10. Compilation

10-1 Summary

Two kinds of compilations were executed: one is for the preparation of the photomap and the other is for the thematic map. Common conditions for both categories are the sheet size is 72cm x 85cm and that polyester sheet of #300 thickness is used.

10-2 Compilation of Photomap

To prepare the compilation manuscript of the photomap, following considerations were taken:

a. Based on the controlled photo mosaic, manuscript of the photomap shall be compiled by laying down contour lines and spot heights obtained from photogrammetry (plotting), position of horizontal and vertical control points obtained from geodetic control survey and pricking and administrative names, geographical names, names of principal public buildings and classification of roads for four wheeled vehicles collected in the field survey. Four corners of neat lines and control points shall be plotted by coordinate graph. Plotting error shall not be more than 0.2mm on the map.

b. For preparing notation sheet, the location, letter size, letter style, letter space, etc. of notation items shall be followed in accordance with the lettering rules given in Tab. 10.1. An example of the notation sheet is shown in Fig. 10.1.

LETTERING RULES							
CLASSIFICATION		SIZE		SPACE	STYLE TYPESETTING	SAMPLE	
IBU KOTA KABUPATEN		5.0 mm	15 pt	1/4 ~ 1/2	NEWS GOTHIC E08-24	BARABAI	Caps
KECAMATAN		4.5 mm	14	1/4	〃	KEC. PANDAWAN	〃
IBUKOTA(KECAMATAN)		4.0 mm	12	〃	〃	KASARANGAN	〃
VILLAGE(DESA)		3.0 mm	10	1/4 ~ 1/2	〃	Timbuk Bahalang	U/L
RIVER	(BIG)	4.0 mm	12	1/4 ~ 1/1	NEWS GOTHIC ITALIC E08-25	*S.Negara*	〃
	(SMALL)	3.0 mm 2.5 ~ 3.5	10 8~11	〃	〃	*S.Tanbatan Babau*	〃
BUILDING		2.5 mm	8	1/4	NEWS GOTHIC CONDENSED E08-22	MESTIO JAMI	Caps
CONTROL POINT AND SPOT HEIGHT		2.0 mm	7	1/4	NEWS GOTHIC E08-24	△23.15	
SPOT HEIGHT(PHOTOGRAMMETRC)		1.5 mm	5.5	1/4	NEWS GOTHIC ITALIC E08-25	*12.5*	
GRID VALUES		2.0 mm	7	1/4	NEWS GOTHIC E08-24	9760	
SHEET INDEX		2.5 mm	8	1/4	〃	IV-7	
ADMINISTRATNIVE BOUNDARIES	(KABUPATEN)	2.5 mm	8	1/4	〃	KAB. HULU SUNGAI TENGAH	Caps
	(KECAMATAN)	2.0 mm	7	1/4	〃	KEC. LABUAH AMAS UTARA	〃
SHEET NUMBER		4.5 mm	14	1/4	〃	IV-7	
LAND CLASSIFICATION etc		1.8 mm	6	1/4	〃	Sawa	U/L

Tab. 10.1 Lettering Rules

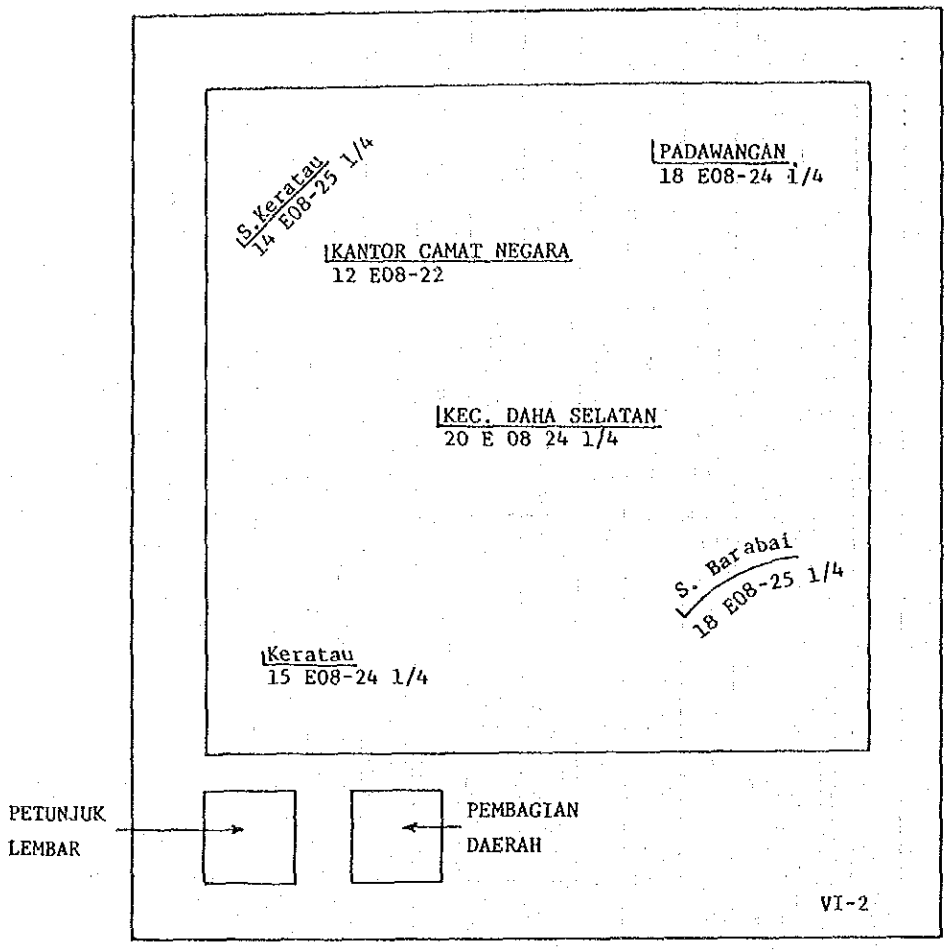


Fig. 10.1 Notation Sheet

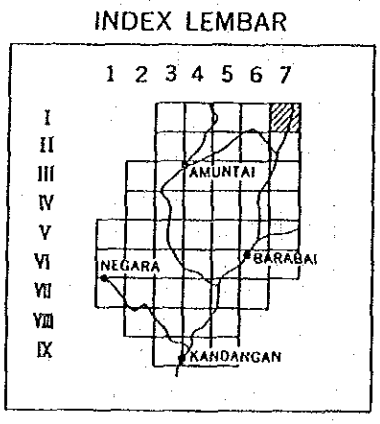


Fig. 10.2
Sheet Index

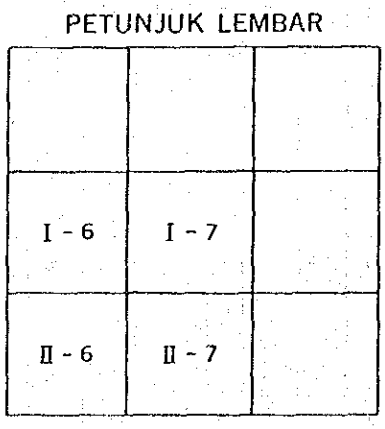


Fig. 10.3
Adjoining Sheet Index

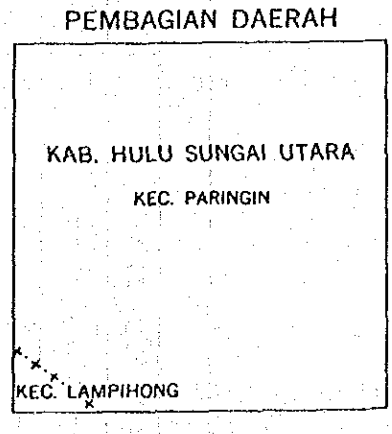


Fig. 10.4
Diagram of Administrative Boundaries

c. Neat lines shall be 6km x 6km. UTM zone No.50 shall be adopted for the coordinate system.

d. Sheet number shall be determined locally as shown in Fig. 10.2, where the number shown by hatch corresponds to I -7.

e. On the notation sheet, diagrams showing adjoining sheets (Fig. 10.3) and administrative boundaries (Fig. 10.4) shall be attached. The smallest unit showing administrative boundaries shall be Kecamatan. They shall not be shown inside the photomap.

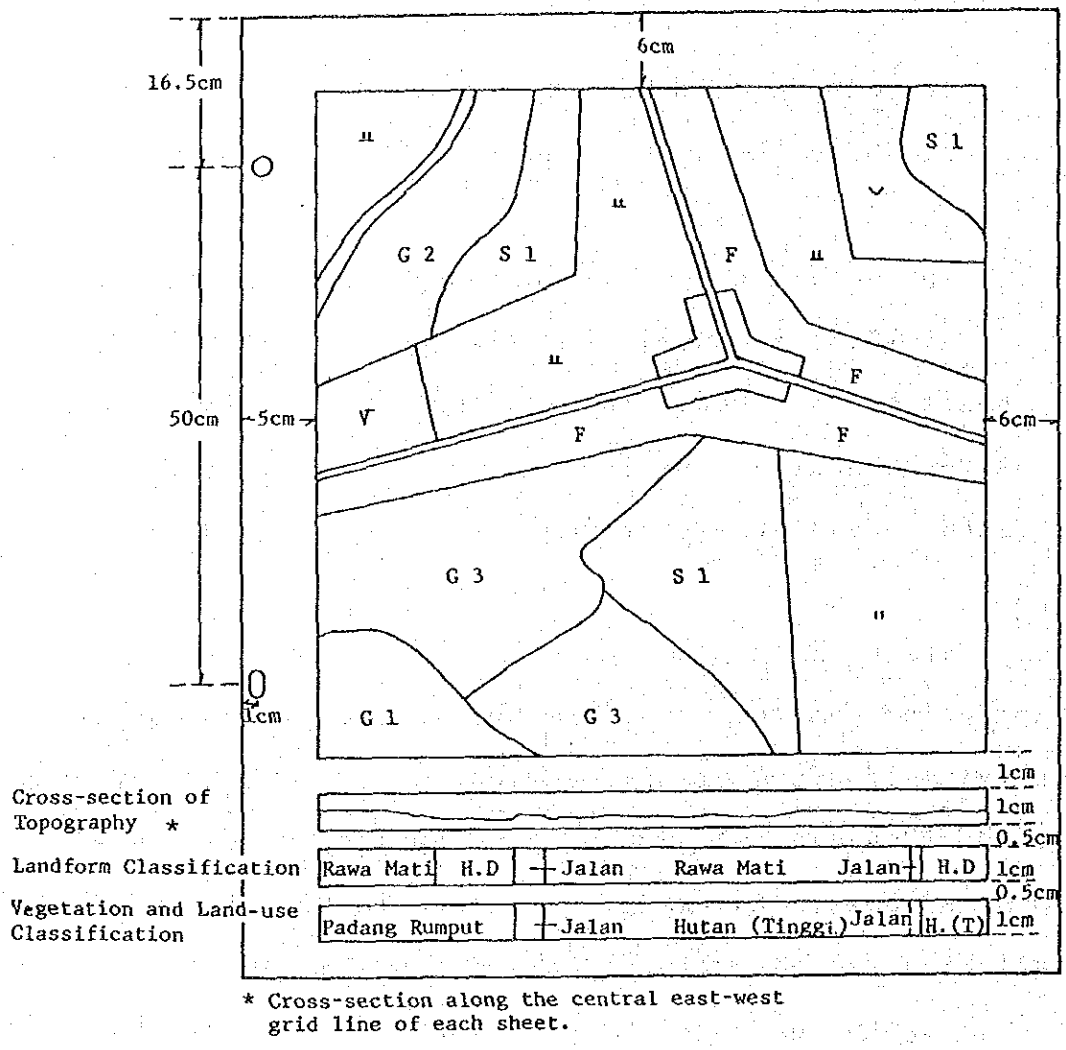
10-3 Compilation of Thematic Map

Compilation manuscript of the thematic map shall be prepared by classifying landform classification, distribution of vegetation and state of land-use obtained by geographical survey based on the photomap by symbols. An example is shown in Fig. 10.5. Below the map, shall be attached a cross section showing landform, its classification, vegetation and land-use along the central east-west grid line of the map. Symbols used for the compilation manuscript shall be those given in Tab. 10.2, where are also given map symbols for final drawings and colour for printing.

11. Cartography

11-1 Summary

Final drawings were prepared, using compilation manuscript of photomapping, notation sheets and compilation manuscript of thematic map, following the map specifications and their application rules



* Cross-section along the central east-west grid line of each sheet.

Fig. 10.5 Compilation Manuscript of Thematic Mapping

Item		Symbol (Compiled manuseript)	Symbol (Final drawing)	Printing colour
Residential area	Daerah Pemukiman			
Paddy field (dry season)	Persawahan (Musim Kemarau)	II		Blue
Paddy field (rainy season)	Persawahan (Musim Penghujan)	丄		Blue
Fallow paddy field	Tegalan	艹		Blue
Field	Ladang	⌄	20 %	Brown
Pasture	Padang Rumput	⌄	40 %	Brown
Forest	Hutan (Tinggi)	F	70 %	Green
Shrub	Hutan (Rendah)	S 1	50 %	Green
Burnt feild	Perladangan Berpindah	V		Brown
Tall humidiherbosa	Padang Rumput (Tinggi)	G 1	30 %	Green
Short humidiherbosa	Padang Rumput (Rendah)	G 2	15 %	Green
Dry meadow	Alang-Alang	G 3		Green
Floating grass	Rumput Air	U		Blue
Water surface (dry season)	Permukaan Air (Musim Kemarau)		30 %	Blue
Water surface (rainy season)	Permukaan Air (Musim Penghujan)	⊜		Blue
Natural levee	Tanggul Alam	N		Red
Swanp	Rawa Mati	S		Red
Old river channel	Sungai Mati	R		Red
Upper delta	Hilir Delta	U		Red
Lower delta	Hulu Delta	L		Red
Hill	Daerah Perbukitan	H	Daerah Perbukitan	Red

Tab. 10.2 Symbols for Thematic Mapping

agreed upon with Indonesian side, in order to be ready for printing plate making. They consist of scribed sheets, mask sheets and sheets for marginal information and notations in colour separation.

11-2 Marginal Information and Notation

The marginal information comprises sheet number, legend, explanation, adjoining and whole sheet indices and a diagram of administrative boundaries. Lettering rules are shown in Tab. 10.1.

11-3 Materials

Following materials were used for cartography:

scribing sheet	(thickness: 0.12mm)
mask sheet	(thickness: 0.12mm)
polyester sheet	(thickness: 0.08mm)
negative film	(thickness: 0.10mm)
positive film	(thickness: 0.10mm)

The size of each sheet is 72cm x 85cm.

11-4 Operation Flow

Operation flow of cartography is shown in Fig. 11.1. As shown in this figure, negative film was prepared with normal image for each colour separation. From the negative film a positive film with mirror image was reproduced so that composite films for plate-making might be of mirror image, as printing plates were to be made by positive plate-making process.

11-5 Contents of Each Colour Separation

(1) Sheets for black

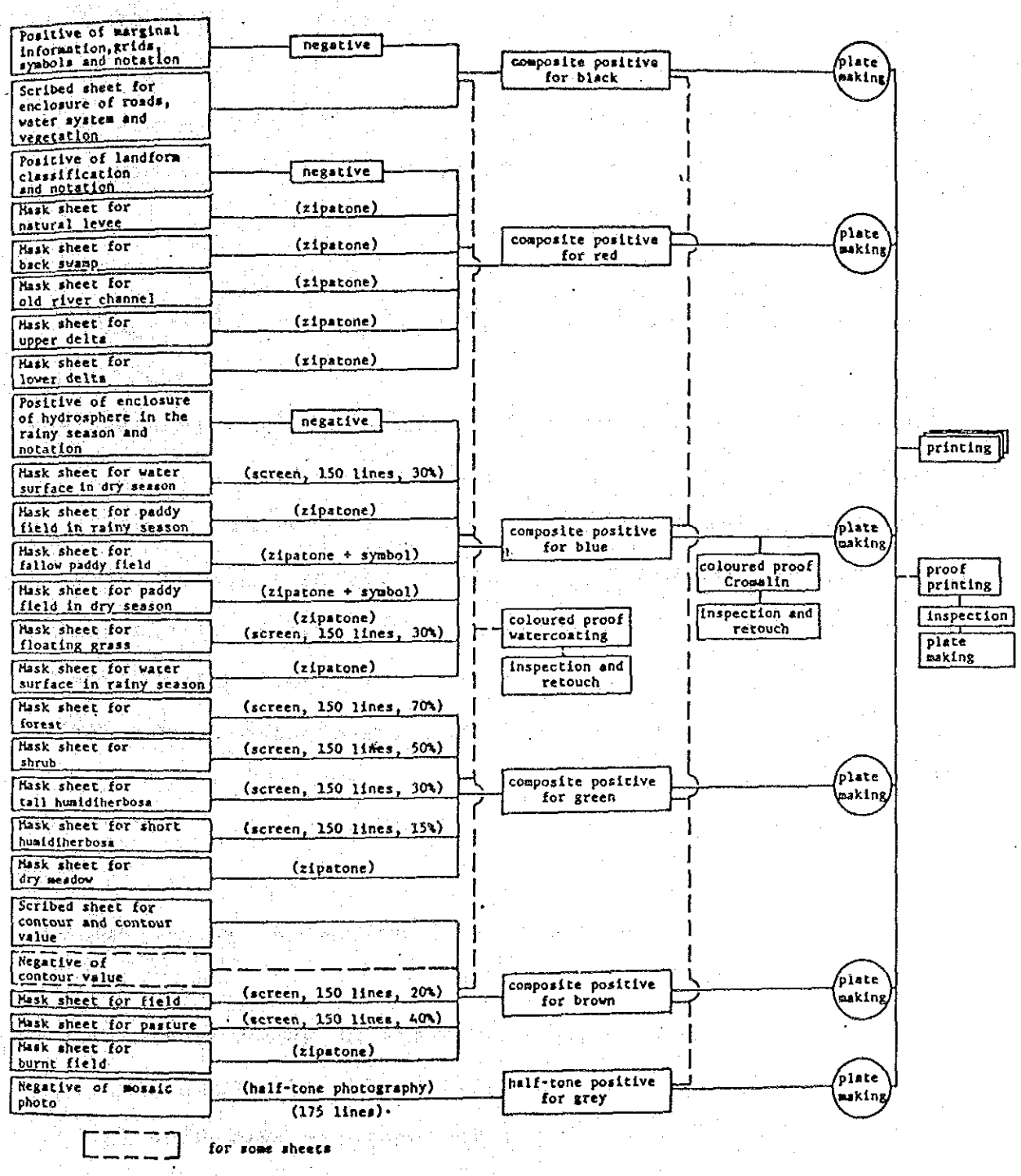


Fig. 11.1 Schematic Diagram for Cartography and Reproduction

a. polyester sheets: marginal information, administrative names, building names, names of hills, grids, grid values, symbols and values of spot heights

b. scribed sheets : enclosures of land-use and vegetation, shore lines of rivers and lakes

(2) Sheets for red

a. scribed sheets : enclosures of landform classification, notation of hills

b. mask sheets : natural levees (zipatone), swamps (zipatone), old river channels (zipatone), upper deltas (zipatone), lower deltas (zipatone)

(3) Sheets for blue

a. polyester sheets: notations for river and lake names

b. mask sheets : paddy fields in rainy season (zipatone), paddy fields in dry season (zipatone), fallow paddy fields (zipatone), floating grasses (zipatone + half-tone), water surface in dry season (half-tone), water

surface in rainy season (zipatone)

(4) Sheets for green

a. mask sheets : forests (half-tone), shrubs (half-tone), tall humidiherbosa (half-tone), short humidiherbosa (half-tone), dry meadows (zipatone)

(5) Sheets for brown

a. scribed sheets : contour lines, contour values

b. mask sheets : fields (half-tone), pastures (half-tone), burnt fields (zipatone), contour values (for some sheets)

(6) Sheet for grey

a. photo imagery

11-6 Process of Operations

(1) Positioning of imageries of each colour separation

In order to put the relative position of the imageries on each colour separation together, holes were punched on sheets and the compiled manuscripts at the same time before operation (punching hole system). Furthermore, at the central area of four margins of a sheet, cross

registration marks were made as guides for plate-making and printing.

(2) Preparation of scribed sheets

Normal imageries of the compiled manuscript were printed on scribing sheets by diazo method as a guide for scribing in principle. However, some sheets of simple imageries were scribed directly by tracing the imageries on the manuscript.

(3) Preparation of mask sheets

Mask sheets were prepared by peeling peel coat sheets. Enclosures of peeling parts were etched by photo-etching method using scribed sheet engraved the enclosures of peeling parts. Cross registration marks were also made by tracing lines on the scribed sheets.

(4) Preparation of sheets for marginal information and notations

a. The original positive for common marginal information was prepared on a polyester sheet. Its negative was then reproduced by photographic method and required number of sheets were reproduced from it. On each sheet, marginal information, annotation items, etc. which are different for each sheet were stuck up by using photocomposed letters printed on positive films.

b. Notations to be printed in red (items of landform

classification) and those in brown (contour values) were stuck up directly on corresponding scribed sheets by preparing negatives of photocomposed letters.

(5) Preparation of sheets for grid lines and neat lines

As neat lines are defined by UTM grid lines, the grid lines (and neat lines) are common to all sheets. Master sheet for grid lines (and neat lines) was scribed by using a precision coordinate graph on a scribing sheet and the positives were reproduced photographically on polyester films for marginal information.

11-7 Proofreading and Inspection

A colour composite of the whole colour separations was prepared by photographic method (similar to water coating method) for proofreading. Proofreading was carried out in cooperation with Indonesian counterparts, who stayed in Japan for individual training, to correct mistakes in writing and drawing, omissions, deviations from the map specifications, etc. Later, inspection was done by a competent public organization.

12. Reproduction

12-1 Summary

Composite positive films were prepared from colour separations so that one composite film may correspond to one colour to make plates easy. Before printing, using those composite films, proof prints were prepared for proofreading. After finishing proofreading,

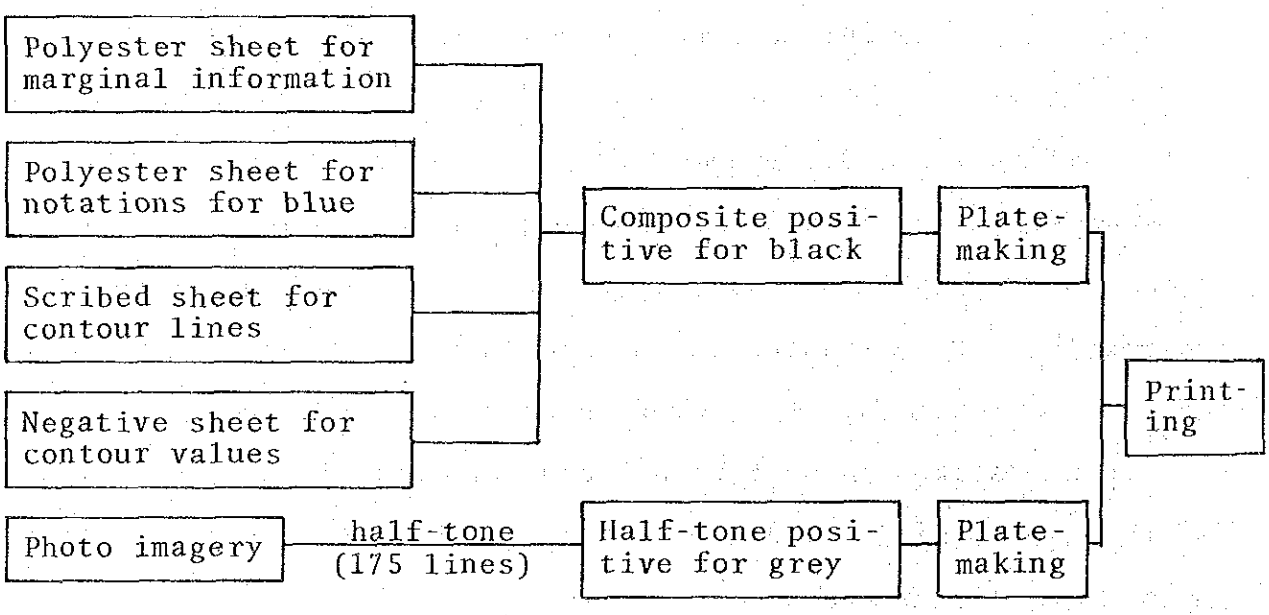
final proof prints were prepared by Cromalin method.

Printing was executed by offset printing machine. Photomaps were printed in two colours and thematic maps in six colours.

12-2 Plate-making

Printing plates were made photo-mechanically by using composite positive films and aluminum pre-sensitized plates (positive plate-making method).

Printing plates for the photomap consist of two plates for black and grey composing of the following elements:



As shown in Fig. 11.1, those for the thematic map are six plates for black, red, blue, green, brown and grey.

12-3 Printing

Main specifications for printing are as follows:

(1) Photomaps shall be printed in two colours and thematic

Item			Average	Maximum	Minimum
Folding endurance (time)	Dry	Machine direction	3,800	6,100	2,300
Tension/1 kg (MIT type tester)	Wet	Cross direction	7,500	9,000	5,600
Bursting strength (kgf/cm2)	Dry		6.09	7.25	5.45
	Wet		1.90	2.35	1.50
Tensile Breaking strengh (kgf)	Dry	Machine direction	11.6	12.3	11.0
		Cross direction	9.45	9.80	9.20
	Wet	Machine direction	3.35	3.50	3.15
		Cross direction	2.88	3.05	2.65
Tearing strength (gf)	Machine direction		105	112	100
	Cross direction		102	108	96.0
Smoothness (sec)	Surface		120	140	110
	Back		97	110	90
Expansion (%) (RH 60 - 80)	Machine direction		0.07	-	-
	Cross direction		0.18	-	-
Opacity (%)			88.7	89.0	88.3
Brightness (%)			85.7	86.2	85.2
Size condition (sec)			74	88	62
Thickness (mm)			0.102	0.104	0.099
Surface strength (A) Surface			26	26	26
Weight (g/m2)			92.6		
Water content (%)			9.3		
PH			6.7		

Paper material	Unbreached pulp
Ground pulp	Not contained
Flow of fibres	Good
Curling and other defects	None
Texture	Good
Dust	None
Difference in quality between surface and back	Little

NOTE: Wet means the condition in which the specimen has been immersed in water of 20°C for an hour and is soaked with superflous water.

Tab. 12.1 Physical and Chemical Characteristics of Printing Paper

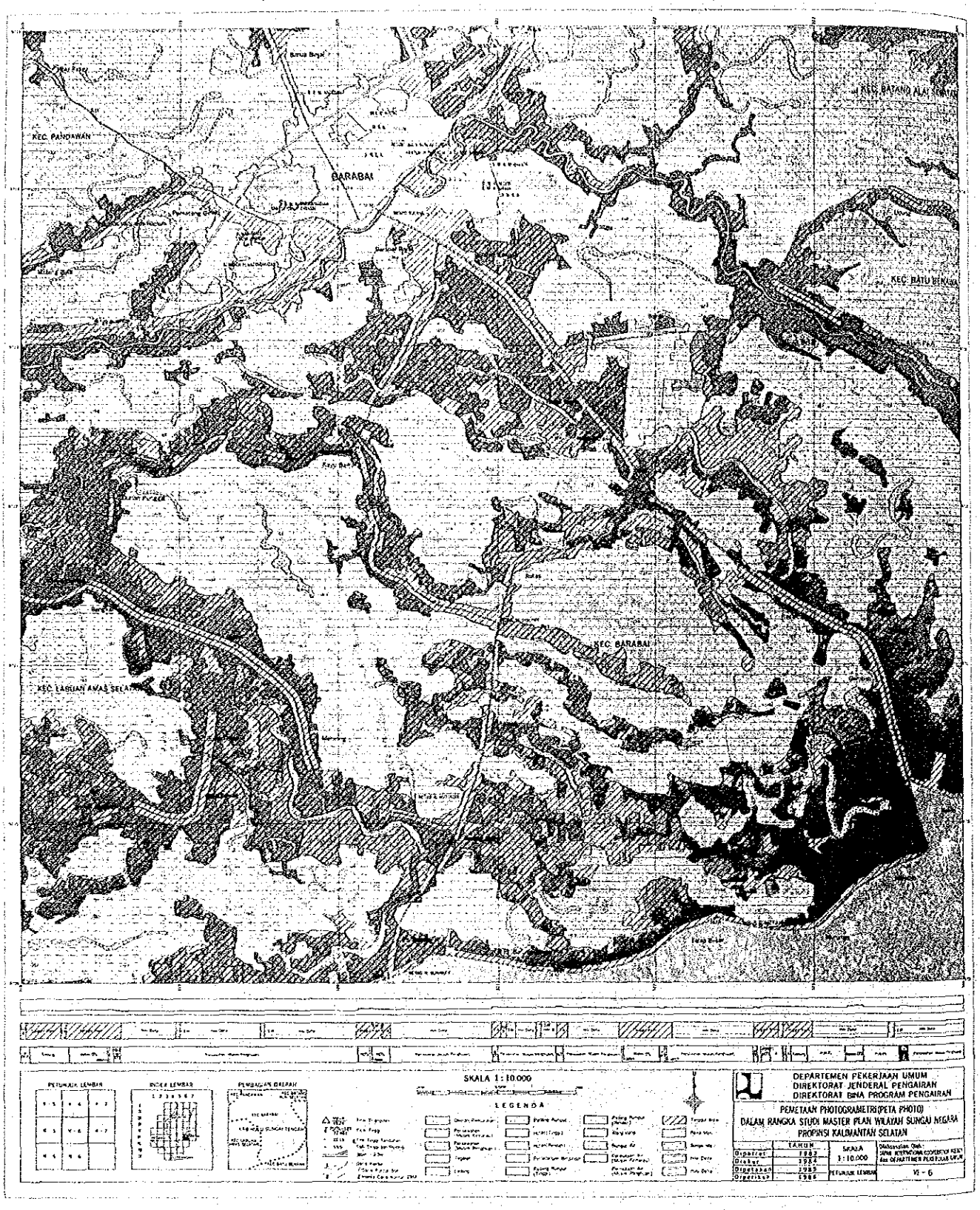


Fig. 12.1 Sample of Printed Thematic Map

maps in six colours by offset printing.

(2) Printing paper shall be 90 g/m^2. In Tab. 12.1 are shown the results of analysis of physical and chemical characteristics of the printing paper by an authorized laboratory.

(3) The dimensions of the final products shall be 64.0cm x 76.5cm.

An example of the printed thematic map is shown in Fig. 12-1.

13. Overview of the Project Area from Thematic Maps

13-1 Overview of the Barito and Negara River Basin from the Interpretation of LANDSAT Imagery

Here, first of all, we make overview of the conditions of the Barito River and the Negara River Basin which includes the survey area of 1,200km^2.

The Negara River Basin constitutes an alluvial plain extending about 200km from south to north, and about 80km east to west. To make such a vast area an object of survey and to collect information from all over the area with equal accuracy, the use of remote sensing is most effective.

In this survey, from among the imageries (path: 126, row: 62) taken by LANDSAT No.3, the data of August 23, 1982 in which relatively small amount of cloud is shown, are selected. (See PLATE I, II.) Satellite imagery of LANDSAT is multispectro imagery different from the conventional color photo. The imagery records the

strength of each of the bands into which the wave length of the reflection light from the objects on the earth is divided. Wave length of each band is as shown in Tab. 13.1.

In this survey, the imagery of band 5 only, and composite imagery in false color of three bands of 4, 5 and 7, both are used. In case of the former imagery, water content of the soil is delicately reflected such that the swamp is taken in thin black while natural levee and terraces are taken in white. In case of the latter imagery, vigor of plants is sensed such that the denser are the plants and the stronger is vigor of the plants, the thicker is the color of red. Any of these imageries are very useful to make a landform classification of very low relief alluvial plain.

Fig. 13.1 shows Geomorphological Classification Map of the downstream area of the Barito River and the Negara River basin based on the interpretation of LANDSAT imagery.

The landform of the alluvial plain developing along the Barito River and the Negara River can be roughly divided into delta I and delta II.

Along the Negara River flowing on the delta I, the natural levee is continuously developed generating extremely low swampy area behind it. On the other hand, along the Barito River flowing down the same delta I, natural levee has poorly developed. Instead, swamp is extending widely parallel to a channel. This phenomenon proves the difference of accumulation and erosion in the recent time in both rivers on delta I. Also, in general, the delta I is largely occupied by swampy area. Especially, in the region whose photomaps have been prepared this time, it is seen that the swamp exists in the wide area between the delta formed by the Batangalai River spreading over the foot of the eastern mountainous area and

Band	Wave length (μm)	Sensor	Number of sensos	Instant field view (μ rad)	Resolution (m)
4	0.5～ 0.6 (green)	Photo-multiplier	6	86	79
5	0.6～ 0.7 (red)	Photo-multiplier	6	86	79
6	0.7～ 0.8 (near infra-rad)	Photo-multiplier	6	86	79
7	0.8～ 1.1 (near infra-rad)	silicon-diode	6	86	79
8	10.4～12.6 (thermal infra-red)	Hg・Cd・Te	2	258	237

Tab. 13.1 Characteristics of LANDSAT MMS

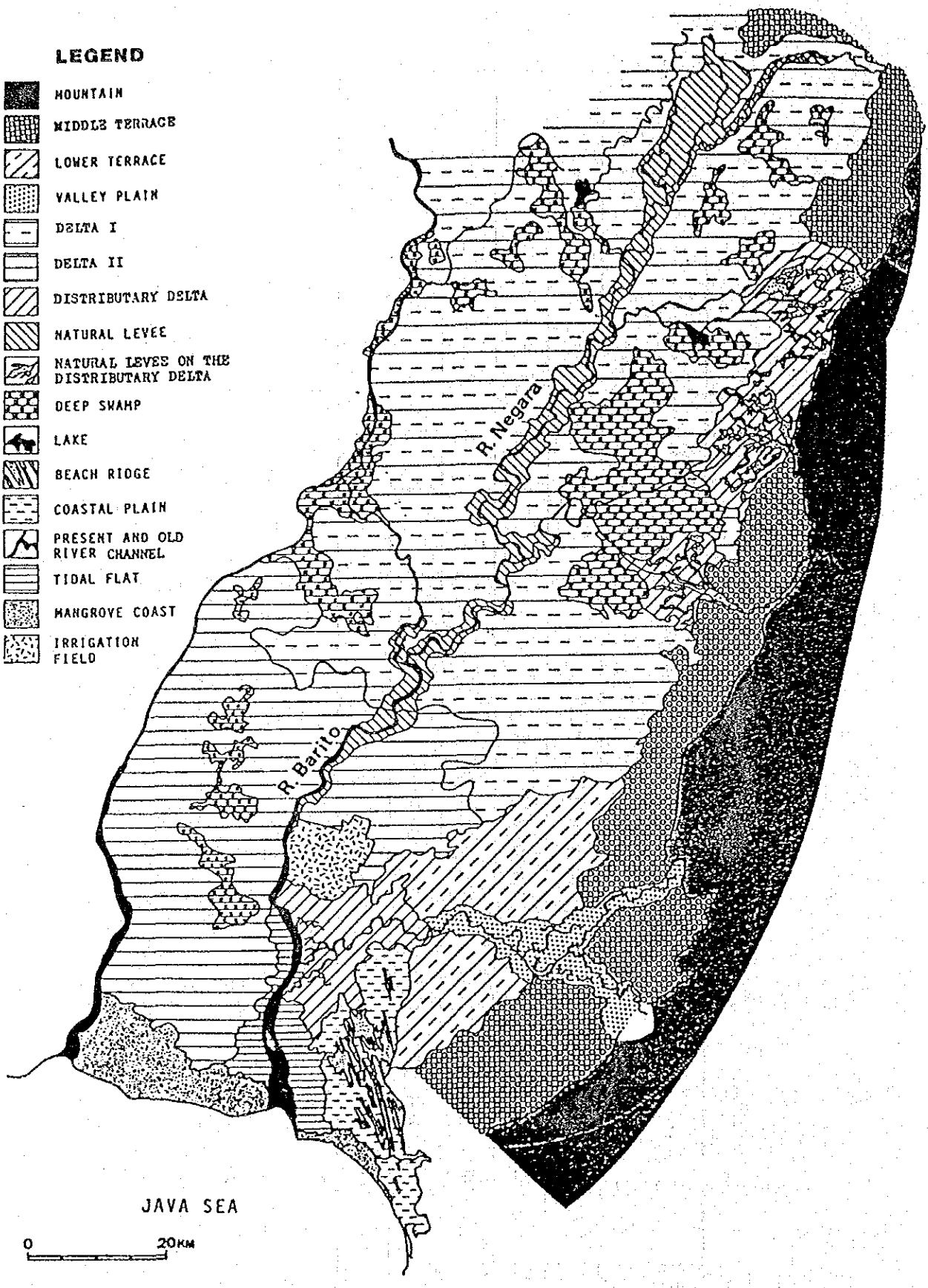


Fig. 13.1 Geomorphological Landform Classification Map of the Downstream Area of the Barito River Basin Derived from LANDSAT Imagery

the natural levee along the Negara River.

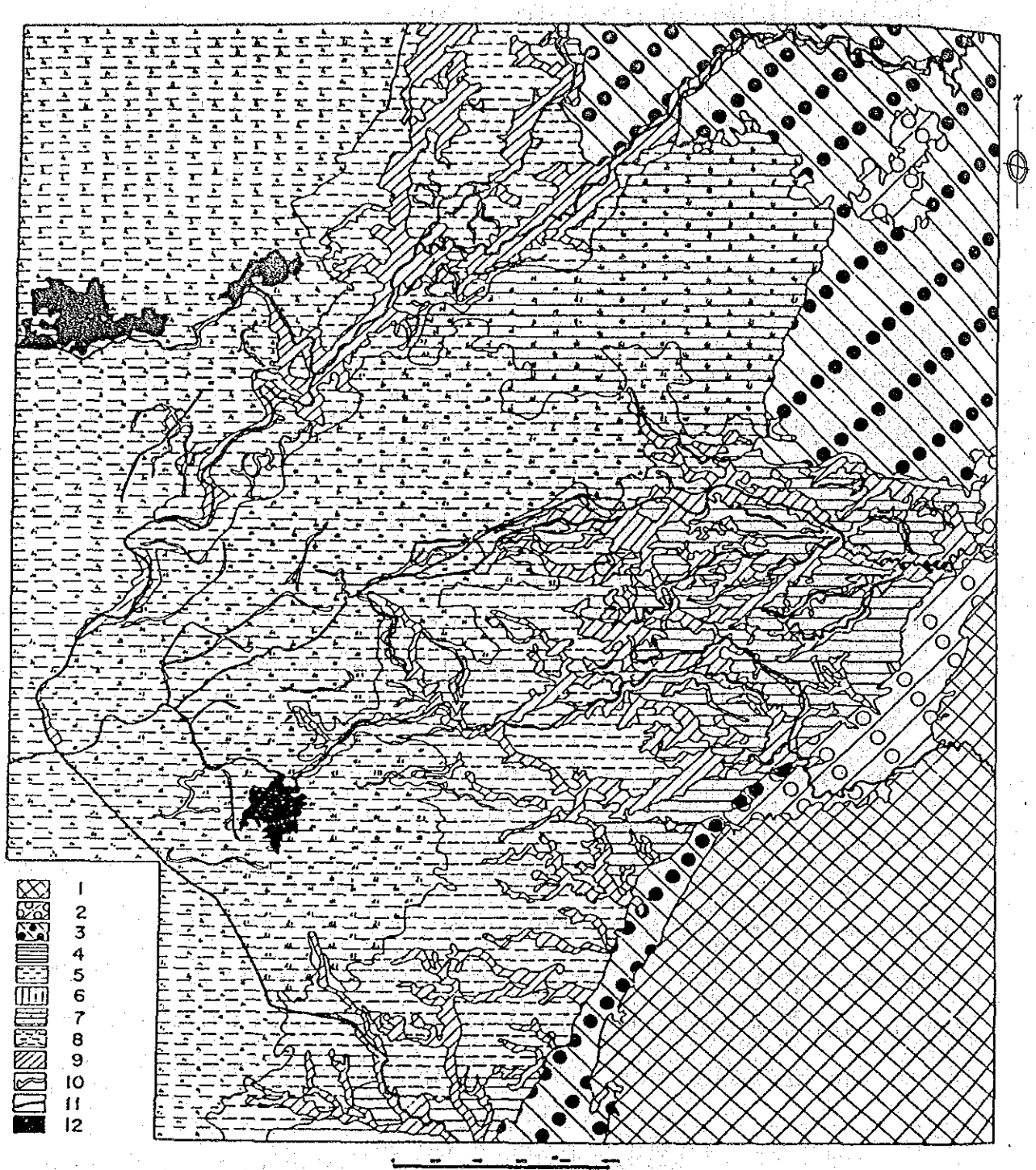
On the other hand, on the delta II, the natural levees of both the Negara River and the Barito River are poorly developed. Also, along the Jawa Sea, beach ridges are ranged about 20km into the inland region and the river mouth remains widely as a tidal flat like an estuary. This shows that the accumulation by the river on the Delta II is not got sufficient.

Banjarmasin, the city of South Kalimantan Province, is located on the delta of the Marutapula River which is flowing west from the eastern mountainous area. This delta is slightly higher in elevation than the Delta II which surrounds it. It is considered that because the materials transported by the Marutapula River is more abundant than those by the Negara River, the accumulation on the delta of the Marutapula River preceeded that on the Delta II.

13-2 Topographic Characteristics of the Survey Area
- Study by Using Landform Classification Map -

Next, the features of the more detailed landform of the survey area are explained based on the landform classification by aerial photo interpretation. In Fig. 13.2, the geomorphological landform classification map of the survey area is shown in which the landform of the area covering the photomap area of 1,200km^2 is classified. As shown in Fig. 13.1, this area is occupied by the swamp (on the delta I) on the left side of the Negara River and the delta of the tributaries from the eastern mountainous area.

The mountainous area distributed at the eastern end of the plain is low relief mountainous area of 200 - 300m in elevation having many clear lineaments (may be faults) extending from north-northeast to south-southwest. The valleys of the mountainous area



1 mountain
2 upper terrace
3 middle terrace
4 upper delta
5 lower delta
6 valley plain
7 swamp covered by forest
8 swamp covered by grass field
9 natural levee
10 old river channel
11 present river
12 lake

Fig. 13.2 Geomorphological Landform Classification Map of the Survey Area Derived from Aerial Photos

are not so well developed showing the roundish surface on the whole. The geology constructing the mountain are mainly sandstone and mudstone of the Mesozoic era, however, on the eastern slope, intruded granites are widely distributed, and also the outcropsof limestone were confirmed here and there in the field survey.

At the foot of mountain, two steps of terraces are seen, in the upper and middle, forming the flat surfaces at the height of 80 - 100m and 30 - 50m in elevation, respectively. However, in the upper terrace the erosion has considerably advanced so that the remaining condition of the flat surface is remarkably bad, and in view of geomorphology, the terrace is now close to a hilly land.

On the other hand, the middle terrace which holds relatively wide flat surface shows well development toward the north eastern part of the survey area. The terrace deposits are that of old alluvial fan or delta mainly made of silt and clay layer covered by a thick laterite, though some gravel and sand are mixed near mountainous area.

The plain of the survey area can be roughly divided into two. One consists of a delta made by the Batangalai River and the Barabai River in the eastern part of the survey area, and the other part consists of swamp widely remains behind the Negara River in the western part of the survey area. While the elevation of the former region is 5 - 13m, the latter is the land of 3m or lower widely distributed except the parts of natural levee and delta along the Negara River which are slightly higher than the surrounding area by 1 - 2 meters.

The delta consists of a thick silt and a clay layer containing a little sand and geomorphologically divided into two surfaces of the upper and the lower. The upper delta develops at the upper

stream of the Batangalai River and the Barabai River, which is dissected in 5 - 7m by the present river.

On the other hand, the lower delta is 2 - 3m high relative to the river, and in rainy season, some parts of delta surface are submerged in every rainy season as well as swampy area. Also, the boundary area of the upper and the lower deltas often experiences the floods.

In other words, as seen in the figure of landform profile along the Barabai River in Fig. 9.2, the boundary of both deltas constitutes a nick point of the remarkable land slope, at the downstream area of which, the relative height of the land and the riverbed intermittently decreases. In the field survey it is confirmed that the continuous artificial dike is constructed along either side of the Barabai River from this area. This proves that this area has been suffering from floods since the old times.

In swamp, even in dry season, water covered areas are widely distributed, and the density of the natural levee and old river channel is very poor. The swamp is divided into two areas, one of which is covered by forests and the other of which is covered mainly by shrub and grass field, and there is a slight difference in elevation between two areas. In Fig.13-2,above-mentioned two different types of these areas are shown. The swamp covered by forests is widely spread in the northern part of the survey area. The area in general is 4 - 5m in elevation, and anywhere of the area is rarely covered by water even in rainy season. So this area is considered stable.

On the other hand, the swamp covered by shrub and grass field are seen in the lower downstream areas of the Batangalai River and the Barabai River, and the elevation of most part of the

area is lower than 3m. The swamp is covered by water in wide range in rainy season. Wide part of the swamp is always under water. The difference of the landform between the above-mentioned areas was caused by the difference of time those landforms were formed. It is considered that the former swamp was formed earlier than the latter one. In case of the swamp which was formed earlier, the accumulation has still been in advance due to flooding of rivers, burying the swamp in extremely slow speed. Accordingly, from the viewpoint of stability of landform, the swamp covered by forests may have bigger potentiality for the future agricultural development than the swamp covered by shrub and grass field.

13-3 Relationship between Landform and Soil

It is recognized that in general there is a close relationship between the micro-landform of the alluvial plain and the surface geology or the soil type.[9] The data of the soil survey obtained by each boring are developed in relation to landform classification. For this reason, it is preferable that geomorphological survey and soil survey are conducted in parallel.

In the field survey, the distribution of the micro-landform interpreted in aerial photos was confirmed, and the observation of the soil type was carried out by means of a 1.5m boring stick at several places. As for the soil, observation was made with the special attention to the grain size.

Fig. 9.5 is landform cross-section map showing the general surface, natural levees and old river channels on the upper delta, in which the result of the boring conducted along these places is described. In this Figure, the circular graph below shows the component materials of the general surface, natural levee and old river

channel and percent of sand, silt and clay contents of each landform type. According to the graph, the natural levee shows higher content percent of sand than other landform and the general surface of the delta shows the lower percent. Also, the old channel shows clay content as high as 50%. It also shows higher sand percentage compared with the general surface of delta.

Dr. Watanabe (1961) [10] states the formation of the natural levees as follows:

When the flooding water spreads over the plain along the riverbank, the water rushes into the wide area so that friction with the bottom of the flow occurs causing to slow the flow speed rapidly. Thus the loads in the flow are accumulated. The area which has the largest quantity of accumulation is near the riverbank where the flow speed is suddenly decreased first. This causes to create some higher parts along the riverbank. This is how the natural levee is formed. In this case, the granular materials of bigger specific gravity are accumulated first so that generally, the natural levee is composed of coarse grains such as sand. This principle has been proved correct in general in view of the fact that even in areas like the survey area where rivers rarely transport coarse materials such as sand and gravel, relatively coarse grains (fine sand in case of the survey area) are distributed.

In case of old channels, they are buried by accumulation slowly over a long period after the channels were abandoned so that fine grains like clay become to exceed other materials.

Fig. 13.3 shows characteristics of the deposits on the surface layer of each type of the classified landforms by a grain size cumulation curve. Of the classified landforms, the grain size characteristics of the upper delta, the lower delta and swamp are seen

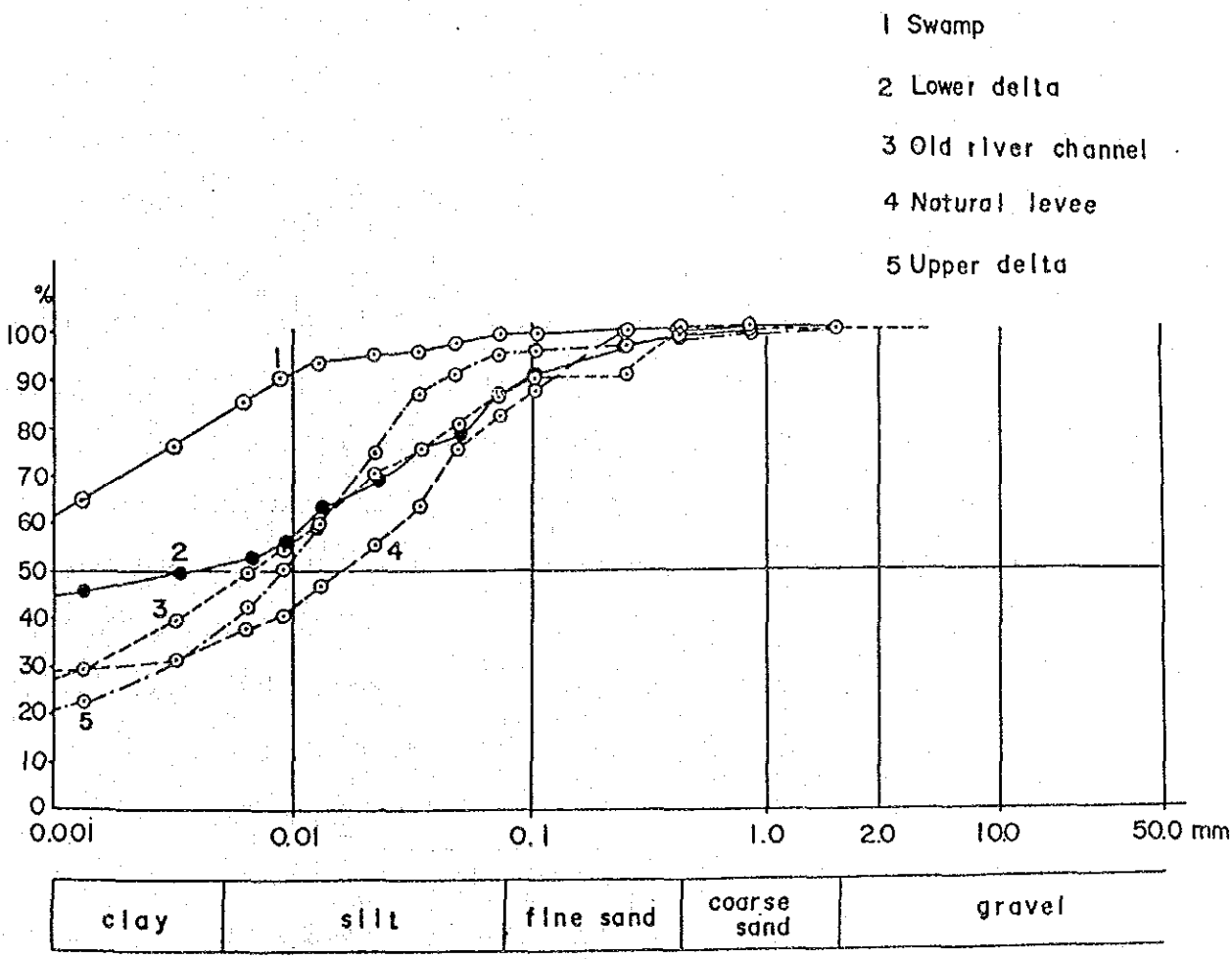


Fig. 13.3 Grain-size Distribution Curve

and understood that the higher is the delta toward the upper streams, the more coarse are the grains, whereas the lower are the swamp toward the down stream, the finer are the grains. In other words, it has been verified that such rivers as the Batangalai River and the Barabai River flowing down the eastern mountainous area, overflowed and accumulated a little amount of sand over the upper delta extending in the foot of the mountains, so that very little amount of sand has been transported down to the swamp. The samples collected from the swamp are composed of clay and silt components up to 99%.

Swamp is fundamentally an unburied area left outside the effect of accumulation by rivers. It consists of the deposits of the era of the sea bottom (intra-bay) formed by the rise of the sea level in the Holocene epoch (10,000 years ago and onward). Consequently, the difference in characteristics of grain size between the delta and swamp may be understood in a way to be caused by the difference in the forces of land formation between the delta plain formed by river deposits and the swamp by marine action.

13-4 Landform Classification and Landscape

The survey area consists of the flat, low swamp so that it is often difficult to confirm the micro-landform classified by aerial photo-interpretation in the field. However, since landform is closely related with land-use and vegetation, it is possible to presume the landform condition (landform classification) by the landscape composed by the land-use and vegetation.

The relationship between the landform classification and land-use and vegetation made by geographical survey is as shown in Tab. 13.2. In the table, for example, the areas where there are paddy

	Land-use						Vegetation					Transportation
	Residential area	Paddy field (dry season)	Paddy field (rainy season)	Field	Pasture	Burnt field	Forest	Shrub	Tall & Short humidiherbosas	Dry meadow	Floating grass	
Hill				◎			◎ Rubber plantation			◎		Vehicle
Upper delta	◎		◎				◎ Palm trees					Vehicle
Lower delta	◎		○						○			Vehicle
Swamp		◎			◎	◎	○ Natural forest	◎	◎		○	Boat
Natural levee	◎		◎	◎			◎ Palm trees・banana			◎		Vehicle
Old river channel							○ Nippa palm trees				◎	

◎ : Correspondence remarkable ○ : Corrspondence recognizable

Tab. 13.2 Correspondence between Landform Classification and Landscape

fields (farming in dry season), shrubs, tall and short humidiherbosas, etc. are judged a landscape of swamp, and the areas where there are paddy fields (farming in rainy season), palm trees, small villages, etc. are judged a landscape of natural levees.

Shown hereafter in Figs. 13.4 - 13.6 are typical examples of the landform classification and their corresponding landscapes.

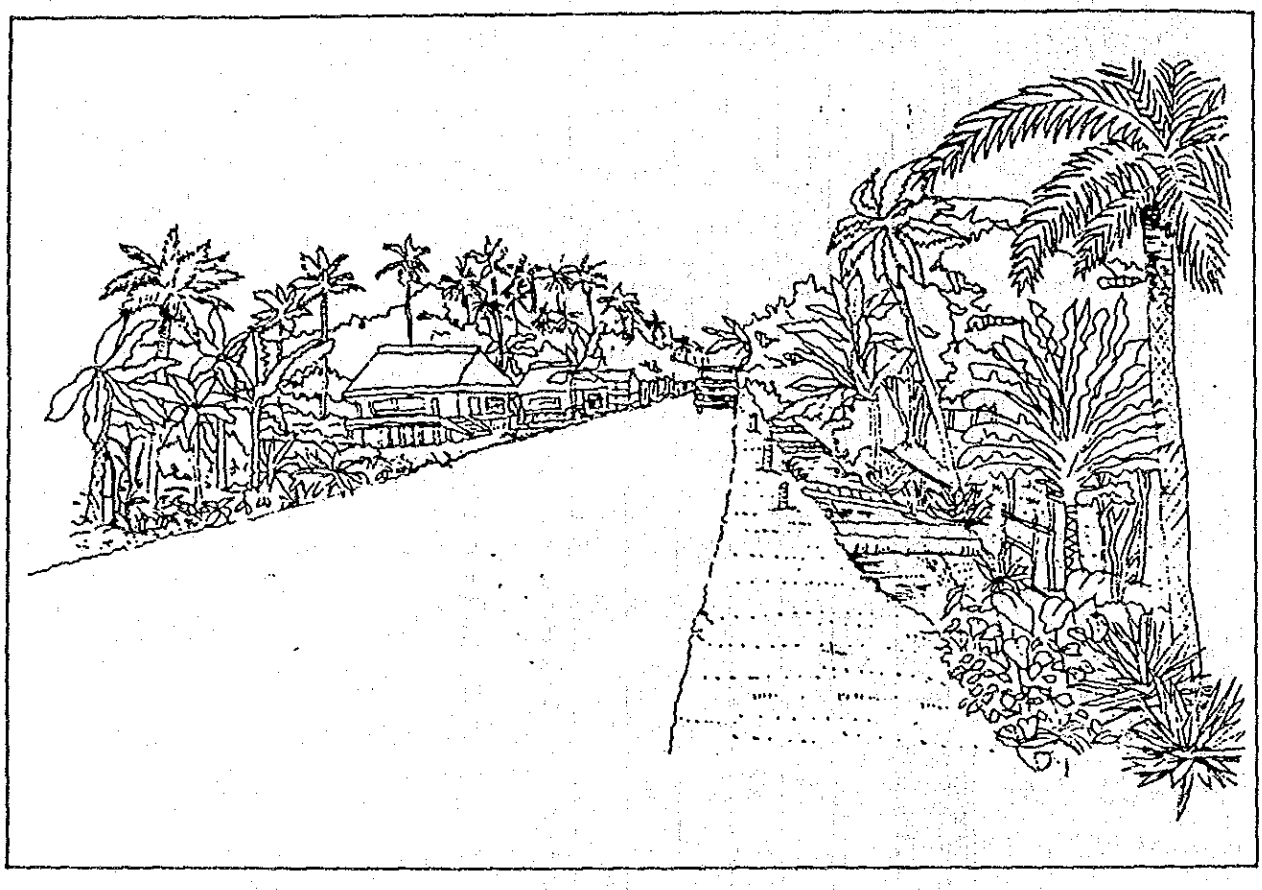


Fig. 13.4 Landscape of Natural Levee

- Landform Classification: Natural levee

- Landscape: Small villages are scattered and banana trees are planted around the villages. The palm trees are

scattered towering above them. Roads are constructed along anywhere of the natural levees, and cars and motorcycles pass the roads. Also, small scaled fields and dry meadows are seen here and there.

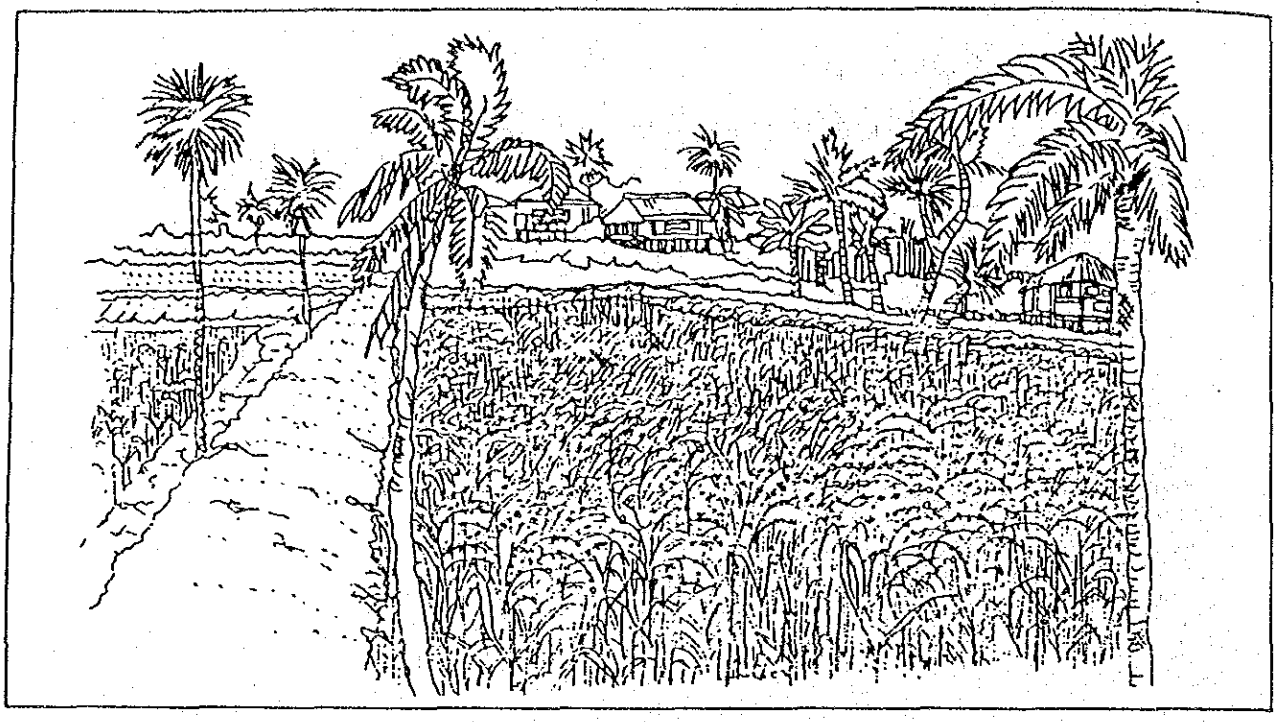


Fig. 13.5 (a) Landscape of Delta in Rainy Season

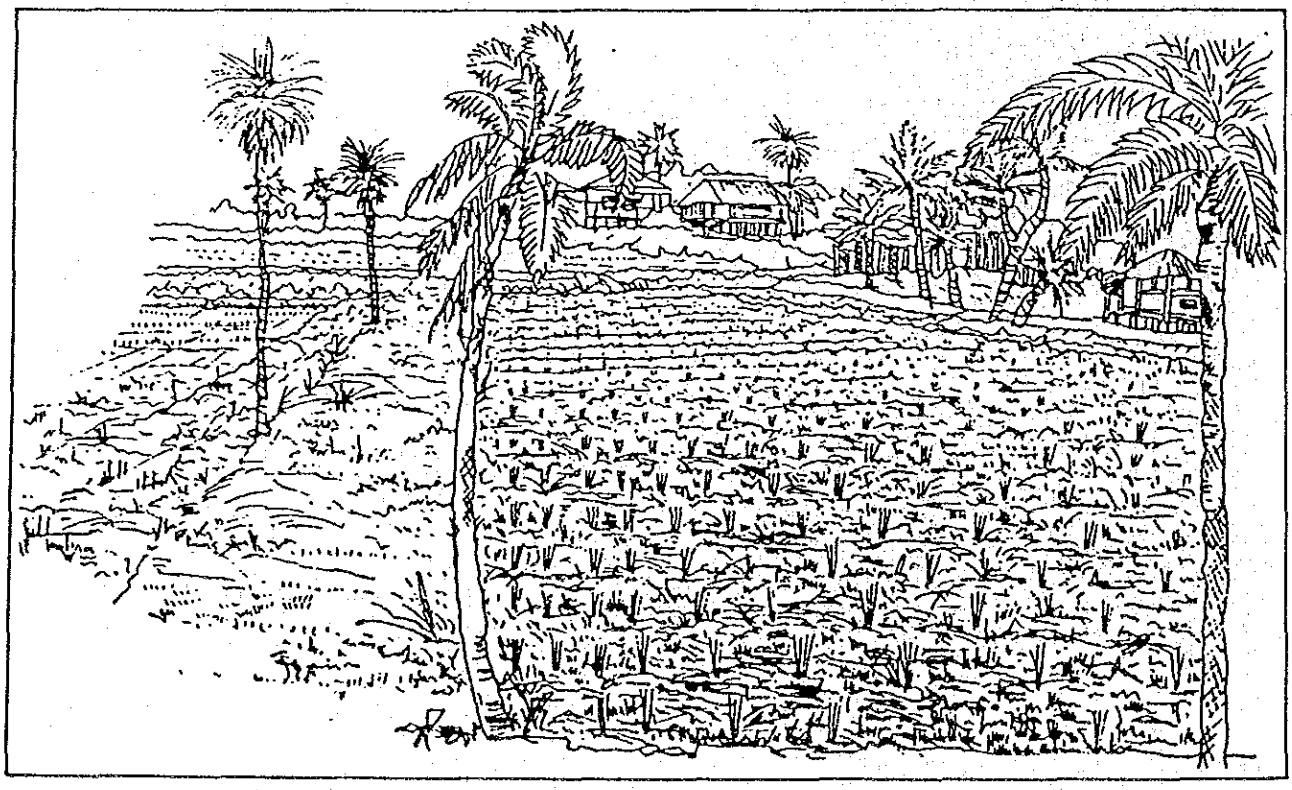


Fig. 13.5 (b) Landscape of Delta in Dry Season

. Landform Classification: Upper and lower deltas

. Landscape: Paddy field is spread and along footpath between paddy fields, palm trees and banana trees are planted. In the far landscape, the crown of the palm trees is seen. The residential areas are not many and they are dotted around.

The paddy field is cultivated in rainy season, and the paddy field at this time turns green and yellow brown all over it. In dry season, cultivation of the paddy field is not done. Also, very little water exists in the paddy field during the season.

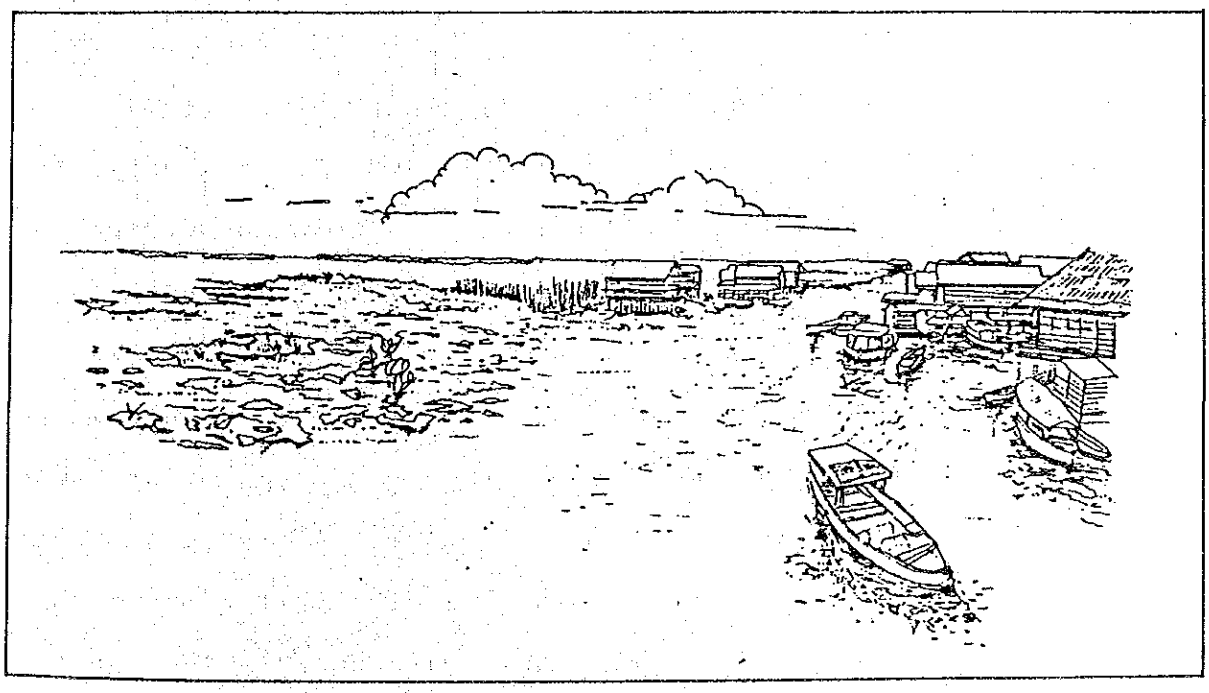


Fig. 13.6 Landscape of Swamp in Rainy Season

· Landform Classification: Swamp

. Landscape (dry season): Grass field spreads over to the horizon. Smoke of land burning for farming arises here and there. Residential areas are extremely few and in the areas of high-floored houses, there are always boats which are primary transportation means. In the swamp, tall and short humidiherbosas are spread. In some parts, shrubs and pastures are seen.

Landscape (rainy season): Swamp and water surface spread over to the horizon, and some portions show the landscape of only water surface.

13-5 Swamp and Vegetation

Relationship between the landscape composed by land-use and vegetation and landform classification is heretofore stated. Stated hereunder is the condition of vegetation in the swampy area.

In the flat swamp like the survey area, vegetation depends on the height of ground (water condition). However, to connect directly the vegetation with the height of ground, there are two problems. One is that the land for natural growth of plants may be distorted due to destruction of plants by fire and withering caused by men. The other one is destructive effect to plants due to water flood. What are most influenced by this are the tall humidiherbosas such as ditch reed and shrub. The least influenced is the short humidiherbosa. The underdeveloped natural levee along the small river is slightly higher than the surrounding land and shrub should exist on it. However, in many cases, short humidiherbosa grows thick. It is considered that this is caused by the influence of water flood-instability of locational conditions.

Nevertheless, when generally observing vegetation in the swamp taking the above-mentioned points into consideration, the clear relationship between vegetation and height of land can be recognized as follows:

The swampy area surveyed can be roughly divided into two kinds of swamps, swamp covered by forest and swamp covered by grass field. In the former, forest distributed areas are high in relative height so that they are rarely submerged in water even in rainy season forming stable landform as land formation proceeds. Also, as land formation proceeds, a variety of vegetation such as <Blechnum orientale L.> [Hiring] which are not seen in the grassy swamp are distributed. (See Fig. 13.7.)

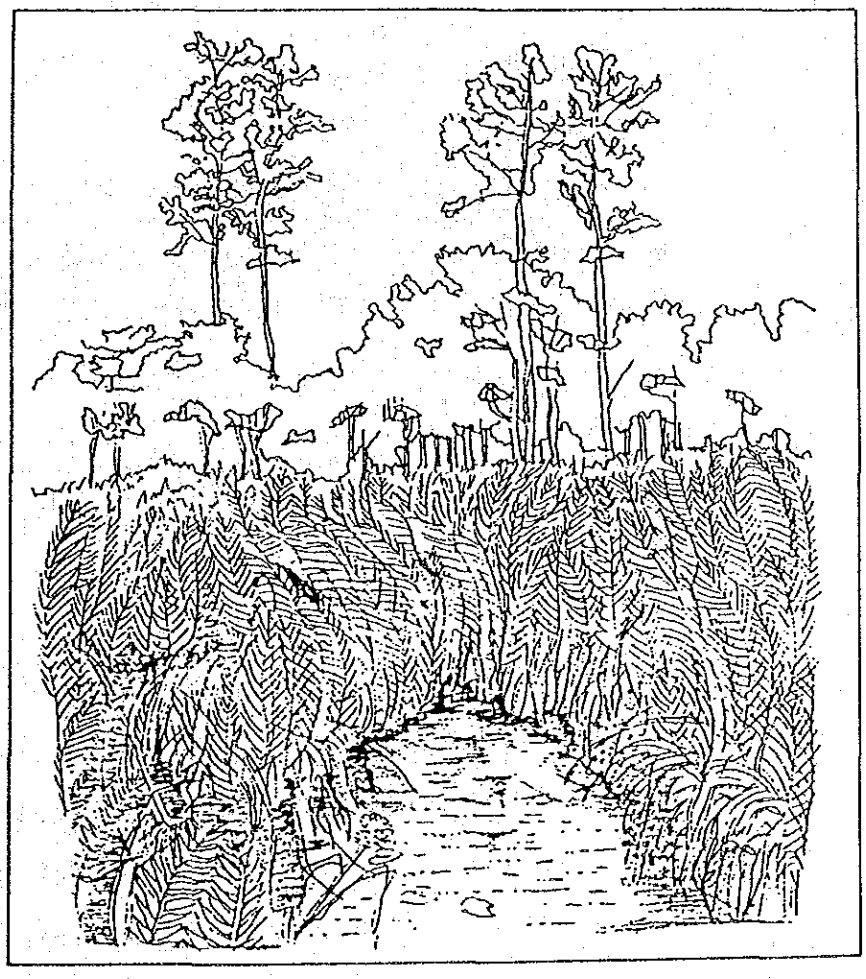


Fig. 13.7 Landscape of Swamp (covered by forest)

In the latter, most of the regions are submerged in water in rainy season. As there is no forest distribution, monotonous vegetation conditions spread over consisting of grass field and shrub. Also, it is another feature of this swamp that in water covered area, such floating grass as <Eichhornia crassipes> [Ilung] grows thick. (See Fig. 13.8.)

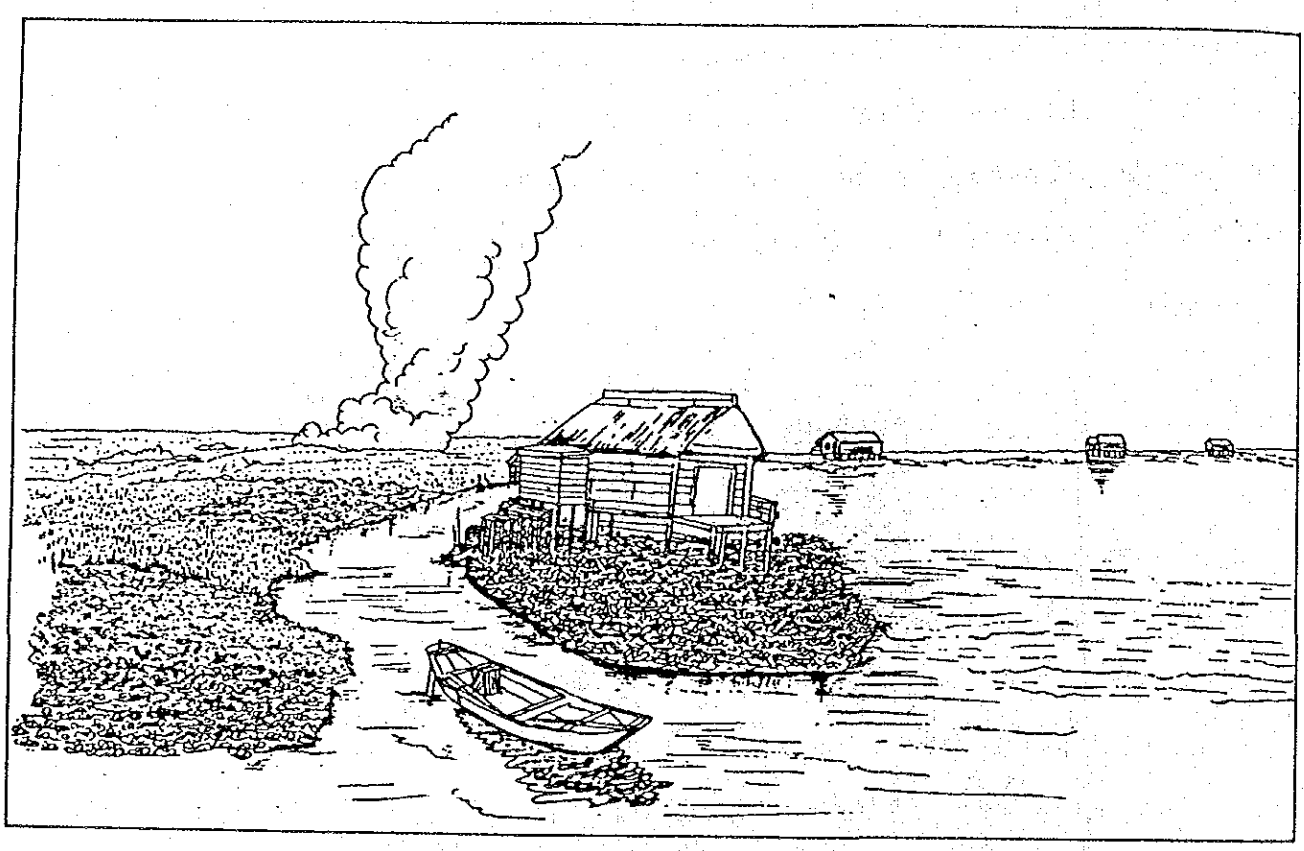


Fig. 13.8 Landscape of swamp (covered by grass field)

Further, as regards the shrubs consisting mainly of <Mimosa pigra L.> [Jepung], they have the relative height of 10 - 30cm as compared to grass field, though it is not so clear as that of forests. It is presumed that the distribution areas of such shrub may be more or less stable in the swamp covered by grass field.

13.6 Overview of the Survey Area

An ground height map of the survey area was made on the basis of the result of geographical survey and spot heights. (See Fig. 13.9.)

In the survey area, the highest areas are concentrated in the north-eastern part, and these areas are roughly identified as hills of 15m - 75m high and the natural levees on the upper delta. The second highest area is the upper delta around Barabai, which has the ground height of 10m - 15m or 18m in general. Around this upper delta, the region of 4 - 10m in elevation occupies the area in wide range which consists of a part of the lower delta, swamp covered by forest and the natural levee developed on the lower delta along the Negara River.

The area of the lowest ground height exists in the south western part of the survey area. This area consists of the swamp of 1m or less in ground height, the central part of which is largely occupied by water covered area during rainy season. The ground height of this water covered area is generally about 0.5m.

The relationship between the ground height and landform classification, land-use and vegetation is shown in Tab. 13.3.

Next, landform classification and the form of ground are shown in Tab. 13.4. The index of the landform features shown in the table is based on the relative height of grounds from the water level of rivers, the result of the reconnaissance of soil, the underground water level, etc. executed in parallel with the landform survey in the field.

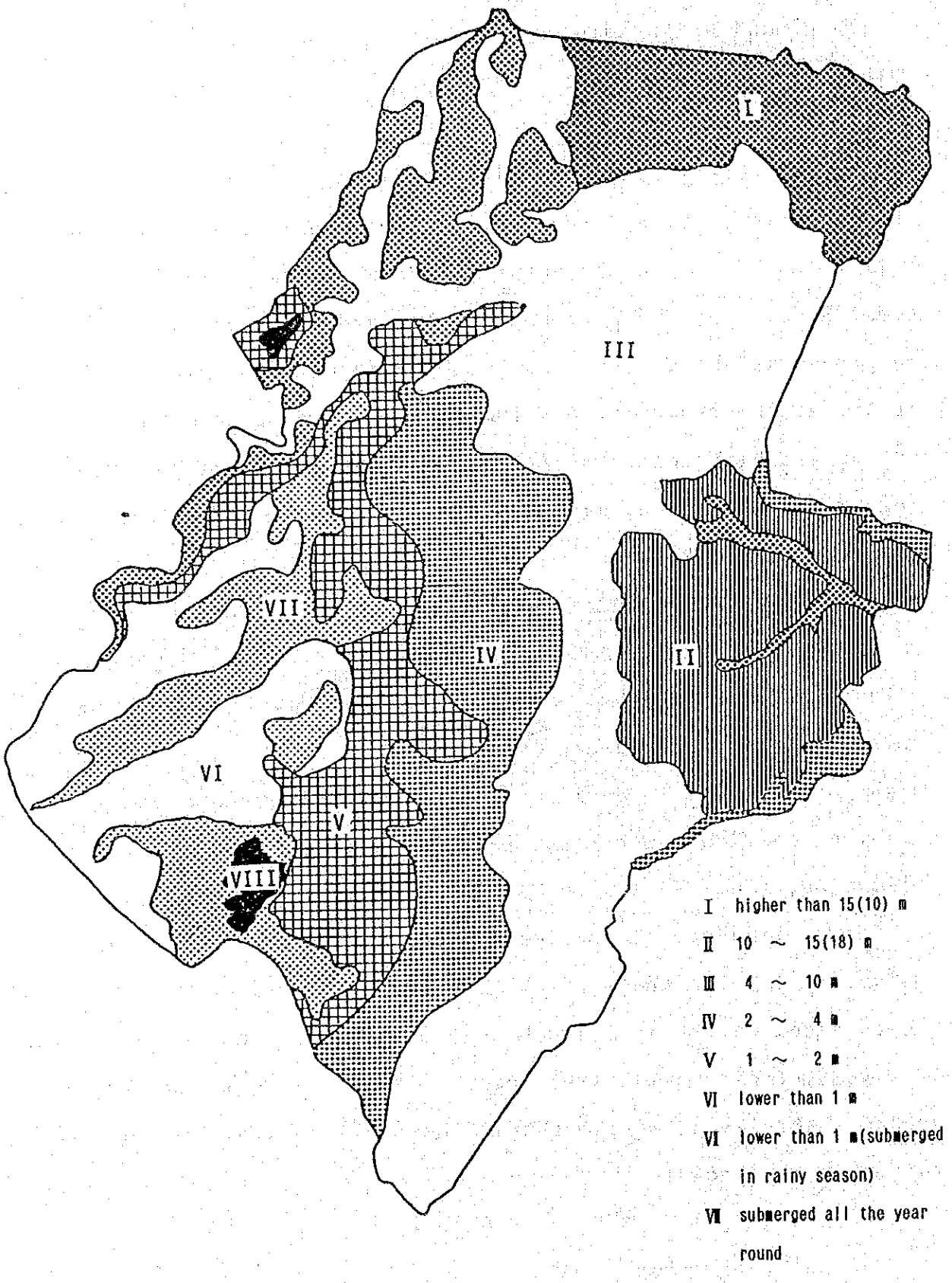


Fig. 13.9 Ground Height Map of the Survey Area

	Ground height	Landform-, land-use-, vegetation-classification
1	more than 15(10)m	Hill, natural levee on upper delta
2	10~15 (18m)	General surface of upper delta
3	4~10m	Natural levee & general surface on/of lower delta (paddy field cultivated in rainy season) Swamp covered by forest
4	2~ 4m	General surface of lower delta (paddy field cultivated in dry season)
5	1~ 2m	Swamp covered by grass field
6	less than 1m	Swamp covered by grass field
7	less than 1m (Water covered area in rainy season)	Swamp covered by grass field (water covered area in rainy season)

Tab. 13.3 Ground Height vs. Landform, Land-use and Vegetation

Landform		Landscape	Relative height above the river surface	Soil	Ground water level
Hill		Forest	more than 15 m	Red-Brown laterite	
Upper delta	Natural levee	Forest Village	6 ~ 8 m	Dark brown~Dark grey Alluviosol Silt content is dominant	20~40 m
	General surface (including old river channel)	Paddy field in rainy season	5 ~ 7 m	Dark grey Alluviosol Silt content is dominant	20~40 m
Lower delta	Natural levee	Forest Village Field	4 ~ 5 m	Dark brown~Dark grey Alluviosol Silt content is dominant	40~60 m
	General surface (including old river channel)	Paddy field in dry and rainy seasons	2 ~ 4 m	Dark grey Alluviosol Silt content is dominant	40~60 m
Swamp	Swamp covered by forest	Forest	4 ~ 5 m	Dark grey Alluviosol Black ~Black brown Clay content is dominant	unknown
	Swamp covered by grass field	Shrub Grass field	0 ~ 1 m	Dark grey Alluviosol Black ~Black brown Peat	80~100 m

Note: Underground water level is estimated from the well water level obtained at the interview on the spot.

Tab. 13.4 Landform Classification vs. State of Ground