Working Report
of
Forest Analysis and Topographic Analysis
on
the Forest Inventory for the Management Plan of Upper Musi Watershed in South Sumatera, The Republic of Indonesia

March 1980

Japan International Cooperation Agency
(J. I. C. A.)

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Contents

A. Purpose and objective area

1. Purpose

This work was carried out for the sake of the forest exploitation survey of Upper Musi Watershed in South Sumatera by Japan International Cooperation Agency (J.I.C.A.).

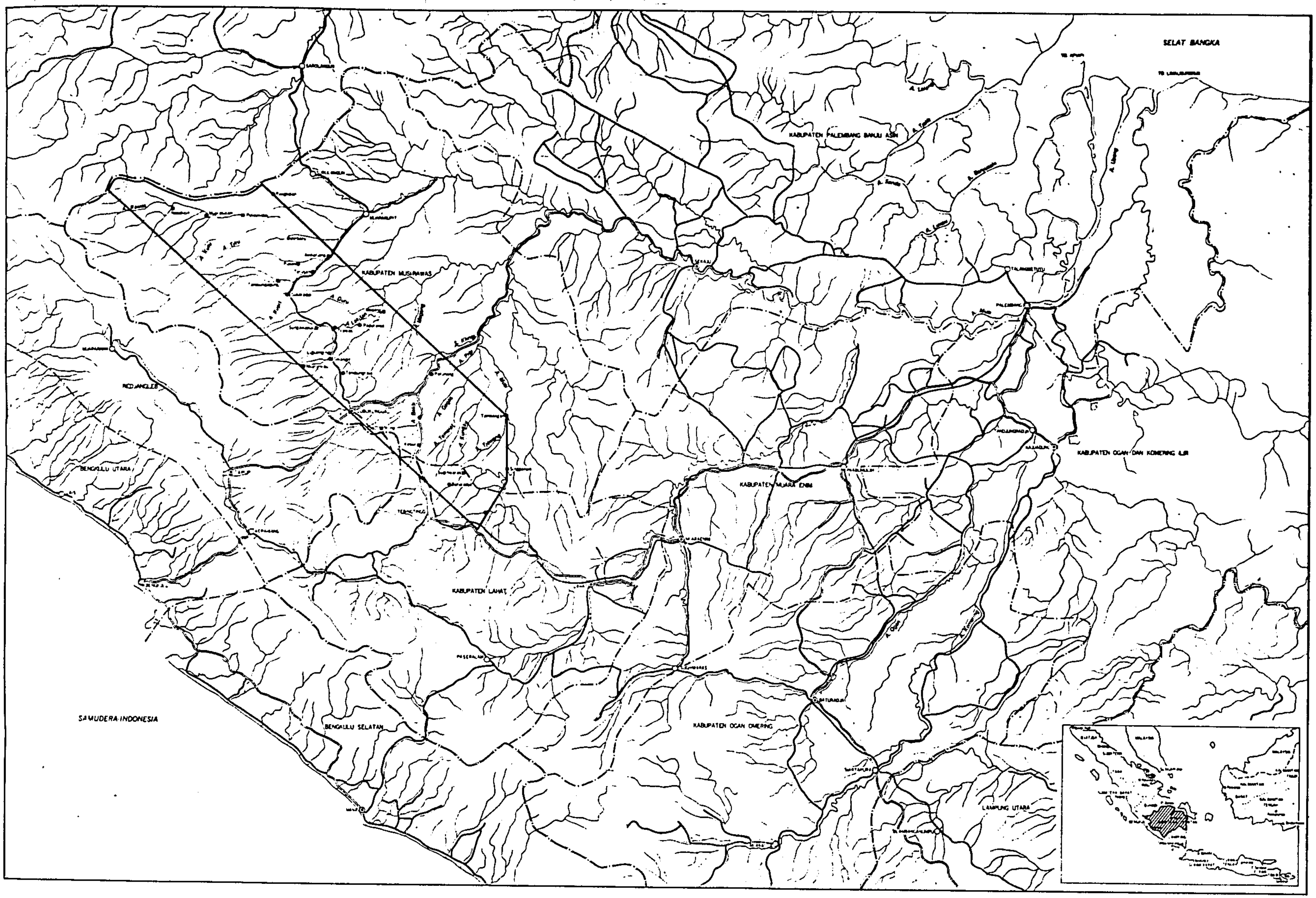
This work was continued from photographing of aerial photos in 1977 and mapping of topographical maps (scale 1:20,000) and preparation of photo volume table, etc. in 1978. Results of this work offer many kinds of data to a design of watershed management plan which consider land and water conservation in this area.

2. Objective area

Objective area of this work is about 400,000 ha, and the location is in upper watershed of A. Musi, South Sumatera Province, The Republic of Indonesia, as Fig. 1.

(remarks: A. Musi = Air Musi = Musi River)

Fig. 1 LOCATION OF THE OBJECTIVE AREA (Scale about 1:1,000,000)

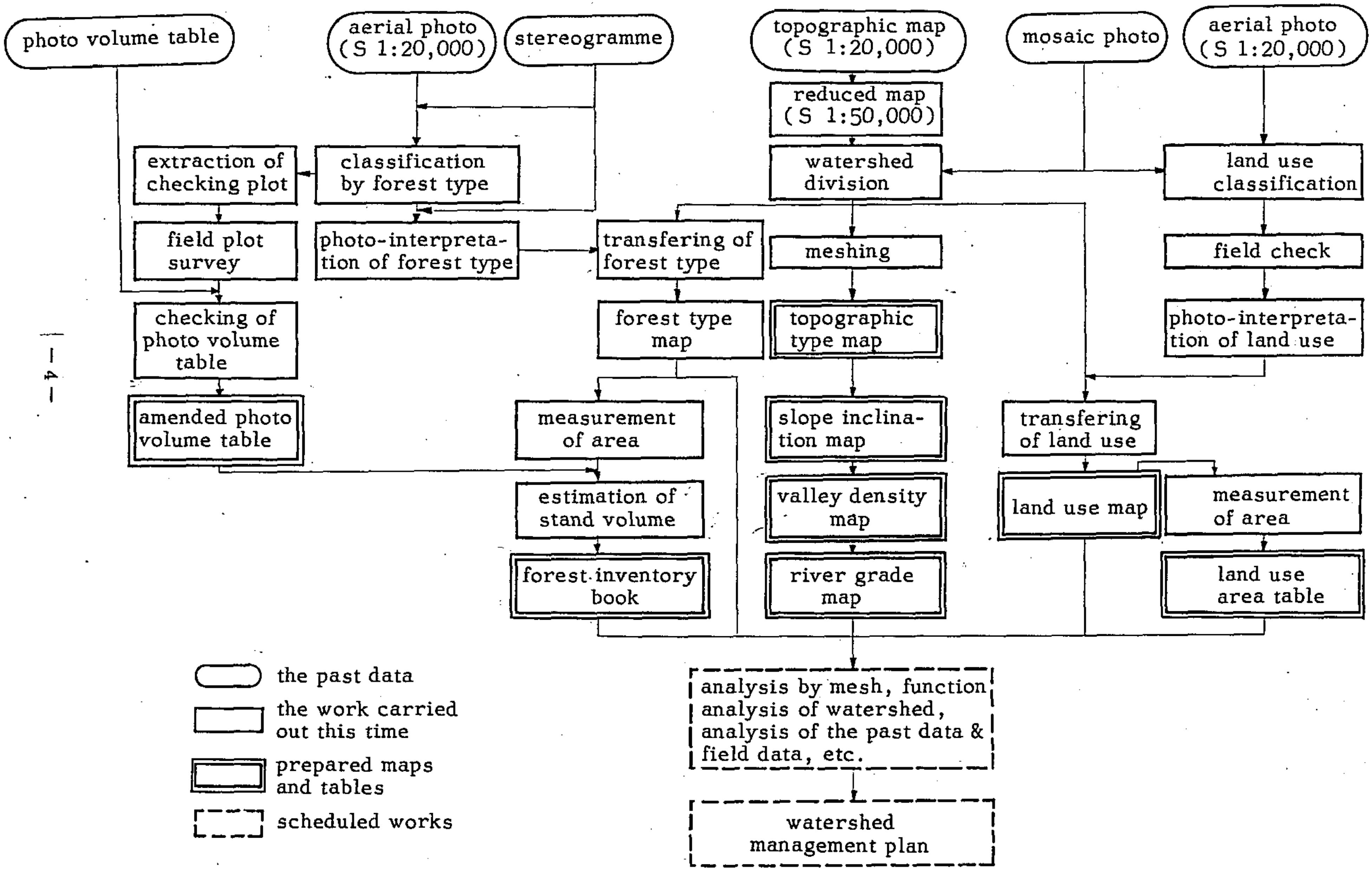


B. Method of this work and the result

1. Outline of the method

The whole work was put in practice according to a flow chart such as Fig. 2.

Fig. 2 Flow Chart of the Whole Work



2. Preparatory work

1) Preparation of reduced map

In 1978 and 1979, J.I.C.A. made topographical maps (scale 1:20,000) which cover this area by 24 sheets. But, these maps are too large and inconvenient to be used for the analysis of forest and topography and for the watershed management plan in the very large area.

Therefore, the maps were reduced and edited newly, and 6 sheets of maps scaled 1:50,000 were prepared.

2) Watershed division

For convenience sake of the arrangement of working results, this area was divided to large, middle, small and unit watershed by following way.

(1) On topographic maps (scale 1:100,000), a river basin whose length is over about 20 km was marked off as one watershed. And then, the boundary line was ammended by topographic maps (scale 1:50,000) and aerial photographs.

(2) Regarding the lower reaches of A. Musi - under the confluence of A. Rawas and A. Musi - as the first watershed, each watershed was decided the order such as the second, the third, ------, and sixth watershed.

(3) For convenience sake, the second watershed was regarded as a large watershed, the third one as a middle one and the fourth one as a small one. And, each watershed was named after the river name on the maps (scale 1:100,000).

(4) If the area of a small watershed was excessively over about 10,000 ha, it was subdivided into several unit watersheds on following points.

a. boundary of the fifth or the sixth watershed

b. confluence of two large rivers

c. large winding point

d. varied point of geographical features

In this way, this area was divided into 2 large watersheds, 6 middle watersheds, 26 small watersheds and 59 unit watersheds. The name and area of each watershed are shown in Table 1, and the location is shown in Fig. 3.

Table 1. THE DRAINAGE SYSTEM AND UNIT WATERSHED

the 1st	Large Watershed the 2nd	Middle Watershed the 3rd	Small Watershed the 4th	the 5th	Unit Watershed	No.
A. Musi	A. Rawas	A. Rawas	A. Rawas		S. Keruh	1
					A. Rawas (U)	2
					A. Rawas (M)	3
					A. Rawas (L)	4
			S. Kukus		S. Kukus	5
			S. Senawar		S. Senawar	6
			S. Mungkulam		S. Mungkulam	7
			S. Kuwis		S. Kuwis	8
			S. Kutu		S. Kutu	9
		A. Rupit	A. Ulas		A. Ulas	10
			A. Minak		A. Minak (U)	11
					A. Minak (M)	12
					A. Minak (L)	13
			A. Tiku		A. Tiku (U)	14
					A. Tiku (L)	15
			A.B. Pu	A. Leko	A. Leko	16
				A.B. Pu	A.B. Pu (U)	17
					A.B. Pu (L)	18
			A. Rupit		A. Rupit (U)	19
					A. Rupit (L)	20
		S. Liam	S. Liangedang	S. Malamingan	S. Malamingan	21
				S. Petal	S. Petal	22
			S. Liamkecil		S. Liamkecil	23
					A. Dulu (U-A)	24a
	A. Musi	A. Lakitan	A. Dulu		A. Dulu (U-B)	24b
					A. Dulu (L)	25
			A. Bal	A. Plikai	A. Plikai	26
				A. Bal	A. Bal	27
			A. Lakitan		A. Lakitan (U)	28
					A. Lakitan (L)	29
			A. Malus		A. Malus (U)	30
					A. Malus (L)	31
			S. Megang	S. Tikipbelago	S. Tikipbelago	32
				S. Megang	S. Megang (U)	33
					S. Megang (L)	34
				S. Ketuan	S. Ketuan	35
		A. Klingi	A. Klingi		A. Klingi (U)	36
					A. Klingi (L)	37
			S. Teman		S. Teman	38
			A. Beliti	A. Beliti	A. Beliti	39
				A. Koti	A. Koti	40
				A. Sinie	A. Sinie	41
				S. Saling	S. Saling	42
		A. Musi	A. Temelat	A. Pigi	A. Pigi	43
				A. Gegas	A. Gegas	44
				A. Temelat	A. Temelat (U)	45
					A. Temelat (L)	46
				A. Kungku	S. Bungin (U)	47
					S. Bungin (L)	48
					A. Kungku (U)	49
					A. Kungku (L)	50
			A. Tambangan		A. Tambangan	51
			A. Musi		A. Musi (U)	52
					A. Musi (L)	53a
					A. Musi (L)	53b
			S. Banyu		S. Banyu	54
			A. Kikim	A. Kikim	A. Kikim	55
				A. Aur	A. Aur	56
				A. Pangi	A. Pangi	57
(1)	(2)	(6)	(26)	(38)	(59)	

(Remarks)

(U): the upper reach of river
(M): the middle reach of river
(L): the lower reach of river

UPPER MUSI WATERSHED

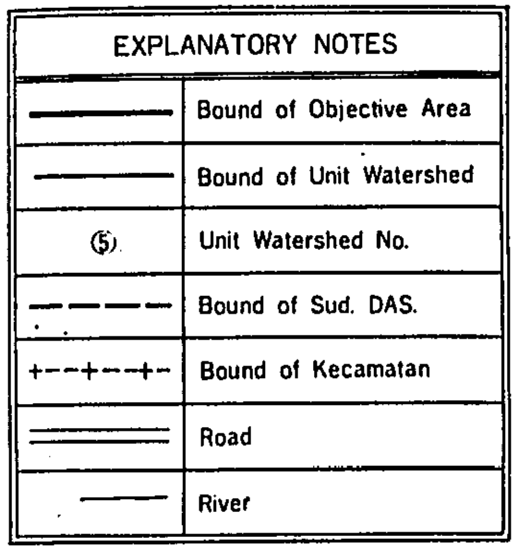
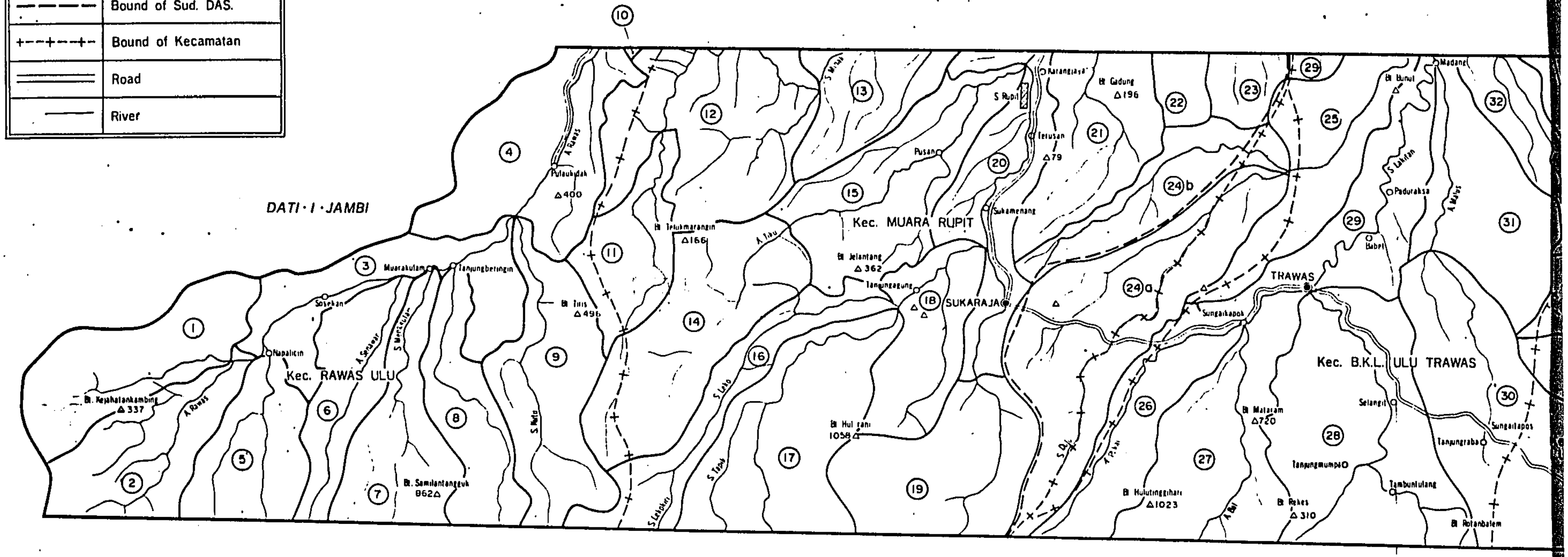
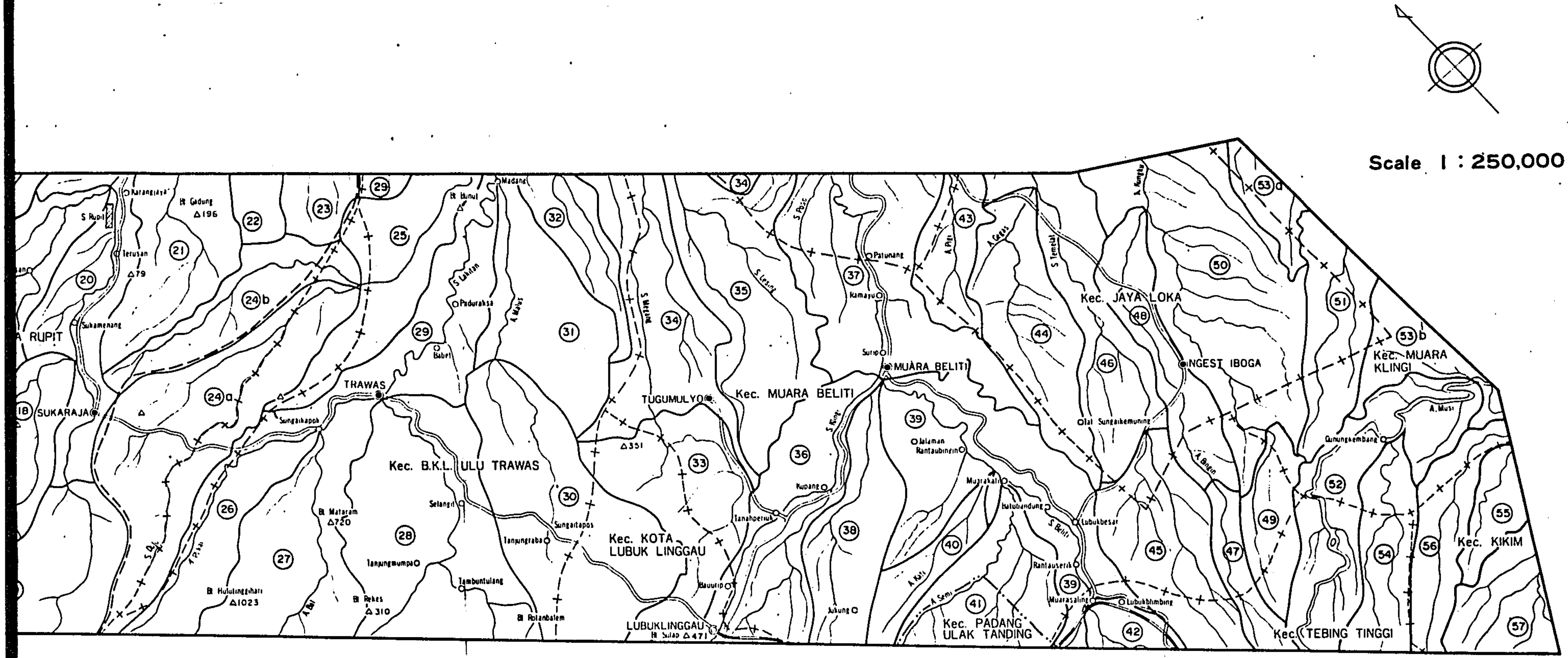


Fig. 3 Watershed Division Map



DAS MUSI HULU-RAWAS
PROP. SUMATERA SELATAN

Fig. 3 Watershed Division Map



DAS MUSI HULU-RAWAS
PROP. SUMATERA SELATAN

3. Forest analysis

1) Checking of photo volume table

This work was carried out for the sake of amendment of the photo volume table that was made in 1978. Namely, it is to change the photo volume table into a more suitable and available table for this whole area.

(1) Preparatory work

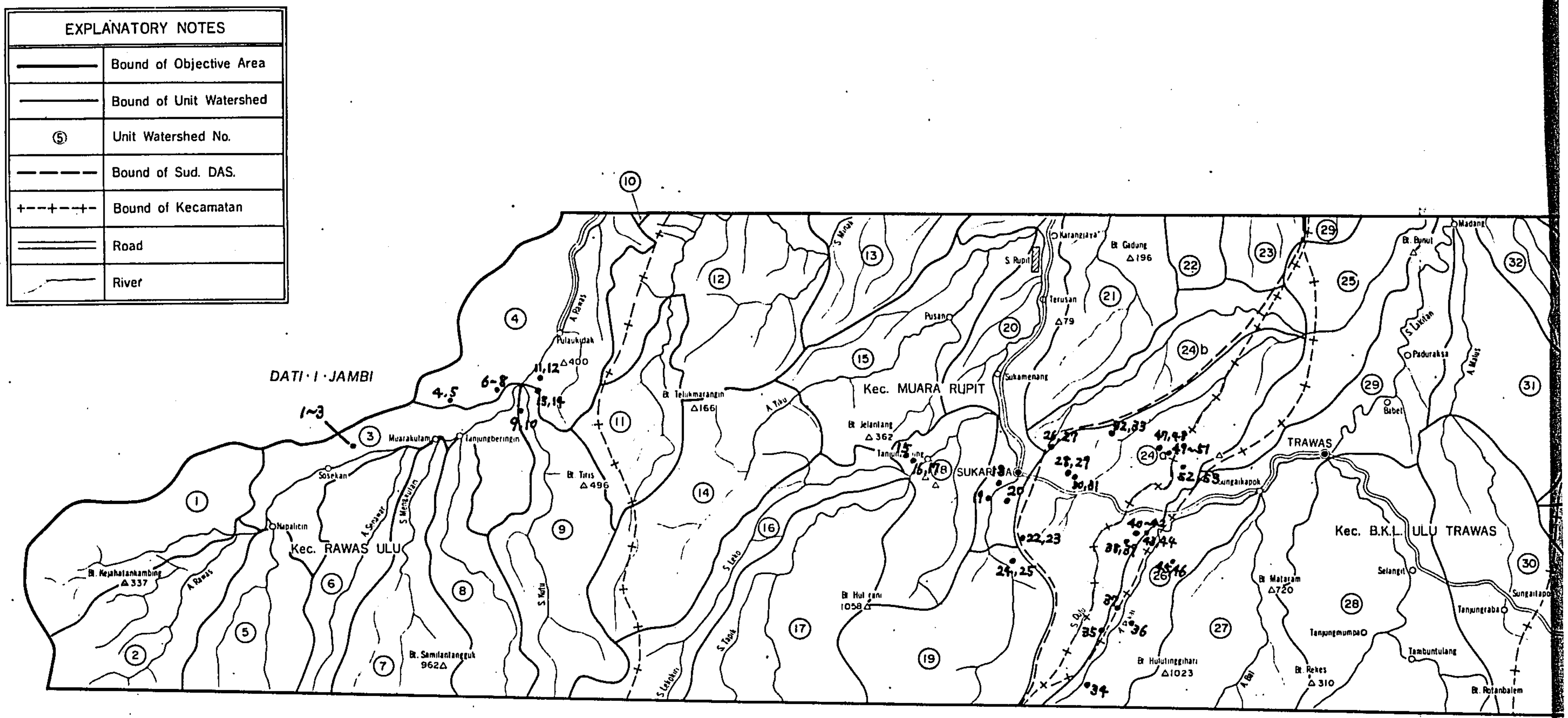
Natural forest in this area was classified by forest types on the aerial photos, and the division boundaries are checked and amended by a stereogramme and data of field survey that were prepared in 1978.

(2) Extraction of checking plots

Checking plots were extracted from all kinds of forest types with the aerial photos drawn the forest type classification. 58 checking plots were extracted and surveyed actually. The location of these plots is roughly shown in Fig. 4.

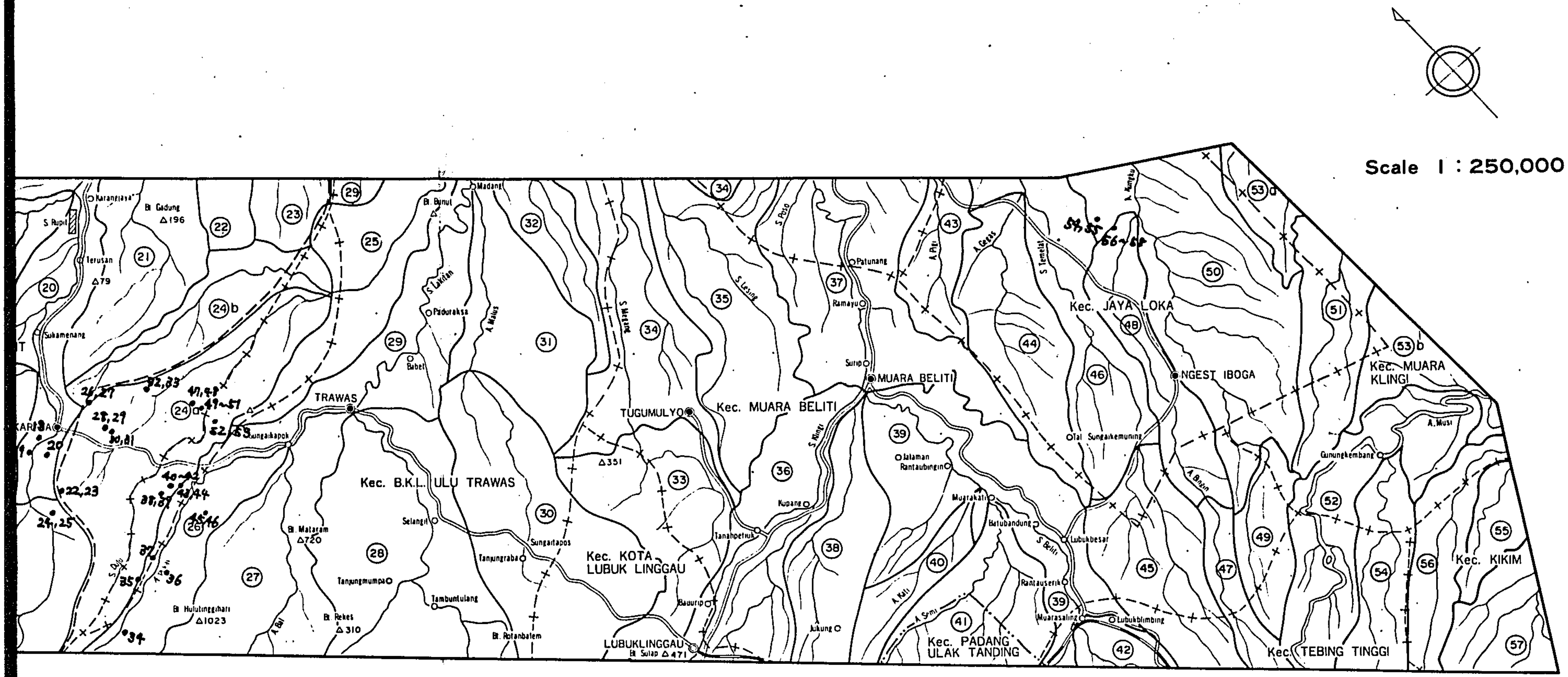
Fig. 4 **PLOT LOCATION MA**

UPPER MUSI WATERSHED



DAS MUSI HULU-RAWAS
PROP. SUMATERA SELATAN

PLOT LOCATION MAP



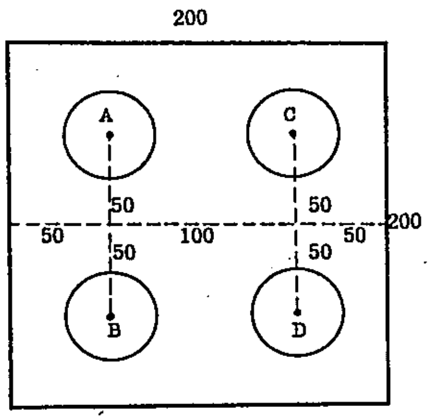
DAS MUSI HULU-RAWAS
PROP. SUMATERA SELATAN

(3) Field plot survey

The field survey of checking plots was done for 45 days from 1 July to 14 August, 1979. In order to grasp stand volume of each plot as fast and exactly as possible, Bitterlich Method was applied this time. The summary is as follows.

a. area of a checking plot was 4 ha, and 4 measuring points were set up in it systematically by compass survey. (See Fig. 5)

Fig. 5



(Remarks)
Unit: meter
A-D: measuring points

b. Objective trees were extracted with a Dendrometer (K=4) at each measuring point. They were upper storied trees over 40cm on d.b.h. in the same way to last field survey in 1978.

c. These trees were measured about follows.
- Tree species - vernacular names
- Diameter breast high - measuring with a diameter tape
- Tree height - measuring with a hypsometer (Blume-Leiss)

- Clear length - measuring with a hypsometer (Blume-Leiss)

d. Each stand volume per ha in checking plot was calculated with the result of field survey.

As the result of field plot survey, Table 2 was obtained.

(4) Estimation of stand volume in checking plot

On the aerial photos, squares (1cm x 1cm) were marked at the same location that the field survey was done, being based on the pricking points that were pricked in time of the field survey.

About the squares, two factors of stand condition - crown diameter and crown density - were measured by photo-interpretation. The method is similar to last survey. (Cf. "PHOTO VOLUME TABLE" March, 1979 Japan International Cooperation Agency)

The interpreted values were applied to above-mentioned photo volume table, and each stand volume were found. Table 3 shows the result of photo-interpretation and volume estimation.

(5) Preparation of amended photo volume table

Each stand volume obtained by the field plot survey was regarded as an actual value (Y), and on the other hand, the volume obtained by the photo-interpretation was regarded as the estimated value (X). And, the precision of photo-interpretation - namely the precision of the former photo-volume table - was analyzed with the regression analysis between X and Y. The result was as follows. (See Fig. 6)

Regression formula	$Y = 37.36 + 0.74X$
Correlation coefficient	0.7431

(Plot Nos, 44, 45, 46, 48, 49 and 51 were not used in this calculation, because their values were considered as errors of measurement in the field survey)

The above precision is more or less low. It is caused by the variety of forest condition in this area, and this regression formula is available for the estimation of stand volume in this broad area.

The values in the former photo volume table were all amended with the formula, and the amended photo volume table was prepared as Table 4.

Remarks on this photo volume table:

a. The volume is the merchantable stand volume (clear length volume of upper storied trees over 40cm on d.b.h.

b. The volume to the crown diameter and the crown density not shown in this table will be calculated with following formulas.

$$v = 0.0002484 \times \overline{CD}^{0.5300308} \times R^{2.8775892}$$

$$V = 37.36 + 0.74\,v$$

v (m^3/ha): Stand volume that should be amended

$\overline{CD}$ (m): Crown diameter

R (%): Crown density

V (m^3/ha): Stand volume that was estimated and amended.

Table 2. RESULT OF FIELD PLOT SURVEY

plot No.	date	district name	condition by field observation			average of plot (about trees over 40cm d.b.h)				
			forest type	crown diameter	tree height	number of trees(pc's/ha)	d.b.h	tree height	clear length	stand volume
				m	m		cm	m	m	m3/ha
1	23 July	Kec. Rawas Ulu	M	13~20	21~30	77	54.8	19.7	12.1	190.4
2	"	"	"	"	"	72	57.7	23.6	14.4	216.3
3	"	"	"	"	"	90	55.1	22.6	13.0	212.1
4	"	"	"	"	"	76	50.5	21.0	11.2	150.2
5	"	"	"	"	"	60	51.9	22.6	12.9	128.7
6	22 July	"	"	~12	"	35	65.5	21.7	14.3	137.9
7	"	"	"	"	"	91	58.4	23.6	16.3	305.9
8	"	"	"	"	"	56	53.7	23.3	13.5	122.5
9	"	"	H	13~20	~20	53	50.6	20.0	11.5	90.3
10	"	"	"	"	21~30	25	56.5	24.9	15.6	72.1
11	24 July	"	"	"	"	44	58.2	23.6	12.6	107.8
12	"	"	M	~12	"	60	55.8	22.7	12.8	144.9
13	"	"	"	21~30	"	36	53.3	26.1	15.4	101.2
14	"	"	"	"	"	40	51.1	26.7	15.7	105.4
15	18 July	Kec. Muararupit	H	13~20	"	54	49.8	22.6	14.9	111.3
16	"	"	"	"	"	41	48.6	22.4	15.2	87.5
17	"	"	S	"	"	35	49.7	21.9	16.5	84.0
18	17 July	"	H	"	"	14	68.3	22.7	14.6	51.1
19	"	"	"	"	"	15	65.1	26.9	13.1	48.3
20	14 July	"	M	"	"	35	57.4	23.8	15.7	113.4
21	"	"	"	21~30	"	55	62.0	22.8	14.3	182.7
22	"	"	"	13~20	"	60	57.3	30.6	19.7	226.8
23	"	"	"	"	"	63	53.5	29.3	19.1	205.8
24	18 July	"	"	~12	"	47	53.8	23.7	14.0	105.7
25	"	"	"	"	"	67	56.4	23.4	13.2	165.9
26	15 July	"	"	13~20	"	32	63.5	24.3	14.0	100.8
27	"	"	S	"	"	7	84.6	25.0	11.5	37.8
28	"	"	M	"	"	94	51.0	26.9	18.0	257.6
29	"	"	"	"	"	69	46.1	24.1	16.9	144.9
30	"	"	"	"	"	79	48.9	26.2	15.3	175.0
31	"	"	"	"	"	25	54.7	24.9	14.8	60.9
32	"	"	F	21~30	"	60	51.8	29.7	21.2	190.4
33	11 July	"	S	"	"	19	68.5	29.0	20.3	100.1
34	10 July	Kec. Ulu Trawas	M	"	"	29	69.7	30.4	18.7	161.7
35	9 July	"	"	"	"	37	60.0	28.8	18.9	136.5
36	10 July	"	"	13~20	"	28	62.0	25.7	16.8	108.0
37	9 July	"	"	"	"	51	58.7	25.2	18.1	187.6
38	19 July	"	"	"	"	55	54.6	22.7	16.0	161.0
39	"	"	"	"	"	46	61.0	21.1	13.7	156.1
40	"	"	"	"	"	76	53.4	21.9	12.3	166.6
41	"	"	"	~12	"	58	52.4	21.6	12.8	121.1
42	"	"	"	"	~20	96	49.4	17.7	10.1	144.2
43	17 July	"	"	13~20	21~30	58	56.6	26.0	15.9	165.2
44	"	"	"	~12	"	61	54.3	25.9	17.7	105.7
45	10 July	"	"	13~20	31~	181	51.9	35.3	26.5	802.2
46	"	"	"	"	"	170	52.7	33.5	22.0	585.9
47	11 July	Kec. Muararupit	F	"	21~30	70	50.8	26.2	17.1	195.3
48	"	"	"	"	"	97	54.6	28.1	17.3	335.3
49	12 July	"	"	"	"	64	54.9	26.4	15.4	179.2
50	"	"	"	"	"	67	48.9	24.7	16.8	154.0
51	"	"	"	21~30	"	49	49.7	27.8	18.6	137.2
52	"	Kec. Ulu Trawas	"	"	"	51	55.5	23.7	14.5	134.4
53	"	"	"	"	"	30	51.3	25.2	16.8	157.7
54	28 July	Kec. Jayaloka	"	"	"	50	44.7	20.9	14.2	79.1
55	"	"	"	13~20	"	35	58.6	22.4	14.7	109.9
56	"	"	"	"	~20	72	50.8	21.3	11.7	128.8
57	"	"	"	"	21~30	45	64.6	21.7	12.0	147.0
58	"	"	"	"	"	39	56.8	20.6	11.6	83.3

Table 3. RESULT OF PHOTO-INTERPRETATION

Plot No.	R	D	E.V	A.V	Plot No.	R	D	E.V	A.V
1	65	15	172	190.4	30	55	17	114	175.0
2	65	16	178	216.3	31	50	18	89	60.9
3	75	17	277	212.1	32	65	14	166	190.4
4	70	15	213	150.2	33	55	16	110	100.1
5	70	13	197	128.7	34	55	14	102	161.7
6	60	16	141	137.9	35	55	15	106	136.5
7	80	14	301	305.9	36	60	13	127	108.0
8	60	16	141	122.5	37	60	15	137	187.6
9	65	12	153	90.3	38	60	14	132	161.0
10	60	14	132	72.1	39	55	14	102	156.1
11	55	16	110	107.8	40	65	15	172	166.6
12	55	17	114	144.9	41	55	14	102	121.1
13	50	17	86	101.2	42	65	13	159	144.2
14	50	17	86	105.4	43	60	15	137	165.2
15	65	13	159	111.3	44	70	13	197	105.7
16	45	15	60	87.5	45	75	16	269	802.2
17	50	14	78	84.0	46	75	15	259	585.9
18	40	13	39	51.1	47	70	16	220	195.3
19	45	14	58	48.3	48	55	18	117	335.3
20	55	14	102	113.4	49	45	14	58	179.2
21	70	17	227	182.7	50	55	13	99	154.0
22	65	15	172	226.8	51	40	17	45	137.2
23	60	15	137	205.8	52	55	17	114	134.4
24	50	17	86	105.7	53	60	16	141	157.7
25	60	16	141	165.9	54	60	16	141	79.1
26	50	14	78	100.8	55	65	14	166	109.9
27	35	15	29	37.8	56	60	16	141	128.8
28	70	14	205	257.6	57	65	16	178	147.0
29	65	15	172	144.9	58	60	16	141	83.3

Remarks:

R = Crown density (%)
D = Crown diameter (m)
E.V = Estimated stand volume (m^3/ha) by a photo volume table made last time
A.V = Actual stand volume (m^3/ha) by field survey

Fig. 6. Relationship of Actual Volume to Estimated Volume

Actual Volume = Result of Field Survey

Estimated Volume = Result of Photo — interpretation (by the last photo volume table)

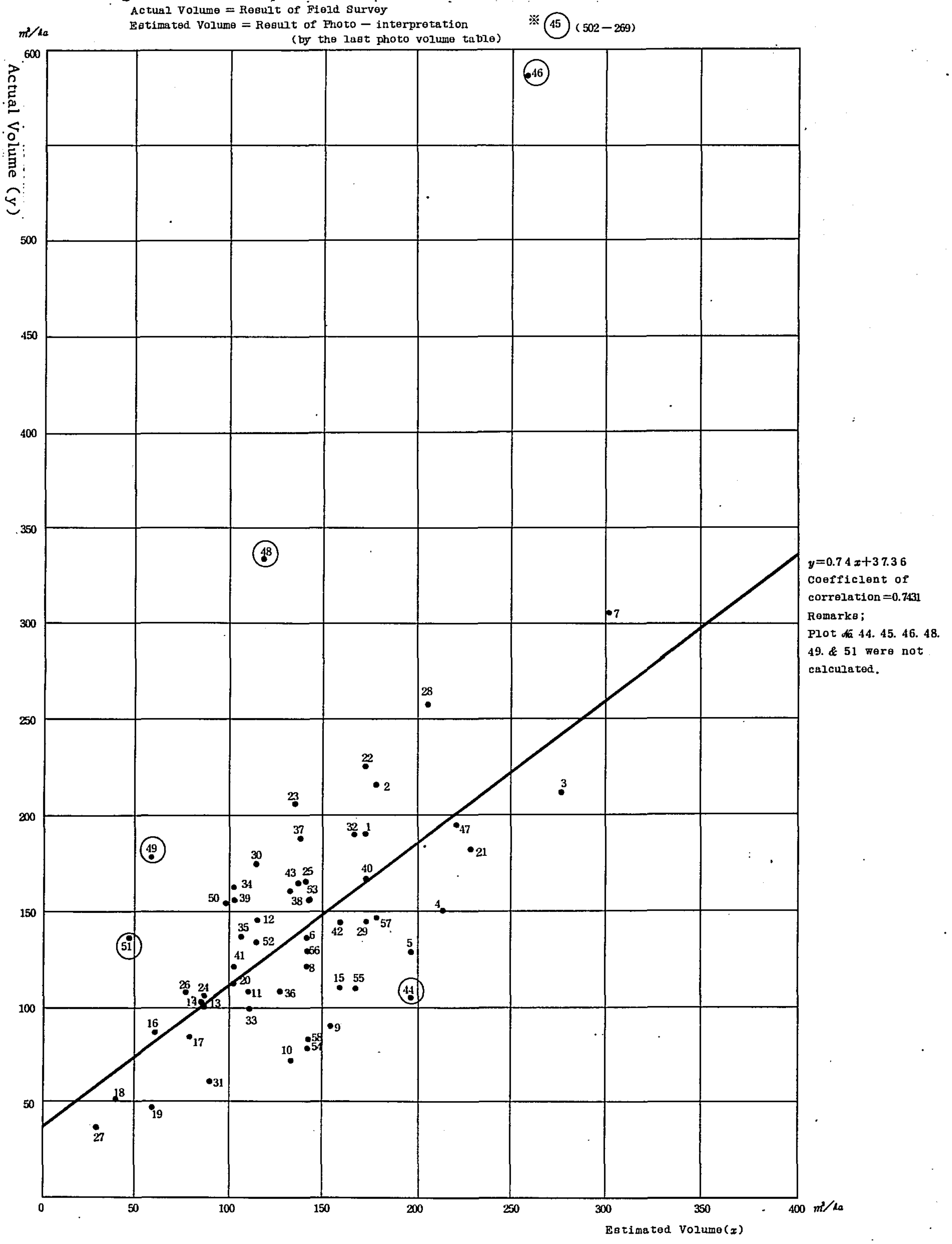


Table 4. PHOTO VOLUME TABLE (AMENDED)

Objective stand : Natural forest
Objective area : Upper Musi Watershed, South Sumatora

(Unit: m^3/ha)

	(M) (%)	CROWN DIAMETER															
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
CROWN DENSITY	35	54	56	57	57	58	59	60	60	61	62	63	63	63	64	65	65
	40	63	64	65	66	68	69	70	71	72	73	74	75	76	77	78	79
	45	73	75	77	78	80	82	83	85	86	88	88	90	91	93	94	95
	50	85	88	91	93	95	97	100	101	103	105	107	109	111	112	114	116
	55	101	104	107	111	113	116	119	122	124	126	129	131	134	136	138	140
	60	119	123	127	131	135	139	142	145	148	152	155	158	161	164	167	170
	65	140	145	151	155	160	165	169	174	177	182	185	189	193	197	201	204
	70	165	171	177	183	189	195	200	205	211	216	221	225	230	235	239	244
	75	192	200	208	216	222	229	236	242	249	255	261	267	273	278	284	289
	80	224	233	243	252	260	268	276	285	292	299	307	313	321	327	334	341
	85	259	271	282	293	303	313	322	331	341	350	358	367	375	383	390	398
	90	299	313	326	338	350	361	373	384	395	405	415	425	435	444	454	463

Remarks: $Y = 0.74 X + 37.36$, Y = Estimated volume that was amended by the result of field survey
X = Estimated volume of the last photo volume table (made in March, 1979)

2) Preparation of forest type map

(1) Classification by forest type

Natural forest in this area was classified by several forest types through photo-interpretation and marked on the aerial photo with the symbols. The standard of each classification is shown in Table 5.

Table 5

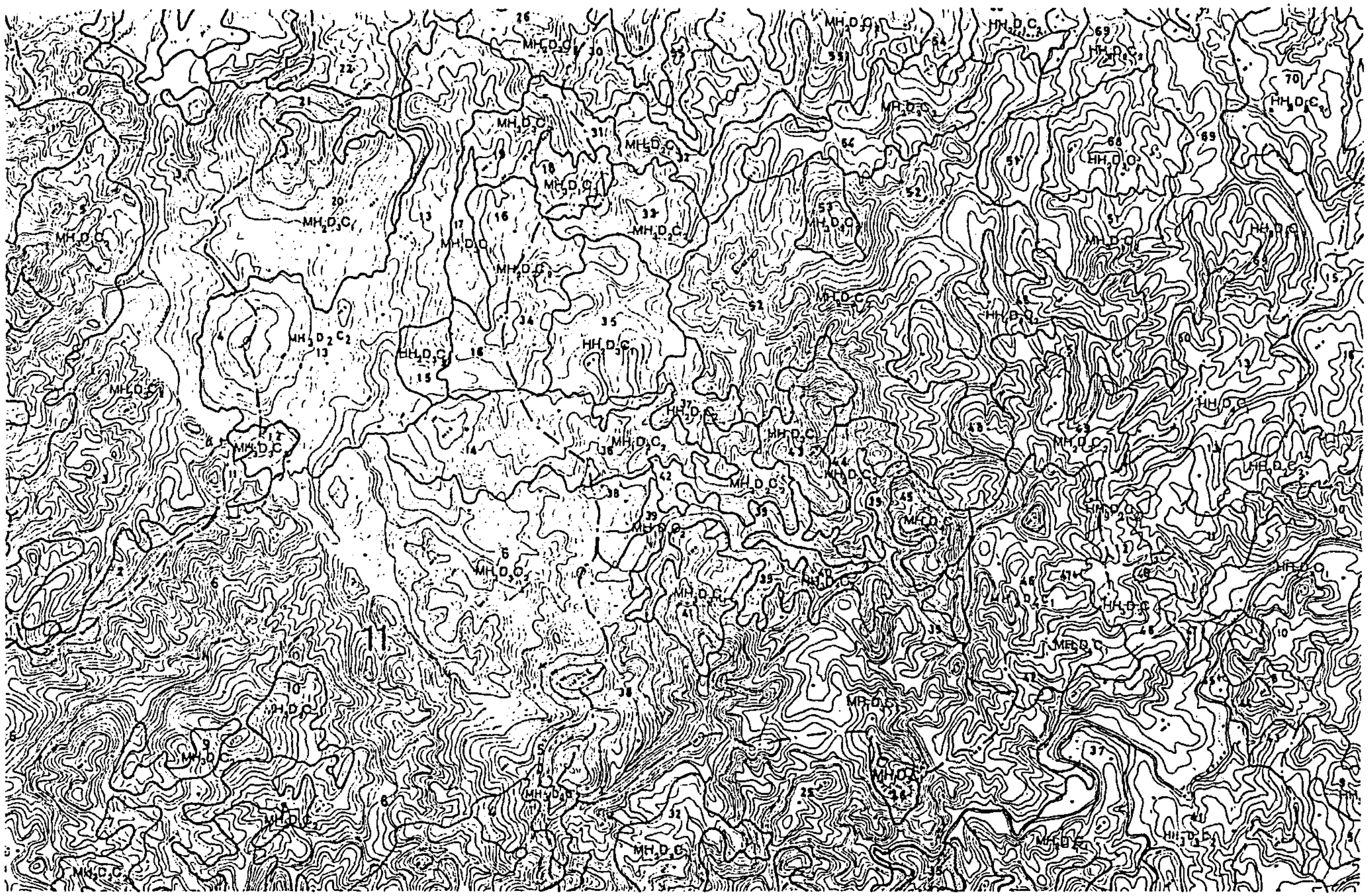
Factor	Classification	Symbol	Remark
Forest type	Mountain forest Hill forest Flat land forest Swamp forest	M H F S	
Tree height	Less than 20m 21m - 30m More than 31m	H_1 H_2 H_3	
Crown density	Less than 40% 41% - 60% 61% - 80% More than 81%	D_1 D_2 D_3 D_4	The forest was measured every 5% and judged the class
Crown diameter	Less than 12m 13m - 21m More than 22m	C_1 C_2 C_3	The forest was measured every 1m and judged the class

(2) Preparation of forest type map

The above mentioned classification on the aerial photos was transfered into the topographic maps (scale 1:50,000), and they were drafted as "forest type map".

The part of forest type map is shown in Fig. 7 as an example.

Fig. 7 FOREST TYPE MAP



Scale 1 : 50,000

3) Arrangement of forest inventory book

(1) Measurement of area

On the forest type map, each area of division was measured with a dot plate. And then, the areas were summed up each forest compartment and each watershed (unit, small, middle and large watershed).

(2) Volume estimation

The numeric values of crown diameter and crown density in each division were applied to the amended photo volume table, and the stand volume per ha was obtained.

The total volume in each division was estimated with the multiplication of the stand volume per ha and the area. And moreover, they were summed up each forest compartment and each watershed in the same way to the arrangement of areas.

(3) Arrangement of forest inventory book

In this way, each forest division, forest compartment, and watershed, the area and stand volume were arranged into a same table. And, these tables were bound as a "forest inventory book". (See the separate volume.)

4. Land use classification

1) Preparation of land use map

In order to know the present condition of land use in this area, the division and classification by several types of land use were made over the whole area on the aerial photos and the topographic maps (scale 1:50,000).

The land use types shown in Table 6 were used for this working.

The above mentioned classification was checked and amended by the field investigation, and was issued with color printing as a set of "land use map". The part of land use map is shown in Fig. 8 as an example.

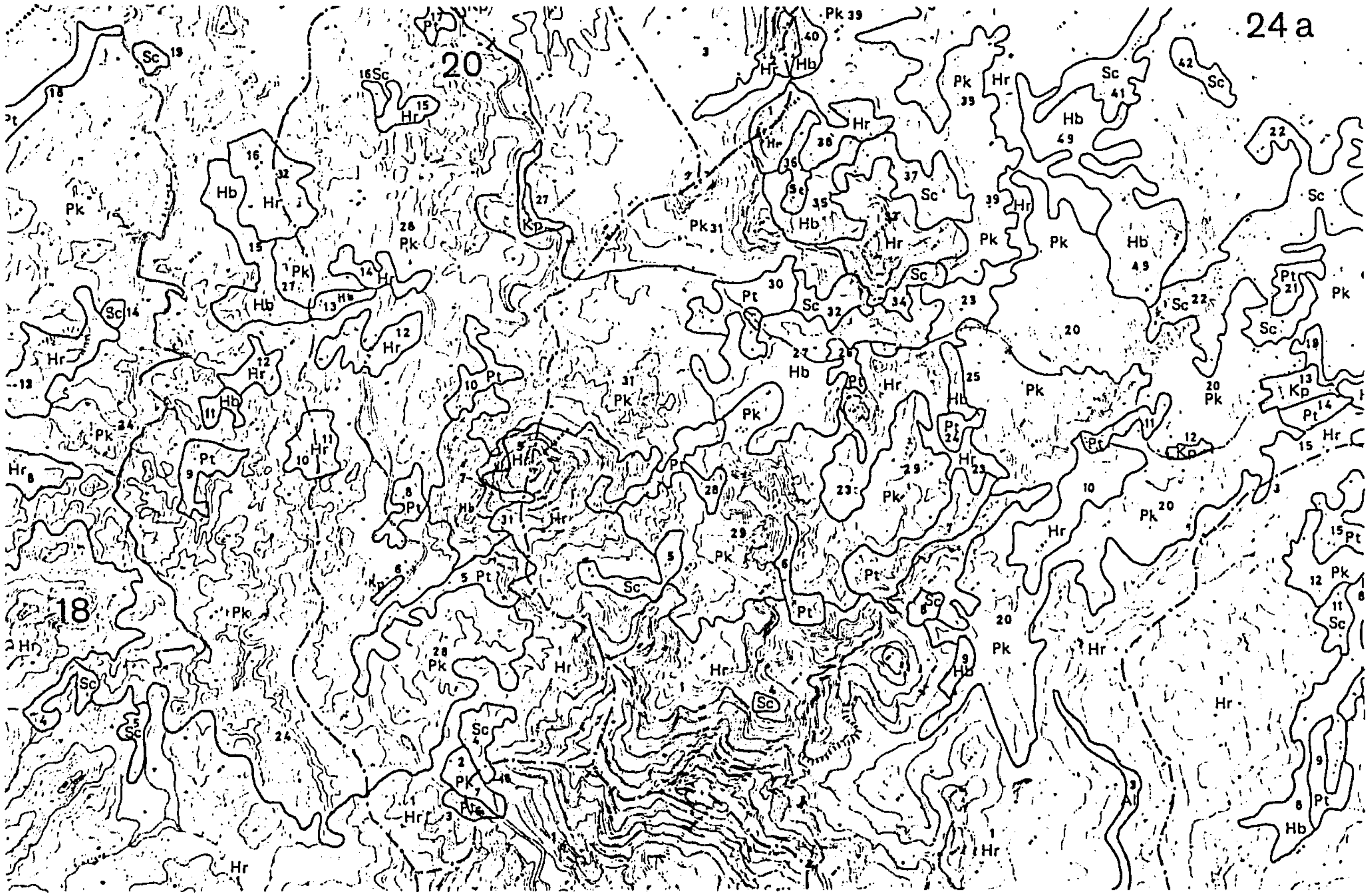
Table 6

Classification	Symbol	Remark
Natural forest	Hr	
Man-made forest	Ht	
Secondary-growth	Hb	excepting rubber plantation
Rubber plantation	Pk	including left rubber-forest
Grass land	Al	"alang-alang", pasture
Bare land	Tk	slided land, erosive land, etc.
Farm land	Pt	fixedly cultivated field
Shifting cultivation	Sc	active "ladang"
Urban site	Kp	
Swamp and water site	Rw	

2) Arrangement of land use area table

On the land use map, each area of division was measured with a dot plate. The areas were summed up each watershed. These areas were described in a set of "land use area table". (See the separate volume.)

Fig. 8 LAND USE MAP



Scale 1 : 50,000

5. Topographic analysis

As topographic factors that can be measured with the topographic maps and are need for the design of watershed management plan, geographical features, slope inclination, valley density and river grade were selected this time.

1) Meshing

Mesh method is very useful in order to grasp systematically and objectively the topographic characteristics of this broad area.

The size of mesh was decided on 500m square (area 25 ha), and 1cm square mesh was covered over all topographic maps (scale 1:50,000).

2) Classification by geographical features

Geographic types shown in Table 7 were considered to be suitable types for the expression of geographical features in this area. Fig. 9 is a model figure (a sectional plan).

All meshes were judged their types ever one mesh according to Table 7 and Fig. 9, and the symbols were written in the meshes. This map was called a "topographic type map" for convenience' sake. The part of topographic type map is shown in Fig. 10 as an example.

Table 7. A standard of classification by geographic features

Large classification	Middle classification	Small classification	Symbol	Relief height	Slope inclination	Remark
Mountainous land	-	Ridge (Convex slope)	Mr	More than 200 m	More than 30°	
	-	Mountain-side (Graded slope)	Ms			
	-	Dale (Concave slope)	Md			
Hilly land	-	Large wave land	Hi	30m ~ 200m	15° ~ 30°	including diposi-tional piedmont whose relief is large
Flat land	Diluvial upland	Small wave land	Fw	5m ~ 30m	5° ~ 15°	including diposi-tional piedmont whose relief is small
		Flat plateau	Fp		0° ~ 5°	
	Alluvial plain	Flood plain	Fa	0m ~ 5m	0° ~ 5°	only about rela-tively large rivers

Fig. 9. A MODEL OF CLASSIFICATION BY GEOGRAPHIC FEATURES

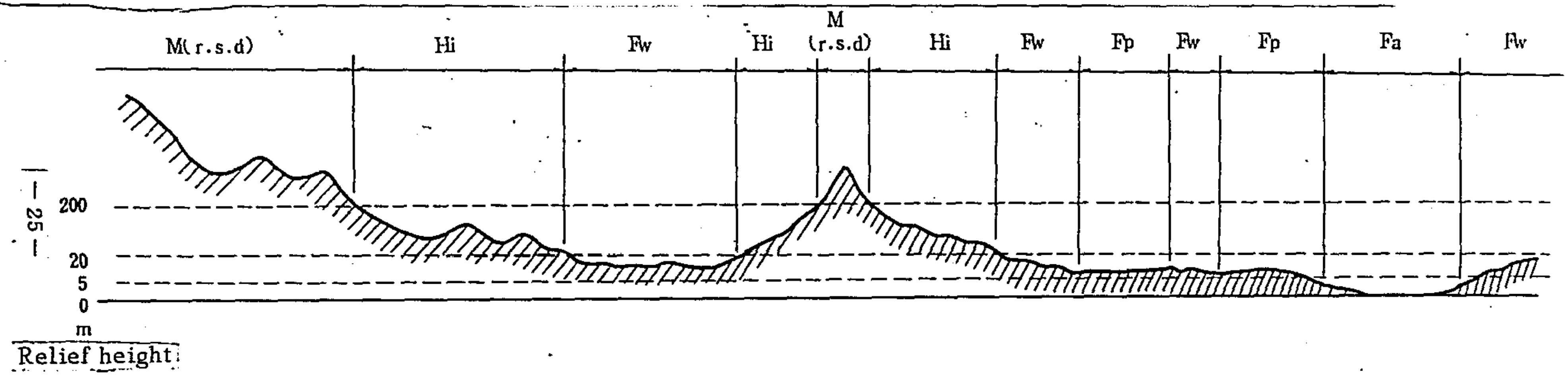
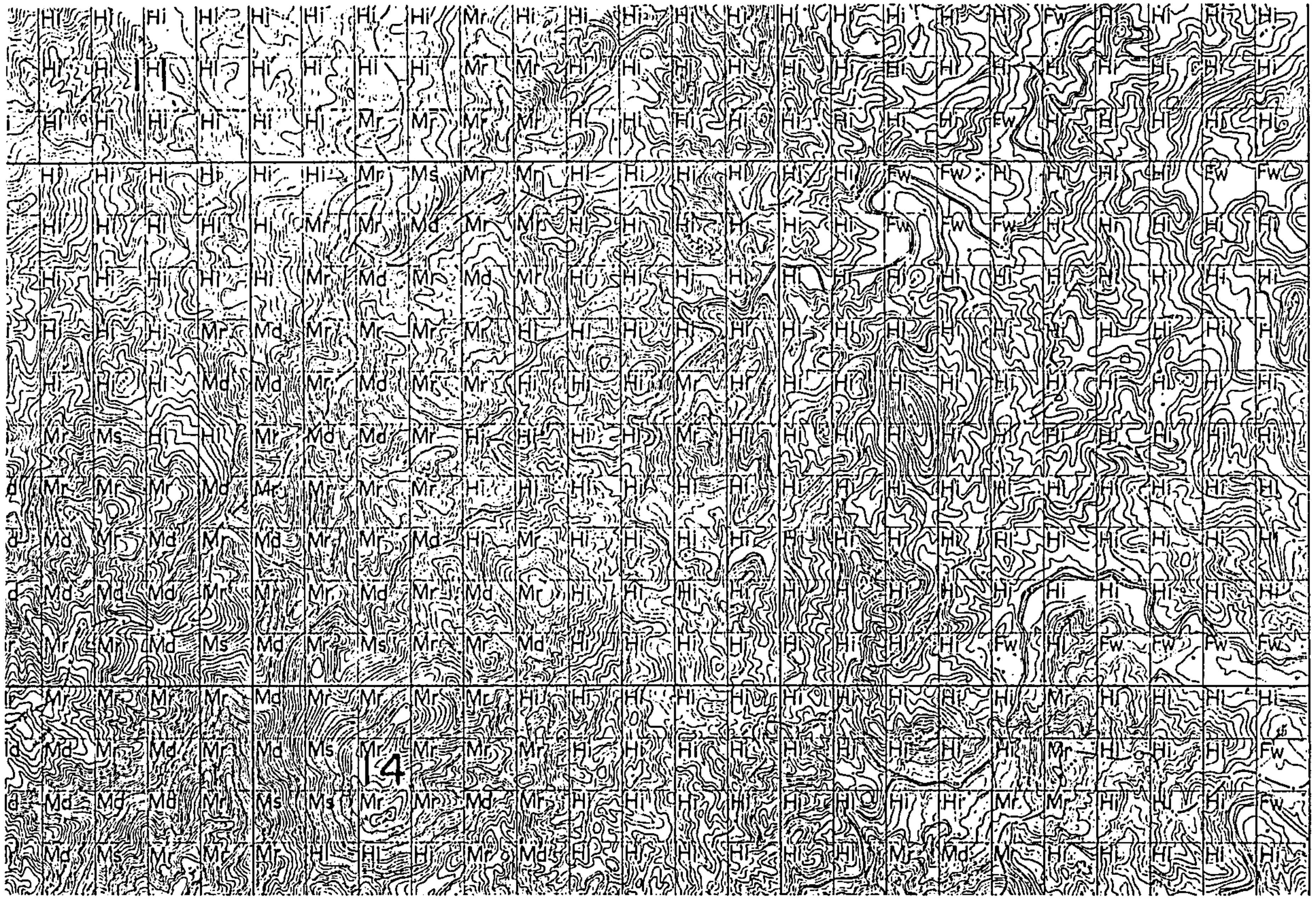


Fig. 10 TOPOGRAPHIC TYPE MAP



Scale 1 : 50,000

3) Classification by slope inclination

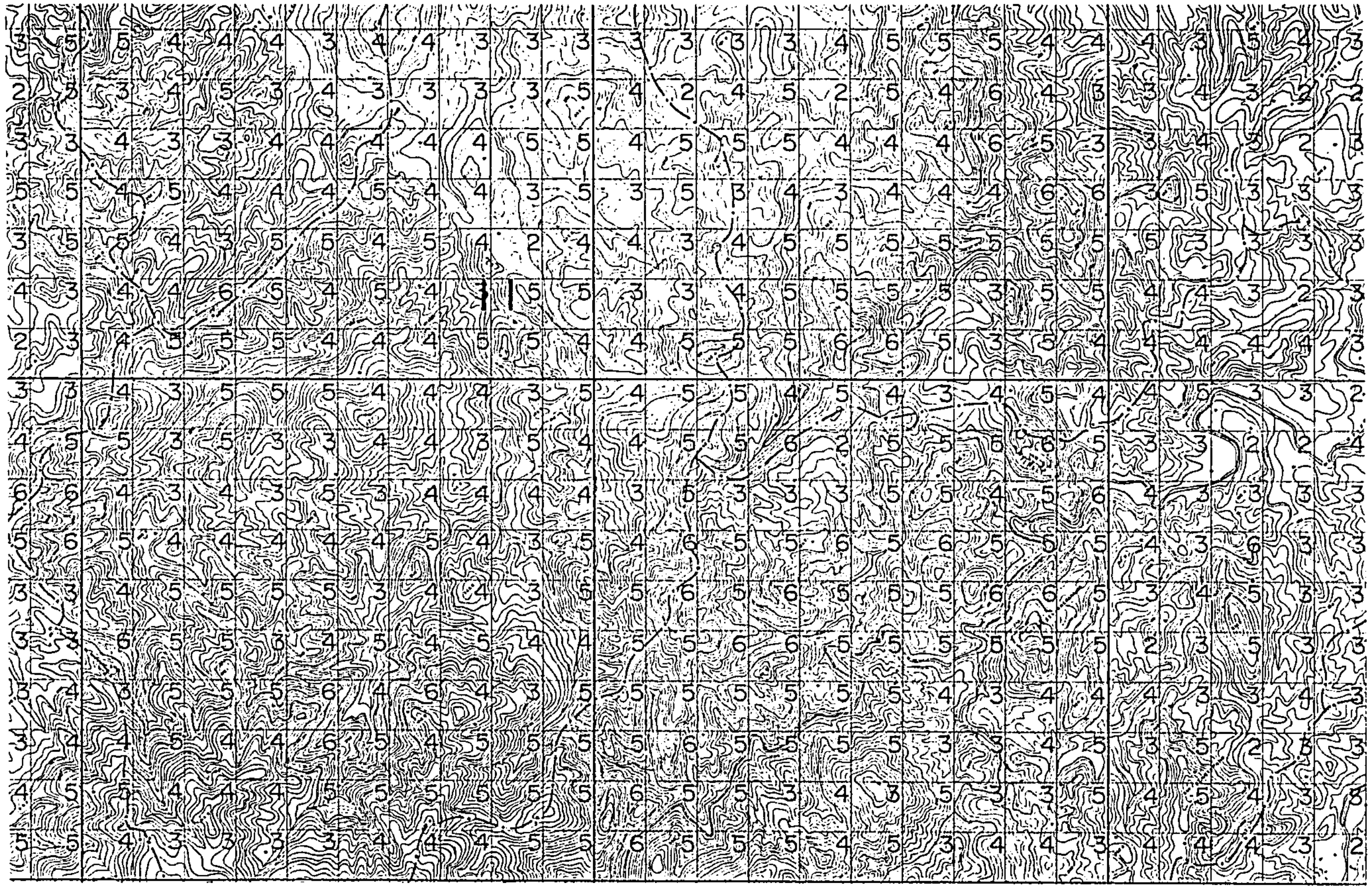
In order to measure the average slope inclination in each mesh, a circle (the diameter is 5mm) was put on the average slope in the mesh, and the number of contour lines (the contour interval is 10m) in the circle was counted and converted into gradient (°).

As the gradient was applied to the classification table (Table 8), the symbol was written in each mesh. This map was called a "slope inclination map" for convenience' sake. The part of slope inclination map is shown in Fig. 11.

Table 8

Classification	Symbol	Remark
0° - 1°	I_1	Number of contour lines in the circle 0
2° - 5°	I_2	" 1 - 2
6° - 10°	I_3	" 3 - 4
11° - 15°	I_4	" 5 - 6
16° - 20°	I_5	" 7 - 9
21° - 30°	I_6	" 10 - 14
More than 31°	I_7	" More than 15

Fig. 11 SLOPE INCLINATION MAP



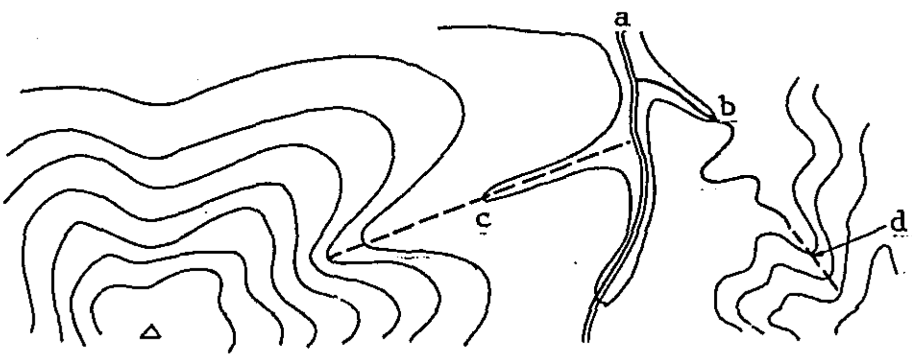
Scale 1 : 50,000

4) Classification by valley density

First of all, a drainage system map was prepared with the topographic map (scale 1:50,000). As the water lines were marked on the map, the same standard was used.

Namely, the water lines were marked on all clear valleys whose horizontal extension on the lower side were less than 60 degrees. (See Fig. 12)

Fig. 12



(Explanatory notes)

a & b : Rivers on which the water lines had already been marked in the topographic maps.

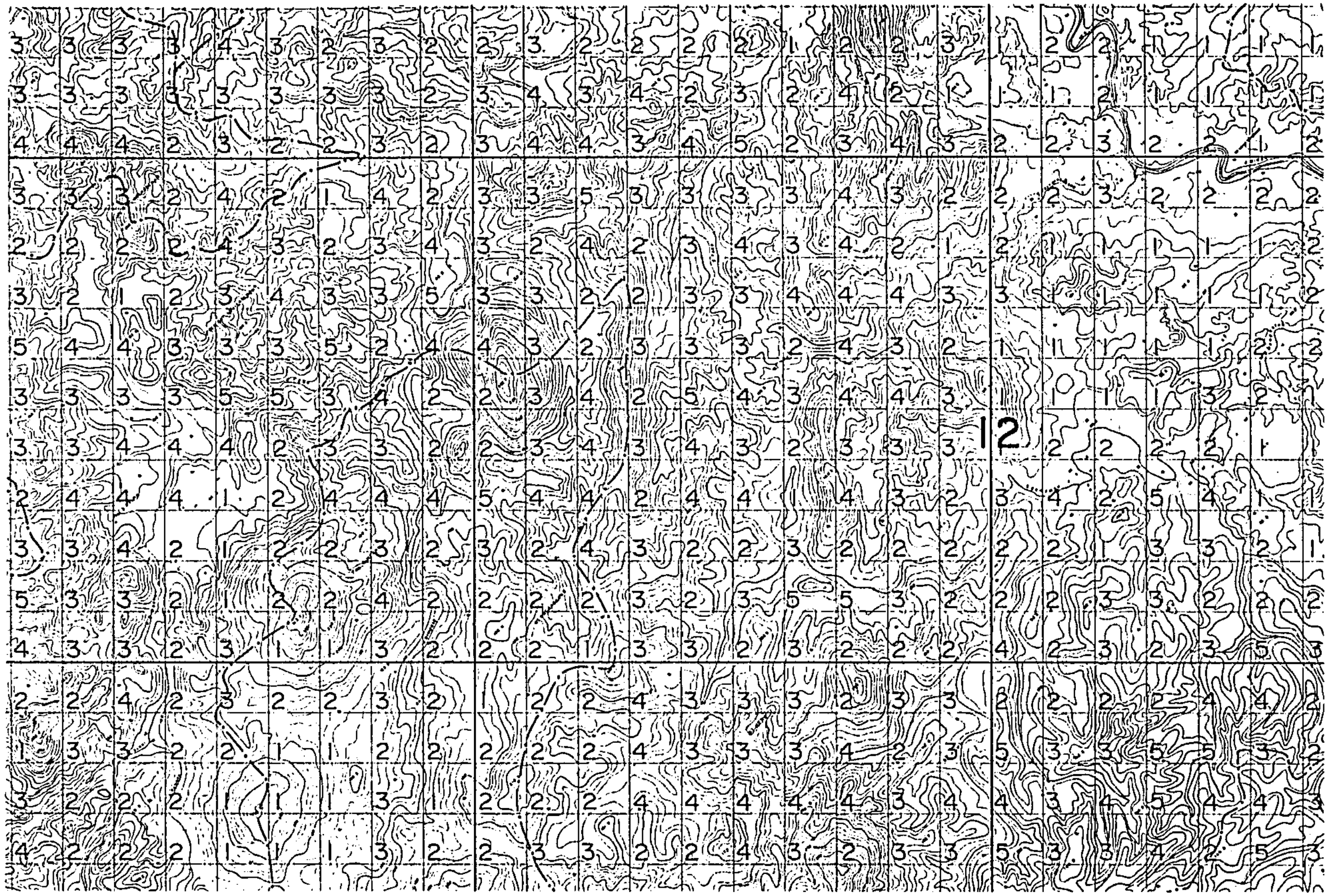
c & d : Rivers on which the water lines were marked newly.

Next, the number of valleys in each mesh was counted on the drainage system map, and the meshes were classified according to the classification as Table 9. This valley density map is used for a comparison of erosion cycle - progress condition of erosion - within this area. A part of this map is shown in Fig. 13.

Table 9

Classification		Symbol
Number of valleys in mesh	0	R_1
"	1	R_2
"	2	R_3
"	3	R_4
"	more than 4	R_5

Fig. 13 VALLEY DENSITY MAP



Scale 1 : 50,000

5) Measurement of stream gradient

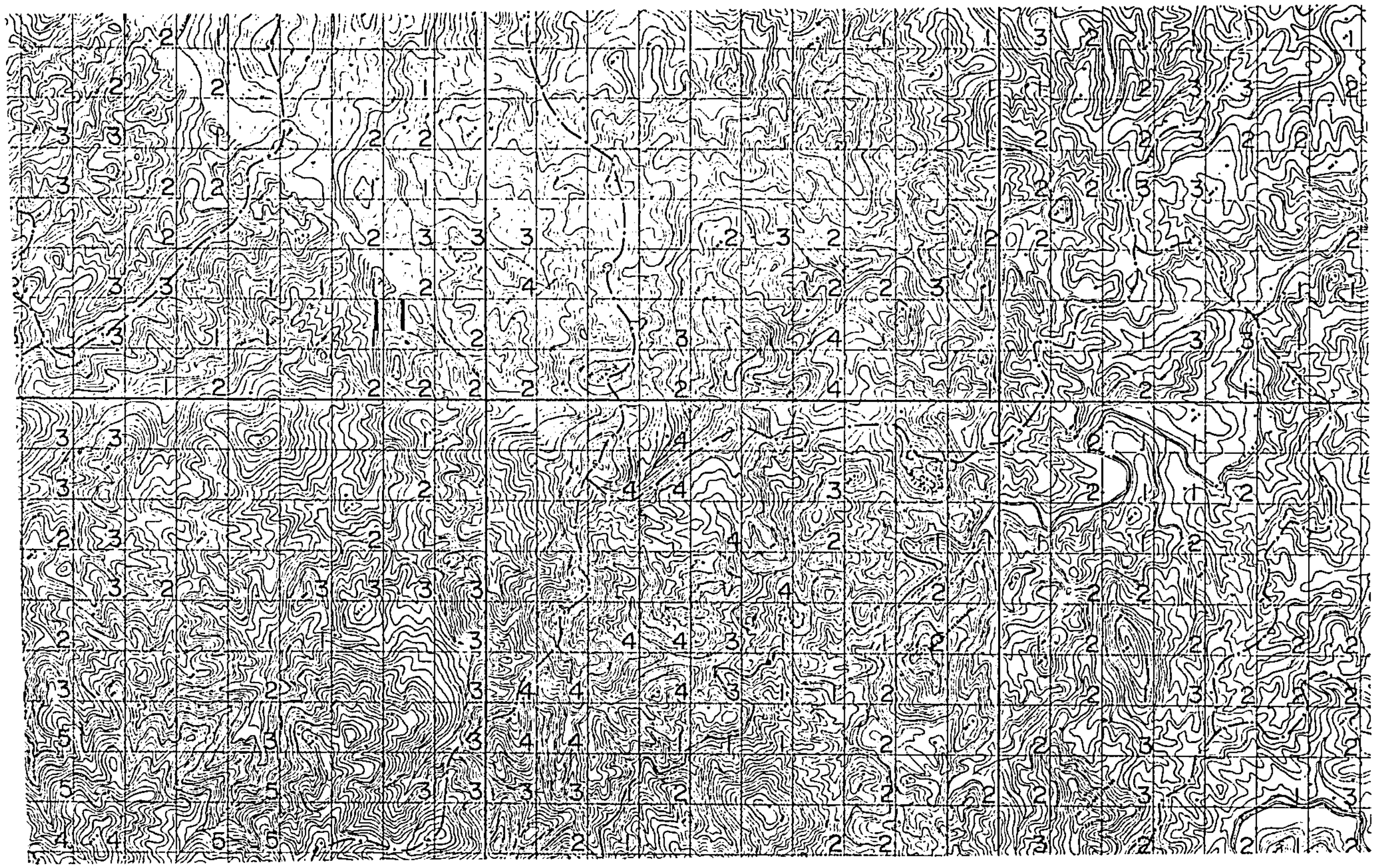
This work was done only about main rivers in this area unlike the classification by slope inclination. This stream gradient closely resembles river-bed gradient.

The number of contour lines in 500m on horizontal distance along the main river was counted each mesh that includes the main river, and the number was converted into gradient ($^{\circ}$) and moreover the symbol of classification according to Table 10. Such a stream gradient map was prepared, as the symbols were written in meshes related with all main rivers.
The example is shown in Fig. 14.

Table 10

Classification	Symbol	Remark	
0°	G_1	Number of contour lines in 500m	0
1°	G_2	"	1
2° - 4°	G_3	"	2 - 3
5° - 9°	G_4	"	4 - 8
10° - 14°	G_5	"	9 - 12
More than 15°	G_6	"	more than 13

Fig. 14   STREAM GRADIENT MAP



Scale 1 : 50,000

C. Result articles

As the result of above mentioned works, following maps and tables were prepared this time.

1. Maps (scale 1:50,000):

(1)	Forest type map	(polyester base)
(2)	Land use map	(color printing)
(3)	Topographic type map	(polyester base)
(4)	Slope inclination map	(")
(5)	Valley density map	(")
(6)	Stream gradient map	(")

2. Tables:

(1) Forest inventory book

(2) Land use area table

3. Working report

D. General conditions examined by this work

General conditions in this area - such as natural forest, land use, topographic features, slope inclination, valley density and stream gradient - were examined and analysed by the above mentioned ways. And, many kinds of results were obtained as Chapter C.

With these results, the physical conditions can be explained roughly as follows.

1. Natural forest (See Tables 11 and 12)

1) Distribution of natural forest

This objective region covers an area of 405,401 ha and has natural forest area of 144,243 ha (35.4%). 67.7% of natural forest area belongs to Large Watershed A. Rawas in the northern part as mountain forest. And, the remaining 32.3% only distributes in Large Watershed A. Musi of the southern part as flat land forest, swampy forest and hill forest.

As respects Middle Watersheds, Watershed A. Rupit has 38.9% of natural forest area because of the broad and mountainous watershed. Next, Watershed A. Rawas has 26.4%, and W (watershed) A. Lakitan has 23.10%. Natural forest areas in W.A. Klingi and W.A. Musi are very small.

As respects Unit Watershed, following watersheds have the high percentage (more than 5% to whole area of natural forest).

A. Minak (M)	7.6%,	A. Tiku (U)	6.5%
A.B. Pu (U)	6.4%,	A. Dulu (U-A)	6.0%
S. Kutu	5.4%,	A. upit (U)	5.1%

2) Growing stock of natural forest

The growing stock is estimated approximately 25,410,000 m^3 or 176 m^3/ha on the whole. This volume is the merchantable stand volume (clear length volume of upper storied trees over 40 cm on d.b.h.)

Large Watershed A. Rawas has 71% of the stock, and indicates 185 m^3/ha. W. A. Musi has only 29% and 157 m^3/ha. Thus, the growing stock in the northern part is much more than it in the southern part as well as natural forest area.

In regard to Middle Watersheds, W.A. Rupit has 39% of the whole stock, but the average volume is relatively low (178 m^3/ha). W.A. Rawas has much and high stock such as 29% and 195 m^3/ha. The average stocks in W.S. Liam and W.A. Klingi are high (190 m^3/ha), but the total volumes are little because of the small forest area. The stock in W.A. Musi is the most least (134 m^3/ha) in this area.

In regard to Unit Watersheds, the watersheds that have high percentages of growing stock to the whole are as follows.

A. Tiku (U)	8.2%,	S. Kutu	8.1%,
A.B. Pu (U)	6.5%,	A. Minak (M)	6.3%,
A. Dulu (U-A)	5.3%		

And, in regard to the average stock (m^3/ha),

S. Kutu	263,	A. Sinie	259,
A. Tiku (U)	222,	A. Rawas (M)	215,
S. Liam Kecil	215 and	A. Ulas	214

are the watersheds that have the high averages. And more, the averages in following watershed are low.

A. Musi (L)	77,	A. Kungku (U)	93,
A. Pigi	97,	A. Pangi	100

Table 11. The Conditions of Land Use and Natural Forest in each Middle Watershed

Watershed name	Area		Land use (%)								Natural forest				
	Area (ha)	(%)	Hr	Hb	Pk	Al	Tk	Pt	Sc	Kp	Area: Area (ha)	Area: (%)	Volume: Volume (m3)	Volume: (%)	per ha (m3/ha)
A. Rawas	58,130	14.34	66	3	27	-	-	1	3	-	38,135	26.44	7,434,799	29.26	195
A. Rupit	79,408	19.59	71	1	24	-	-	2	2	-	56,121	38.91	9,998,049	39.35	178
S. Liam	9,616	3.37	66	2	28	-	-	1	3	-	3,430	2.38	650,851	2.56	190
Total (L.W. A. Rawas)	147,154	36.30	66	2	28	-	-	1	3	-	97,686	67.72	18,083,699	71.17	185
A. Lakitan	116,386	28.71	29	2	45	3	-	17	2	2	33,320	23.10	5,636,778	21.11	161
A. Klingi	50,397	12.43	7	2	77	4	-	6	3	1	3,424	2.37	649,475	2.56	190
A. Musi	91,464	22.56	11	2	60	19	-	5	3	-	9,813	6.80	1,311,094	5.16	134
Total (L.W. A. Musi)	258,247	63.70	18	2	56	9	-	11	3	1	46,557	32.28	7,324,347	28.83	157
Total (Whole area)	405,401	100.00	35	2	46	6	-	7	3	1	144,243	100.00	25,408,046	100.00	176

(Remarks) L.W. = Large watershed, Hr = Natural forest, Hb = Secondary-growth, Pk = Rubber forest,
Al = Grass land, Tk = Bare land, Pt = Farm land, Sc = Shifting cultivation, Kp = Urban site

Table 12. The Conditions of Land Use and Natural Forest in each Unit Watershed

the 1st	Large Watershed the 2nd	Middle Watershed the 3rd	Small Watershed the 4th	the 5th	Unit Watershed	No.	Area (ha.)	Percentage of occupation area by each land use type (%) Hr	Hb	Pk	Al	Tk	Pt	Sc	Kp	Natural forest Area (ha)	Volume (m3)	Average (m3/ha)
A. Musi	A. Rawas	A. Rawas	A. Rawas		S. Keruh	1	6828	84	1	13	-	-	-	2	-	5768	1,084,452	188
					A. Rawas (U)	2	5849	71	1	25	1	-	-	2		4144	539,119	130
					A. Rawas (M)	3	7766	40	6	47	1		2	4		3084	662,997	215
					A. Rawas (L)	4	9352	53	7	33	1			6		4905	917,120	187
			S. Kulus		S. Kulus	5	4802	51	5	39			2	3		2438	494,862	203
			S. Senawar		S. Senawar	6	4342	50	6	38			1	5		2194	375,978	171
			S. Mungkulam		S. Mungkulam	7	6404	66	2	26			2	4		4251	722,381	170
			S. Kuwis		S. Kuwis	8	4688	76		22				2		3566	590,366	166
			S. Kutu		S. Kutu	9	8099	96		4						7785	2,047,524	263
		A. Rupit	A. Uias		A. Uias	10	72	100								72	15,418	214
			A. Minak		A. Minak (U)	11	5620	100								5620	1,172,848	209
					A. Minak (M)	12	12363	89	1	4				6		10933	1,605,673	147
					A. Minak (L)	13	3837	47	2	42			1	8		1810	367,940	203
			A. Tiku		A. Tiku (U)	14	9366	100								9353	2,072,380	222
					A. Tiku (L)	15	10823	39	3	53			2	3		4268	720,378	169
			A.B. Pu	A. Leko	A. Leko	16	6052	80		19				1		4834	765,806	158
				A.B. Pu	A.B. Pu (U)	17	10965	84	1	13			1	1		9211	1,656,615	180
					A.B. Pu (L)	18	5624	40	1	55		1	2	1		2255	431,614	191
			A. Rupit		A. Rupit (U)	19	7493	98		2						7343	1,117,614	152
					A. Rupit (L)	20	7193	6	1	80			11	1	1	422	71,763	170
		S. Liam	S. Liangedang	S. Malamingan	S. Malamingan	21	5762	13	3	77	3		1	3		750	100,598	134
				S. Petal	S. Petal	22	1803	43	6	47	2			2		783	141,902	181
			S. Liamkecil		S. Liamkecil	23	2051	93		7						1897	408,351	215
	A. Musi	A. Lakitan	A. Dulu		A. Dulu (U-A)	24a	12022	72	3	17	1		2	5		8598	1,338,465	156
					A. Dulu (U-B)	24b	4715	53		28	12		5	2		2530	386,310	153
					A. Dulu (L)	25	9035	60	1	32			3	4		5433	972,180	179
			A. Bai	A. Plikai	A. Plikai	26	6945	71	1	21	1	2	4			4903	987,839	201
				A. Bal	A. Bal	27	9248	60	2	34			2	2		5543	855,557	154
			A. Lakitan		A. Lakitan (U)	28	14053	6	2	78			12	2		780	101,003	129
					A. Lakitan (L)	29	6311	19		73	1		5	2		1181	177,859	151
			A. Malus		A. Malus (U)	30	14567	6		80			11	2	1	850	99,182	117
					A. Malus (L)	31	8831	4	2	45	3		41	1	4	365	39,531	108
			S. Hegang	S. Tikipbelago	S. Tikipbelago	32	3072		11	17	1		61		10	7	721	103
				S. Megang	S. Megang (U)	33	8307	1	3	51	3		35	4	3	113	22,600	200
					S. Megang (L)	34	8893	3	2	10	11		58		16	294	41,603	142
				S. Ketuan	S. Ketuan	35	10387	26		42	13		13	3	3	2723	339,713	125
		A. Klingi	A. Klingi		A. Klingi (U)	36	7973		2	64	9		19	3	3	-	-	-
					A. Klingi (L)	37	11709	11	1	81	2		4	1		1297	225,760	174
			S. Teman		S. Teman	38	6138	4	4	70	15		2	4	1	256	42,891	168
			A. Beliti	A. Beliti	A. Beliti	39	12518	4	1	85			5	4	1	514	89,498	174
				A. Koti	A. Koti	40	4369	19	1	70	2		2	5	1	835	155,944	187
				A. Sinie	A. Sinie	41	6279	8	3	82	1		2	4		522	135,382	259
				S. Saling	S. Saling	42	1411			93	3		1	1	2	-	-	-

1st	Large Watershed the 2nd	Middle Watershed the 3rd	Small Watershed the 4th	the 5th	Unit Watershed	No.	Area (ha.)	Percentage of occupation area by each land use type (%)								Natural forest		
								Hr	Hb	Pk	Al	Tk	Pt	Sc	Kp	Area (ha)	Volume (m3)	Average (m3/ha)
		A. Musi	A. Temelat	A. Pigi	A. Pigi	43	3871	1	6	63	22		2	6		23	2,231	97
			A. Gegas	A. Gegas		44	8195	1	3	56	34		2	3	1	102	15,491	152
			A. Temelat	A. Temelat (U)		45	8237	13	1	78			2	6		1039	141,352	136
				A. Temelat (L)		46	7542	5	5	56	23		9	1	1	413	53,412	129
			A. Kungku	S. Bungin (U)		47	2625	15		80				5		399	49,893	125
				S. Bungin (L)		48	4517	7	2	49	26		13	2	1	317	36,892	116
				A. Kungku (U)		49	3297	16	1	71	7			5		532	49,697	93
				A. Kungku (L)		50	15366	9	2	37	39		10	2	1	1451	250,321	173
			A. Tambangan		A. Tambangan	51	5763	16	3	64	9		7	1		913	99,032	108
			A. Musi		A. Musi (U)	52	9107	8		75	5		5	6	1	770	83,710	109
					A. Musi (L)	53a	3533	14	1	65	19			1		507	106,805	211
					A. Musi (L)	53b	3430	2	1	83	10		2	2		72	5,576	77
			S. Banyu		S. Banyu	54	5467	21		59	15		2	3		1141	127,453	112
			A. Kikim	A. Kikim	A. Kikim	55	1847	33		57	10					605	82,182	136
				A. Aur	A. Aur	56	4306	24		54	20			2		1041	158,231	152
				A. Pangi	A. Pangi	57	4361	11		54	30		5			488	48,816	100
						Total	405401	35	2	46	6	-	7	3	1	144,243	25,408,046	176
(1)	(2)	(6)	(26)	(38)	(59)													

(Remarks)

(U): the upper reach of river
(M): the middle reach of river
(L): the lower reach of river

(Remarks)

Land use type		
Natural forest	Hr	
Man-made forest	Ht	x
Secondary forest	Hb	
Rubber plantation	Pk	
Grass land	Al	
Bare land	Tk	
Farm land	Pt	
Shifting cultivation	Sc	
Urban site	Kp	
Swamp and water site	Rw	x

2. Land use (See Tables 11 and 12)

In this objective area, rubber forest covers broad area of 46% to the whole area. Next, natural forest covers an area of 35%, and farm land 7%, grass land 6%, shifting cultivation (new and active one) 3%, urban site 1%. The area of bare land is very small, and man-made forest of commercial trees is not at all.

In regard to Large Watersheds, the percentage of natural forest is high in northern W.A. Rawas, but low in southern W.A. Musi. The percentages are respectively 66% and 18%. On the contrary, the percentage of rubber forest is high (56%) in southern part, but low (28%) in northern part. The percentages of grass land (9%), farm land (11%) and urban site (1%) are also high in southern part. That is the northern part is undeveloped yet as compared with the southern part.

In regard to Middle Watershed A. Rawas, A. Rupit and Liam, the percentages of natural forest are all high, but rubber forest is relatively little. This is caused by the mountainous or swampy topography and the remoteness. These watershed is, so to speak, a forestry zone. W.A. Lakitan has a large percentage of farm land as 17%. Especially, a southern part of this watershed may be called an agricultural zone in the suburbs of Lubuk Linggau City. W.A. Klingi has a large percentage of rubber forest as 77%. And, W.A. Musi has broad grass lands (19%). So to speak, the former is a rubber production zone, and the latter is an afforestation zone.

5 Unit Watersheds that have high occupation percentages of land use classifications are as follows respectively.

Natural forest:	A. Ulas	100 (%)
	A. Minak (U)	100
	A. Tiku (U)	100
	S. Kutu	96
	S. Liamkecil	93

Rubber forest:	S. Saling	93
	A. Beliti	85
	A. Musi (L)	83
	A. Simie	82
	A. Klingi (L)	81
Grass land:	A. Kungku (L)	39
	A. Gegas	34
	A. Pangi	30
	S. Bungin (L)	26
	A. Temelat (L)	23
Farm land:	S. Tikipbelago	61
	S. Megang (L)	58
	A. Malus (L)	41
	S. Megang (U)	35
	A. Klingi (U)	19
Shifting cultivation:	A. Minak (L)	8
	A. Rawas (L)	6
	A. Minak (M)	6
	A. Pigi	6
	A. Temelat (U)	6
	A. Musi (U)	6
Urban site:	S. Megang (L)	16
	S. Tikipbelago	10
	A. Malus (L)	4
	S. Megang (U)	3
	S. Ketuan	3
	A. Klingi (U)	3

3. Topography

1) Geographical features

Table 13 shows the occupation percentages of each feature and the comparison with L.W.A. Rawas and L.W.A. Musi. W.A. Rawas is relatively a mountainous region, and the mountains consists of many ridges (fine and complex topography). On the contrary, most of L.W.A. Musi is a low hill land or a flat land. On the whole, this objective area consists of diluvial upland and mountainous land roughly.

Table 13. Conditions of geographical features each L.W.

(unit: %)

Classification	A. Rawas	A. Musi	Whole area
Mountainous land Ridge	23.8	3.2	10.7
" " Mountain-side	6.6 } 44.8	1.9 } 6.9	3.6 } 20.7
" " Dale	14.4	1.8	6.4
Hilly land Large wave land	31.1	3.2	13.4
Diluvial upland Small wave land	20.7 } 23.1	72.6 } 87.9	53.6 } 64.2
" " Flat plateau	2.4	15.3	10.6
Alluvial plain Flood plain	1.0	2.0	1.7
Total	100.0	100.0	100.0

Also in regard to Middle Watersheds, the mountainous land decreases and the diluvial upland increases as the watershed is situated at a southern part of this area. Table 14 shows this geographical characteristic of this area.

W.A. Lakitan is very suitable for an agricultural zone such as rice crop, export crops and so on, because the flat land - flat plateau and flood plain - is broad. It will be able to change W.S. Liam and W.A. Klingi into big agricultural zones by irrigation works.

Table 14. Conditions of geographical features each M.W.

(unit: %)

Classification	A. Rawas	A. Rupit	S. Liam	A. Lakitan	A. Klingi	A. Musi
Ridge	35.1	18.2	0	7.2	0	0
Mountain-side	8.2 }64.0	6.3 }36.1	0 }0	4.2 }15.5	0 }0	0 }0
Dale	20.7	11.6	0	4.1	0	0
Hilly land	28.2	34.4	21.7	7.1	0	0
Small wave land	7.1 }7.7	25.9 }27.7	60.4 }78.3	46.8 }75.0	89.3 }99.7	95.9 }97.6
Flat plateau	0.6	1.8	17.9	28.2	10.4	1.7
Alluvial plain	0.1	1.8	0	2.4	0.3	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Next, following Unit Watersheds have the high occupation percentage of each feature. (See Table 15)

Mountainous land/Ridge (unit: %)

S. Kuwis 50.8, S. Kutu 50.6, S. Kulus 42.2, S. Mungkulam 39.6, S. Senawar 37.3

Mountainous land/Mountain-side

A. Rupit 23.7, A.B. Pu (U) 17.6, A. Plikai 17.5, A. Bal 16.6, S. Kulus 15.8

Mountainous land/Dale

S. Mungkulam 36.6, S. Kuwis 34.9, A. Rupit 32.5 S. Kutu 27.5, A. Plikai 23.1

Hilly land/Large wave land

A. Ulas 100, A. Minak (M) 71.3, A. Tiku (U) 66.3, A. Rawas (L) 64.5, A. Rawas (U) 45.3

Diluvial upland/small wave land

S. Saling 100, S. Bungin (U) 100, A. Kungku (U) 100, A. Tambangan 100, A. Musi (L-b) 100

Diluvial upland/Flat plateau

A. Dulu (L) 62.3, S. Tikipbelago 60.9, S. Megang (L) 48.4, A. Malus (L) 45.8, A. Dulu.(U-b) 41.5

Alluvial plain/Flood plain

A. Musi (U) 20.4, A. Rupit (L) 11.5, A. Lakitan (U) 8.7, A. Lakitan (L) 8.7, A. Bal 6.5

Table 15. Conditions of geographical features each Unit Watershed

3-1

L	M	S	U	Mr		Ms		Md		Hi		Fw		Fp		Fa		Total	
W	W	W	W	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
1	1	1	1	2,322	34.0	1,024	15.0	1,345	19.7	2,035	29.8	102	1.5	0	0	0	0	6,828	100.0
			2	1;387	23.7	684	11.7	748	12.8	2,650	45.3	380	6.5	0	0	0	0	5,849	100.0
			3	2,680	34.5	272	3.5	1,452	18.7	2,190	28.2	1,056	13.6	116	1.5	0	0	7,766	100.0
			4	1,403	15.0	253	2.7	748	8.0	6,031	64.5	823	8.8	47	0.5	47	0.5	9,352	100.0
			T	7,792	26.2	2,233	7.5	4,293	14.4	12,906	43.3	2,361	7.9	163	0.5	47	0.2	29,795	100.0
		2	5	2,026	42.2	759	15.8	788	16.4	797	16.6	269	5.6	139	2.9	24	0.5	4,802	100.0
		3	6	1,619	37.3	365	8.4	734	16.9	656	15.1	942	21.7	26	0.6	0	0	4,342	100.0
		4	7	2,536	39.6	500	7.8	2,344	36.6	640	10.0	378	5.9	6	0.1	0	0	6,404	100.0
		5	8	2,378	50.8	263	5.6	1,639	34.9	366	7.8	42	0.9	0	0	0	0	4,688	100.0
		6	9	4,099	50.6	640	7.9	2,227	27.5	1,020	12.6	113	1.4	0	0	0	0	8,099	100.0
		T		20,450	35.1	4,760	8.2	12,025	20.7	16,385	28.2	4,105	7.1	334	0.6	71	0.1	58;130	100.0
	2	7	10	0	0	0	0	0	0	72	100.0	0	0	0	0	0	0	72	100.0
		8	14	910	16.2	51	0.9	747	13.3	3,727	66.3	185	3.3	0	0	0	0	5,620	100.0
			12	235	1.9	25	0.2	12	0.1	8,815	71.3	2,917	23.6	359	2.9	0	0	12,363	100.0
			13	0	0	0	0	0	0	518	13.5	3,304	86.1	15	0.4	0	0	3,837	100.0
			T	1,145	5.2	76	0.3	759	3.5	13,060	59.9	6,406	29.4	374	1.7	0	0	21,820	100.0
		9	14	3,381	36.1	328	3.5	1,808	19.3	3,830	40.9	19	0.2	0	0	0	0	9,366	100.0
			15	0	0	0	0	0	0	4,167	38.5	5,985	55.3	465	4.3	206	1.9	10,823	100.0
			T	3,381	17.2	328	1.6	1,808	9.0	7.997	40.1	6,004	29.7	465	2 3	206	0.1	20,189	100.0
		10	16	1,888	31.2	363	6.0	1,374	22.7	1,901	31.4	520	8.6	0	0	6	0.1	6,052	100.0
			17	4,287	39.1	1,930	17.6	2,281	20.8	2,039	18.6	307	2.8	55	0.5	66	0.6	10,965	100.0
			18	899	16.0	484	8.6	529	9.4	1,254	22.3	2,182	38.8	0	0	276	4.9	5,624	100.0
			T	7,074	31.3	2,777	12.3	4,184	18.5	5,194	22.9	3,009	13.3	55	0.2	348	1.5	22,641	100.0
		11	19	2,661	35.5	1,776	23.7	2,435	32.5	345	4.6	202	2.7	22	0.3	52	0.7	7,493	100.0
			20	216	3.0	50	0.7	0	0	676	9.4	4,927	68.4	503	7.0	827	11.5	7,193	100.0
			T	2,877	19.6	1,826	12.4	2,435	16.6	1,021	7.0	5,123	34.8	525	3.6	879	6.0	14,686	100.0
		T		14,477	18.2	5,007	6.3	9,186	11.6	27,344	34.4	20,542	25.9	1,419	1.8	1,433	1.8	79,408	100.0
	3	12	21	0	0	0	0	0	0	657	11.4	4,270	74.1	835	14.5	0	0	5,762	100.0
			22	0	0	0	0	0	0	691	38.3	705	39.1	407	22.6	0	0	1,803	100.0
			T	0	0	0	0	0	0	1,348	17.8	4,975	65.8	1,242	16.4	0	0	7,565	100.0
		13	23	0	0	0	0	0	0	738	36.0	835	40.7	478	23.3	0	0	2,051	100.0

L	M	S	U	Mr		Ms		Md		Hi		Fw		Fp		Fa		Total	
W	W	W	W	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
		T		0	0	0	0	0	0	2,086	21.7	5,810	60.4	1,720	17.9	0	0	9,616	100.0
	T			34,927	23.8	9,767	6.6	21,211	14.4	45,815	31.1	30,457	20.7	3,473	2.4	1,504	1.0	147,154	100.0
2	4	14	24a	1,851	15.4	649	5.4	866	7.2	2,224	18.5	2,705	22.5	3,703	30.8	24	0.2	12,022	100.0
			24b	0	0	0	0	0	0	462	9.8	2,296	48.7	1,957	41.5	0	0	4,715	100.0
			25	0	0	0	0	0	0	786	8.7	2,620	29.0	5,629	62.3	0	0	9,035	100.0
			T	1,851	7.2	649	2.5	866	3.4	3,472	13.5	7,621	29.6	11,289	43.7	24	0.1	25,772	100.0
		15	26	2,063	29.7	1,215	17.5	1,604	23.1	181	2.6	1,000	14.4	771	11.1	111	1.6	6,945	100.0
			27	2,137	23.1	1,535	16.6	1,156	12.5	795	8.6	1,489	16.1	1,535	16.6	601	6.5	9,248	100.0
			T	4,200	26.0	2,750	17.0	2,760	17.0	976	6.0	2,489	15.4	2,306	14.2	712	4.4	16,193	100.0
		16	28	998	7.1	408	2.9	646	4.6	885	6.3	9,719	58.2	174	12.2	1,223	8.7	14,053	100.0
			29	0	0	0	0	0	0	341	5.4	3,427	54.3	1,994	31.6	549	8.7	6,311	100.0
			T	998	4.9	408	2.0	646	3.2	1,226	6.0	13,146	64.6	2,168	10.6	1,772	8.7	20,364	100.0
		17	30	379	2.6	452	3.1	117	0.8	1,617	11.1	11,230	77.1	568	3.9	204	1.4	14,567	100.0
			31	79	0.9	221	2.5	26	0.3	194	2.2	4,134	46.8	4,045	45.8	132	1.5	8,831	100.0
			T	458	2.0	673	2.9	143	0.6	1,811	7.7	15,364	65.7	4,613	19.7	336	1.4	23,398	100.0
		18	32	9	0 3	25	0.8	0	0	18	0.6	1,149	37.4	1,871	60.9	0	0	3,072	100.0
			33	548	6.6	258	3.1	174	2.1	523	6.3	4,844	58.3	1,960	23.6	0	0	8,307	100.0
			34	302	3.4	71	0.8	125	1.4	276	3.1	3,815	42.9	4,304	48.4	0	0	8,893	100.0
			35	0	0	0	0	0	0	0	0	6,108	58.8	4,279	41.2	0	0	10,387	100.0
			T	859	2.8	354	1.2	299	1.0	817	2.7	15,916	51.8	12,414	40.5	0	0	30,659	100.0
		T		8,366	7.2	4,834	4.2	4,714	4.1	8,302	7.1	54,536	46.8	32,790	28.2	2,844	2.4	116,386	100.0
	5	19	36	16	0.2	16	0.2	0	0	0	0	5,198	65.2	2,671	33.5	72	0.9	7,973	100.0
			37	0	0	0	0	0	0	0	0	10,105	86.3	1,557	13.3	47	0.4	11,709	100.0
			T	16	0.1	16	0.1	0	0	0	0	15,303	77.7	4,228	21.5	119	0.6	19,682	
		20	38	0	0	0	0	0	0	0	0	5,665	92.3	473	7.7	0	0	6,138	100.0
		21	39	0	0	0	0	0	0	0	0	12,155	97.1	338	2.7	25	0.2	12,518	100.0
			40	0	0	0	0	0	0	0	0	4,229	96.8	140	3.2	0	0	4,369	100.0
			41	0	0	0	0	0	0	0	0	6,204	98.8	75	1.2	0	0	6,279	100.0
			42	0	0	0	0	0	0	0	0	1,411	100.0	0	0	0	0	1,411	100.0
			T	0	0	0	0	0	0	0	0	23,999	97.6	553	2.3	25	0.1	24,577	100.0

L	M	S	U	Mr		Ms		Md		Hi		Fw		Fp		Fa		Total	
W	W	W	W	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
		T		16	0	16	0	0	0	0	0	44,967	89.3	5,254	10.4	144	0.3	50,397	100.0
	6	22	43	0	0	0	0	0	0	0	0	3,751	96.9	120	3.1	0	0	3,871	100.0
			44	0	0	0	0	0	0	0	0	7,638	93.2	557	6.8	0	0	8,195	100.0
			45	0	0	0	0	0	0	0	0	8,163	99.1	74	0.9	0	0	8,237	100.0
			46	0	0	0	0	0	0	0	0	7,301	96.8	241	3.2	0	0	7,542	100.0
			47	0	0	0	0	0	0	0	0	2,625	100.0	0	0	0	0	2,625	100.0
			48	0	0	0	0	0	0	0	0	4,467	98.9	50	1.1	0	0	4,517	100.0
			49	0	0	0	0	0	0	0	0	3,297	100.0	0	0	0	0	3,297	100.0
			50	0	0	0	0	0	0	0	0	14,966	97.4	246	1.6	154	1.0	15,366	100.0
			T	0	0	0	0	0	0	0	0	52,208	97.3	1,288	2.4	154	0.3	53,650	100.0
		23	51	0	0	0	0	0	0	0	0	5,763	100.0	0	0	0	0	5,763	100.0
		24	52	0	0	0	0	0	0	0	0	7,249	79.6	0	0	1,858	20.4	9,107	100.0
			53a	0	0	0	0	0	0	0	0	3,480	98.5	53	1.5	0	0	3,533	100.0
			53b	0	0	0	0	0	0	0	0	3,430	100.0	0	0	0	0	3,430	100.0
			T	0	0	0	0	0	0	0	0	14,159	88.1	53	0.3	1,858	11.6	16,070	100.0
		25	54	0	0	0	0	0	0	0	0	5,451	99.7	0	0	16	0.3	5,467	100.0
		26	55	0	0	0	0	0	0	0	0	1,827	98.9	20	1.1	0	0	1,847	100.0
			56	0	0	0	0	0	0	0	0	4,259	98.9	47	1.1	0	0	4,306	100.0
			57	0	0	0	0	0	0	0	0	4,016	92.1	140	3.2	205	4.7	4,361	100.0
			T	0	0	0	0	0	0	0	0	10,102	96.0	207	2.0	205	2.0	10,514	100.0
		T		0	0	0	0	0	0	0	0	87,683	95.9	1,548	1.7	2,233	2.4	91,464	100.0
	T			8,382	3.2	4,850	1.9	4,714	1.8	8,302	3.2	187,186	72.6	39,592	15.3	5,221	2.0	258,247	100.0
T				43,309	10.7	14,617	3.6	25,925	6.4	54,117	13.4	217,643	53.6	43,065	10.6	6,725	1.7	405,401	100.0

(Remarks) Mr: Mountainous land/Ridge, Ms: Mountainous land/Mountain-side,
Md: Mountainous land/Dale, Hi: Hilly land/Large wave land,
Fw: Diluvial upland/Small wave land, Fp: Diluvial upland/Flat plateau,
Fa: Alluvial plain/Flood plain,
L.W.: Large Watershed, M.W.: Middle Watershed, S.W.: Small Watershed,
U.W.: Unit Watershed

2) Slope inclination

Tables 16 and 17 show following characteristics of this area about slope inclination.

(1) Almost all slopes of this area are gentle on the whole.

(2) The northern part such as W.A. Rawas and W.A. Rupit has relatively steep slopes because of the mountainous land.

(3) The central and southern parts such as W.S. Liam, W.A. Klingi and W.A. Musi are almost very gentle slope lands or flat lands.

Table 16. Conditions of slope inclination each L.W.

(unit: %)

Classification (°)	A. Rawas	A. Musi	Whole area
0 - 1	2.6	16.8	11.6
2 - 5	18.3	65.3	48.4
6 - 10	22.0	9.1	13.8
11 - 15	19.4	2.5	8.6
16 - 20	24.0	3.2	10.7
21 - 30	11.9	2.5	5.9
31 -	1.8	0.6	1.0
Total	100.0	100.0	100.0

Table 17. Conditions of slope inclination each M.W.

(unit: %)

Classification (°)	A. Rawas	A. Rupit	S. Liam	A. Lakitan	A. Klingi	A. Musi
0 - 1	1.3	1.9	15.0	25.0	10.1	9.8
2 - 5	7.3	22.0	55.5	45.3	82.7	81.5
6 - 10	19.8	24.2	17.3	10.2	7.2	8.7
11 - 15	23.5	18.0	6.7	5.5	0	0
16 - 20	30.8	21.3	5.2	7.1	0	0
21 - 30	15.2	10.9	0.3	5.5	0	0
31 -	2.1	1.7	0	1.2	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Following Unit Watersheds have the high occupation percentage of each classification. (See Table 18)

0° - 1° (unit: %)

S. Tikipbelago 47.4, A. Dulu (L) 43.9,
S. Megang (L) 42.0 A. Malus (L) 37.8,
S. Ketuan 33.9

2° - 5°

A. Kati 92.0, A. Sinie 91.1, A. Musi (L-b) 91.0,
A. Musi (L-a) 89.2, A. Temelat (L) 89.1

6° - 10°

A. Rawas (U) 39.3, A. Minak (M) 37.5,
S. Saling 35.4, A.B. Pu (L) 34.5,
A. Tiku (L) 33.8

11° - 15°

A. Minak (U) 33.6, A. Rawas (M) 29.5,
A. Rawas (U) 28.8, A.B. Pu (U) 25.6,
A. Tiku (U) 23.8

16° - 20°

A. Tiku (U) 37.5, A. Leko 35.2, S. Mungkulam 34.4, S. Kutu 34.2, A. Rupit 34.0

21° - 30°

A. Rupit (U) 31.4, S. Kutu 28.2, A. Plikai 25.9,
A.B. Pu (U) 21.6, S. Kuwis 20.6

31° -

A. Rupit (U) 9.3, A. Plikai 6.9, A. Bal 5.4,
S. Kutu 5.3, S. Mungkulam 4.3

Table 18. Conditions of slope inclination each Unit Watershed

3-1

L W	M W	S W	U W	I_1 ha	I_1 %	I_2 ha	I_2 %	I_3 ha	I_3 %	I_4 ha	I_4 %	I_5 ha	I_5 %	I_6 ha	I_6 %	I_7 ha	I_7 %	Total ha	Total %
1	1	1	1	0	0	423	6.2	1,632	23.9	1,311	19.2	2,178	31.9	1,120	16.4	164	2.4	6,828	100.0
			2	23	0.4	772	13.2	2,299	39.3	1,685	28.8	883	15.1	164	2.8	23	0.4	5,849	100.0
			3	0	0	746	9.6	1,375	17.7	2,290	29.5	2,438	31.4	870	11.2	47	0.6	7,766	100.0
			4	75	0.8	860	9.2	2,029	21.7	2,684	28.7	2,825	30.2	879	9.4	0	0	9,352	100.0
			T	98	0.3	2,801	9.4	7,335	24.6	7,970	26.7	8,324	28.0	3,033	10.2	234	0.8	29,795	100.0
		2	5	82	1.7	485	10.1	879	18.3	903	18.8	1,583	33.0	788	16.4	82	1.7	4,802	100.0
		3	6	74	1.7	595	13.7	916	21.1	808	18.6	1,228	28.3	673	15.5	48	1.1	4,342	100.0
		4	7	365	5.7	224	3.5	909	14.2	1,326	20.7	2,204	34.4	1,101	17.2	275	4.3	6,404	100.0
		5	8	159	3.4	28	0.6	572	12.2	1,064	22.7	1,740	37.1	966	20.6	159	3.4	4,688	100.0
		6	9	0	1.0	113	1.4	915	11.3	1,587	19.6	2,771	34.2	2,284	28.2	429	5.3	8,099	100.0
		T		778	1.3	4,246	7.3	11,526	19.8	13,658	23.5	17,850	30.8	8,845	15.2	1,227	2.1	58,130	100.0
	2	7	10	0	0	0	0	72	100.0	0	0	0	0	0	0	0	0	72	100.0
		8	11	0	0	180	3.2	1,686	30.0	1,888	33.6	1,652	29.4	214	3.8	0	0	5,620	100.0
			12	74	0.6	2,806	22.7	4,636	37.5	2,745	22.2	1,929	15.6	173	1.4	0	0	12,363	100.0
			13	61	1.6	2,575	67.1	1,128	29.4	15	0.4	58	1.5	0	0	0	0	3,837	100.0
			T	135	0.6	5,561	25.5	7,450	34.1	4,648	21.3	3,639	16.7	387	1.8	0	0	21,820	100.0
		9	14	9	0.1	244	2.6	1,564	16.7	2,229	23.8	3,513	37.5	1,573	16.8	234	2.5	9,366	100.0
			15	520	4.8	4,697	43.4	3,658	33.8	1,299	12.0	487	4.5	162	1.5	0	0	10,823	100.0
			T	529	2.6	4,941	24.5	5,222	25.8	3,528	17.5	4,000	19.8	1,735	8.6	234	1.2	20,189	100.0
		10	16	12	0.2	460	7.6	1,114	18.4	1,041	17.2	2,130	35.2	1,216	20.1	79	1.3	6,052	100.0
			17	99	0.9	340	3.1	1,458	13.3	2,807	25.6	3,630	33.1	2,368	21.6	263	2.4	10,965	100.0
			18	124	2.2	1,440	25.6	1,940	34.5	827	14.7	832	14.8	427	7.6	34	0.6	5,624	100.0
			T	235	1.0	2,240	9.9	4,512	19.9	4,675	20.6	6,592	29.2	4,011	17.7	376	1.7	22,641	100.0
		11	19	0	0	315	4.2	420	5.6	1,161	15.5	2,547	34.0	2,353	31.4	697	9.3	7,493	100.0
			20	633	8.8	4,388	61.0	1,582	22.0	259	3.6	151	2.1	137	1.9	43	0.6	7,193	100.0
			T	633	4.6	4,703	32.0	2,002	13.6	1,420	9.7	2,698	18.4	2,490	17.0	740	4.7	14,686	100.0
		T		1,532	1.9	17,445	22.0	19,258	24.2	14,271	18.0	16,929	21.3	8,623	10.9	1,350	1.7	79,408	100.0
	3	12	21	720	12.5	3,665	63.6	761	13.2	351	6.1	265	4.6	0	0	0	0	5,762	100.0
			22	245	13.6	752	41.7	534	29.6	121	6.7	142	7.9	9	0.5	0	0	1,803	100.0
			T	965	12.5	4,417	58.9	1,295	17.1	472	6.2	407	5.2	9	0.1	0	0	7,565	100.0
		13	23	500	24.4	888	43.3	365	17.8	174	8.5	103	5.0	21	1.0	0	0	2,051	100.0

L W	M W	S W	U W	I1 ha	I1 %	I2 ha	I2 %	I3 ha	I3 %	I4 ha	I4 %	I5 ha	I5 %	I6 ha	I6 %	I7 ha	I7 %	Total ha	Total %
		T		1,465	15.0	5,305	55.5	1,660	17.3	646	6.7	510	5.2	30	0.3	0	0	9,616	100.0
	T			3,775	2.6	26,996	18.3	32,444	22.0	28,575	19.4	35,289	24.0	17,498	11.9	2,577	1.8	147,154	100.0
2	4	14	24a	2,621	21.8	3,607	30.0	1,082	9.0	1,286	10.7	1,839	15.3	1,250	10.4	337	2.8	12,022	100.0
			24b	1,127	23.9	3,047	64.6	358	7.6	141	3.0	14	0.3	28	0.6	0	0	4,715	100.0
			25	3,967	43.9	3,930	43.5	786	8.7	226	2.5	126	1.4	0	0	0	0	9,035	100.0
			T	7,715	29.9	10,584	41.1	2,226	8.6	1,653	6.4	1,979	7.7	1,278	5.0	337	1.3	25,772	100.0
		15	26	875	12.6	931	13.4	333	4.8	791	11.4	1,736	25.0	1,800	25.9	479	6.9	6,945	100.0
			27	1,618	17.5	2,147	23.2	444	4.8	1,054	11.4	1,618	17.5	1,868	20.2	499	5.4	9,248	100.0
			T	2,493	15.4	3,078	19.0	777	4.8	1,845	11.4	3,354	20.7	3,668	22.7	978	6.0	16,193	100.0
		16	28	1,967	14.0	7,083	50.4	2,431	17.3	1,335	9.5	984	7.0	253	1.8	0	0	14,053	100.0
			29	2,127	33.7	3,686	58.4	290	4.6	151	2.4	44	0.7	13	0.2	0	0	6,311	100.0
			T	4,094	20.1	10,769	52.9	2,721	13.4	1,486	7.3	1,028	5.0	266	1.3	0	0	20,364	100.0
		17	30	1,107	7.6	7,327	50.3	4,122	28.3	845	5.8	612	4.2	510	3.5	44	0.3	14,567	100.0
			31	3,338	37.8	4,866	55.1	212	2.4	115	1.3	97	1.1	177	2.0	26	0.3	8,831	100.0
			T	4,445	19.0	12,193	52.2	4,334	18.5	960	4.1	709	3.0	687	2.9	70	0.3	23,398	100.0
		18	32	1,456	47.4	1,560	50.8	3	0.1	3	0.1	25	0.8	25	0.8	0	0	3,072	100.0
			33	1,861	22.4	3,563	42.9	1,412	17.0	341	4.1	831	10.0	249	3.0	50	0.6	8,307	100.0
			34	3,735	42.0	4,242	47.7	258	2.9	116	1.3	311	3.5	231	2.6	0	0	8,893	100.0
			35	3,521	33.9	6,741	64.9	125	1.2	0	0	0	0	0	0	0	0	10,387	100.0
			T	10,573	34.5	16,106	52.5	1,798	5.9	460	1.5	1,167	3.8	505	1.6	50	0.2	30,659	100.0
		T		29,320	25.2	52,730	45.3	11,856	10.2	6,404	5.5	8,237	7.1	6,404	5.5	1,435	1.2	116,386	100.0
	5	19	36	2,121	26.6	4,688	58.8	1,140	14.3	24	0.3	0	0	0	0	0	0	7,973	100.0
			37	1,592	13.6	9,918	84.7	199	1.7	0	0	0	0	0	0	0	0	11,709	100.0
			T	3,713	18.9	14,606	74.2	1,339	6.8	24	0.1	0	0	0	0	0	0	19,682	100.0
		20	38	614	10.0	5,285	86.1	239	3.9	0	0	0	0	0	0	0	0	6,138	100.0
		21	39	501	4.0	11,078	88.5	939	7.5	0	0	0	0	0	0	0	0	12,518	100.0
			40	183	4.2	4,020	92.0	166	3.8	0	0	0	0	0	0	0	0	4,369	100.0
			41	94	1.5	5,720	91.1	465	7.4	0	0	0	0	0	0	0	0	6,279	100.0
			42	0	0	912	64.6	499	35.4	0	0	0	0	0	0	0	0	1,411	100.0
			T	1,778	3.2	21,730	88.4	2,069	8.4	0	0	0	0	0	0	0	0	24,577	100.0

L W	M W	S W	U W	I1 ha	I1 %	I2 ha	I2 %	I3 ha	I3 %	I4 ha	I4 %	I5 ha	I5 %	I6 ha	I6 %	I7 ha	I7 %	Total ha	Total %
		T		5,105	10.1	41,621	82.7	3,647	7.2	24	0	0	0	0	0	0	0	50,397	100.0
	6	22	43	1,076	27.8	2,768	71.5	27	0.7	0	0	0	0	0	0	0	0	3,871	100.0
			44	1,672	20.4	6,498	79.3	25	0.3	0	0	0	0	0	0	0	0	8,195	100.0
			45	124	1.5	7,125	86.5	988	12.0	0	0	0	0	0	0	0	0	8,237	100.0
			46	588	7.8	6,720	89.1	234	3.1	0	0	0	0	0	0	0	0	7,542	100.0
			47	74	2.8	1,740	66.3	811	30.9	0	0	0	0	0	0	0	0	2,625	100.0
			48	551	12.2	3,889	86.1	77	1.7	0	0	0	0	0	0	0	0	4,517	100.0
			49	0	0	2,338	70.9	959	29.1	0	0	0	0	0	0	0	0	3,297	100.0
			50	1,245	8.1	13,322	86.7	799	5.2	0	0	0	0	0	0	0	0	15,366	100.0
			T	5,330	9.9	44,400	82.8	3,920	7.3	0	0	0	0	0	0	0	0	53,650	100.0
		23	51	150	2.6	5,031	87.3	582	10.1	0	0	0	0	0	0	0	0	5,763	100.0
		24	52	1,776	19.5	6,102	66.7	1,229	13.8	0	0	0	0	0	0	0	0	9,107	100.0
			53a	357	10.1	3,151	89.2	25	0.7	0	0	0	0	0	0	0	0	3,533	100.0
			53b	154	4.5	3,122	91.0	154	4.5	0	0	0	0	0	0	0	0	3,430	100.0
			T	2,287	14.2	12,375	77.0	1,408	8.8	0	0	0	0	0	0	0	0	16,070	100.0
		25	54	273	5.0	4,390	80.3	804	14.7	0	0	0	0	0	0	0	0	5,467	100.0
		26	55	105	5.7	1,341	72.6	401	21.7	0	0	0	0	0	0	0	0	1,847	100.0
			56	168	3.9	3,725	86.5	413	9.6	0	0	0	0	0	0	0	0	4,306	100.0
			57	641	14.7	3,293	75.5	427	9.8	0	0	0	0	0	0	0	0	4,361	100.0
			T	914	8.7	8,359	79.5	1,241	11.8	0	0	0	0	0	0	0	0	10,514	100.0
		T		8,954	9.8	74,555	81.5	7,955	8.7	0	0	0	0	0	0	0	0	91,464	100.0
	T			43,379	16.8	168,906	65.3	23,458	9.1	6,428	2.5	8,237	3.2	6,404	2.5	1,435	0.6	258,247	100.0
T				47,154	11.6	195,902	48.4	55,902	13.8	35,003	8.6	43,526	10.7	23,902	5.9	4,012	1.0	405,401	100.0

(Remarks) I_1: 0° - 1°, I_2: 2° - 5°, I_3: 6° - 10°, I_4: 11° - 15°, I_5: 16° - 20°, I_6: 21° - 30°, I_7: 31°-
L.W.: Large Watershed, M.W.: Middle Watershed, S.W.: Small Watershed, U.W.: Unit Watershed

3) Valley density

Tables 19 and 20 show following characteristics of this area about valley density.

(1) The measurement was made each small mesh with 25 ha on area. Therefore, the difference between regions cannot be made clear. But, the northern part has relatively a great many valleys and the erosion is progressing remarkably.

(2) The central part such as M.W. S. Liam and M.W. A. Lakitan has low valley densities because it has very broad flat-lands.

(3) The southern part such as M.W. A. Klingi and M.W. A. Musi has relatively high valley densities, for it is mostly a small wave land where innumerable valleys are advanced.

Table 19. Conditions of valley density each L.W.

(unit: %)

Classification	A. Rawas	A. Musi	Whole area
pc's 0	16.2	25.3	22.1
1	30.7	27.1	28.4
2	28.1	24.1	25.5
3	16.1	14.6	15.1
More than 4	8.9	8.9	8.9
Total	100.0	100.0	100.0

Table 20. Conditions of valley density each M.W.

(unit: %)

Classification	A. Rawas	A. Rupit	S. Liam	A. Lakitan	A. Klingi	A. Musi
pc's 0	8.5	20.1	45.9	43.2	12.6	9.8
1	31.9	28.5	31.4	32.7	23.8	21.8
2	32.1	26.0	17.0	16.2	28.3	31.7
3	18.6	15.6	4.9	5.5	20.3	22.9
More than 4	8.9	9.8	0.8	2.4	15.0	13.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Following Unit Watersheds have the high occupation percentage of each classification. (See Table 21)

0 (piece) (unit: %)

S. Tikipbelago 81.0, A. Malus (L) 66.6, S. Megang (L) 63.5, A. Lakitan (L) 61.0, A. Dulu (U-b) 56.2

1 (piece)

A. Rawas (U) 44.1, S. Kulus 43.6, A. Tiku (L) 41.5, A. Malus (U) 38.4, A. Dulu (U-a) 38.2

2 (pieces)

A. Ulas 44.9, A. Kungku (U) 43.4, A. Tambangan 36.5, S. Senawar 36.4, S. Bungin (L) 35.9, A. Musi (L-b) 35.9

3 (pieces)

S. Bungin (U) 30.7, S. Saling 30.4, A. Kungku (U) 29.0, A. Temelat (U) 28.2; A. Musi (L-b) 27.7

More than 4 (pieces)

S. Saling 27.4, A. Tiku (U) 27.2, A. Kikm 25.0, A. Sinie 24.7, A. Temelat (L) 23.4

Table 21. Conditions of valley density each Unit Watershed

3-1

L W	M W	S W	U W	R1 ha	R1 %	R2 ha	R2 %	R3 ha	R3 %	R4 ha	R4 %	R5 ha	R5 %	Total ha	Total %
1	1	1	1	615	9.0	1,959	28.7	2,533	37.1	1,393	20.4	328	4.8	6,828	100.0
			2	632	10.8	2,579	44.1	1,719	29.4	632	10.8	287	4.9	5,849	100.0
			3	528	6.8	1,770	22.8	2,696	34.7	1,755	22.6	1,017	13.1	7,766	100.0
			4	608	6.5	2,759	29.5	3,021	32.3	2,132	22.8	832	8.9	9,352	100.0
			T	2,383	8.0	9,067	30.4	9,969	33.5	5,912	19.8	2,464	8.3	29,795	100.0
		2	5	653	13.6	2,094	43.6	1,234	25.7	538	11.2	283	5.9	4,802	100.0
		3	6	299	6.9	1,455	33.5	1,580	36.4	721	16.6	287	6.6	4,342	100.0
		4	7	897	14.0	2,312	36.1	1,940	30.3	954	14.9	301	4.7	6,404	100.0
		5	8	286	6.1	1,482	31.6	1,448	30.9	980	20.9	492	10.5	4,688	100.0
		6	9	397	4.9	2,130	26.3	2,503	30.9	1,725	21.3	1,344	16.6	8,099	100.0
		T		4,915	8.5	18,540	31.9	18,674	32.1	10,830	18.6	5,171	8.9	58,130	100.0
	2	7	10	2	3.4	17	24.1	33	44.9	20	27.6	0	0	72	100.0
		8	11	540	9.6	1,658	29.5	1,523	27.1	1,236	22.0	663	11.8	5,620	100.0
			12	1,756	14.2	3,919	31.7	3,820	30.9	2,151	17.4	717	5.8	12,363	100.0
			13	1,730	45.1	1,408	36.7	549	14.3	150	3.9	0	0	3,837	100.0
			T	4,026	18.5	6,985	32.0	5,892	27.0	3,537	16.2	1,380	6.3	21,820	100.0
		9	14	225	2.4	1,545	16.5	2,622	28.0	2,426	25.9	2,548	27.2	9,366	100.0
			15	3,323	30.7	4,492	41.5	2,251	20.8	714	6.6	43	0.4	10,823	100.0
			T	3,548	17.6	6,037	29.9	4,873	24.1	3,140	15.6	2,591	12.8	20,189	100.0
		10	16	345	5.7	1,307	21.6	1,888	31.2	1,259	20.8	1,253	20.7	6,052	100.0
			17	1,261	11.5	3,465	31.6	3,301	30.1	1,831	16.7	1,107	10.1	10,965	100.0
			18	1,429	25.4	1,721	30.6	1,608	28.6	765	13.6	101	1.8	5,624	100.0
			T	3,035	13.4	6,493	28.7	6,797	30.0	3,855	17.0	2,461	10.9	22,641	100.0
		11	19	555	7.4	1,364	18.2	2,420	32.3	1,798	24.0	1,356	18.1	7,493	100.0
			20	3,417	47.5	2,626	36.5	1,057	14.7	79	1.1	14	0.2	7,193	100.0
			T	3,972	27.0	3,990	27.2	3,477	23.7	1,877	12.8	1,370	9.3	14,686	100.0
		T		14,583	20.1	23,522	28.5	21,072	26.0	12,429	15.6	7,802	9.8	79,408	100.0
	3	12	21	2,322	40.3	1,988	34.5	1,106	19.2	323	5.6	23	0.4	5,762	100.0
			22	876	48.6	321	17.8	404	22.9	146	8.1	56	3.1	1,803	100.0
			T	3,198	42.3	2,309	30.5	1,510	20.0	469	6.2	79	1.0	7,565	100.0
		13	23	1,216	59.3	708	34.5	127	6.2	0	0	0	0	2,051	100.0

L W	M W	S W	U W	R1 ha	R1 %	R2 ha	R2 %	R3 ha	R3 %	R4 ha	R4 %	R5 ha	R5 %	Total ha	Total %
		T		4,414	45.9	3,017	31.4	1,637	17.0	469	4.9	79	0.8	9,616	100.0
	T			23,912	16.2	45,079	30.7	41,383	28.1	23,728	16.1	13,052	8.9	147,154	100.0
2	4	14	24a	4,737	39.4	4,593	38.2	1,719	14.3	745	6.2	228	1.9	12,022	100.0
			24b	2,650	56.2	1,707	36.2	273	5.8	85	1.8	0	0	4,715	100.0
			25	4,924	54.5	2,972	32.9	949	10.5	154	1.7	36	0.4	9,035	100.0
			T	12,311	47.8	9,272	36.0	2,941	11.4	984	3.8	264	1.0	25,772	100.0
		15	26	1,403	20.2	2,070	29.8	1,979	28.5	896	12.9	597	8.6	6,945	100.0
			27	2,469	26.7	2,747	29.7	2,238	24.2	980	10.6	814	8.8	9,248	100.0
			T	3,872	24.4	4,817	29.3	4,217	26.0	1,876	11.6	1,411	8.7	16,193	100.0
		16	28	3,471	24.7	5,227	37.2	3,401	24.2	1,279	9.1	675	4.8	14,053	100.0
			29	3,850	61.0	1,761	27.9	561	8.9	139	2.2	0	0	6,311	100.0
			T	7,321	36.0	6,988	34.3	3,962	19.4	1,418	7.0	675	3.3	20,364	100.0
		17	30	4,239	29.1	5,593	38.4	3,540	24.3	1,049	7.2	146	1.0	14,567	100.0
			31	5,881	66.6	2,323	26.3	592	6.7	35	0.4	0	0	8,831	100.0
			T	10,120	43.3	7,916	33.8	4,132	17.7	1,084	4.6	146	0.6	23,398	100.0
		18	32	2,488	81.0	584	19.0	0	0	0	0	0	0	3,072	100.0
			33	3,306	39.8	3,157	38.0	1,404	16.9	415	5.0	25	0.3	8,307	100.0
			34	5,647	63.5	2,606	29.3	551	6.2	89	1.0	0	0	8,893	100.0
			35	5,255	50.6	2,732	26.3	1,641	15.8	551	5.3	208	2.0	10,387	100.0
			T	16,696	54.5	9,079	29.6	3,596	11.7	1,055	3.4	233	0.8	30,659	100.0
		T		50,320	43.2	38,072	32.7	18,848	16.2	6,417	5.5	2,729	2.4	116,386	100.0
	5	19	36	2,440	30.6	2,655	33.3	1,969	24.7	606	7.6	303	3.8	7,973	100.0
			37	1,557	13.3	3,677	31.4	3,618	30.9	2,049	17.5	808	6.9	11,709	100.0
			T	3,997	20.3	6,332	32.2	5,587	28.4	2,655	13.5	1,111	5.6	19,682	100.0
		20	38	730	11.9	1,320	21.5	1,750	28.5	1,307	21.3	1,031	16.8	6,138	100.0
		21	39	851	6.8	2,266	18.1	3,442	27.5	3,180	25.4	2,779	22.2	12,518	100.0
			40	258	5.9	883	20.2	1,620	37.1	896	20.5	712	16.3	4,369	100.0
			41	383	6.1	1,030	16.4	1,570	25.0	1,745	27.8	1,551	24.7	6,279	100.0
			42	128	9.1	151	10.7	316	22.4	429	30.4	387	27.4	1,411	100.0
			T	1,620	6.6	4,330	17.6	6,948	28.3	6,250	25.4	5,429	22.1	24,577	100.0

3-3

L W	M W	S W	U W	R1 ha	%	R2 ha	%	R3 ha	%	R4 ha	%	R5 ha	%	Total ha	%
		T		6,347	12.6	11,982	23.8	14,285	28.3	10,212	20.3	7,571	15.0	50,397	100.0
	6	22	43	426	11.0	1,076	27.8	1,351	34.9	701	18.1	317	8.2	3,871	100.0
			44	574	7.0	1,795	21.9	2,925	35.7	1,836	22.4	1,065	13.0	8,195	100.0
			45	544	6.6	1,351	16.4	2,421	29.4	2,323	28.2	1,598	19.4	8,237	100.0
			46	407	5.4	1,244	16.5	2,188	29.0	1,938	25.7	1,765	23.4	7,542	100.0
			47	226	8.6	517	19.7	651	24.8	806	30.7	425	16.2	2,625	100.0
			48	212	4.7	538	11.9	1,621	35.9	1,202	26.6	944	20.9	4,517	100.0
			49	191	5.8	455	13.8	1,431	43.4	956	29.0	264	8.0	3,297	100.0
			50	830	5.4	2,505	16.3	4,840	31.5	4,026	26.0	3,165	20.6	15,366	100.0
			T	3,410	6.4	9,481	17.7	17,428	32.4	13,788	25.7	9,543	17.8	53,650	100.0
		23	51	213	3.7	1,527	26.5	2,113	36.5	1,130	19.6	780	13.7	5,763	100.0
		24	52	1,940	21.3	2,731	30.0	2,532	27.8	1,603	17.6	301	3.3	9,107	100.0
			53a	509	14.4	1,162	32.9	1,198	33.9	558	15.8	106	3.0	3,533	100.0
			53b	96	2.8	895	26.1	1,232	35.9	950	27.7	257	7.5	3,430	100.0
			T	2,545	15.8	4,788	29.8	4,962	30.9	3,111	19.4	664	4.1	16,070	100.0
		25	54	990	18.1	1,531	28.0	1,683	30.8	875	16.0	388	7.1	5,467	100.0
		26	55	194	10.5	463	25.1	399	21.6	329	17.8	462	25.0	1,847	100.0
			56	655	15.2	896	20.8	1,377	32.0	1,021	23.7	357	8.3	4,306	100.0
			57	916	21.0	1,239	28.4	1,068	24.5	698	16.0	440	10.1	4,361	100.0
			T	1,765	16.8	2,598	24.7	2,844	27.0	2,048	19.5	1,259	12.0	10,514	100.0
		T		8,923	9.8	19,925	21.8	29,030	31.7	20,952	22.9	12,634	13.8	91,464	100.0
	T			65,590	25.3	69,979	27.1	62,163	24.1	37,581	14.6	22,934	8.9	258,247	100.0
T				89,502	22.1	115,058	28.4	103,546	25.5	61,309	15.1	35,986	8.9	405,401	100.0

(Remarks) R_1: 0 piece, R_2: 1 piece, R_3: 2 pieces, R_4: 3 pieces, R_5: more than 4 pieces;
L.W.: Large Watershed, M.W.: Middle Watershed,
S.W.: Small Watershed, U.W.: Unit Watershed

4) Stream gradient

According to the stream gradient map, the main rivers such as A. Rawas, A. Rupit, S. Liam, A. Lakitan, A. Klingi, A. Musi and so on are very gentle and belong to class 1 (under 30') almost all along the lines except the upper reaches of A. Rawas and the circumferences of confluences of main rivers and the branches.

But, in the north mountainous-land, many steep and short branches run into the main rivers. Therefore, the distribution of steep classes (more than 2^{o}) is also found very often in the mountainous land. Specially nearby upper reaches of S. Kutu, A. Tiku, A.B. Pu and A. Plikai, there are very steep branches with the gradient of more than 15^{o}.

Fig. 13 shows a vertical section (model) of rivers in this area. The conditions of northern part, central part and southern part are similar to the sections A, B and C respectively.