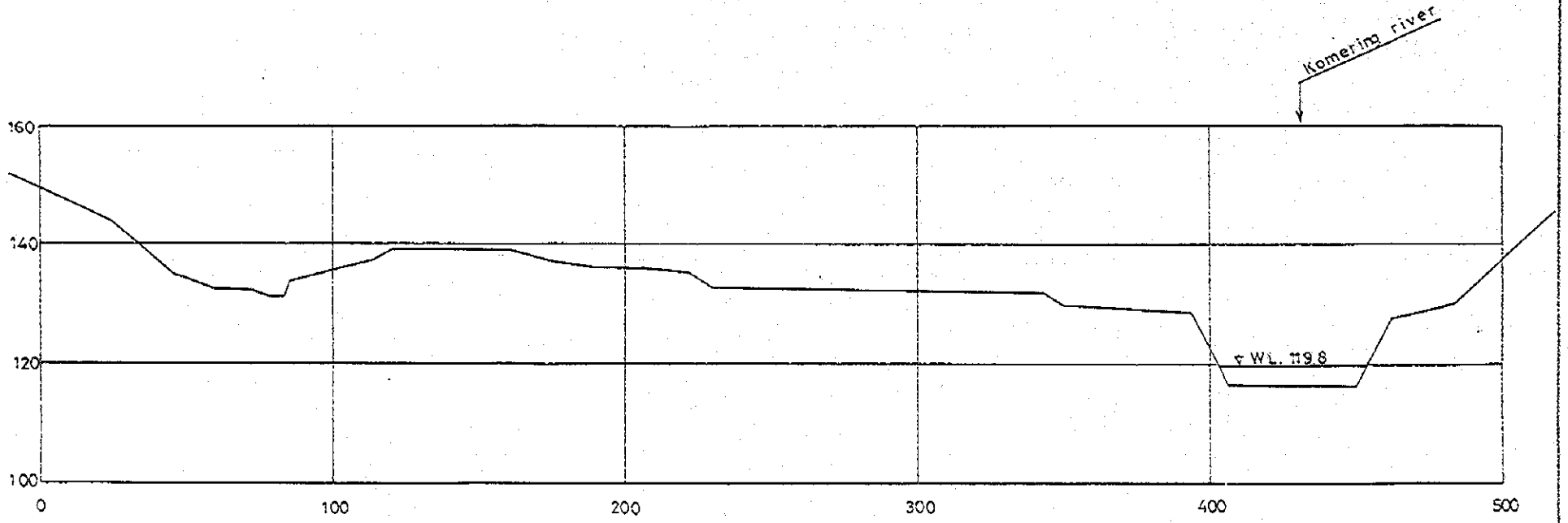


Fig. V-6 PROFILE OF THE SELABUNG RIVER

For Hydro-power Development Schemes of Upper Komering river basin

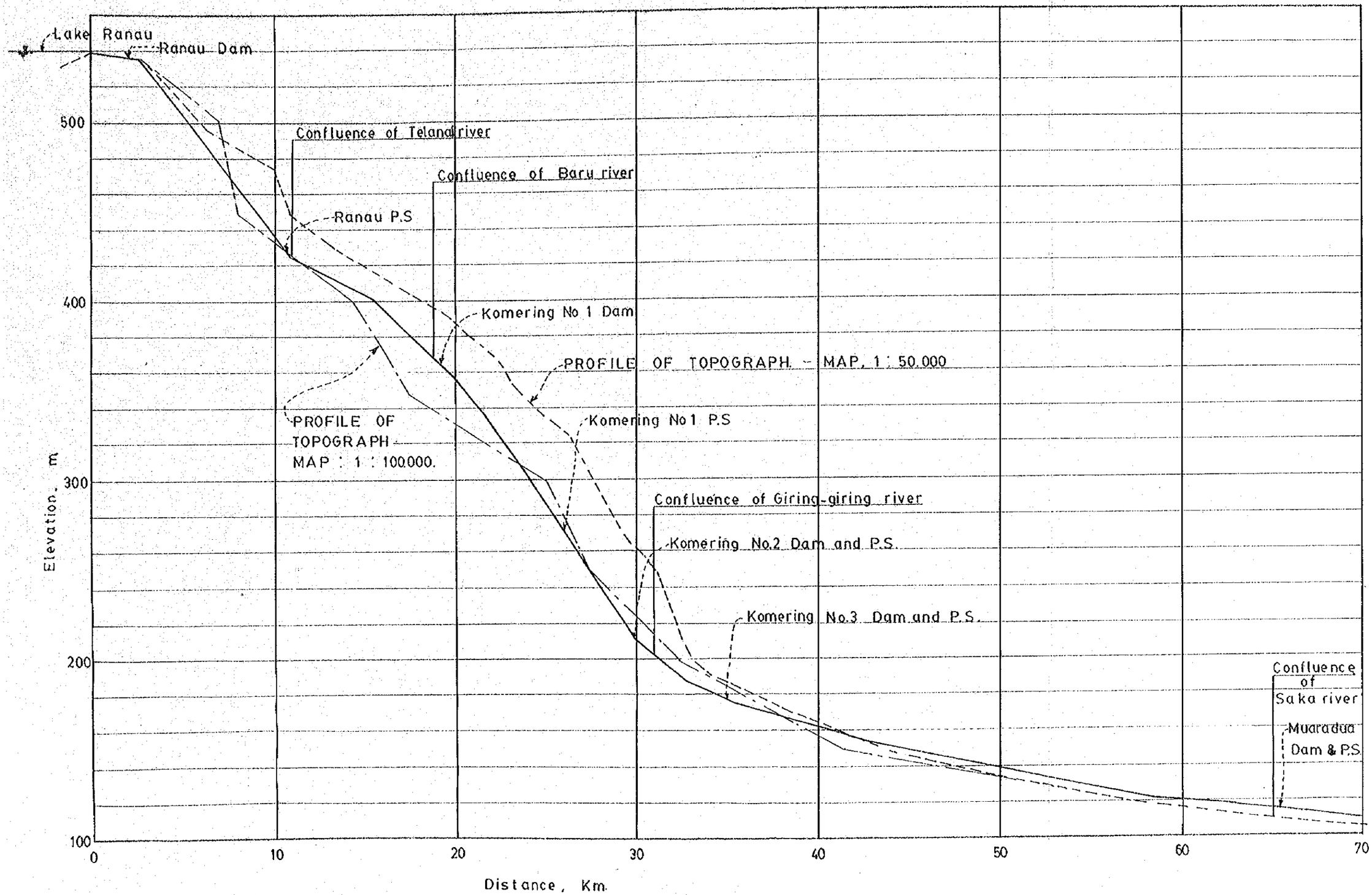
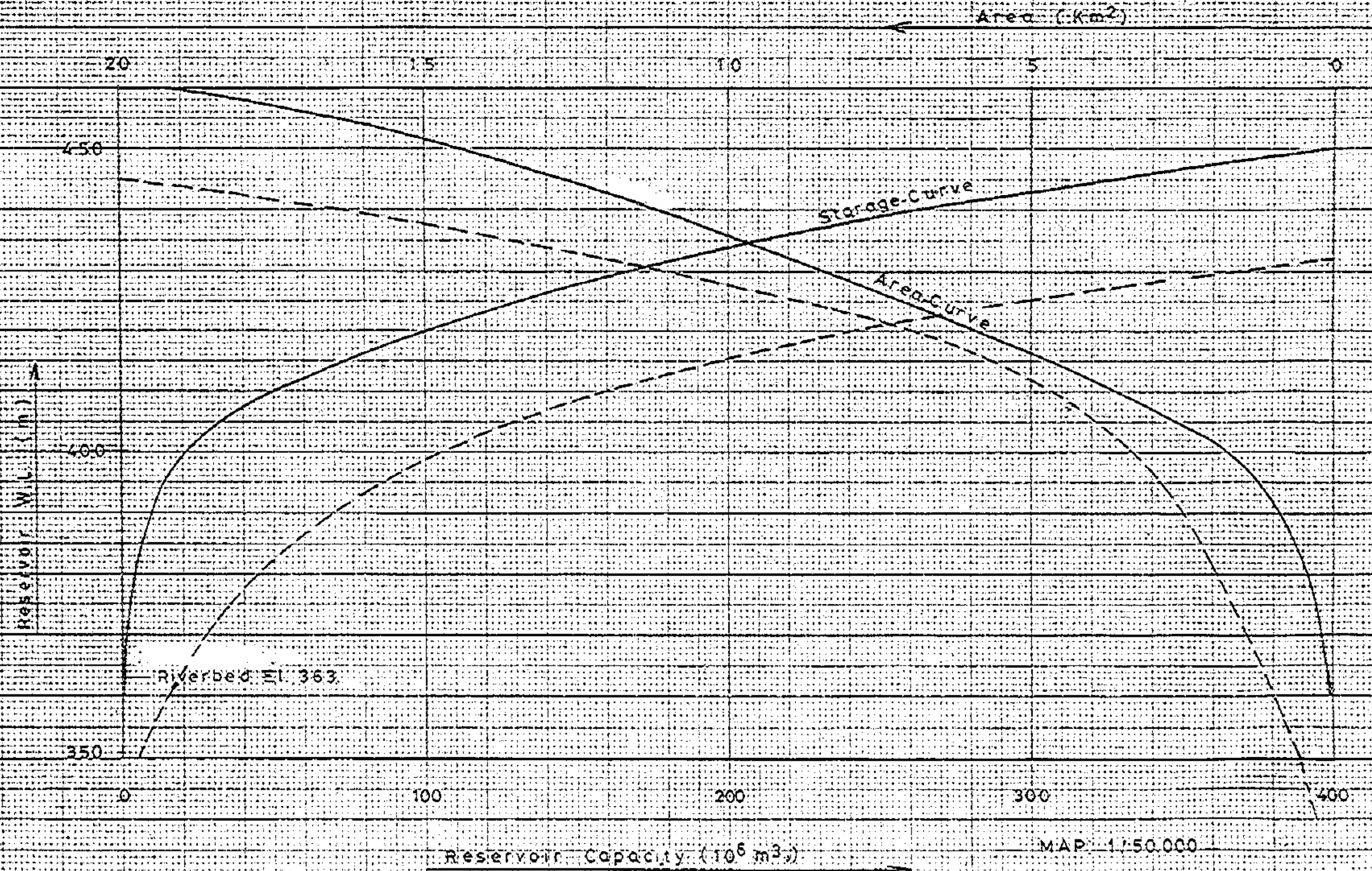


Fig V-7 AREA STORAGE CURVE KOMERING NO. 1



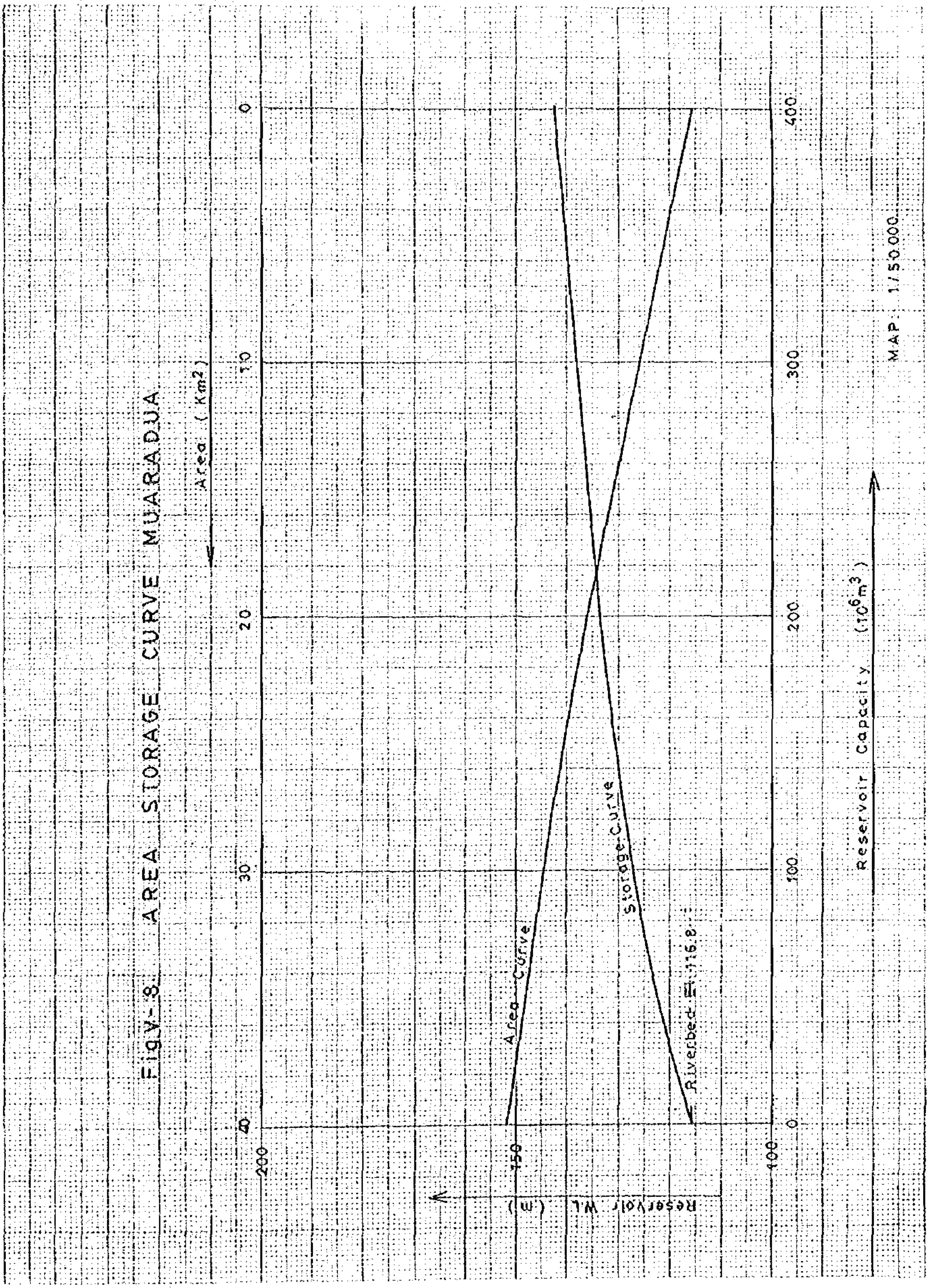


Fig.V-8 AREA STORAGE CURVE MUARADUA
Area (Km2)
0
10
20
30
40
400
300
200
100
0
200
150
100
Area Curve
Storage Curve
Riverbed EL.116.8
Reservoir Capacity (10⁶m³)
Reservoir W.L (m)
MAP 1/50000

Fig. V-9 KOMERING HYDRO-POWER DEVELOPMENT SCHEME

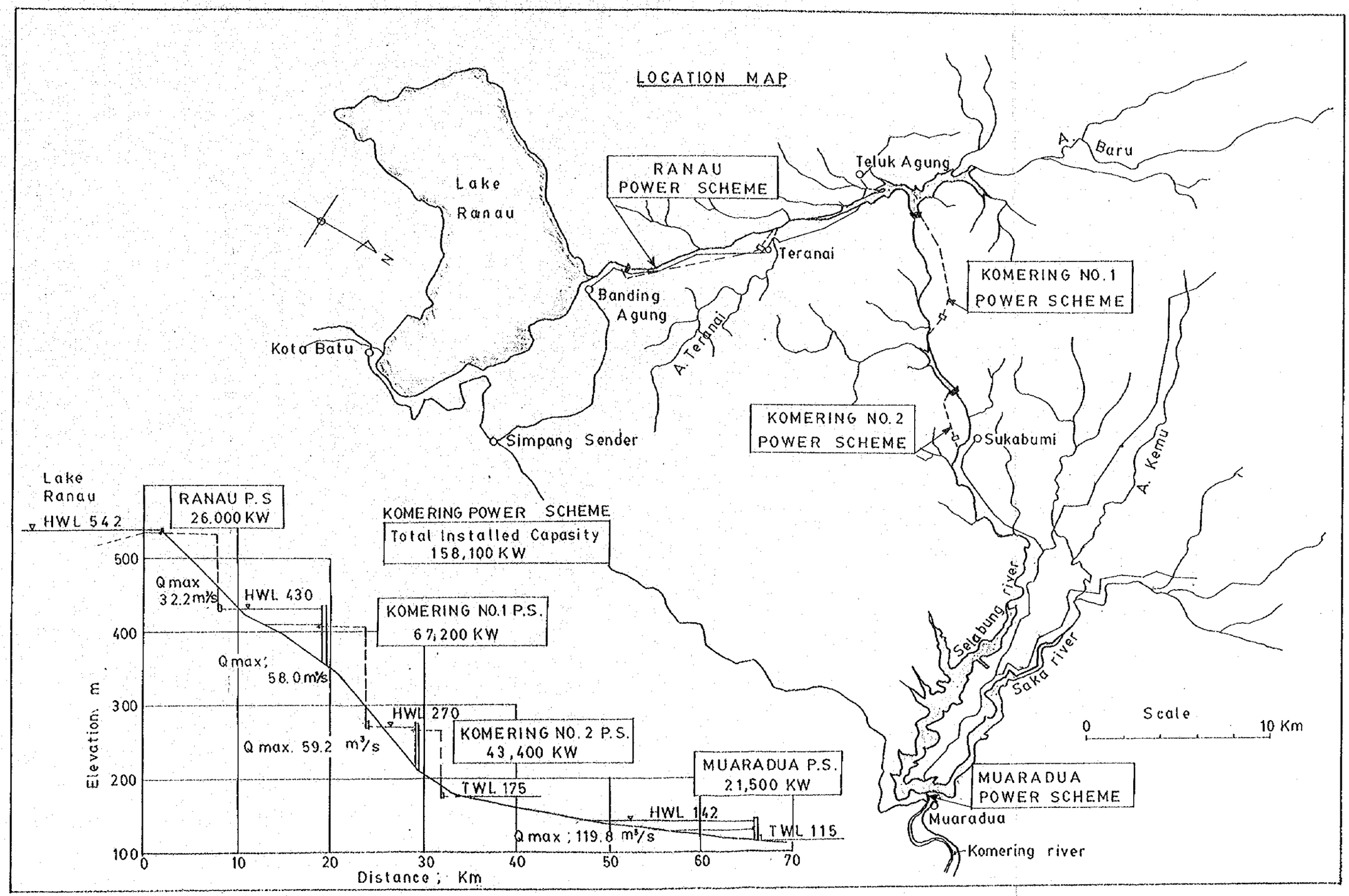


Fig. V-10 DEMAND FORECAST IN PALEMBANG
(ANNUAL ENERGY)

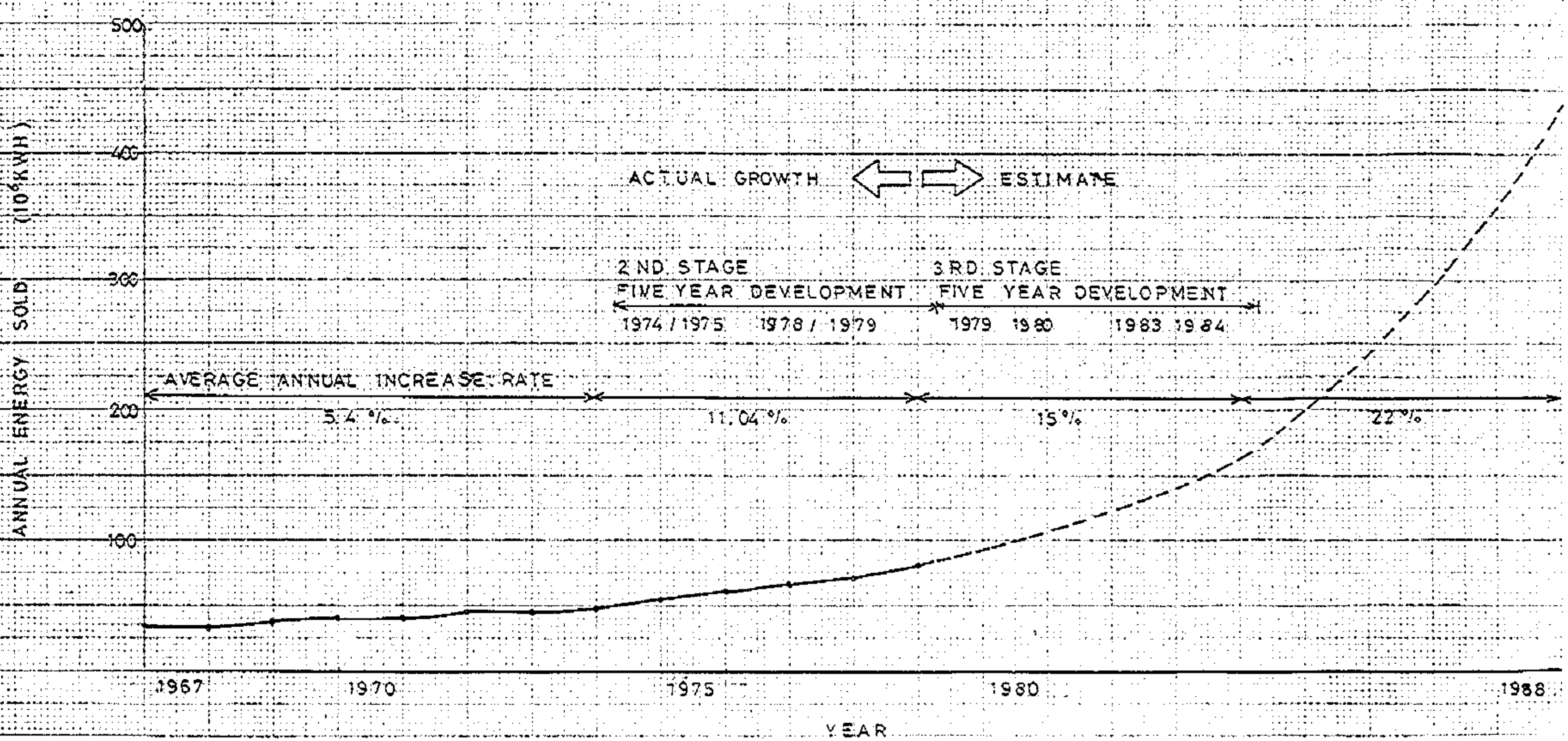


Fig. V-11 DEMAND FORECAST IN PALEMBANG

(PEAK LOAD)

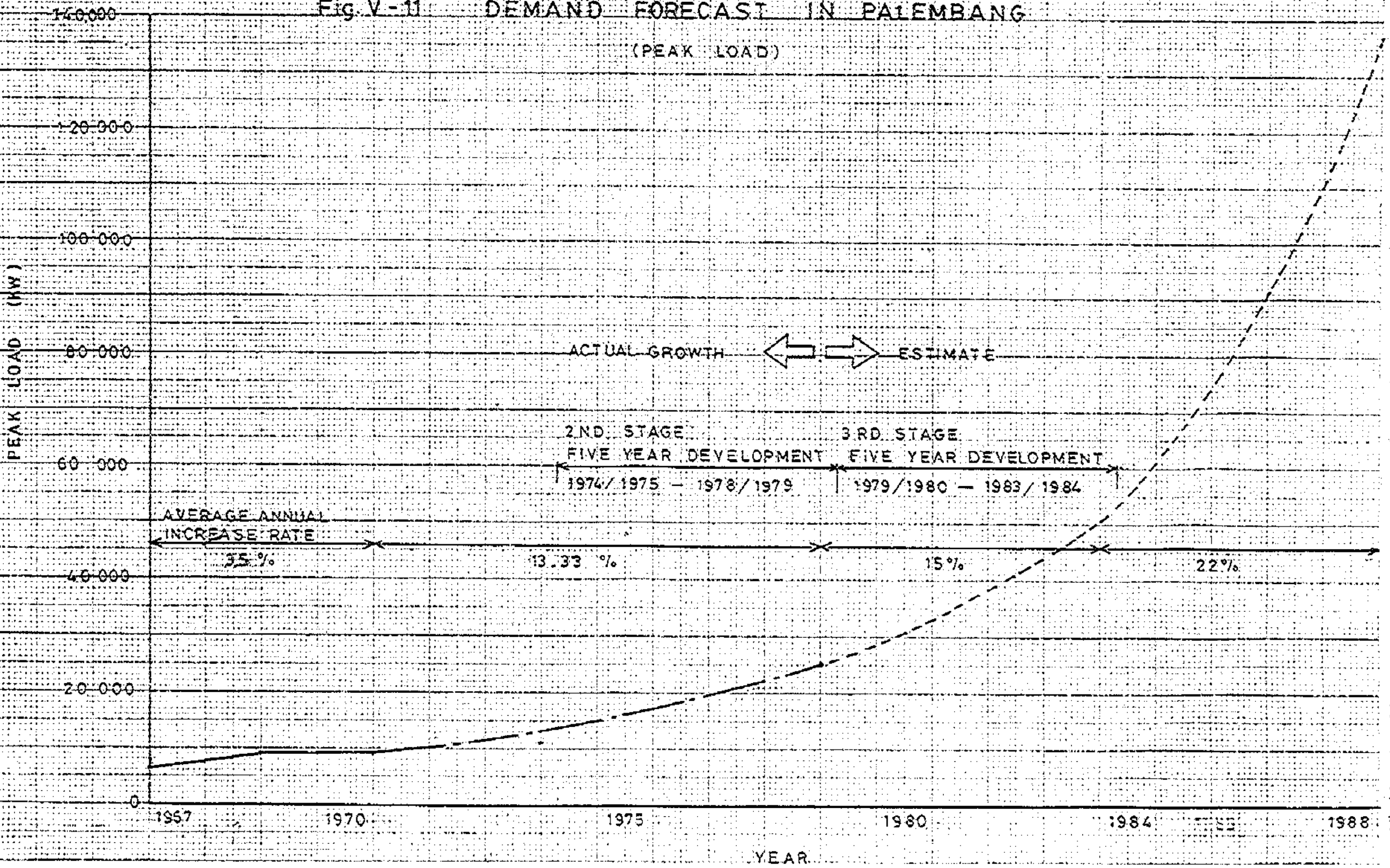


Fig V-12 DEMAND FORECAST IN TANJUNG KARANG

(ANNUAL ENERGY)

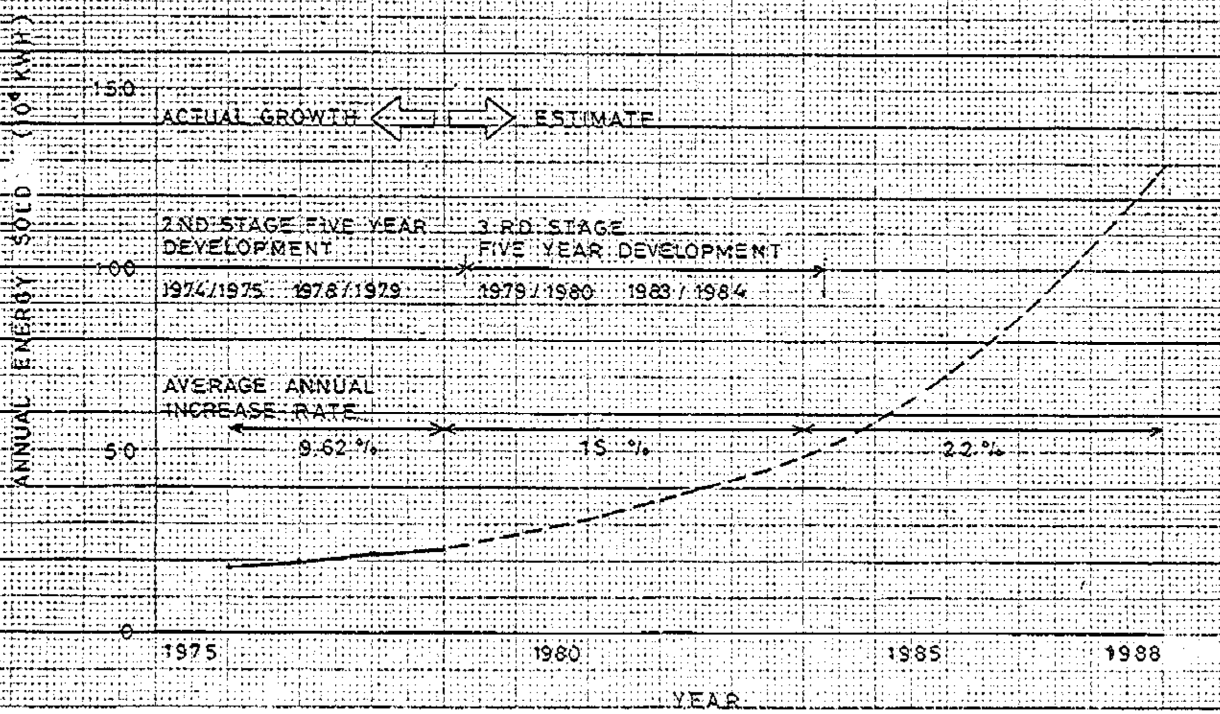


Fig V-13 DEMAND FORECAST IN TANJUNG KARANG

(PEAK LOAD)