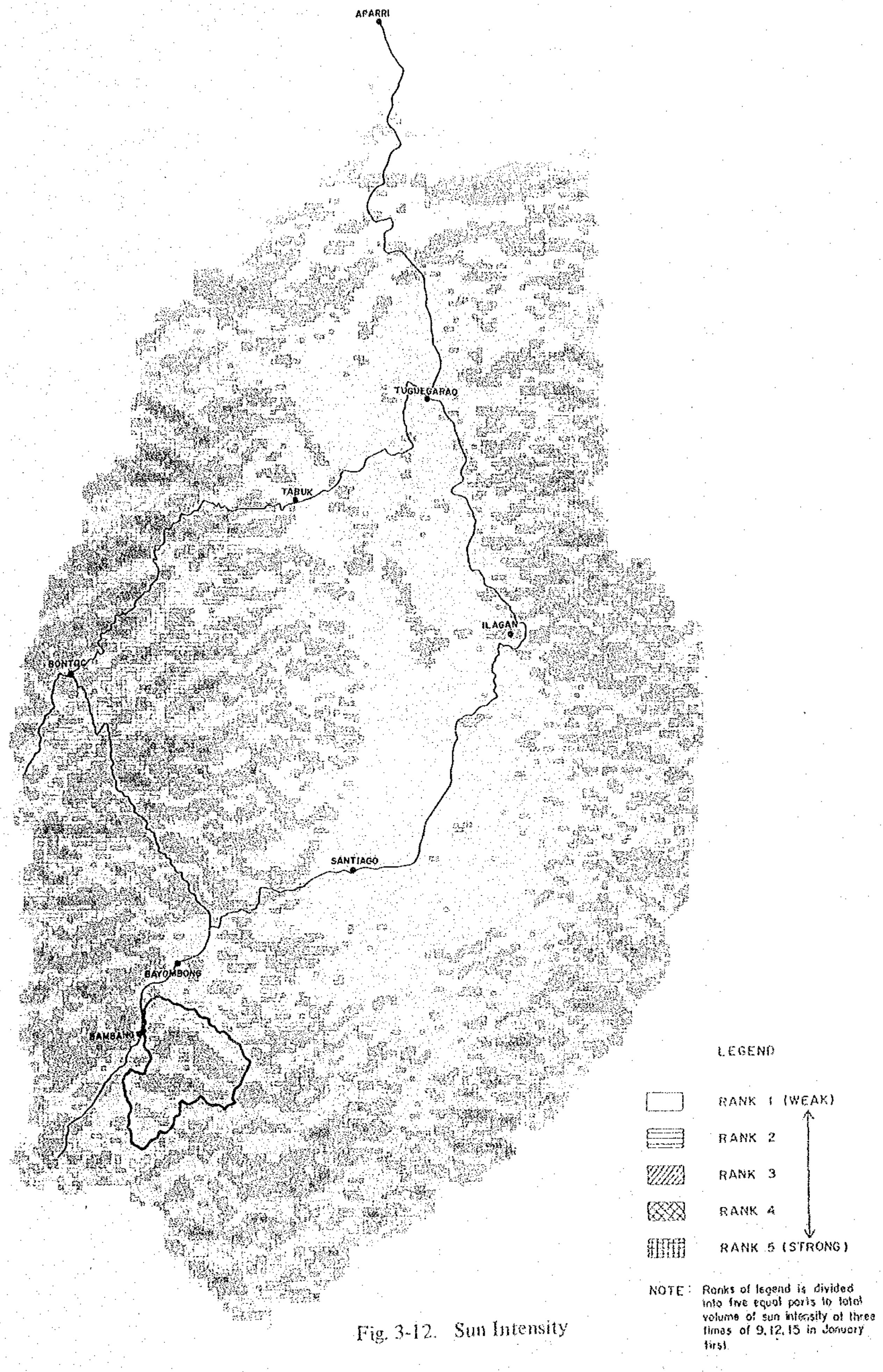
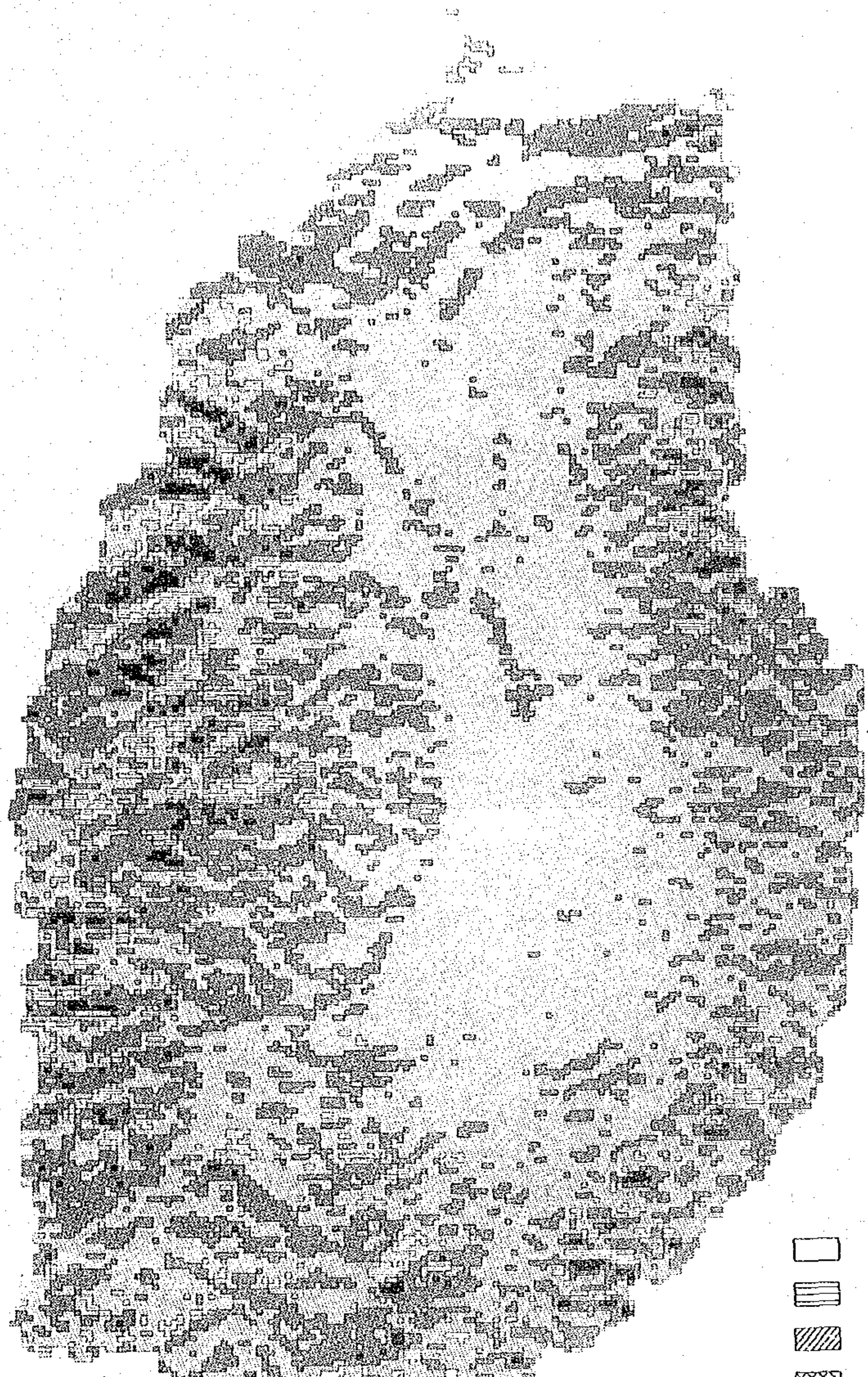


Fig. 3-12. Sun Intensity



LEGEND

RANK 1 (WEAK)

RANK 2

RANK 3

RANK 4

RANK 5 (STRONG)

NOTE: Ranks of legend is divided into five equal parts to total volume of sun intensity of three times of 9, 12, 15 in January first.

Fig. 3-12. Sun Intensity

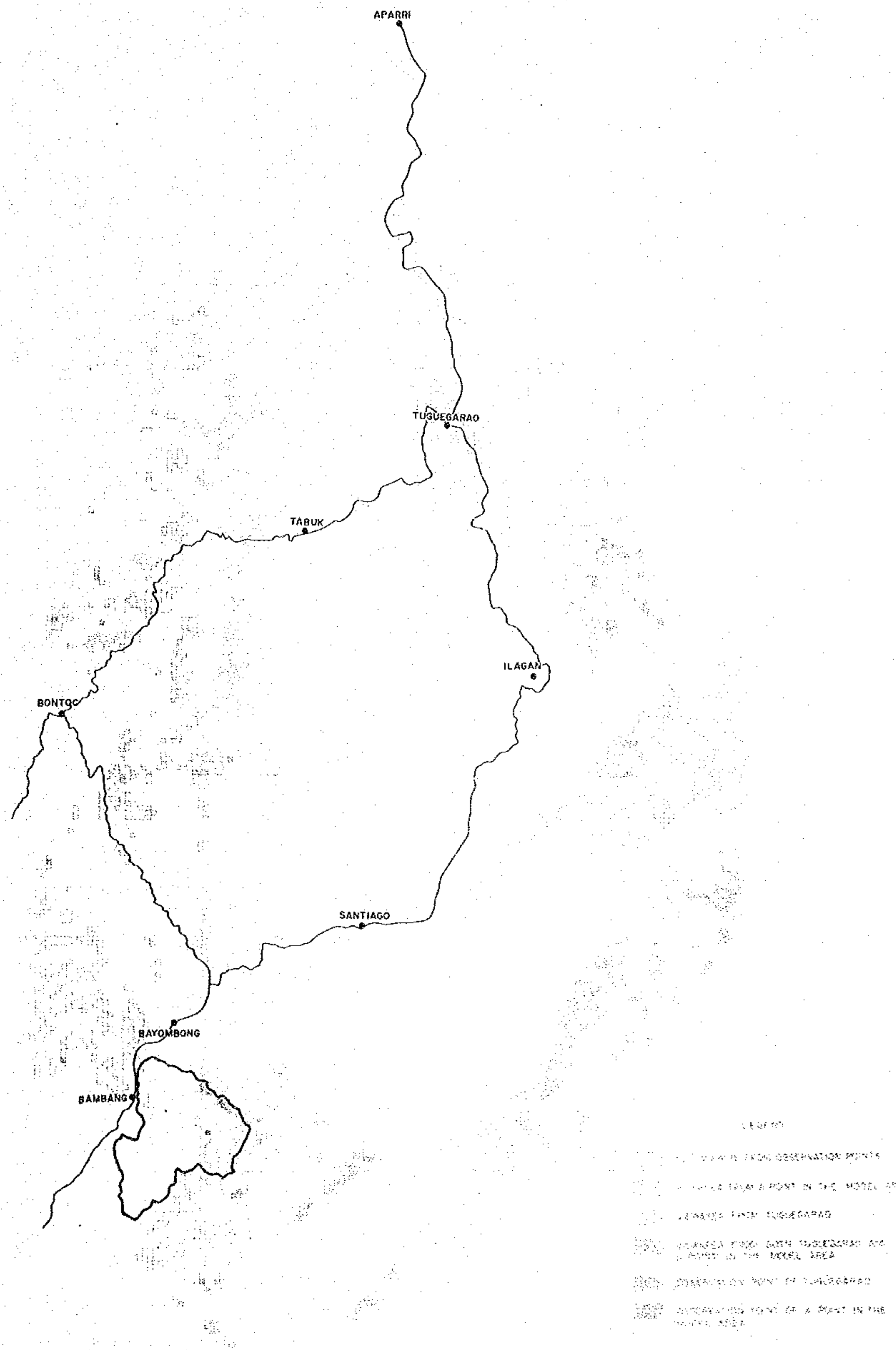

APARRI
TUGUEGARAO
TABUK
ILAGAN
BONTOC
SANTIAGO
BAYOMBONG
BAMBANG

Fig. 3-13. Exposure

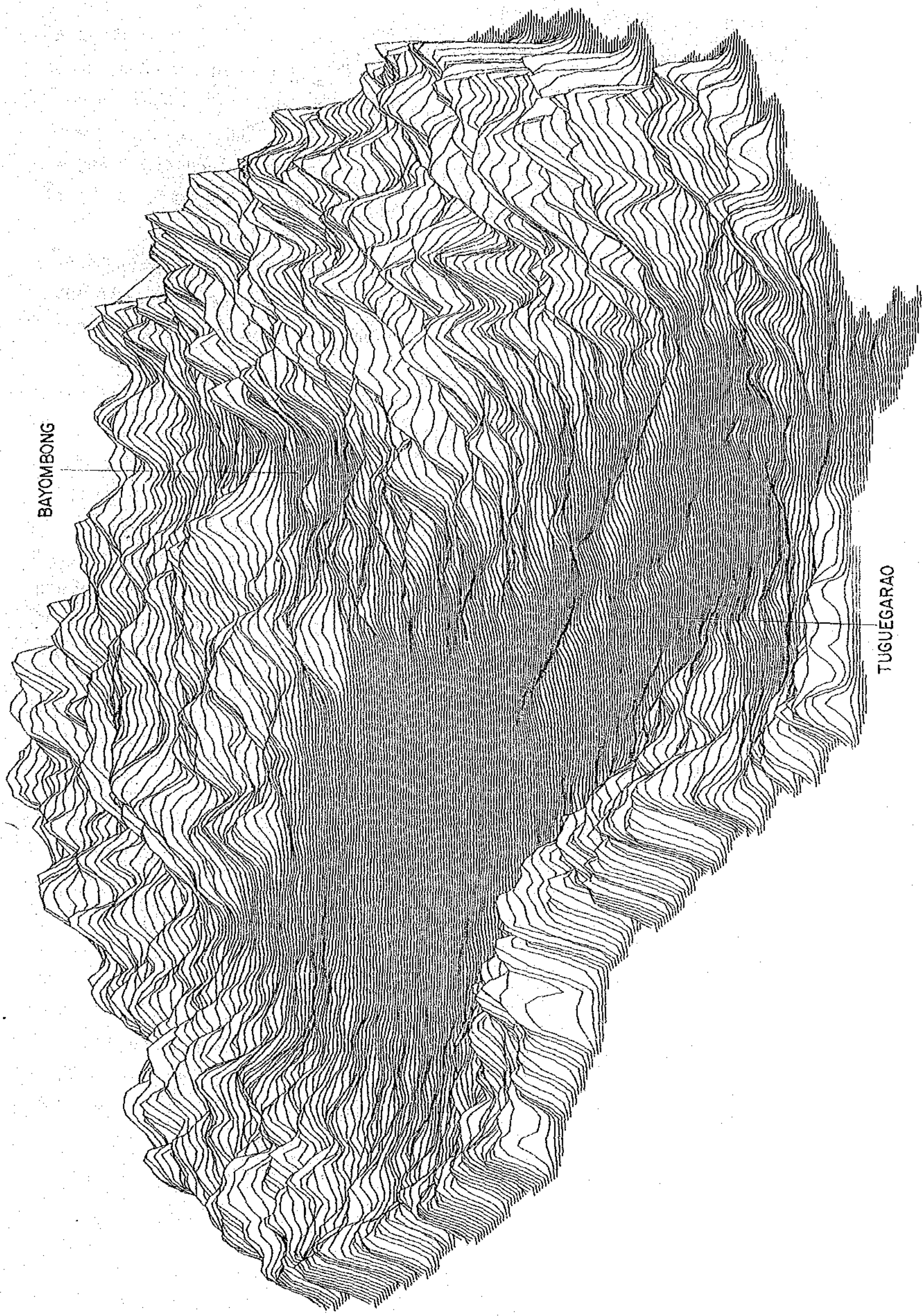


Fig. 3-14. Bird's Eye View

(4) Drainage and Catchment Area

Surrounded by the mountains to the east, south, and the west, the Cagayan River is the largest river in the Republic of the Philippines with its valley encompassing some 2,774 thousand hectares stretching in the north-south direction. The main river flows slightly to the east of the center of the valley from south to north to drain into the South China Sea at Aparri. Major tributaries include, from upstream, Adalan, Magat, Chico, on the left, and Rinagauan de Ilagan, Pinacuan de Tuguegarao, Dummon, on the right.

The Cagayan River Basin has the Cordillera Central Mountain Range (1,400 m – 2,500m in elevation) to the west, the Siera Madre Range (400m – 2,500m) extending to the sea coast and another range of mountains (1,000m – 1,400m) to the south.

Figure 3-15 shows the drainage patterns and elevations of the Cagayan River Basin. Table 3-16 shows the names of the regional units, their locations and areas.

(5) Geology and Soils

Classifications of surface geology are as shown in Table 3-17. Figure 3-16 was compiled mainly from interpretation of aerial photographs and LANDSAT imagery based on the classifications as shown in the table 3-17. Distributions of limestons were clearly interpreted on the photos and imagery, and therefore represented, whereas other rock types were not distinguished. The weathering levels of sedimentary rocks were compiled by referring to the geomorphology classifications and made into a geology map to define the conditions for forest land classification.

There are few geomorphological characteristics that are attributable to the rock types, and depending on the levels of weathering, either hills or mountains are formed. Namely, most of the hills were composed of heavily weathered sedimentary rocks (sandstones, shale, and their alternate layers) or igneous rocks (andesite, basalt) and well advanced in the process of turning into clay and sands/gravels.

There are some parts which are covered by fluvialite deposits consisting of sands and gravels. Steep slopes in the mountainous areas are comprised mainly of mildly weathered rocks. Limestones often form steep slopes (or Escarpment in the Geomorphology Legend). In areas where limestones are distributed, limestone caves of varying sizes can be observed. One such cave to the west of Bontoc and another to the east of Tuguegarao are made into tourist spots.
Classifications of soils (soil texture) are as shown in Table 3-18.

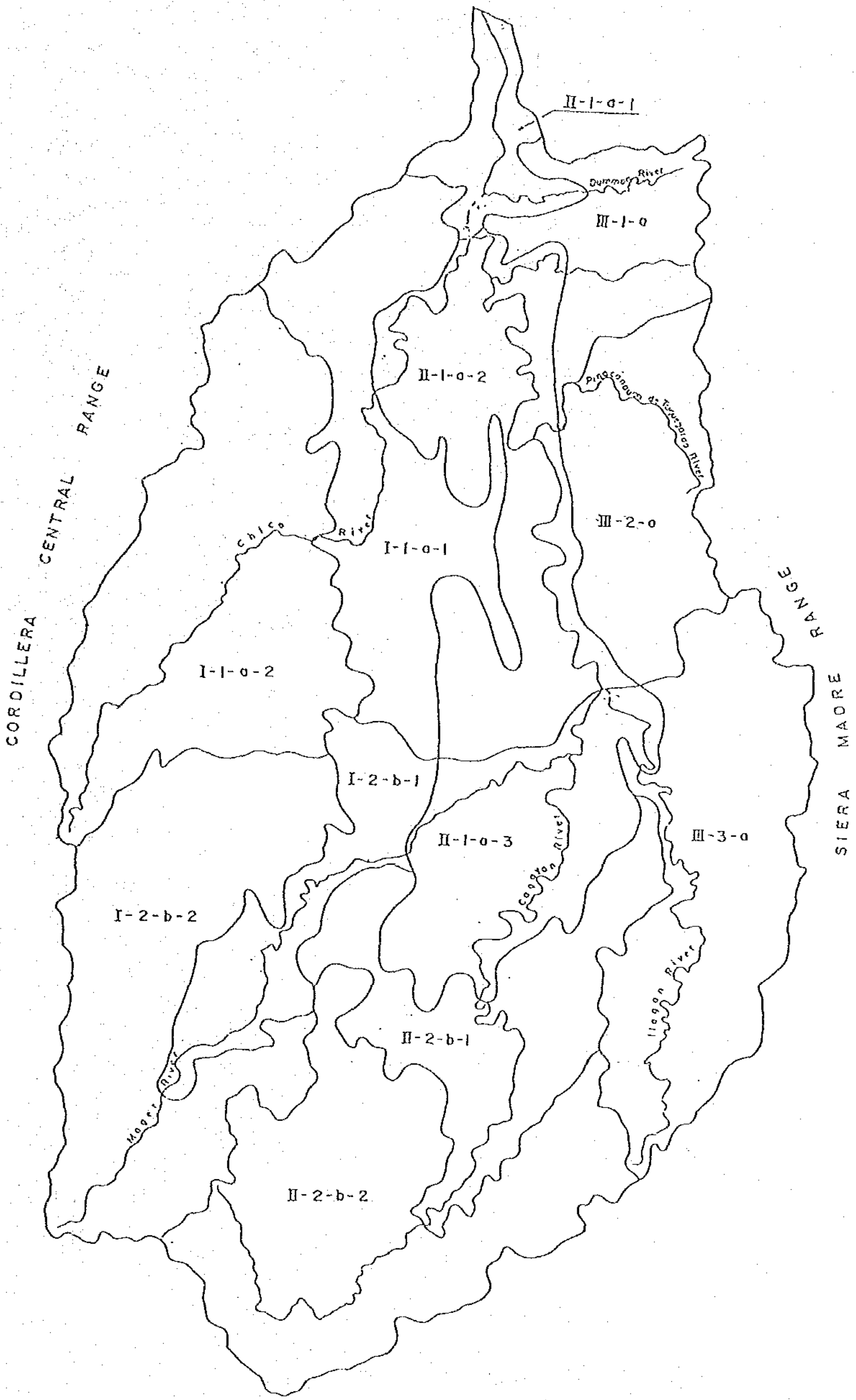


Fig. 3-15. Catchment Area of Cagayan River Basin

Table 3-16. Morphologic Region in Cagayan River Basin

Regional Unit	Elevation (m)	Area (km^2)
I. Cordillera Central Range	100 ~ 2,500	10,828
I-1-a-1. Chico River: Midland	100 ~ 350	2,660
I-1-a-2. Chico River: Highland	350 ~ 2,200	3,275
I-2-b-1. Magat River: Midland	100 ~ 450	1,720
I-2-b-2. Magat River: Highland	450 ~ 2,500	3,173
II. Cagayan River Lowland & Mainstream	0 ~ 1,600	11,658
II-1-a-1. Lower Cagayan River: Lowland	0 ~ 100	1,191
II-1-a-2. Middle Cagayan River: Lowland	30 ~ 100	3,311
II-1-a-3. Upper Cagayan River: Lowland	60 ~ 100	1,456
II-2-b-1. Main Cagayan River: Midland	100 ~ 450	2,420
II-2-b-2. Main Cagayan River: Highland	450 ~ 1,600	3,280
III. Siera Madre Range	100 ~ 1,600	5,249
III-1-a. Dummon River	100 ~ 1,000	819
III-2-a. Pinacanauan de Tuguegarao River	100 ~ 1,600	1,244
III-3-a. Ilagan River	100 ~ 1,400	3,186

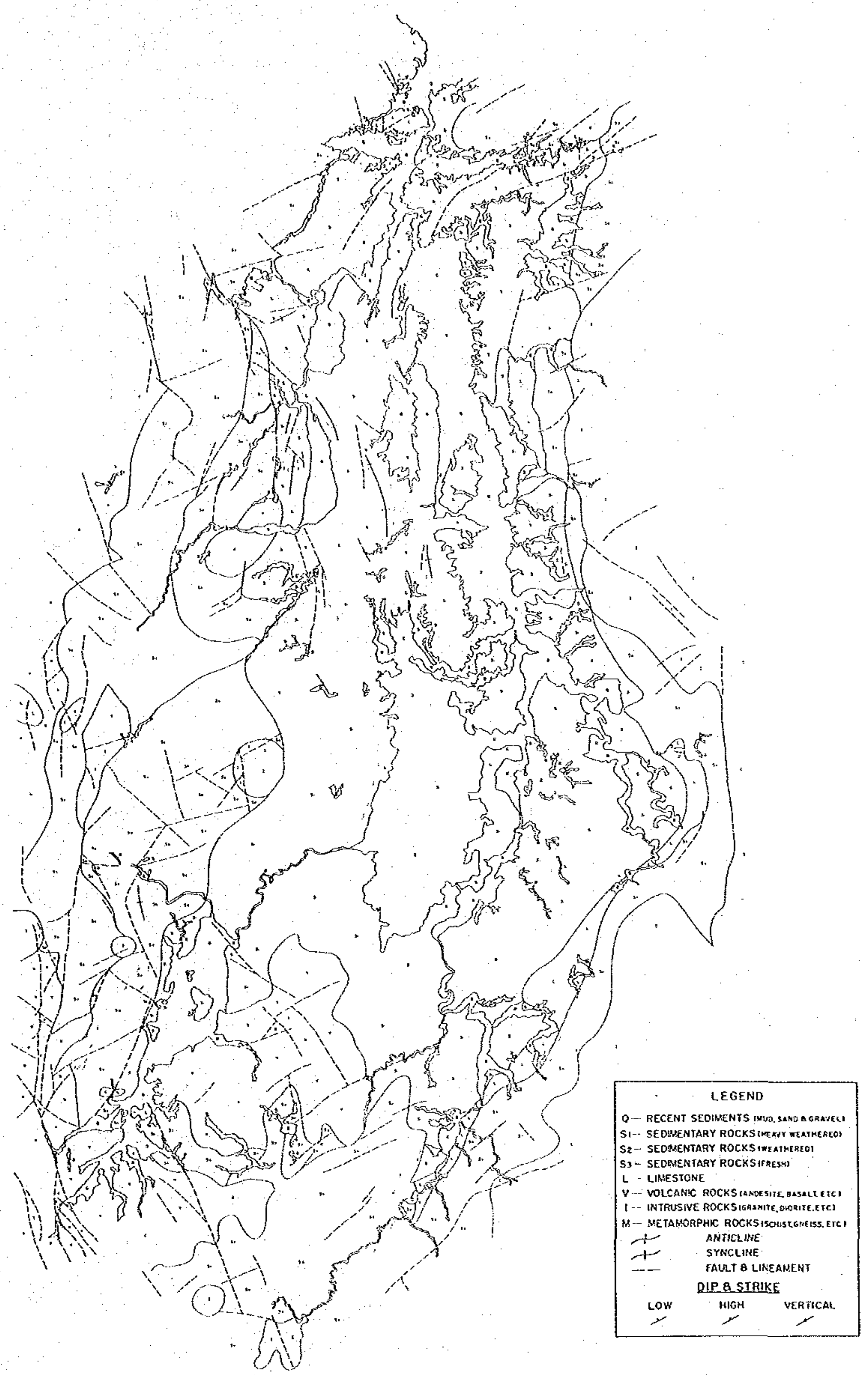


Fig. 3-16. Geology

Table 3-17. Classification of Surface Geology

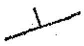
Q	Recent Sediments (Mud, Sand & Gravel)
S_1	Sedimentary Rocks (Heavy Weathered)
S_2	Sedimentary Rocks (Weathered)
S_3	Sedimentary Rocks (Fresh)
L	Limestone
V	Volcanic Rocks (Andesite, Basalt, etc.)
I	Intrusive Rocks (Granite, Diolite, etc.)
M	Metamorphic Rocks (Schist, Gneiss, etc.)


Anticline


Syncline

— — Fault & Linearment

Dip & Ltrike

Low


High

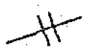

Vertical


Table 3-18 . Classification of Soils (Soil texture)

1. sand (include gravel)	7. sandy clay loam
2. sand ~ gravel (include rock)	8. silty clay loam
3. sandy loam	9. clay loam
4. silt ~ loam	10. clay
5. loam	11. sand
6. silt ~ clay	12. river

Soil classifications were made from existing data and observations of outcrops, on the basis of the geomorphology.

Figure 3-17 was prepared according to the soil classifications as shown in Table 3-18.

From the figure, it can be seen that in flat to gentle slopes of lawland, sandy loam is distributed extensively, followed by silt-clay and sandy clay loam. In mild to steep slopes of hills and mountains, sands and gravels including rocks are distributed most extensively.

In terms of soil depths, Midland (particularly, dissected upland and hills) has the thickest layers of soils while Highland has the thinnest soil covers with Lowland falling in-between.

In terms of hardness of soils, the hardest or consolidated are plateaus and low relief surfaces on the mountains of Highland, and classified as Hard are dissected uplands and hills while Soft to Hard are valley bottoms and fans of Lowland, terraces of Midland and gentle slopes on the mountains and steeply dissected slopes of Highland.

(6) Meteorology

1) Temperature

From the meteorological observation data book published by PAGASA, the data relevant to the study area were picked out and organized with respect to temperatures, rainfalls and tropical cyclone. There are 26 observatories in the study area at locations as shown in Figure 3-18. Temperatures and rainfalls as observed at each observatory are shown in Table 3-19.

According to the meteorological data given in Table 3-19, the average annual temperatures are 26.7°C at Aparri on the northern coast, 27.7°C at Tuguegarao in the north of the Cagayan River Basin and 26.0°C at Bayombong in the southeast. Furthermore, the Mt. Data for the Cordillera Central Range indicate 15.8°C and, similarly, 23.3°C for Bontoc at the lower basin of the Range. Maximum temperatures on record are 39.1°C for Aparri and 42.2°C for Tuguegarao.

2) Rainfall

According to the observation data as shown in Table 3-19 rainfalls vary from one area to another, averaging annually 2,317.9 mm at Aparri, 1,700.8 mm at Tuguegarao, and 1,539.8 mm at Bayombong. The heaviest rainfalls occur in the Cordillera Central Range to the east with 4,687.8 mm at Banaue, 3,781 mm at Barlig, and 3,150.4 mm/year for MT. Data, all being in excess of 3,000 mm.

Based on the recorded rainfalls, the following classifications were made and the study area was divided accordingly as shown in Figure 3-19.

① Less than 2,000 mm/year
② 2,000 – 2,500 mm/year
③ 2,500 – 3,000 mm/year
④ Over 3,000 mm/year

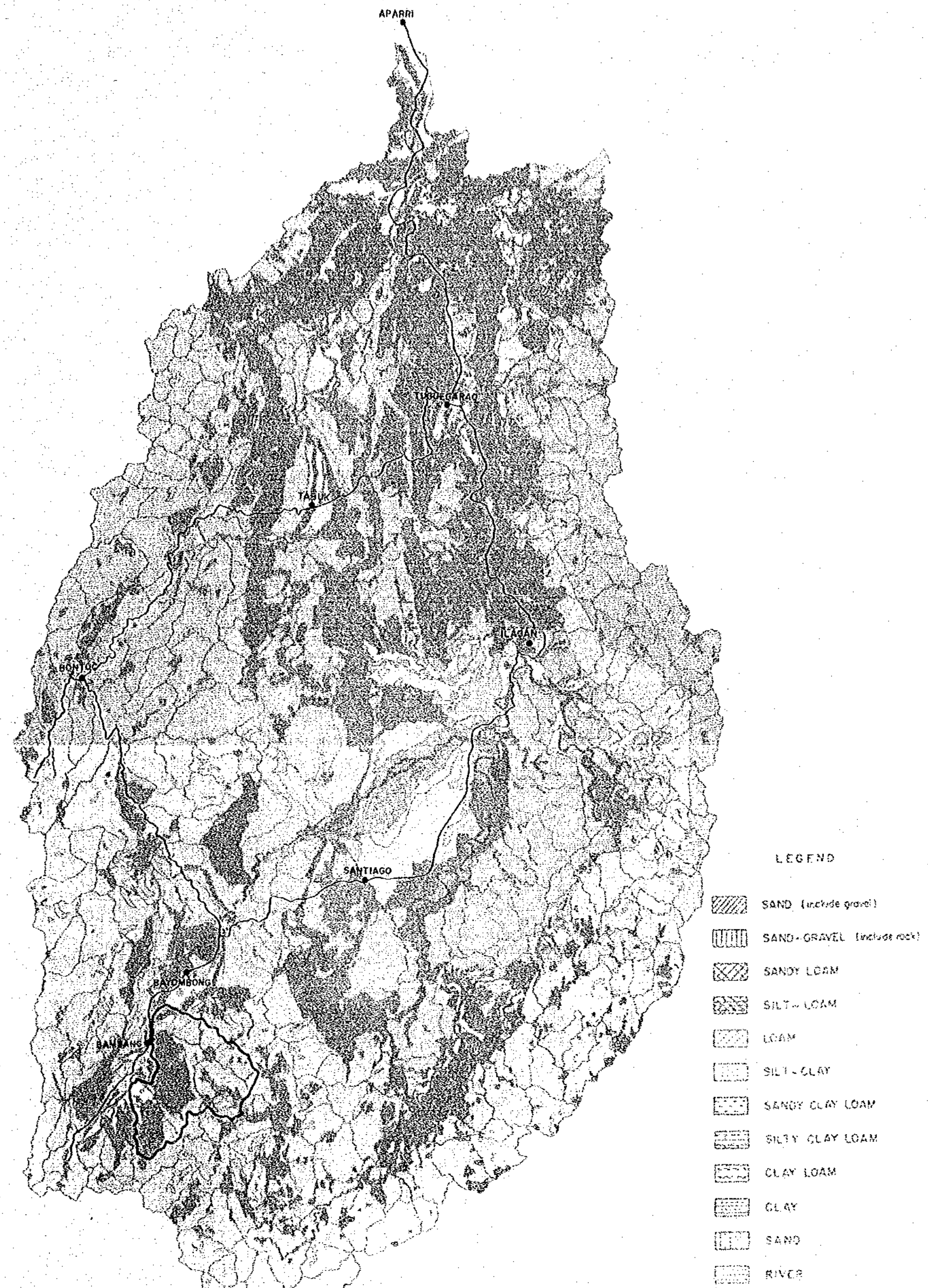


Fig. 3-17. Soil Texture

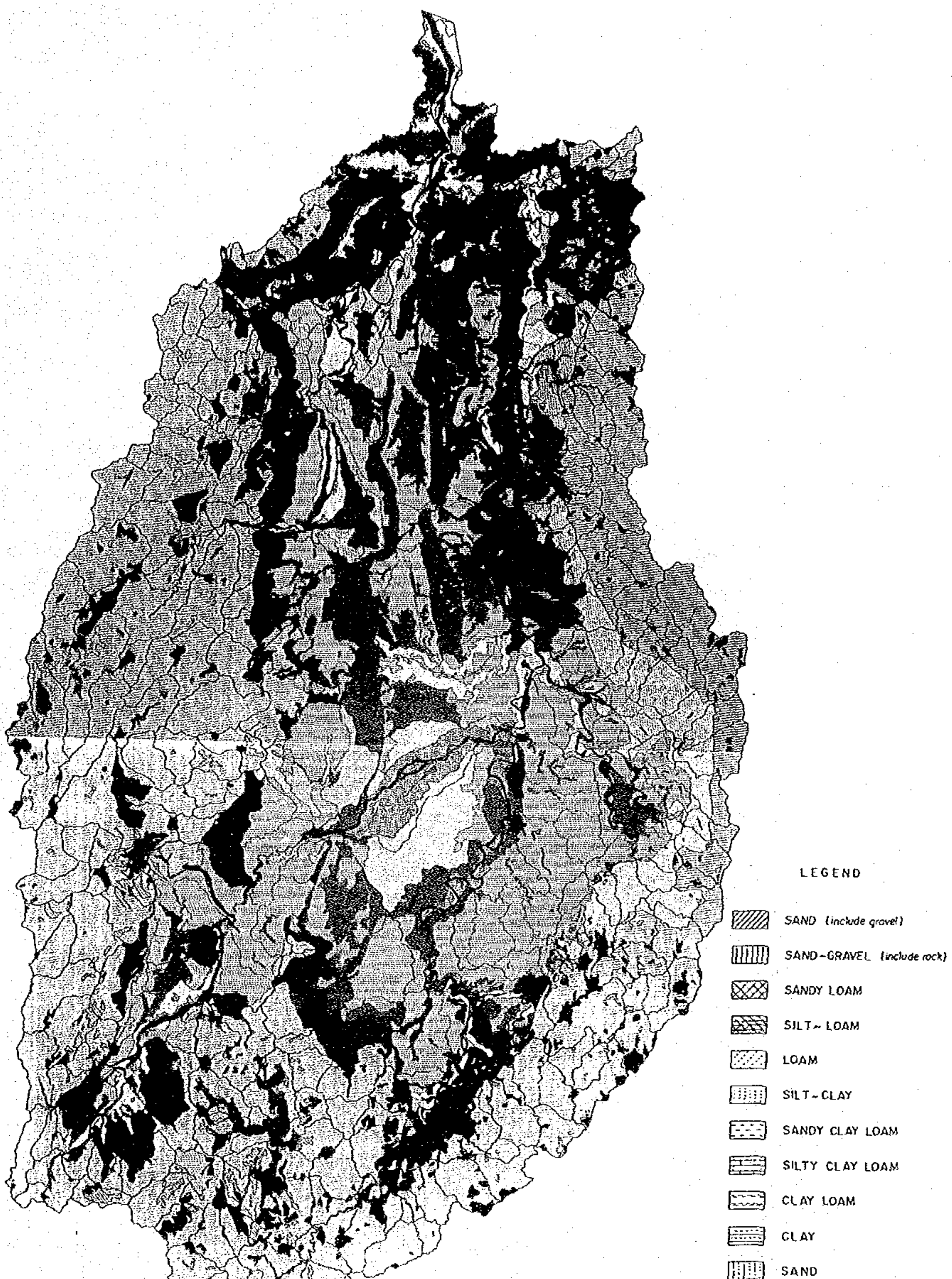


Fig. 3-17. Soil Texture

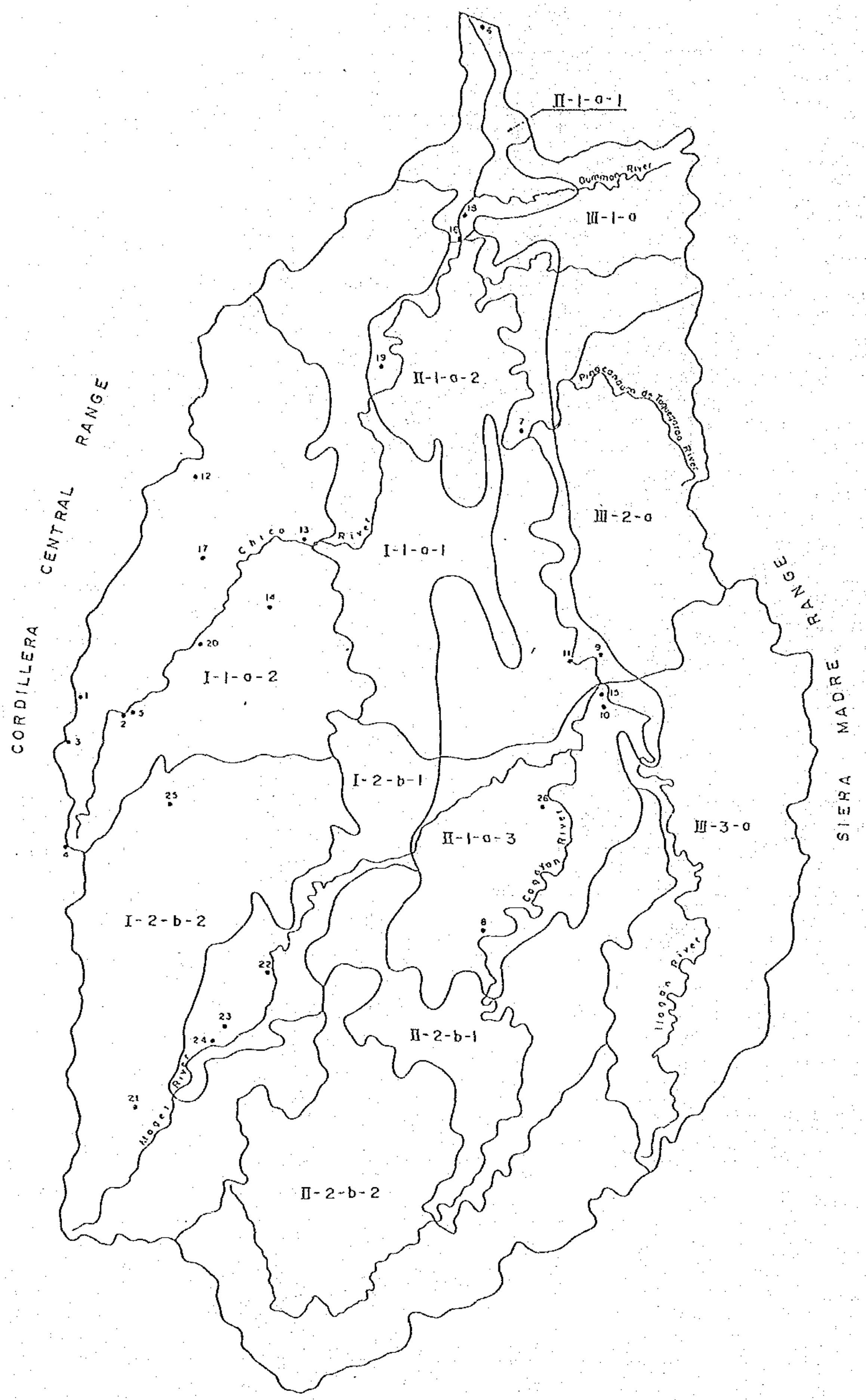


Fig. 3-18. Location of Climatic Observation

Table 3-19. Temperature & Rainfall

No.	Station	Temperature (°C)			Rainfall (mm)			Period of Record	Remarks
		Annual Mean	Monthly Maximum	Highest Data of Occurrence	Annual Mean	Monthly Maximum	Highest Data of Occurrence		
1	Barlig				3,781.0	Nov. 652.1		1963~1970	
2	Constabulary Hill (Bontoc)				2,301.5	Jul. 507.2		1963~1968	
3	Sagada				2,937.7	Jul. 660.4		1918~1939	
4	KM. 102 MT. Data	15.8	Apr. 21.2		3,150.4	Aug. 570.5		1934~1939 1951~1965	
5	Bontoc	23.3	Apr. 31.9		2,150.6	Jul. 386.6		1918~1937	
6	Aparri	26.7	May. Jun. 33.6	Jun. 19, 1966 39.1	2,317.9	Nov. 409.0	Nov. 22, 1973 453.1	1951~1970	
7	Tuguegarao	27.7	May. 37.1	Apr. 29, 1912 May. 11, 1969	1,700.3	Nov. 280.1	Nov. 22, 1973 349.7	1951~1970	
8	Echague	27.2	May. 35.5	Sep. 1, 1910 40.8	1,813.7	Nov. 260.9		1908~1939	
9	Baridad (Ilagan)				2,225.9	Nov. 389.1		1924~1939	
10	Soil Conservation (Ilagan)				1,656.1	Nov. 350.0		1961~1965	
11	Santa Isabel (Ilagan)				1,700.1	Oct. 245.9		1924~1939	
12	Balbalan				1,609.1	Aug. 357.1		1942~1955	
13	Tabuk				2,114.3	Aug. 332.8		1951~1970	
14	Tanudan				2,617.1	Nov. 397.1		1966~1970	
15	Bpi Ilagan	25.6	May. 35.0		1,885.6	Nov. 324.6		1951~1970	
16	Alcala				2,157.2	Aug. 310.1		1956~1970	
17	Lubuagan	22.2	May. 28.9		2,695.4	Jul. 392.8		1966~1970	
18	Lasam				1,080.1	Nov. 254.4		1951~1970	
19	Tuao				1,720.1	Nov. 227.2		1951~1970	
20	Tinglayan				2,740.3	Nov. 388.6		1966~1970	
21	Salinas (Bambang)				1,682.1	Ava. 383.9		1951~1970	
22	Diadi (Magat)				1,896.8	Sep. 279.4		1951~1970	
23	Solano				2,087.6	Sep. 493.3		1966~1970	
24	Bayombong	26.0	May. 34.4		1,539.8	Sep. 228.6		1886~1893 1922~1933	
25	Banaue				4,687.8	Aug. 756.1		1966~1970	
26	Cauayan				1,902.0	Nov. 285.0		1924~1939	

The average annual rainfall is least at 2,000 mm/year in the flat lowlands along the main stream of the Cagayan River, while it stands at 2,000 mm/year – 3,000 mm/year in most of the hills and mountains in the study area and over 3,000 mm/year from Banaue of Western mountains to Bontoc.

3) Tropical Cyclone

Tropical cyclones were compiled in terms of their courses, months, and 24-hour maximum rainfall. Cyclone-caused 24-hour maximum rainfalls were classified as follows and then charted out on the map as shown in Figure 3-19.

① Over 500 mm/24 hours
② 300 – 500 mm/24 hours
③ 100 – 300 mm/24 hours
④ Less than 100 mm/24 hours

It was found that there were more cyclones in the 100–300 mm/24 hours range than any other ranges and most of the cyclones with over 500 mm/24 hours passed through the northern part of the study area.

Figure 3-20 shows distributions of cyclones by month. They occurred mostly in the months of July through October and none in the months of January through March. Their courses are mostly south-east to north-west. By area, there are many in the north of the study area but relatively few in the central part.

(7) Vegetation and Land Use

1) Distribution Characteristics

Vegetation and land use classifications were compiled from interpretations of aerial photos and Landsat imagery, and field surveys, as shown in Table 3-20 (1), (2) and Figure 3-21.

Table 3-20 (1) Classification of Vegetation and Land Use

Ma	Mangrove Forest
F	Flat Plain Forest (0 ~ 100m)
H	Hilly Forest (101 ~ 400m)
M	Mountain Forest (over 401m)
G_1	Grass Land (include Pasture)
G_2	Logging Progress or Logged Over Area
B	Bare Land
A	Agriculture Area (Farm)
K	Kaingin
S	Settlement, Village, Town

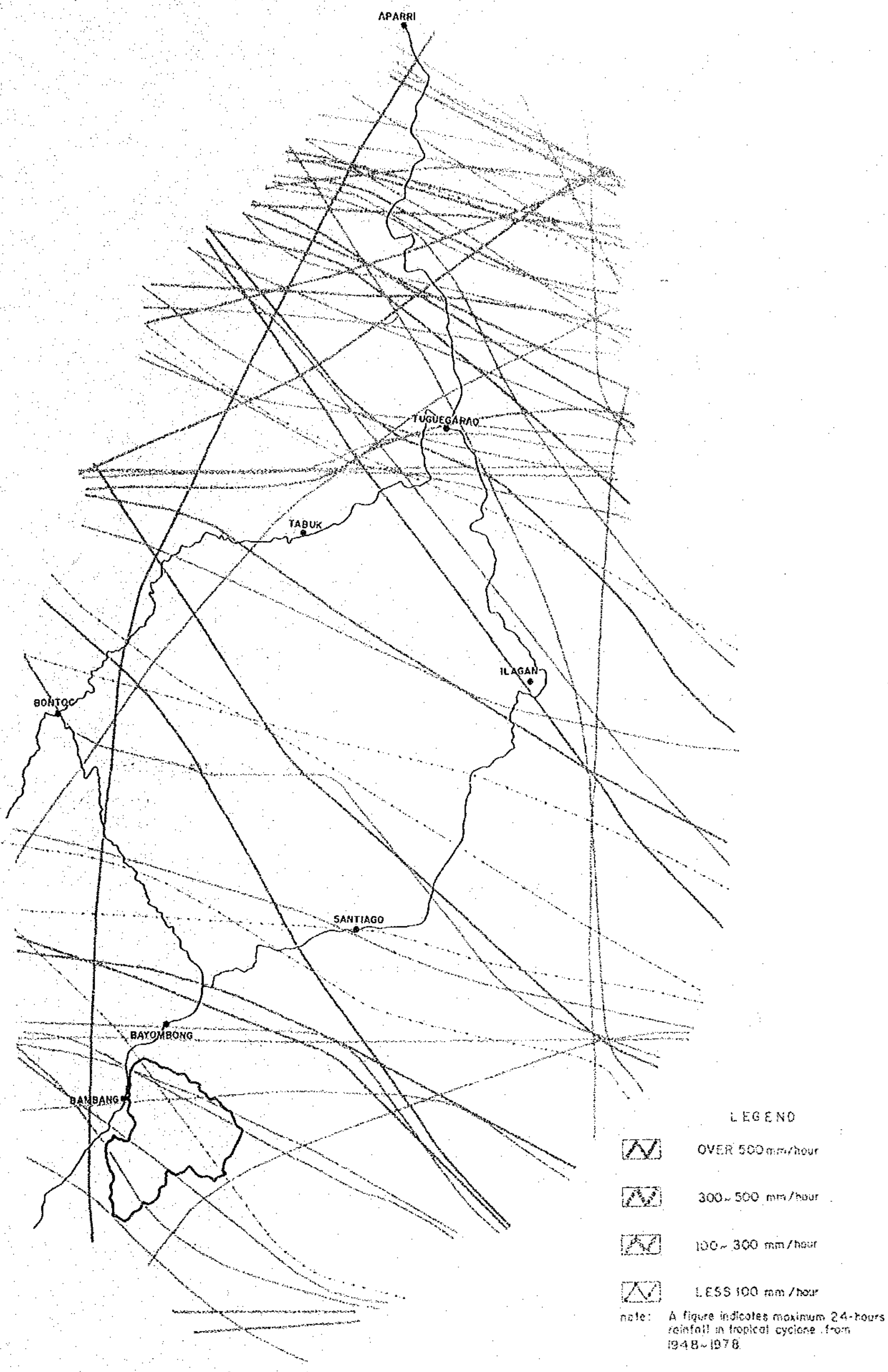


Fig. 3-19. Rainfall and Tropical Cyclone

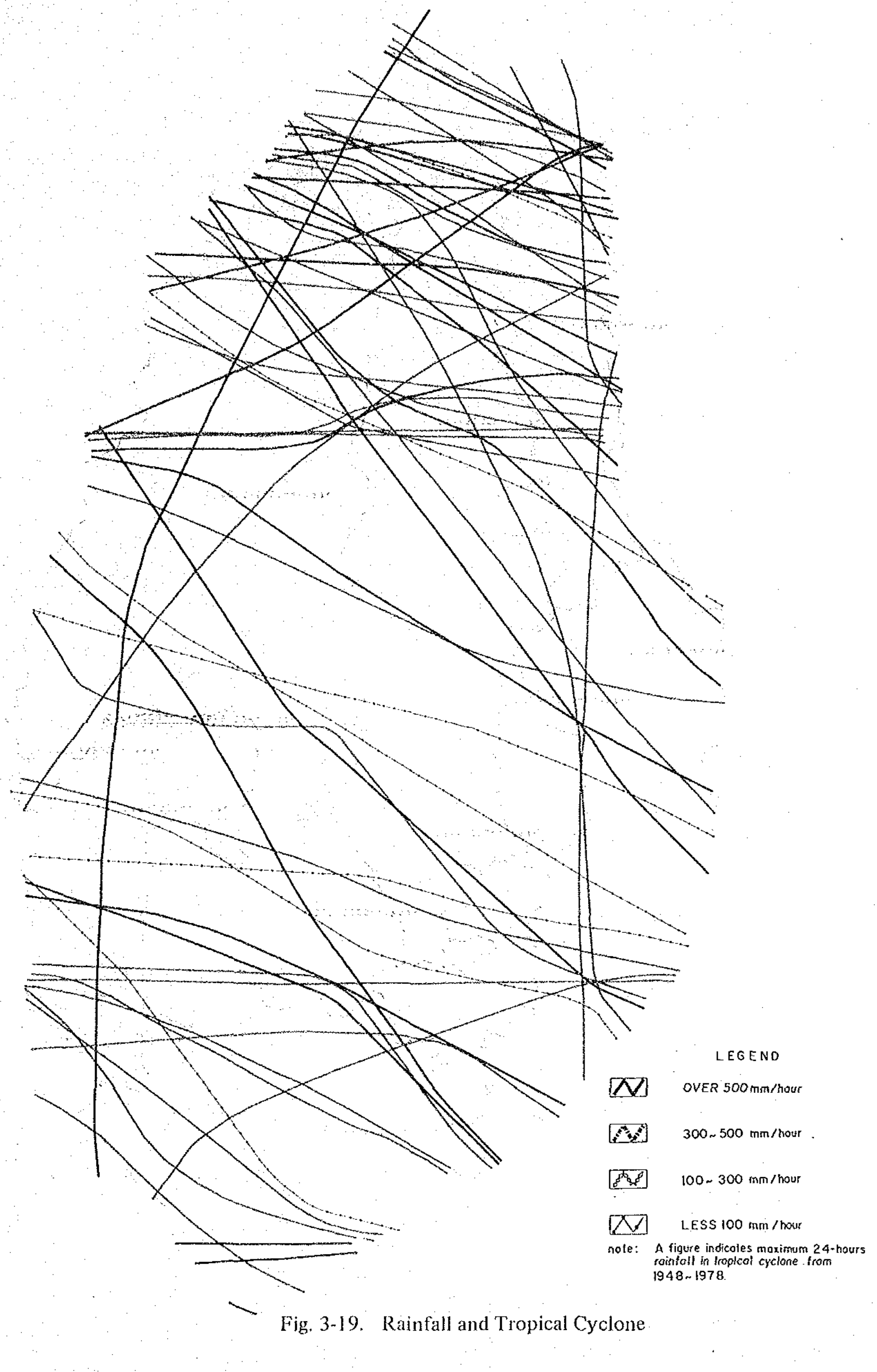


Fig. 3-19. Rainfall and Tropical Cyclone

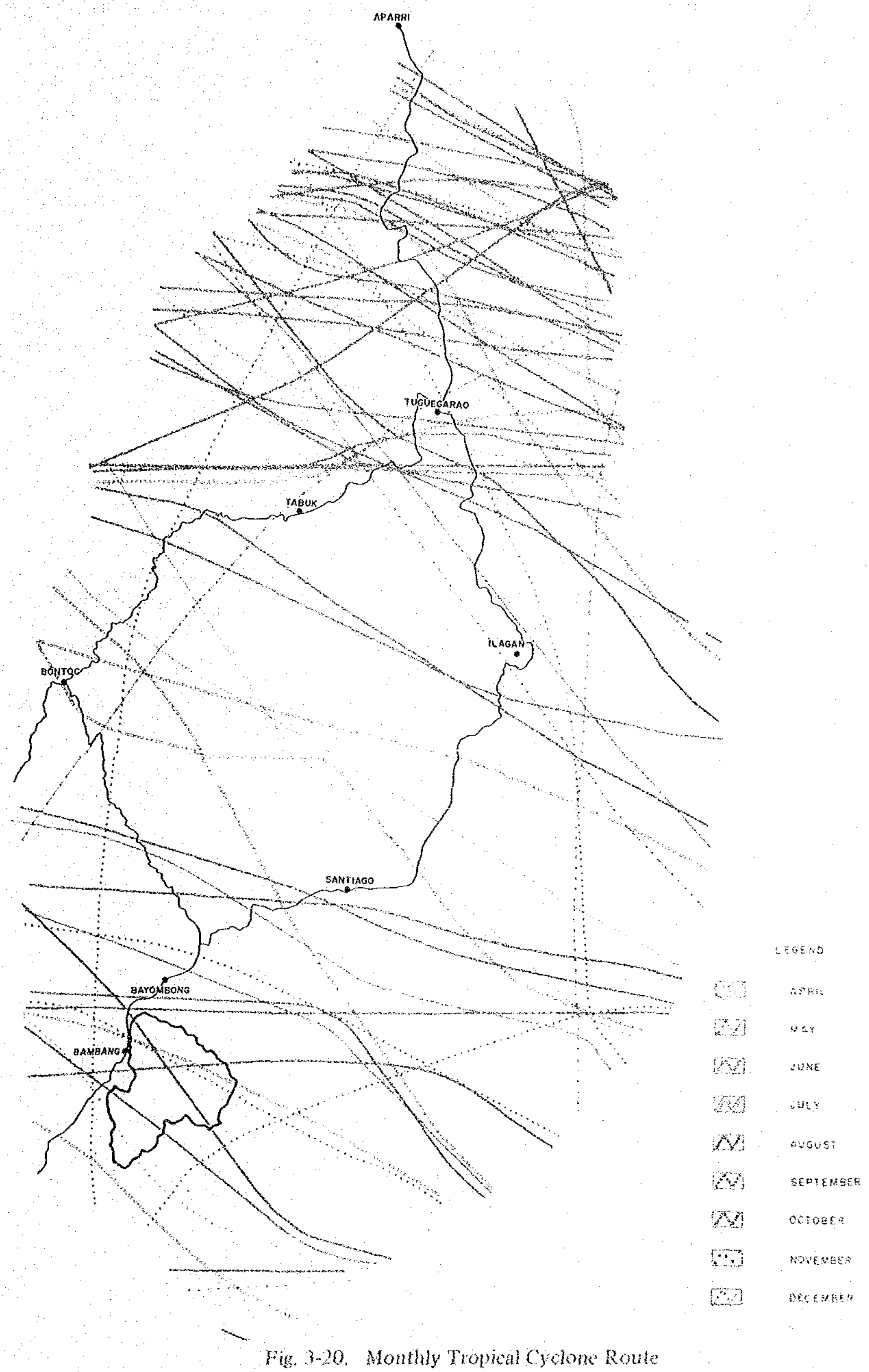


Fig. 3-20. Monthly Tropical Cyclone Route

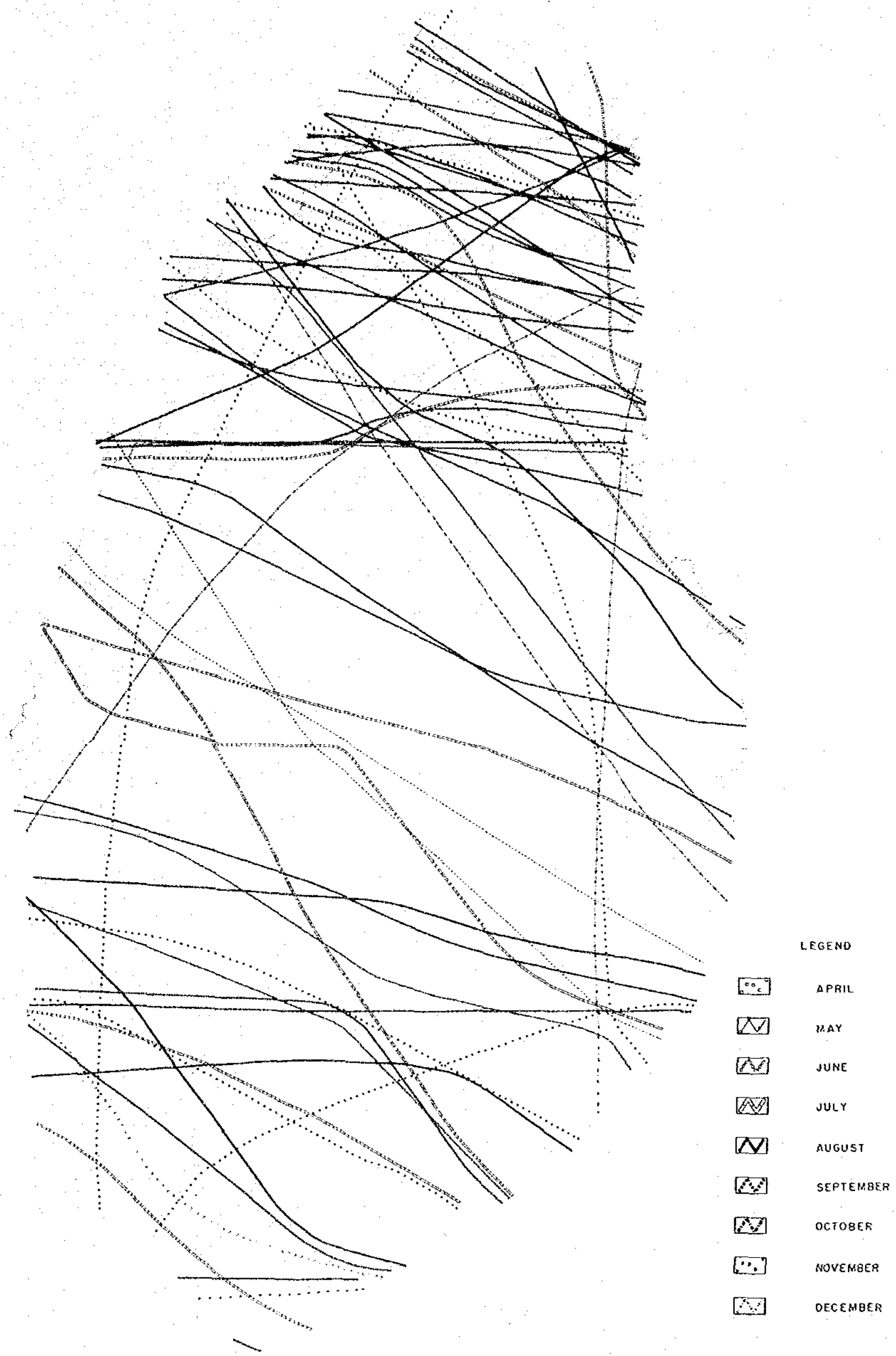


Fig. 3-20. Monthly Tropical Cyclone Route

In the study area from the lowland upto the elevations of about 800m, predominantly Dipterocarpaceae forests are distributed extensively. Other types of forests include mangroves in Aparri and Benquit Pines in Bontac. Forests in the plains (0–100m), hills (101–400m) at mountains are classified by land use.

Table 3-20 (2) Changes of Vegetation and Land Use According to Elevation

(Unit: ha)

Vegetation / Height	Forest							Kaingin	Grassland	Agriculture area	Bareland	Settlement, Village, Town	Total
	Mangrov F.	Flat plain F.	Hilly F.	Mountain F.	Logging P.F.	Benquit pine F.	Subtotal						
0~100m	0 (0)	30,474 (5)	0 (0)	0 (0)	129 (0)	0 (0)	30,603 (5)	58,745 (9)	118,404 (18)	398,949 (62)	31,994 (5)	10,105 (2)	648,800 (100)
101~200m	0 (0)	5,780 (2)	43,609 (12)	0 (0)	15,316 (4)	0 (0)	64,705 (18)	82,292 (23)	120,649 (33)	81,618 (23)	10,409 (3)	727 (0)	360,400 (100)
201~400m	0 (0)	965 (0)	89,847 (21)	29,216 (7)	59,436 (13)	0 (0)	179,464 (41)	83,676 (19)	117,782 (25)	44,824 (10)	10,047 (2)	1,407 (0)	432,200 (100)
401~800m	0 (0)	0 (0)	46,541 (7)	309,841 (50)	84,464 (13)	6,208 (1)	447,049 (71)	48,497 (8)	106,976 (17)	19,814 (3)	3,879 (1)	185 (0)	626,400 (100)
801m~	0 (0)	0 (0)	1,402 (0)	345,541 (49)	50,989 (7)	175,023 (25)	572,955 (81)	45,777 (7)	40,165 (6)	40,952 (6)	851 (0)	0 (0)	700,700 (100)
Total	0 (0)	37,219 (1)	181,399 (7)	684,598 (25)	210,334 (7)	181,226 (7)	1,294,776 (47)	318,987 (12)	503,976 (18)	586,157 (21)	57,180 (2)	12,424 (1)	2,773,500 (100)

Note: The Figures in brackets indicate %.

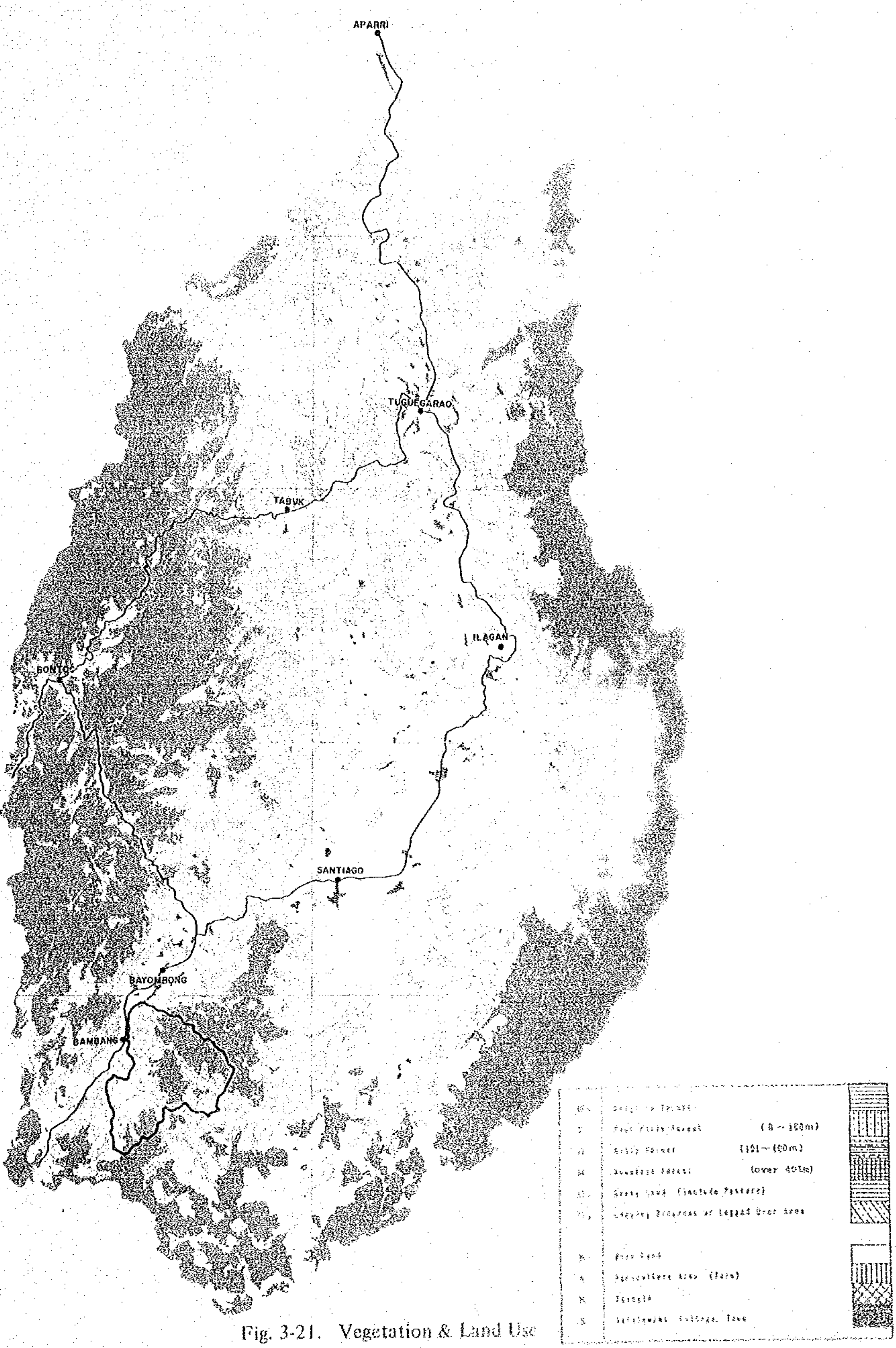
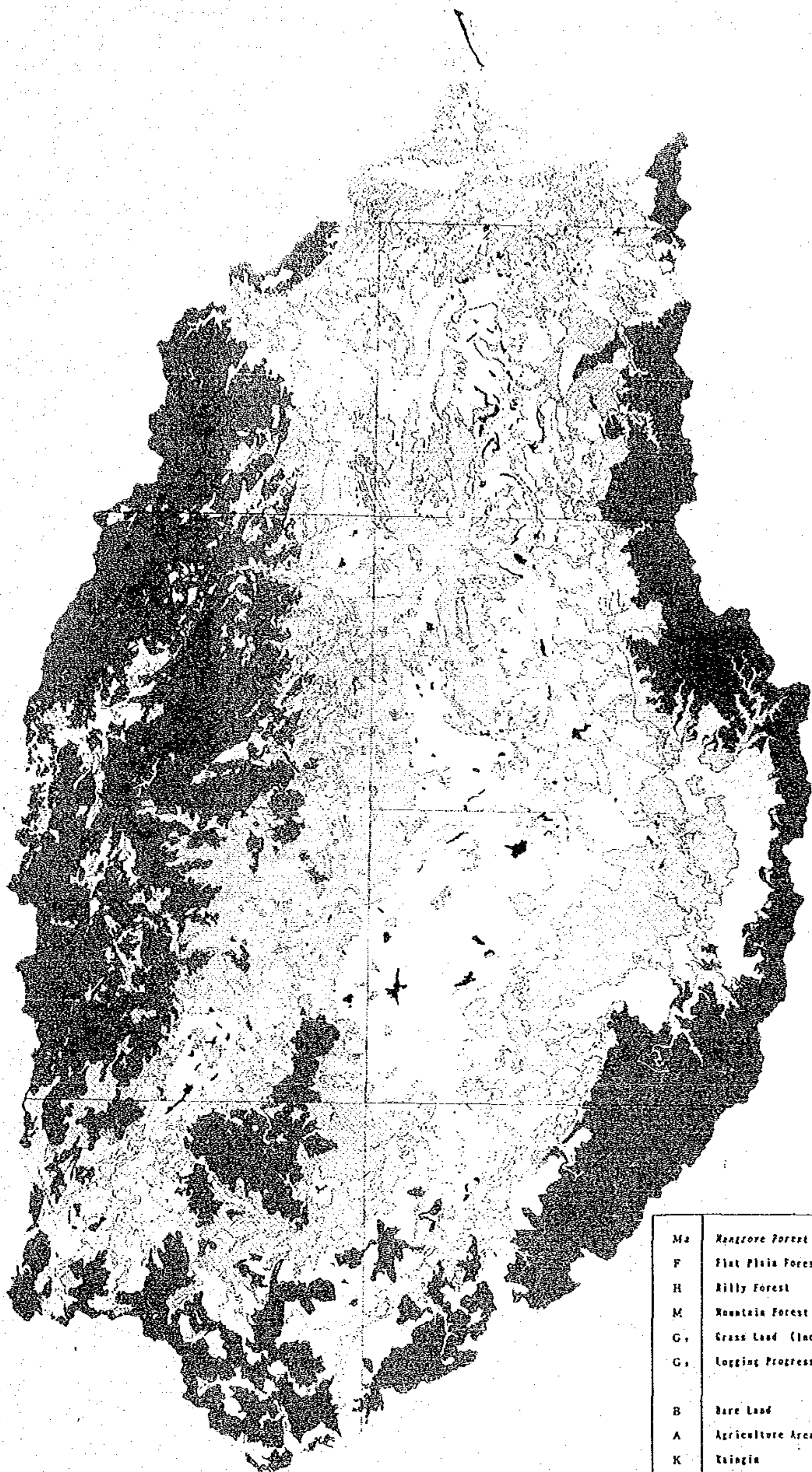


Fig. 3-21. Vegetation & Land Use



Ma	Mangrove Forest
F	Flat Plain Forest (0 ~ 100m)
H	Hilly Forest (101 ~ 400m)
M	Mountain Forest (over 401m)
G_1	Grass Land (Include Pasture)
G_2	Logging Progress or Logged Over Area
B	Bare Land
A	Agriculture Area (Farm)
K	Kaingin
S	Settlement, Village, Town

Fig. 3-21. Vegetation & Land Use

Characteristics of vegetation and land use in terms of elevation are as follows. Forests in the Cagayan River Basin amount to approximately 1.3 million hectares in area representing 47% of the total region. The percentage of forest land area increases as it goes higher in elevation, and, specifically, in areas of 0 – 100m in elevation, there are forest land areas of about 30,000 hectares (or 5%), whereas at 800 meters or higher in elevation, forest land increases to approximately 570 thousand hectares (or 81%). Kaingin occurs most extensively in areas of 101 – 400m but outside that range they decrease in area. The forest land areas total some 320,000 hectares accounting for 12% of the total river basin area.

Grassland amounts to some 500,000 hectares in total or 18%. By elevation, Grassland occurs in some 120,000 ha. or 18% of the area ranging 0 – 100m in elevation, about 120,000 ha. or 33% at 101 – 200m, and about 120,000 ha. or 25% at 201 – 400m, the areas being similar in size, but the figure drops to some 40,000 ha. or 6% for mountains of over 800 meters.

Farmland on the other hand occupies about 590,000 hectares or 21% of the whole basin. By elevation, it takes up some 400,000 hectares or 62% of the lowland area ranging 0 – 100m. Farmland decreases sharply in area as it goes higher. There is some 40,000 hectares of Farmland in the mountains of over 800 meters, which is an aggregate of scattered farmlands in the mountains as well as on the flat tops of mountains.

Bareland totals nearly 60,000 hectares, half of which occurs at elevations ranging 0 – 100m, decreasing rapidly as it goes higher. They occur mostly at the edges of plateaus and terraces, and on steep slopes, but rarely on hills and footslopes.

2) Naturality

By using the Vegetation and Land Use Map, naturality of the study areas was classified according to the levels of human involvement, as shown below. Classifications for the legend are as follows.

1. Natural Forest
2. Planting & Second Growth Forest
3. Logging in Progress or Logged-over Area
4. Kaingin
5. Grassland
6. Agriculture Area
7. Bareland & Settlement

A look into their distributions reveals that Natural Forest is found mainly in the mountains of the Siera Madre Range to the east as well as in the Cordillera Central to the west to some extent. Planting and Second Growth Forest is concentrated in the Cordillera Central Range to the west and rarely found in the Siera Madre Range to the east. Logging in Progress or Logged-over Area concen-

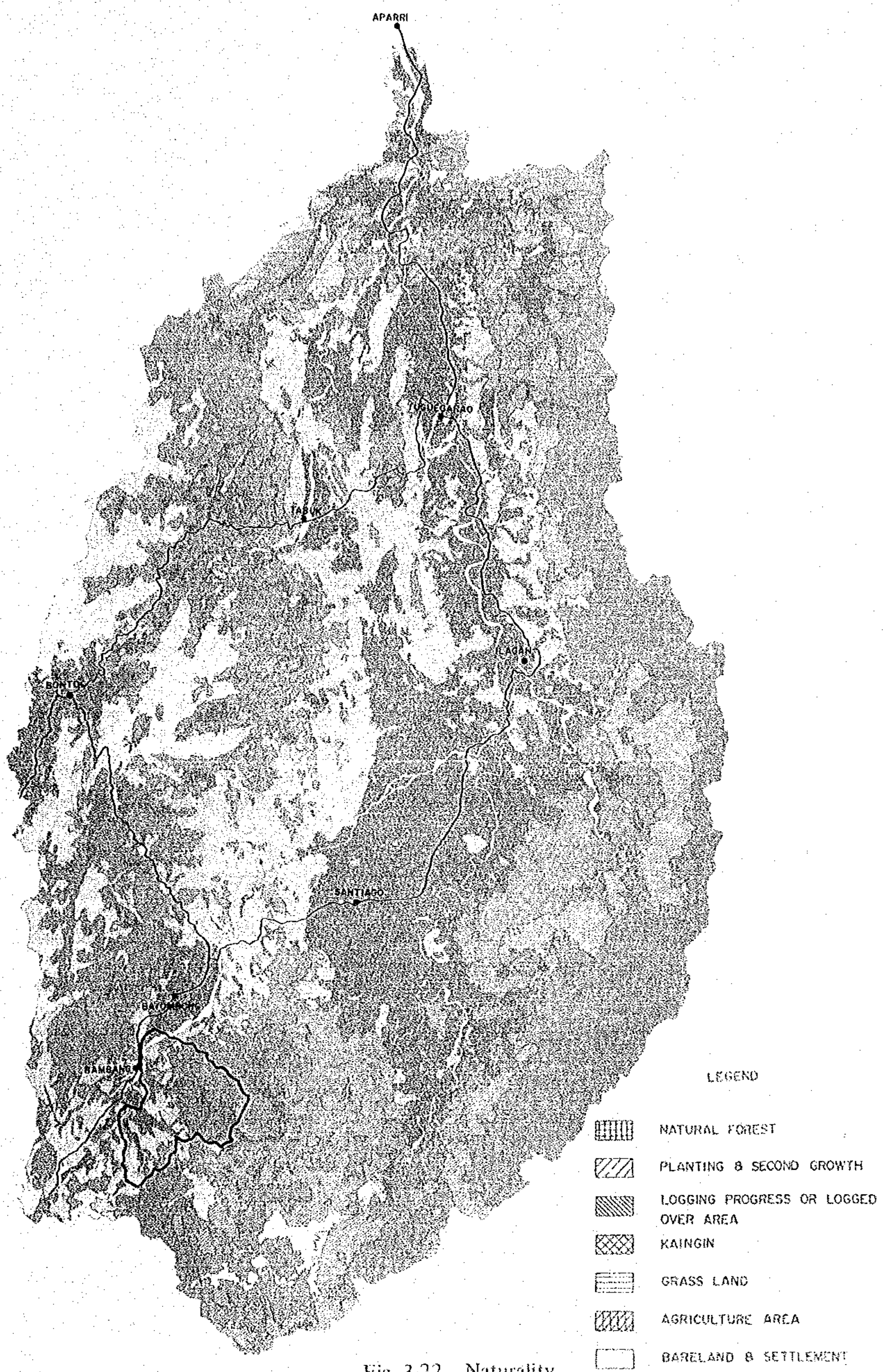


Fig. 3-22. Naturality

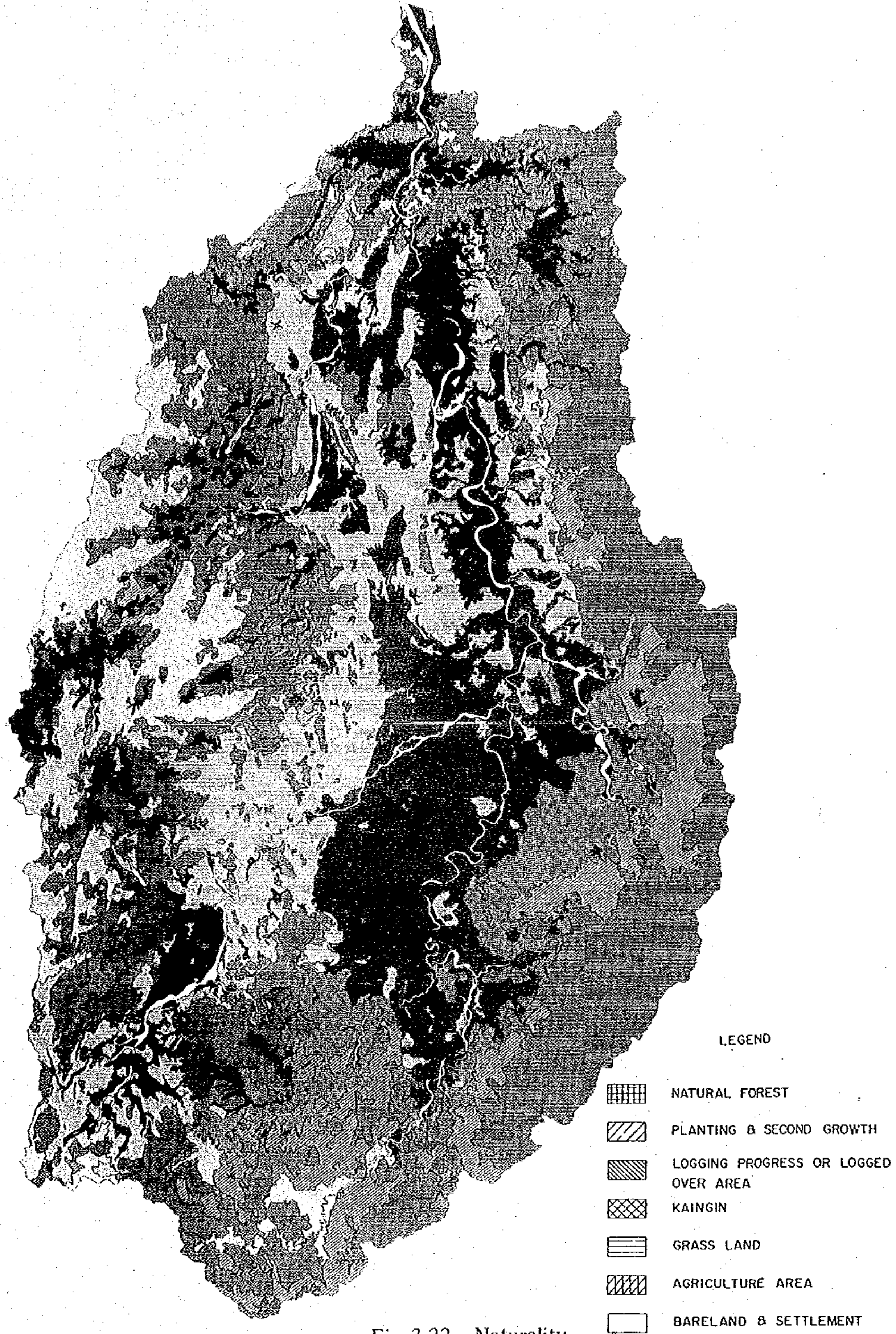


Fig. 3-22. Naturality

trates in the Siera Madre Range to the east and in areas of slightly lower elevations contiguous to Natural Forest. Further below in elevation, there are extensive distributions of Kaingin continuing into Agriculture Area in lowlands and hills. Grassland occurs largely from the central part of the study area to south-west but rarely of the east. Bareland is found only along the rivers.

(8) Evaluation of Natural Environment

The compilation of the basic data pertaining to the study area is summarized as the Land System Classification Table in Table 3-21. The table lists the most basic land form classifications (applicable to any place on the basis of topographic maps and aerial photos) vertically and major, natural environmental factors horizontally to describe the land conditions of the study area as a whole.

Table 3-21. Land System Classification in the Cagayan River Basin, Philippines

	type of Geomorphology \ item	Topography: height m	Topography: slope %	Soil: depth	Soil: texture	Soil: consistensy	Geology	Hazard: landslide	Hazard: soil erosion	Hazard: flooding	Vegetation & Landuse: present land use	Vegetation & Landuse: dominant spieces	Main Location
Lowlands	Coastal ridge, Sand bar, Sand dune	0~10	0~10		sand	soft	sand & clay	NON	active	NON	bare land, plantation	spinifex littoreus merrill, coconuts	around Aparri
	Back marsh	0~100	0~5	thick	clay	very hard	silt & clay	NON	NON	YES	grasslnad	cypress	near Aparri
	Natural levee	0~250	0~10	middle	sand, gravel	hard	sand, gravel	NON	NON	NON	cropland	corn, tobacco	along the Cagayan river
	Flood plain	0~150	0~5	thick	silt~clay	hard	mud, sand & gravel	NON	NON	YES	cropland, grassinad	corn,tobacco rice; talahib	along the main river
	Valley bottom lowland	over 400	0~8	middle	sand~silt	soft~hard	sand, mub & gravel	NON	NON	YES	cropland	rice, corn	along the branch river
	Fan	0~100	0~15	middle	sand~ loam, gravel	soft~hard	sand, mud & gravel	NON	moderate	YES	cropland	corn, tobacco, bean, panut	north of Santiago
	River bed	0~600	0~2	NON	gravel, sand		gravel, sand & mud	NON	NON	YES	river	salix (partly)	main river
Midlands	Terrace	5~400	0~15	middle	sand, gravel	soft~hard	mud, sand & gravel	NON	moderate~ less	NON	cropland	banana, mango	along the main river
	Colluvial slope, Talus	150~1,700	40~50	thick	sand, gravel	soft	mud, sand & breccia	YES	active	NON	cropland grassland	banana, talahib	Banaue, Bayombong-Solano
	Dissected up land	10~250	8~20	thick	silt~loam	hard	heavy weathered andesite sandstone, limestone	YES	moderate	NON	grassland, cropland	cogon, simon	middle~lower stream of Cagayan river
	Hill	10~220	10~25	thick	silt~loam	hard	heavy weathered andesite sandstone, limestone	YES	active~ moderate	NON	grassland	talahib, cogon	middle~lower stream of Cagayan river
	Piedmont (rolling)	100~300	8~20	thick	silt~loam	hard	heavy weathered andsite sandstone, limestone	NON	moderate	NON	cropland (agro-forest)	coffee, banana tangile	Panupnupan, Lagawe
	Piedmont	150~350	20~60	middle~ thick	silt, rock	hard	medium~heavy weathered andesito, sandstone, limestone	YES	moderate~ active	NON	grassland cropland	banana, bean sweet-potato	morth of Tabuk, the left-land side of the Chico river
Highlands	Escarpment	100~400	over 100	NON	rock		fresh limestone	NON		NON	bareland		Callao cave
	Plateau	100~1,000	0~40	thin	loam~silt, rock	consolidate	medium weathered andesite, sandstone, limestone	NON	active	NON	reforestation	gmelina, molave	near Callao cave
	Low relief surface on mountain	400~2,400	8~20	thin	loam~silt, rock	consolidate	medium weathered andesite, sandstone, limestone	NON	moderate	NON	forest, kaingin	mahogany sp., bean, banana, sweet-potato	mountian of above 400m
	Dissected slope on mountain	750~1,400	30~55	thin	loam~silt, rock	hard	medium weathered andesite, sandstone, limestone	NON	moderate	NON	forest, kaingin	mahogany sp., tangile, bean, banana, sweet-potato	Lagawe~Bayombong
	Gentle slope on mountain	over 400	30~45	middle~ thick	silt~leam, rock	soft~hard	heavy weathered andesite, sandstone, limestone	YES	active	NON	kaingin, grassland planting	bean, banana, sweet-potato, benquit pine cogon	west of Tabuk, bontoc, south-east of Bayombong
	Steeply dissected slope	over 400	over 55	thin	sand~ gravel, rock	soft~hard	andesites, sandstone, limestone & granites	YES	active	NON	forest, reforest kaingin	mahogany sp., benquit pine, bean, banana, sweet-potato	mountains

3–2–2 Socio-Economic Environment of Study Area

(1) Administrative Units

The entire country is comprised by 12 administrative units of Regions, Metro Manila being 4A of Region IV. The study area covers nearly the whole of Region II, and parts of Region I (Bontoc area) and Region III (south of Siera Madre Range). (See Figure 3-7.) District and Municipal foundaries and their names are shown in Figure 3-23.

(2) Road Network

The road network was interpreted from existing maps and aerial photos and then represented on the 1/200,000 scale topographic map. (See Figure 3-24.)

Classified in three types, i.e., trunk roads, ordinary roads, and mountain roads, the trunk roads are located along the Cagayan River and Magat River in the north-south direction, connecting such major cities as Aparri, Tuguegarao, Ilagan, Santiago, Bayombong.

Ordinary roads are mostly laid out in grid patterns, covering lowlands ranging up to hills, after branching out from the trunk roads.

Mountain roads are the extension of ordinary roads occurring on the steep slopes ranging from hills to mountains. Most of the mountain roads on the east side of the Cagayan River run dead-end whereas those on the west side from Tabuk and Banaue merge to lead to Baguio.

(3) Development Plans

Specific information was derived from the data supplied by the Philippine side. The listed development projects include those under way. They are classified as follows.

1. Reforestation Project
2. Forest Reserve
3. Experiment Station
4. Protection Forest
5. Integrated Social Forest
6. C.T.F. Project
7. Military Reservation
8. Resettlement Project

In addition, road networks as above are listed as follows:

9. National Road
10. Proposed Road

Figure 3-24 was compiled according to the above classifications.

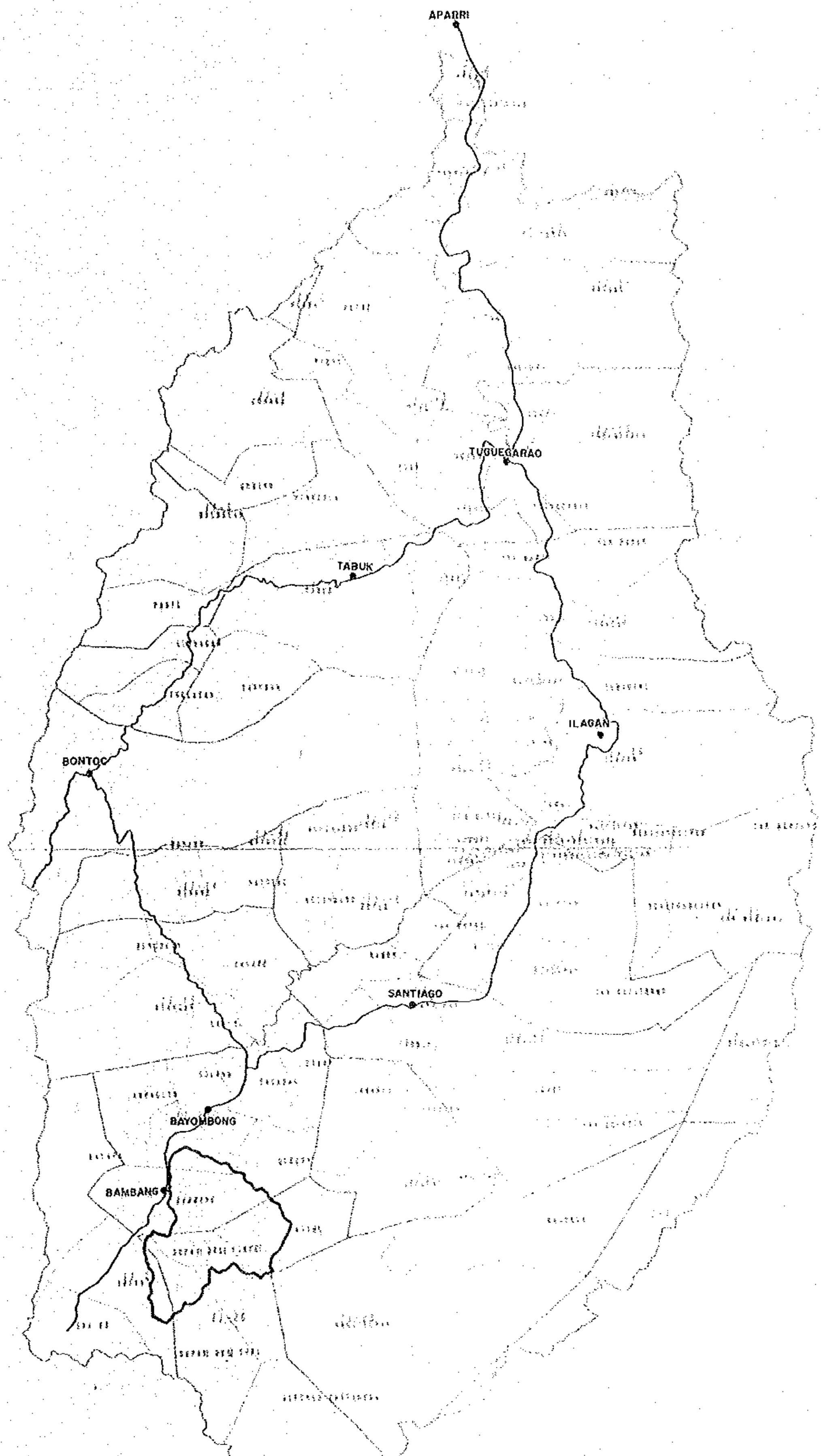


Fig. 3-23. Administrative Boundary

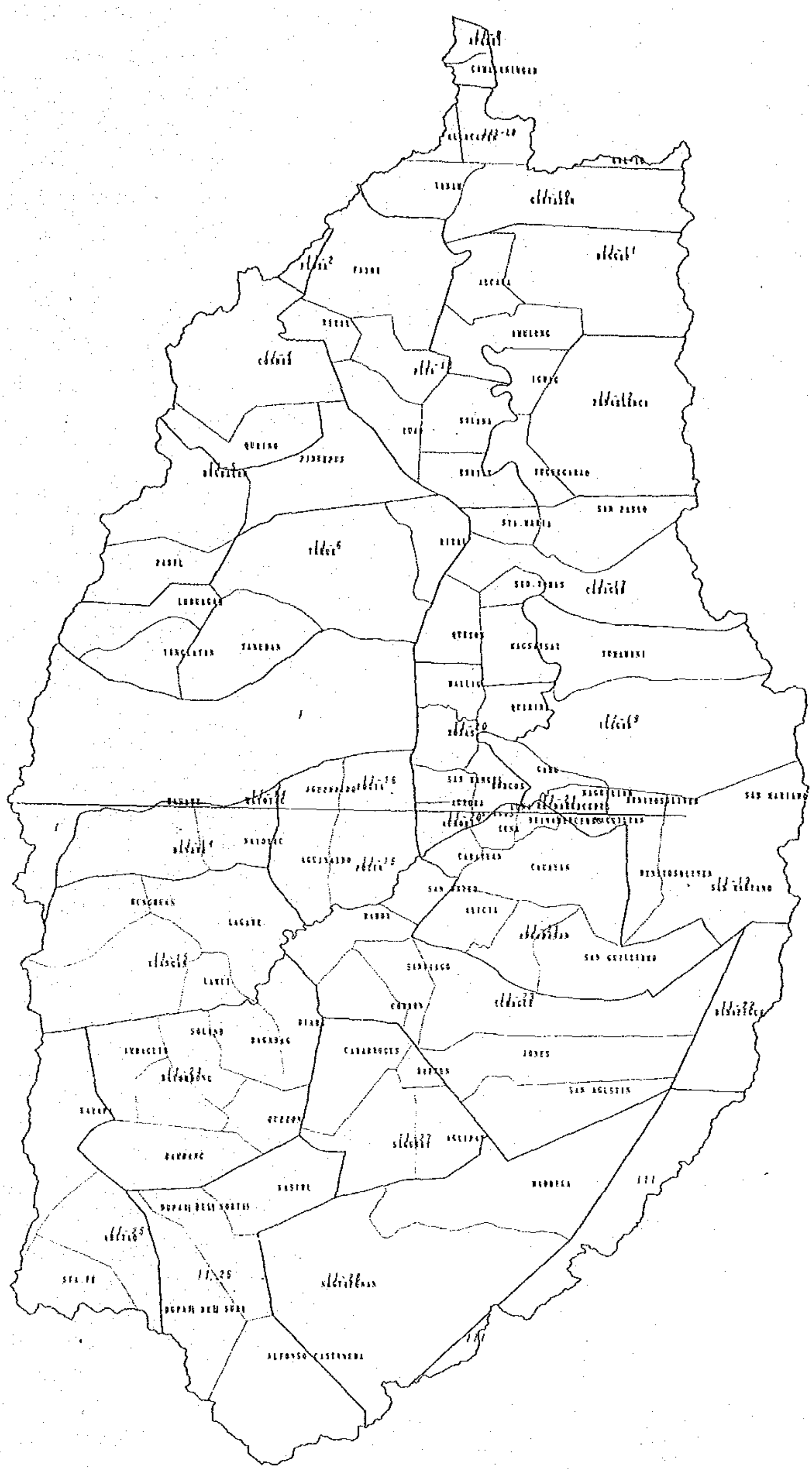


Fig. 3-23. Administrative Boundary

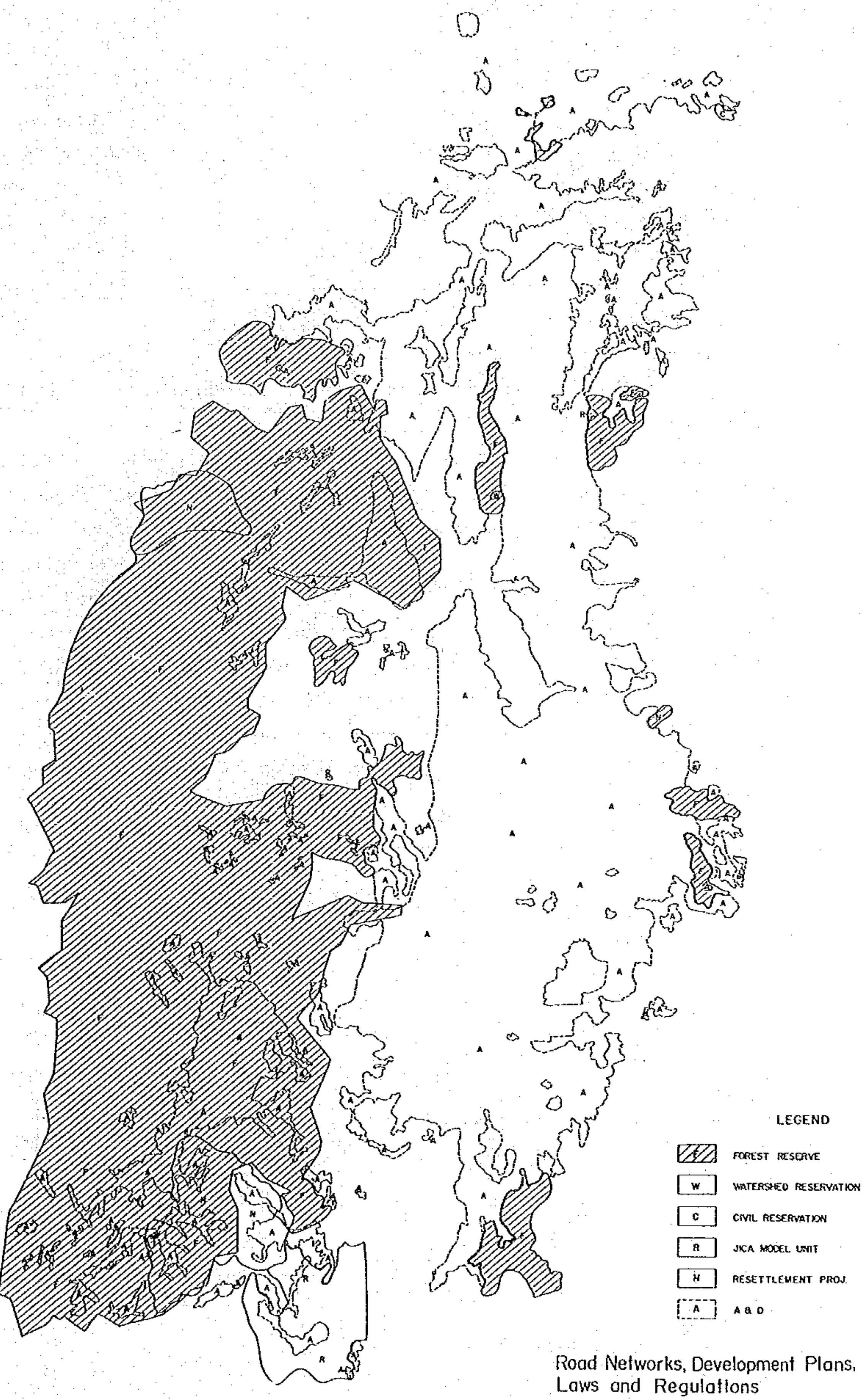


Fig. 3-24. Road Networks, Development Plans, Laws and Regulations

3–2–3 Forest Land Classification Analysis

(1) Data Analysis Flow of Forest Land Classification

Natural environmental elements of the study area are shown in basic combinations in the Land System Classification Table. The following analyses were made to work out the land classification which serves as the basis for the forest management plan formulation.

1. Soil Prevention Potential Analysis
2. Land Collapse & Slide Potential Analysis
3. Water Holding Potential Analysis
4. Flooding Potential Analysis
5. Tree Growth Potential Analysis

Contents and methodology of these analyses are as shown in the flow diagram in Figure 3-25.

To analyse soil erosion and land collapses & slides, it requires the study of not only the characteristics of individual natural environmental factors but also their correlations. The latter correlational analysis was made by cross tabulation of the natural environmental factors in specific combinations of two. For example, Table 3-22 shows the correlation of levels of slopes and incidence of land collapses. From the table, it can be seen that land collapses are most likely to happen in slopes ranging 30%–40%. These results are applied in the analysis of land collapse & slides for identification of relevant factors and evaluation of potential. Similarly, correlations were studied between elevations and slopes, slopes and soils, land collapses and geology, etc. The results of these studies are attached in the annex.

Table 3-22 Slopes and Land Collapses

Slope		Land collapse <number>
percent	degree	
0 ~ 3	0 ~ 2	53 (4 %)
4 ~ 8	2 ~ 6	62 (5 %)
9 ~ 18	6 ~ 10	147 (11 %)
19 ~ 25	10 ~ 14	118 (9 %)
26 ~ 35	14 ~ 19	261 (20 %)
36 ~ 46	19 ~ 24	272 (21 %)
46 ~ 55	24 ~ 29	207 (16 %)
56 ~ 65	29 ~ 33	114 (9 %)
66 ~ 75	33 ~ 37	33 (3 %)
76 ~ 85	37 ~ 40	7 (1 %)
86 ~	40 ~	6 (1 %)
Total		1,208 (100 %)

Forest Land Classification Analysis

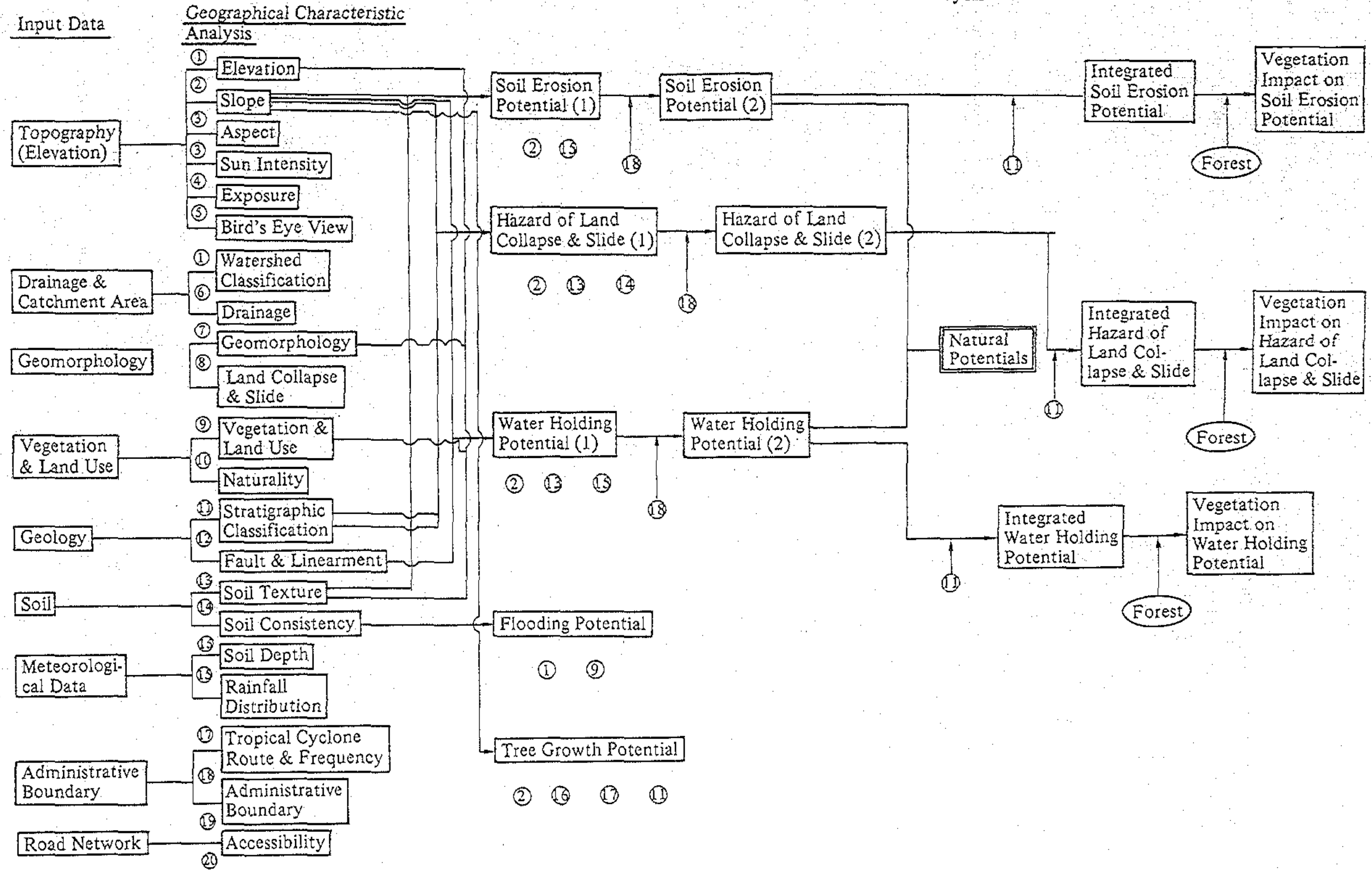


Fig. 3-25 Data Analysis Flow of Forest Land Classification

(2) Analysis of Prevention of Soil Erosion Potential

The soil erosion potential analysis was conducted to define areas that are prone to soil erosion due to rainfall and also to determine the extent of effects vegetation has on soil erosion. The analysis was made of the following items. Weightings applied in each evaluation are shown in a table attached in the Annex.

1. Soil Erosion Potential (1) (Figure 3-26)

This Soil Erosion Potential (1) evaluates the soil erosion potential by correlating slopes and soil textures. Generally, as the terrain becomes steeper, soils tend to become more prone to erosion. In terms of soil textures, sandy soils that contain sands and gravels are sensitive to erosion whereas fine-grained clayish soils are resistant to erosion. Since surface vegetation coverage was not taken into account in this analysis, the mountainous areas of about 400 meters and upwards in elevation rated high in erosion in the analysis results.

2. Soil Erosion Potential (2) (Figure 3-27)

In the Erosion Potential (2), rainfall was introduced as an additional factor conductive to erosion for evaluation erosion potential. Comparison of the two sets of evaluations, i.e., Erosion Potential (1) and (2), shows that the mountainous areas are high in erosion potential in both analyses.

On the other hand, the lowlands along the Cagayan River area are low in that potential due to relatively small amounts of rainfall. Areas of low soil erosion potential ratings are more extensive in the Soil Erosion Potential (2), where the rainfall factor was considered additionally, than in the soil Erosion Potential (1).

3. Integrated Soil Erosion Potential (Figure 3-28)

The Integrated Soil Erosion Potential Analysis is designed to define the effects of existing vegetation and land use (particularly forests) on prevention of soil erosion by introducing the existing vegetation and land use as an additional varible in the Soil Erosion Potential (2).

Generally, forests have the highest potential to prevent soil erosion, followed by grassland, agriculture land and bareland, in that order. For the present analysis, evaluation of vegetation and land use was made on the basis of Bareland, Agriculture area / Kaingin, Grassland / Logging-in-progress or logged-over area, and forests, in the ascending order of preventive potential ratings, according to the field survey findings. (See the Annex for details.)

The analysis results show that most of the mountainous areas in the Siera Madre Range to the east are rated Moderate to indicate the role of existing forests to prevent soil erosion.

Whereas in the Cordillera Central to the west which is characterized by steep topography and heavy rainfalls, there are areas rated high in soil erosion potential despite the presence of forests.

In the southern hills, which are highly developed and lacking in forests, soil erosion is highly likely according to the evaluations.

4. Vegetation Impact on Soil Erosion Potential (Figure 3-29)

While the Integrated Soil Erosion Potential analysis evaluates the soil erosion potential under the existing conditions including vegetation and land use in addition to topography, slopes, soils, and rainfall, the Vegetation Impact on Soil Erosion Potential is designed to determine the preventive impact of forests on soil erosion by comparing the Soil Erosion Potential (2) and the Integrated Soil Erosion Potential and assessing their differences. The legend for this analysis is as follows.

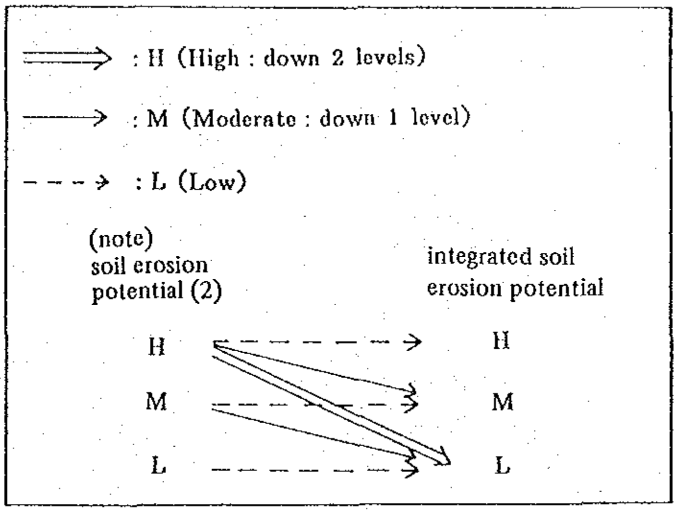


Figure 3-29 was prepared according to the above legend. The figure shows areas rated high in a preventive impact of soil erosion of vegetation are more extensively distributed in the Siera Madre Range on the east than in the Cordillera Range on the west, meaning the forests on the east side have a greater impact on prevention of soil erosion than those on the west.

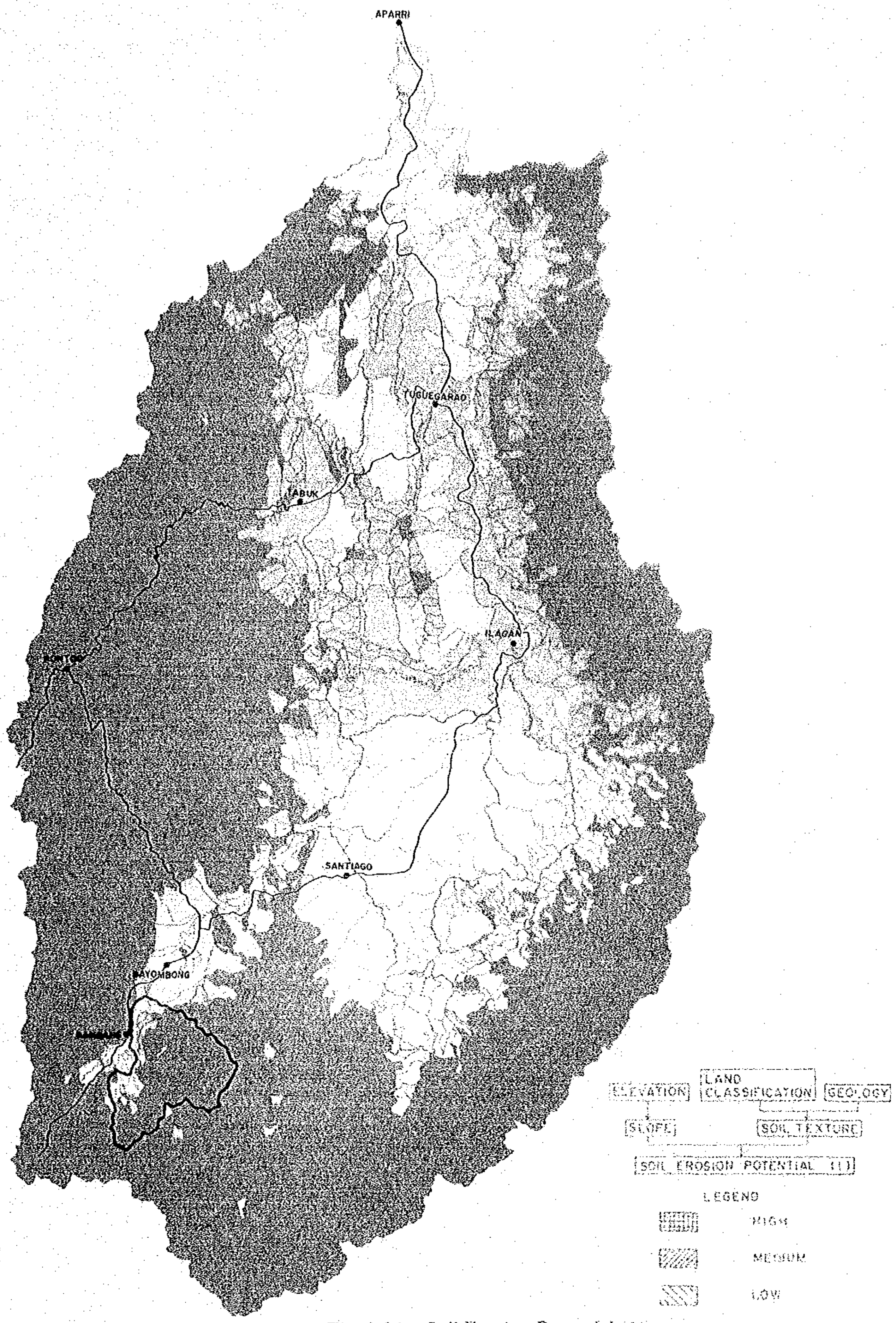


Fig. 3-26. Soil Erosion Potential (1)

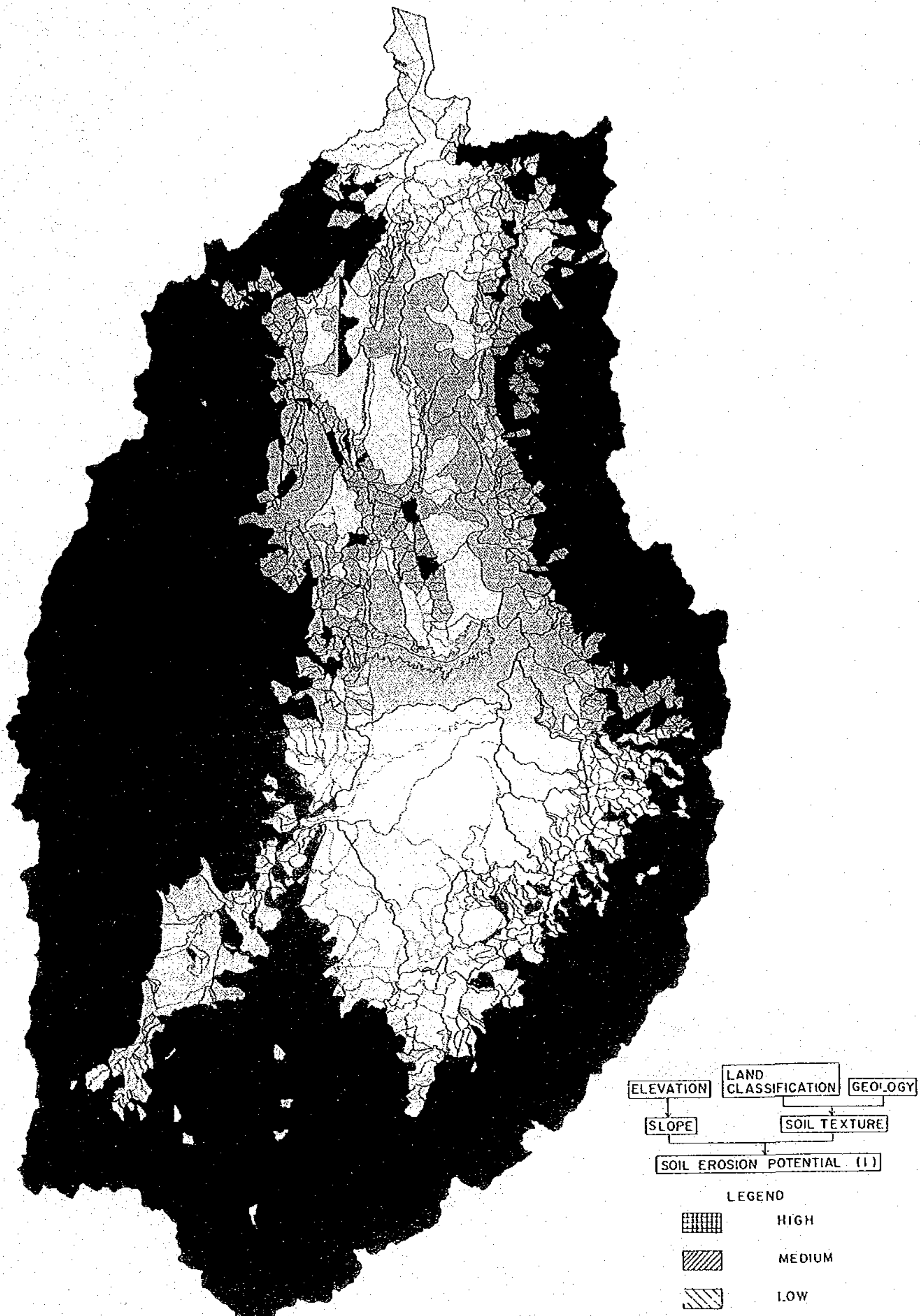


Fig. 3-26. Soil Erosion Potential (1)

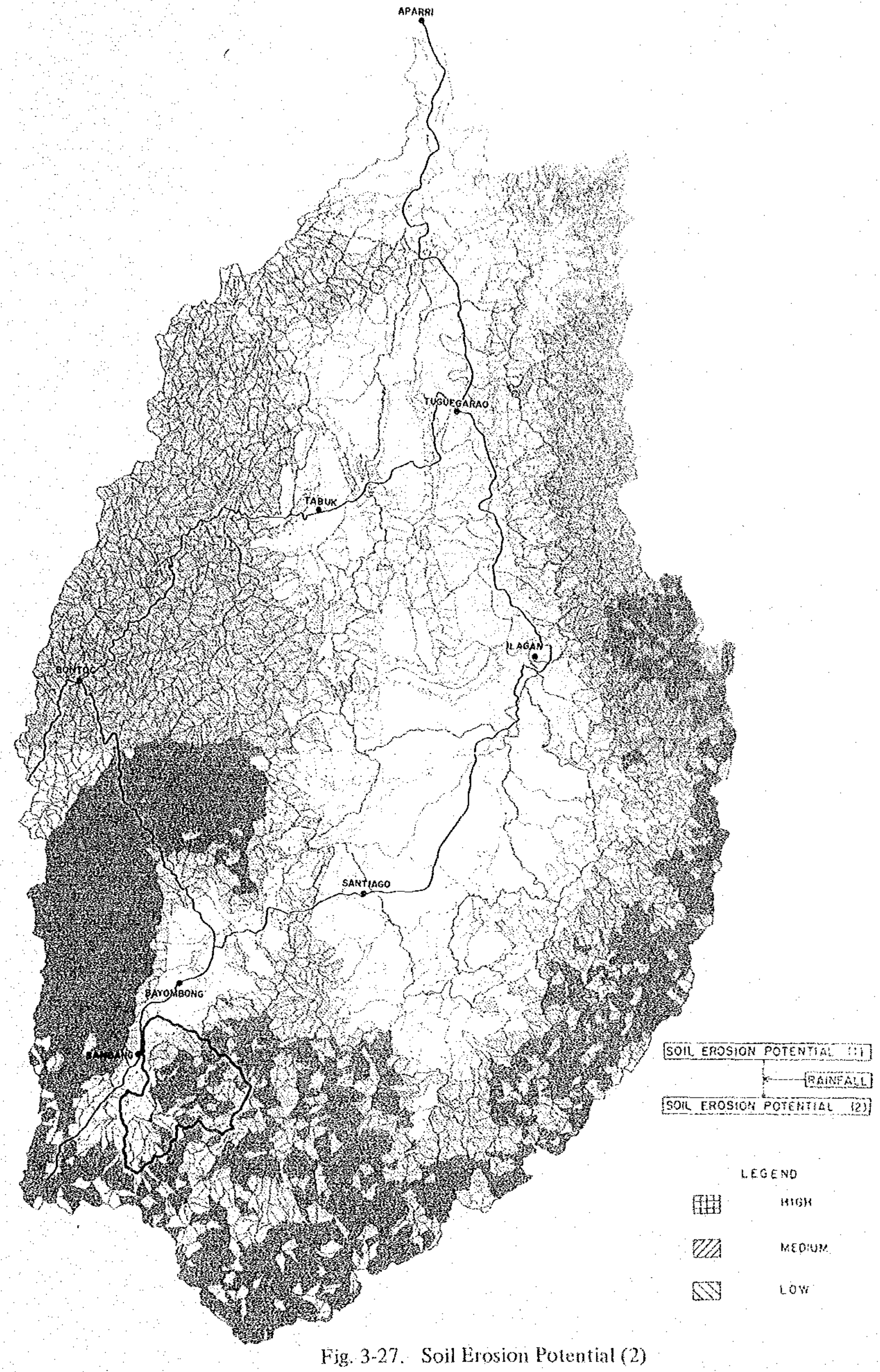


Fig. 3-27. Soil Erosion Potential (2)

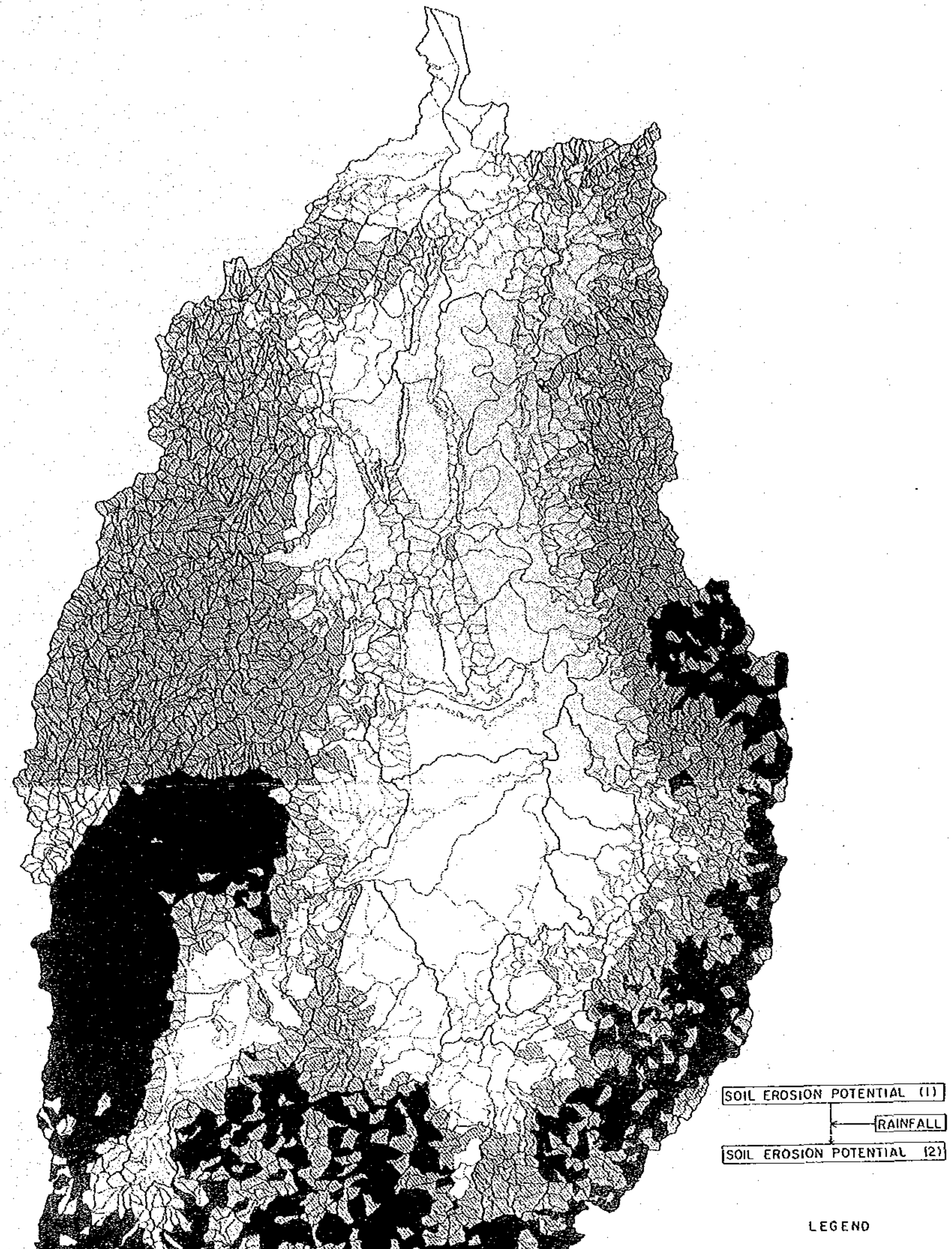


Fig. 3-27. Soil Erosion Potential (2)

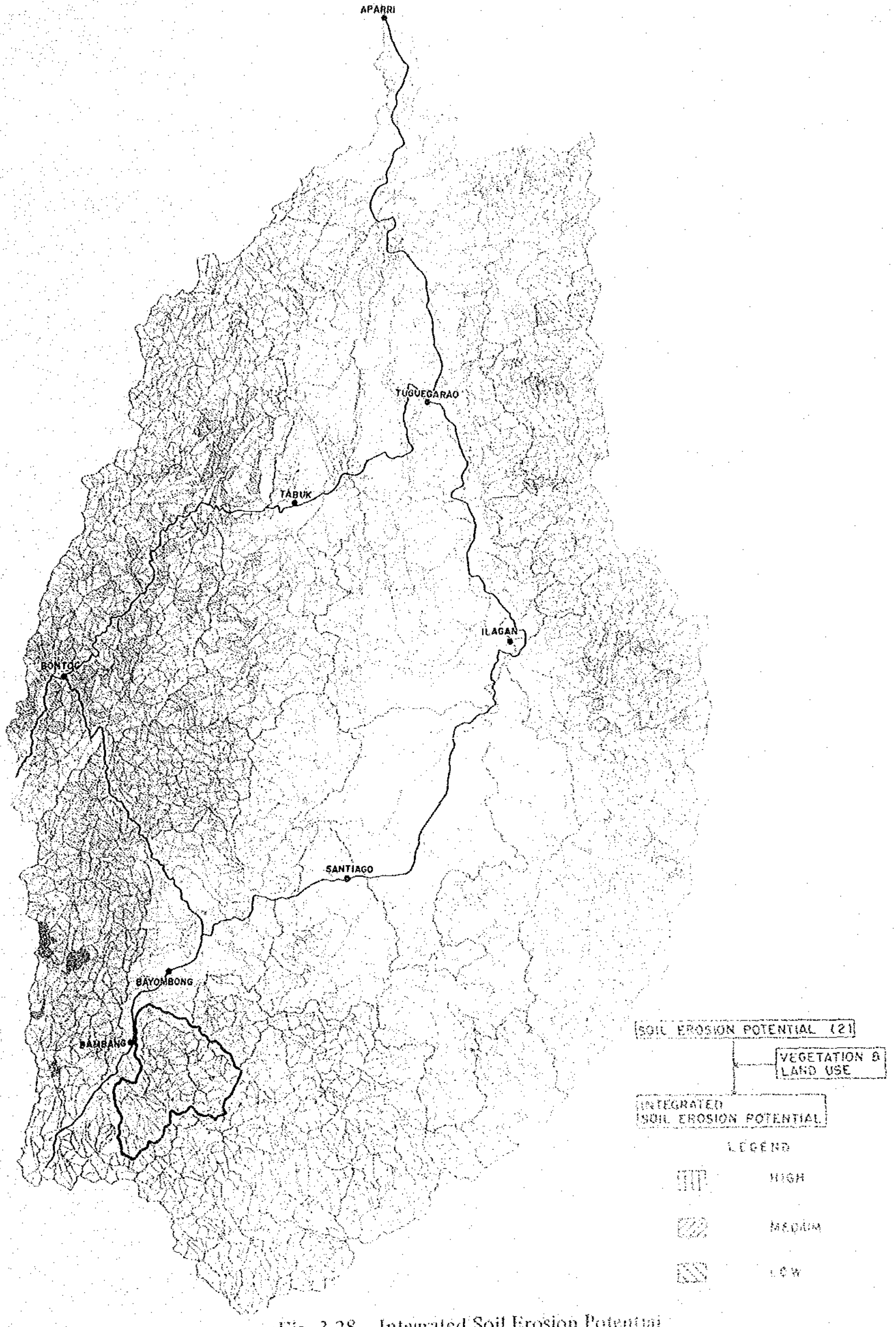


Fig. 3-28. Integrated Soil Erosion Potential

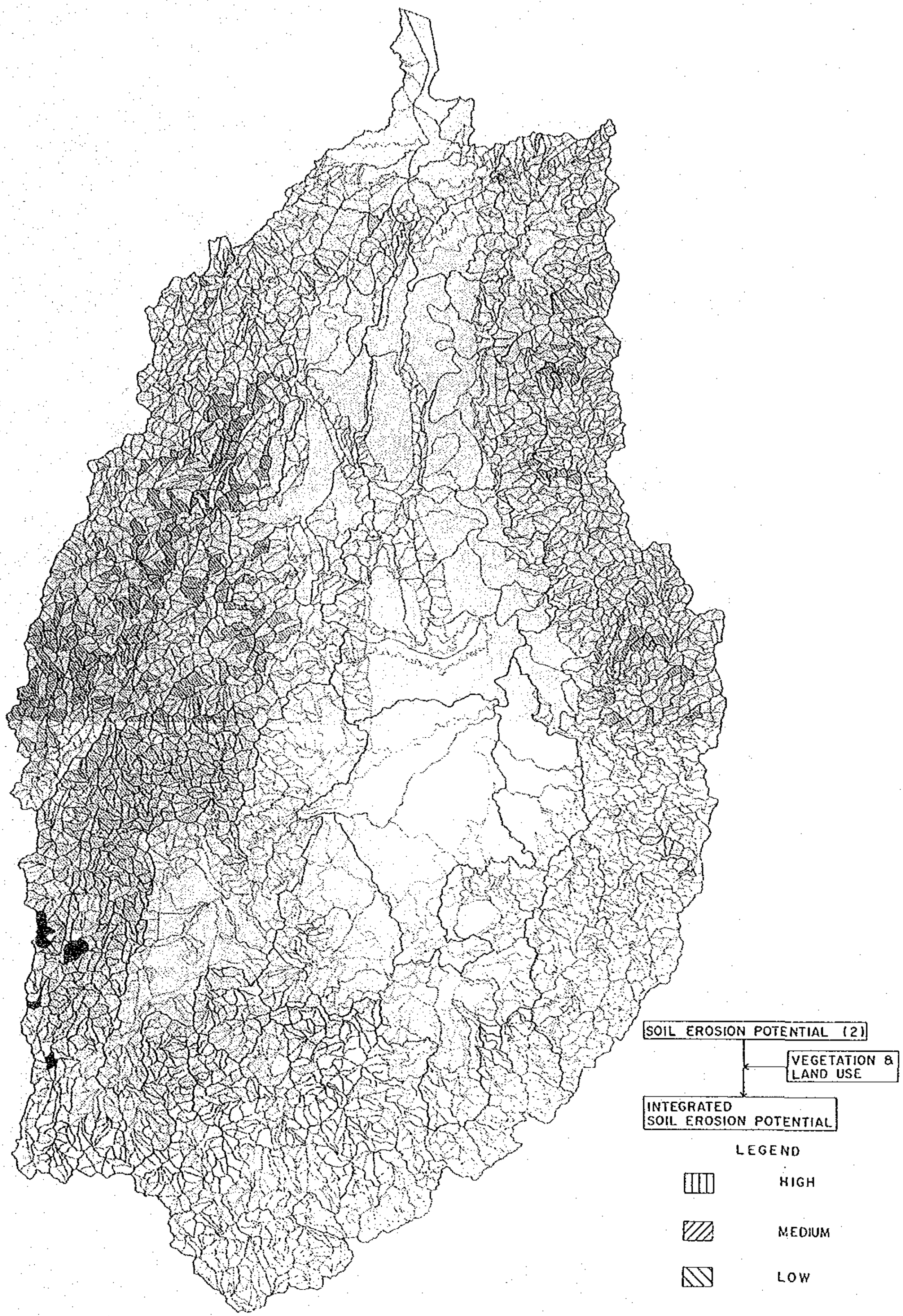


Fig. 3-28. Integrated Soil Erosion Potential