

THE JAPANESE BEHAVIORAL SCIENCE PROJECT 1974-1975

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE SOCIALIST REPUBLIC OF VIET NAM  
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

THE MASTER PLAN STUDY  
ON  
DONG NAI RIVER AND SURROUNDING BASINS  
WATER RESOURCES DEVELOPMENT

FINAL REPORT

VOLUME XI

DATA BOOK

AUGUST 1996

NIPPON KOEI CO., LTD., TOKYO JAPAN

This Report consists of

Volume I	Executive Summary	
Volume II	Main Report	
Volume III	Appendix I	Socio-economy and Institution
Volume IV	Appendix II	Topography and Geology
	Appendix III	Meteorology and Hydrology
Volume V	Appendix IV	Natural Environment
Volume VI	Appendix V	Hydropower Generation
Volume VII	Appendix VI	Agricultural Development and Irrigation
Volume VIII	Appendix VII	Domestic and Industrial Water Supply
Volume IX	Appendix VIII	Flood Mitigation and Urban Drainage
	Appendix IX	Salinity Intrusion
Volume X	Appendix X	Formulation of Master Plan
Volume XI	Data Book	



The cost estimate was based on the December 1995 price level and expressed in US\$ according to the exchange rate of US\$ 1.00 = Vietnamese Dong 11,014 = Japanese Yen 101.53 as of December 15, 1995.

## LIST OF ABBREVIATIONS

AFS	Agriculture and Forestry Service (PC)
CEMMA	Committee for Ethnic Minorities and Mountainous Areas
DCWSSS	Design Company for Water Supply and Sanitation System (HCMC-PC)
EA	Environment Assessment (Multi-lateral Lending Agencies)
ECSP	Evaluation Commission for State Projects
EIA	Environmental Impact Assessment
ENCO	Ho Chi Minh City Environmental Committee
EVN	<i>General Company of Electricity of Viet Nam (Abolished and renamed in November 1995 as Vietnamese Power Corporation)</i>
FIPI	Forest Inventory and Planning Institute (MOARD)
GCOP	Governmental Committee on Organization and Personnel
GDLA	General Department of Land Administration
GDMH	General Department of Meteorology & Hydrology
GOV	Government of Viet Nam
GSO	General Statistical Office
HCMC	Ho Chi Minh City
HEC	Ho Chi Minh Environment Committee (HCMC)
HIDC	Hydraulic Investigation and Design Company (MOARD)
HPC	Ho Chi Minh People's Committee (HCMC)
HSDC (or SDC)	Ho Chi Minh Sewerage and Drainage Company (HCMC)
HWSC (or WSC)	Ho Chi Minh Water Supply Company (HCMC)
IDD	Irrigation and Drainage Department (MOARD)
IEE	Initial Environmental Examination
IER	Institute for Economic Research (HCMC-PC)
IHPH	Institute of Hygiene and Public Health (MOPH)
IM	Institute of Mines (MOID)
INVEsCo	Investment Company for the Development of Water Sector (HCMC-PC/TUPWS)
IOE	Institute of Energy (MOID)
IURP	Institute of Urban and Rural Planning (HCMC-PC/Construction Service)
IWRE	Institute of Water Resources Economics (MOARD)
IWRP	Institute of Water Resources Planning (MOARD)
IWRR	Institute of Water Resources Research (MOARD)
JICA	Japan International Cooperation Agency (Japan)

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IWRE	Institute of Water Resources Economics (MOARD)
IWRP	Institute of Water Resources Planning (MOARD)
IWRR	Institute of Water Resources Research (MOARD)
JICA	Japan International Cooperation Agency (Japan)

<b>MOAFI</b>	<i>Ministry of Agriculture and Food Industry (Abolished and integrated into the new MOARD)</i>
<b>MOAP</b>	Ministry of Aquatic Products
<b>MOARD (New)</b>	Ministry of Agriculture and Rural Development (Created in October 1995 by the merger of the former Ministry of Water Resources, Ministry of Agriculture and Food Industry and Ministry of Forestry )
<b>MOC</b>	Ministry of Construction
<b>MOCI</b>	Ministry of Culture and Information
<b>MOD</b>	Ministry of Defence
<b>MOE</b>	<i>Ministry of Energy (Abolished and integrated into the new MOID)</i>
<b>MOET</b>	Ministry of Education and Training
<b>MOFI</b>	Ministry of Finance
<b>MOFO</b>	<i>Ministry of Forestry (Abolished and integrated into the new MOARD)</i>
<b>MOFA</b>	Ministry of Foreign Affairs
<b>MOHI</b>	<i>Ministry of Heavy Industry (Abolished and integrated into the new MOID)</i>
<b>MOID(New)</b>	Ministry of Industry (Created in November 1995 by the merger of the former Ministries of Heavy Industry, Light Industry and Energy)
<b>MOJ</b>	Ministry of Justice
<b>MOIT</b>	Ministry of Interior
<b>MOLI</b>	<i>Ministry of Light Industry (Abolished and integrated into the new MOID)</i>
<b>MOLWISA</b>	Ministry of Labour, War Invalids and Social Affairs
<b>MOPH</b>	Ministry of Public Health
<b>MOPI (New)</b>	Ministry of Planning and Investment (Formed from a merger of the former SPC and SCCI)
<b>MOSTE</b>	Ministry of Science, Technology and Environment
<b>MOTC</b>	Ministry of Transport and Communications
<b>MOT</b>	Ministry of Trade
<b>MOWR</b>	<i>Ministry of Water Resources (Abolished and integrated into the new MOARD)</i>
<b>MPAC</b>	Ministrial Project Appraisal Committee
<b>NEA</b>	National Environment Agency
<b>NGO</b>	Non-Governmental Organization
<b>NIAPP</b>	National Institute for Agricultural Planning and Projection
<b>NPAC</b>	National Project Appraisal Committee
<b>OECC</b>	Overseas Environmental Cooperation Centre
<b>OECF</b>	Overseas Economic Cooperation Fund (Japan)
<b>PC</b>	People's Committee (executive arm of the People's Council)



PCC	Power Construction Company (VPC)
PIDC	Power Investigation and Design Company (VPC)
PPC	Provincial People's Committee (City People's Committee = CPC)
SBV	State Bank of Viet Nam
SCCI	<i>State Committee for Cooperation and Investment (Abolished and integrated into the new MOPI)</i>
SFEZ (or SFEA)	Southern Focal Economic Zone (or Southern Focal Economic Area)
SIWRP	Sub-Institute of Water Resources Planning (MOARD-IWRP)
SIWRR	Southern Institute of Water Resources Research (MOARD)
SPC	<i>State Planning Committee (Abolished and integrated into the new MOPI)</i>
SRV	Socialist Republic of Viet Nam
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Education Fund
UNIDO	United Nations Industrial Development Agency
VPC (New)	Vietnam Power Corporation (the former General Company of Electricity of Viet Nam = EVN)
WASECO	Water and Sewerage Construction Company (MOC)
WB	World Bank
WHO	World Health Organization
WPMI (IWRPM)	Water Planning and Management Institute (MOARD)
WRD(or WRS)	Water Resources Department or Water Resource Service (PC)
WSC	Water Supply Company (under Construction Services of the PC)

Note: Abbreviations in *Italics* are no more existent (already abolished and integrated in November 1995).

## Measurements

### Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer
ft	=	foot
yd	=	yard

### Area

cm <sup>2</sup>	=	square centimeter
m <sup>2</sup>	=	square meter
ha	=	hectare
km <sup>2</sup>	=	square kilometer

### Volume

cm <sup>3</sup>	=	cubic centimeter
l	=	litre
kl	=	kilolitre
m <sup>3</sup>	=	cubic meter

### Weight

g	=	gram
kg	=	kilogram
ton	=	metric ton

### Time

s	=	second
min	=	minute
h	=	hour
d	=	day
y	=	year

### Electric Measurements

V	=	Volt
A	=	Ampere
Hz	=	Hertz (cycle)
W	=	Watt
kW	=	kilowatt
MW	=	Megawatt
GW	=	Gigawatt

### Other Measures

%	=	percent
PS	=	horsepower
°	=	degree
10 <sup>3</sup>	=	thousand
10 <sup>6</sup>	=	million
10 <sup>9</sup>	=	billion

### Derived Measures

m <sup>3</sup> /s	=	cubic meter per second
kWh	=	Kilowatt hour
MWh	=	Megawatt hour
GWh	=	Gigawatt hour
kVA	=	kilovolt ampere

### Currencies

US\$	=	US Dollar
VND	=	Vietnamese Dong

**VOLUME XI**

**DATA BOOK**

## **Data Book**

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1. LAND USE ANALYSIS BY LANDSAT IMAGE
2. HYDROLOGICAL RECORDS
3. TOPOGRAPHIC SURVEY

# **I. LAND USE ANALYSIS BY LANDSAT IMAGE**



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## 1. INTRODUCTION

A study was made to evaluate agricultural development potential for the seven areas selected in the Study Area by using the Landsat images shot in the year 1992 and 1993. Those seven areas are the Lower La Nga plain, Phan Thiet plain, Phan Ri plain, Phan Rang plain-1 and 2, Song Ray and Dinh area, and Lower Saigon plain as shown in Figure 1.1.

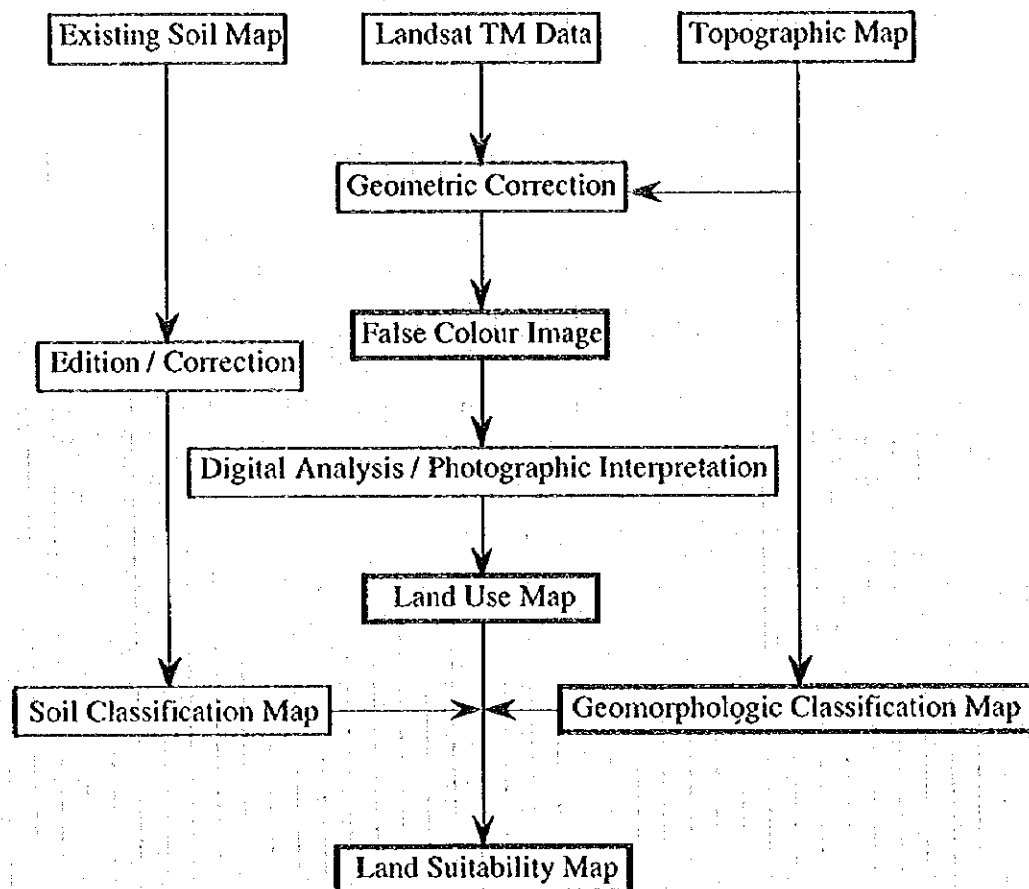
Landsat image analysis in this study extends the classification of land use in the reservoir area to be created by proposed five hydropower projects; Dai Ninh, Dong Nai No. 3, Dong Nai No. 4, Dong Nai No. 8 and Can Dong. The analytical results are used for assessing impacts that the projects induce to the natural and social environments. Furthermore, the flood prone-area extending in the Middle Dong Nai plain was also delineated by Landsat image analysis.

Figure 1.2 shows the false colour images of Landsat shot for the Study Area, which are the base of Landsat image analysis.

## 2. ANALYSIS FOR AGRICULTURAL DEVELOPMENT POTENTIAL

### 2.1 Work Flow

The work flow to analyze the agricultural development potential for the selected seven areas in the Study Area is depicted below:



False colour images for each of the seven areas were compiled from Landsat TM date with geometric correction by topographic maps. Land use maps were furthermore prepared by giving photographic interpretation. On the other hand, geomorphologic classification maps and soil classification maps were respectively prepared from topographic maps and existing soils maps with edition. Land suitability maps were finally drawn by interpreting those three prepared maps; Land use map, geomorphologic classification map and soil classification map.

## 2.2 Study Area

The selected seven areas in the Study Area (refer to Figure 1.1) to evaluate agricultural development potential are summarized by giving the serial number of one to seven as follows:

Area	Name of area	Acreage (ha)
No. 1	Lower La Nga Plain	175,684
No. 2	Phan Thiet Plain	182,859
No. 3	Phan Ri Plain	52,080
No. 4	Phan Rang Plain - 2	124,395
No. 5	Phan Rang Plain - 1	49,216
No. 6	Song Ray & Dinh Area	251,474
No. 7	Lower Saigon Plain	329,531

## 2.3 False Colour Image

The false colour image was compiled from Landsat TM data for the selected seven areas (refer to Attachment-1). The details of Landsat TM data used for the analysis of each area are given as shown below:

Area	Path - Row	Observation date (dry season)	Observation date (rainy season)
No. 1	124 - 52	1993. 3. 9	1993. 5. 12
No. 2	124 - 53	1993. 2. 5	1993. 7. 15
No. 3	123 - 52	1992. 2. 14	1992. 7. 5
No. 4	123 - 52	1993. 2. 14	1992. 7. 5
No. 5	123 - 52	1993. 2. 14	1993. 7. 5
No. 6	124 - 53	1993. 2. 5	1993. 7. 15
No. 7	125 - 53	1993. 2. 12	1993. 7. 17

Geometric correction was made to false colour image so that it may coincide with the topographic map with a scale of 1/250,000.

## 2.4 Land Use Classification

A land use classification map with a scale of 1/100,000 was prepared by the digital analysis of Landsat TM data in combination with the photographic interpretation (refer to Attachment - 1). The land use classification for the seven areas is summarized in

Table 2.1. For the classification categories of land use, the standard applied in Viet Nam was used.

## 2.5 Soil Classification

A soil classification map with a scale of 1/100,000 was prepared by editing the existing the soil map of 1/250,000 and by conforming with the geomorphologic classification map mentioned below (refer to Attachment - 1). The summary of soil classification for the seven areas is given in Table 2.2. The legends used in the existing 1/250,000 soil map are referred to the classification categories of the newly prepared soil classification map.

## 2.6 Geomorphologic Classification

A geomorphologic classification map with a scale of 1/100,000 was prepared by using the topographic map of 1/100,000 and false colour images (refer to Attachment - 1). Table 2.3 summarizes the geomorphologic classification for the seven areas. Geometric correction was given to the false colour image to keep the conformity with the geomorphologic classification map.

## 2.7 Land Suitability

The land is classified into three of "suitable", "moderately suitable" and "non arable" for each of geomorphologic classification categories in terms to agricultural development as given below:

Geomorphologic Classification		Paddy Field	Upland Crop
Alluvial Plain	Sand and gravel bars	C	C
	Low terrace	B	B
	High terrace	A	A
Alluvial Fans or Aprons	Very gentle slopes	A	A
	Gentle slopes	A	A
	Undulating terrain	B	B
	Highly dissected place	C	B
Depositional Basin	Depression	A	A
	High position	B	A
	Gently rolling terrain	C	B
	Highly dissected place	C	C
Mountain or Hill	Moderate to steep slopes	C	B
	Steep to very steep slopes	C	C

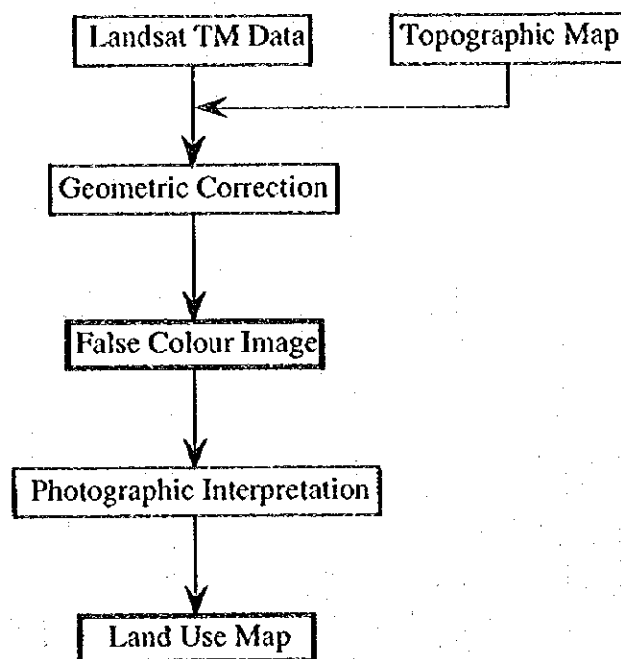
A : Suitable    B : Moderately suitable    C : Non arable

Based on the land suitability category given above, two kinds of land suitability map were prepared with a scale of to 100,000; one is for paddy field and the other is for upland crops (refer to Attachment - 1). Table 2.4 summarizes the land suitability result of seven areas for paddy and upland crops, whilst Table 2.5 shows the present land use for the areas where the land evaluation to judge the suitability of paddy and upland crop cropping was carried out.

### 3. LAND USE IN THE PROPOSED RESERVOIR

#### 3.1 Work Flow

A work flow to prepare a land use map in the reservoir area to be created by the proposed five hydropower projects is given as shown below:



False colour images for each of five areas were compiled from Landsat TM data with geometric correction by topographic map as dealt with in the preceding Section 2.1. Land use maps were furthermore prepared by giving photographic interpretation.

#### 3.2 Study Area

The five reservoir areas to prepare the land use map are summarized by giving the serial number of eight to twelve (refer to Figure 1.1) as follows:

Area	Name of Area	Acreage (ha)
No. 8	Dai Ninh	2,675
No. 9	Dong Nai No. 3	4,438
No. 10	Dong Nai No. 4	1,722
No. 11	Dong Nai No. 8	19,191
No. 12	Can Dong	3,667

### 3.3 False Colour Image

The false colour image was compiled from Landsat TM data for the selected five areas (refer to Attachment - 2). The details of Landsat TM data used for the analysis of each area are given as shown below:

Area	Path - Row	Observation date (dry season)	Observation date (rainy season)
No. 8	124 - 52	1993. 3. 9	1993. 5. 12
No. 9	124 - 52	1993. 3. 9	1993. 5. 12
No. 10	124 - 52	1993. 3. 9	1993. 5. 12
No. 11	125 - 52	1993. 2. 12	1991. 7. 17
No. 12	125 - 52	1993. 2. 12	1991. 7. 17

Geometric correction was made to false colour image so that it may coincide with the topographic map with a scale of 1/250,000.

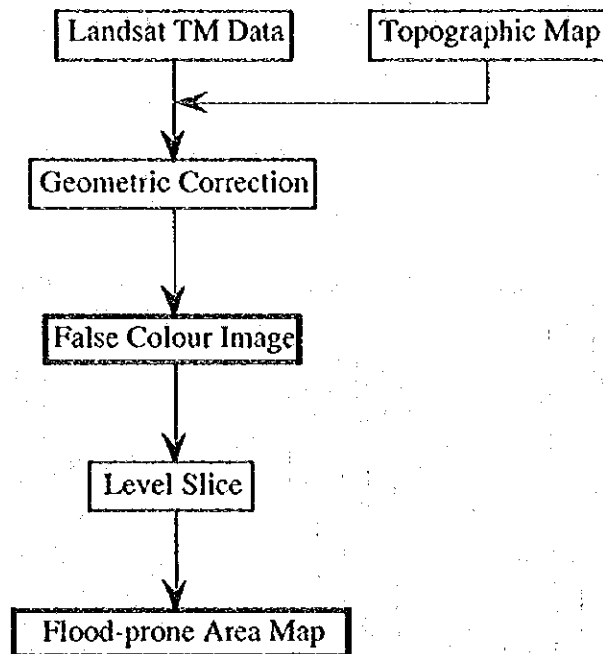
### 3.4 Land Classification

Land use classification maps in the reservoir areas to be created by the proposed five hydropower projects were compiled with a scale of 1/100,000 by the photographic interpretation of false colour image as summarized in Table 3.1.

#### 4. FLOOD-PRONE AREA

##### 4.1 Work Flow

A flood-prone area was delineated by using the near-infrared data (band 4), which is especially sensitive by showing the low value at the place where water content is high among Landsat TM data, by level slice as follows:



##### 4.2 Study Area and Flood-prone Area Map

A vulnerable area to floods lying in the middle Dong Nai plain was selected to prepare the flood-prone area map by giving the serial number of 13 as follows:

Area	Name of Area	Acreage (ha)
No. 13	Middle Dong Nai Plain	212,344

The flood-prone area map so prepared in Area No. 13 by level slice is depicted in Attachment - 3. The Landsat TM data used for analysis have a path-row of 124-52 observed on May 13th, 1993 in the rainy season.





Table 2.2 Soil Classification of Area No.1 to No.7

No.	CATEGORY	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7	
		Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
1	Sandy Soils	3,026	1.7	9,690	5.3	15,461	31.6	3,643	2.9	0	0.0	1,168	0.5	2,949	0.9
2		0	0.0	956	0.5	0	0.0	1,322	1.1	0	0.0	11,534	4.6	0	0.0
3		0	0.0	13,181	7.2	1,988	3.8	4,036	3.2	0	0.0	0	0.0	0	0.0
4	Saline Soils	0	0.0	406	0.2	0	0.0	0	0.0	0	0.0	8,009	3.2	4,655	1.4
5		0	0.0	0	0.0	0	0.0	1,314	1.1	0	0.0	0	0.0	345	0.1
6		0	0.0	0	0.0	0	0.0	7,587	5.1	0	0.0	0	0.0	155,538	47.2
7	Acid Sulphate Soils	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	34,536	10.5
8		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1,860	0.5
9		5,653	3.2	717	0.4	0	0.0	0	0.0	0	0.0	0	0.0	1,365	0.4
10	Alluvial Soils	3,090	1.8	15,872	8.7	13,174	25.3	25,974	21.7	129	0.3	0	0.0	627	0.2
11		7,025	4.0	2,958	1.6	0	0.0	0	0.0	0	0.0	0	0.0	15,639	4.7
12		16,621	8.5	0	0.0	0	0.0	2,618	2.1	0	0.0	1,906	0.8	5,985	1.8
13		2,550	1.5	936	0.5	0	0.0	0	0.0	0	0.0	4,034	1.6	851	0.3
14	Swampy and peaty Soils	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2,385	0.7
15		34,981	19.8	30,583	16.7	0	0.0	2,121	1.7	1,784	3.6	6,686	2.7	0	0.0
16		13,141	7.5	9,379	5.1	10,260	19.7	8,555	7.7	11,280	22.9	26,371	10.5	0	0.0
17	Red & brownish-grey soils	0	0.0	15,599	10.7	0	0.0	14,175	11.4	4,123	8.4	0	0.0	0	0.0
18		298	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
19		19,863	11.2	0	0.0	0	0.0	0	0.0	0	0.0	47,774	19.0	0	0.0
20	Black Tropical Soils	19,677	11.2	3,630	2.0	1,509	2.9	0	0.0	0	0.0	2,023	0.8	5,286	1.6
21		2,710	1.5	0	0.0	0	0.0	0	0.0	0	0.0	28,395	11.3	1,389	0.4
22		8,445	4.8	6,487	3.5	0	0.0	0	0.0	1,816	3.7	59,657	23.7	10,372	3.1
23	Yellow-Red Soils (Ferrallitic Soils)	20,736	11.8	34,961	19.1	4,854	9.3	20,792	16.7	10,173	20.7	859	0.3	22,410	6.8
24		0	0.0	7,258	4.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
25		12,502	7.1	932	0.5	1,884	3.6	0	0.0	6,426	13.1	12,859	5.1	0	0.0
26	Humic Y.R.S	0	0.0	0	0.0	0	0.0	1,801	1.4	0	0.0	0	0.0	0	0.0
27		0	0.0	514	0.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
28		0	0.0	400	0.2	0	0.0	0	0.0	135	0.3	15,788	6.3	9,395	2.9
29	Eroded rocky soils	734	0.4	6,277	3.4	1,407	2.7	4,019	3.2	12,861	25.1	811	0.3	41,658	12.6
30		171,052	97.4	164,737	90.1	51,537	98.9	99,967	80.4	43,737	99.0	227,875	90.7	317,224	96.3
31		4,404	2.5	17,777	9.7	371	0.7	24,117	19.4	371	0.8	23,257	9.2	11,700	3.6
32	TOTAL	228	0.1	206	0.1	88	0.2	165	0.1	56	0.1	342	0.1	457	0.1
33		0	0.0	140	0.1	82	0.2	147	0.1	52	0.1	0	0.0	141	0.0
34		175,684	100.0	182,860	100.0	52,078	100.0	124,396	100.0	49,216	100.0	251,474	100.0	329,532	100.0

Table 2.3 Geomorphologic Classification of Area No. 1 to No. 7

LAND FORM																
No.	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7			
	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%		
1	Sand and gravel bars															
2	Low terrace															
3	Higher terrace															
4	Very gentle slopes															
5	Gentle slopes															
6	Undulating															
7	Highly dissected															
8	Depression															
9	High position, non-dissected															
10	Gently rolling															
11	Highly dissected															
12	Moderate to steep slopes															
13	Steep to very steep slopes															
14	Tidal swamp															
	SUB TOTAL															
15	Water bodies															
16	Road															
17	Railroad															
	TOTAL															

Table 2.4 Land Suitability of Area No.1 to No.7 (Paddy)

Suitability Category	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7	
	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
Suitable	104,959	59	90,274	49	37,915	73	40,178	33	28,786	58	196,218	78	1,228	0
Moderately suitable	28,866	16	843	1	0	0	26,238	21	0	0	0	0	286,334	87
Non arable	38,327	22	73,620	40	13,622	26	33,551	27	19,951	41	31,657	13	29,662	9
SUB TOTAL	171,052	97	164,737	90	51,537	99	99,967	81	48,737	99	227,875	91	317,224	96
Water bodies	4,404	3	17,777	10	371	1	24,117	19	371	1	23,257	9	11,700	4
Road	228	0	206	0	88	0	165	0	56	0	342	0	457	0
Railroad	0	0	140	0	82	0	147	0	52	0	0	0	141	0
TOTAL	175,684	100	182,860	100	52,078	100	124,396	100	49,216	100	251,474	100	329,532	100

Table 2.4 Land Suitability of Area No.1 to No.7 (Upland)

Suitability Category	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7	
	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
Suitable	104,361	59	91,116	49	37,916	72	40,178	33	28,786	59	196,218	79	231,443	70
Moderately suitable	55,079	31	23,345	13	6,570	13	26,238	21	7,049	14	10,808	4	56,117	17
Non arable	11,612	7	50,276	28	7,051	14	33,551	27	12,902	26	21,049	8	29,664	9
SUB TOTAL	171,052	97	164,737	90	51,537	99	99,967	81	48,737	99	227,875	91	317,224	96
Water bodies	4,404	3	17,777	10	371	1	24,117	19	371	1	23,257	9	11,700	4
Road	228	0	206	0	88	0	165	0	56	0	342	0	457	0
Railroad	0	0	140	0	82	0	147	0	52	0	0	0	141	0
TOTAL	175,684	100	182,860	100	52,078	100	124,396	100	49,216	100	251,474	100	329,532	100

Table 2.5 Land Suitability of Area No.1 to No.7  
Taking into Account the Present Land Use (Paddy Field) (1/2)

No.	PRESENT LAND USE	No. 1(ha)				No. 2(ha)				No. 3(ha)				No. 4(ha)			
		Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL
1	Triple irrigated rice	1,484	2,067	27	3,578	5,913	0	0	5,913	0	0	0	0	1,311	13,293	75	14,649
2	Double irrigated rice	128	1,331	0	1,459	37	0	0	37	0	0	0	0	55	976	72	1,103
3	Single irri. + rainfed rice	0	0	0	0	0	0	0	0	2,765	0	144	2,913	0	0	0	0
4	Annual Crops	6,530	17,737	6	22,333	22,016	0	27	22,043	10,929	0	101	11,030	5,468	1,531	38	7,137
5	Single irri./rainfed rice + Upland crops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Upland crops	34,426	2,734	15,041	52,201	20,611	0	558	21,269	4,758	0	3,445	8,201	5,720	5,231	1,614	12,565
7	Pineapple/Sugarcane	10,441	106	552	11,199	0	0	0	0	0	0	0	0	0	0	0	0
8	Shifting land	0	0	0	0	0	0	0	0	748	0	225	974	621	135	45	801
9	Coffee	72	0	0	72	0	0	0	0	0	0	0	0	0	0	0	0
10	Rubber	585	0	0	585	0	0	0	0	0	0	0	0	0	0	0	0
11	Cashew	14,972	1,289	1,851	18,092	831	0	0	931	0	0	0	0	0	0	0	0
12	Mulberry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Custodian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Fruit trees	0	0	0	0	0	0	0	0	0	0	0	0	1,471	3,465	202	5,138
15	Mangrove forests	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Evergreen forests	30,038	1,495	17,535	49,068	984	843	50,553	52,380	2,961	0	3,006	5,967	235	22	9,909	10,165
17	Plantation forests	0	0	0	0	173	0	0	173	0	0	0	0	0	0	0	0
18	Bush/Grass	6,171	1,595	2,789	10,555	37,739	0	22,064	59,857	15,352	0	6,684	22,036	23,020	1,024	20,217	44,261
19	Salt pans	0	0	0	0	311	0	0	311	0	0	0	0	0	0	0	0
20	Bare land	12	0	390	402	545	0	180	725	0	0	0	0	383	384	1,337	2,024
21	Settlement/Orchards	1,039	32	36	1,107	1,147	0	137	1,147	399	0	17	416	1,974	107	42	2,123
	SUB TOTAL	104,359	28,366	38,327	171,052	90,274	843	73,620	164,737	37,915	0	13,622	51,537	40,178	26,238	33,551	99,967

No.	PRESENT LAND USE	No. 5(ha)				No. 6(ha)				No. 7(ha)				No. 8(ha)			
		Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL
1	Triple irrigated rice	993	0	0	998	6,587	0	19	6,606	0	8,218	874	9,092	0	0	0	0
2	Double irrigated rice	0	0	0	0	0	0	0	0	0	5,281	181	5,462	0	0	0	0
3	Single irri. + rainfed rice	159	0	0	159	5,876	0	28	5,904	0	5,331	44	5,375	0	0	0	0
4	Annual Crops	0	0	0	0	13,264	0	521	13,785	912	31,387	10,957	43,266	0	0	0	0
5	Single irri./rainfed rice + Upland crops	0	0	0	0	0	0	0	0	0	19,158	387	19,545	0	0	0	0
6	Upland crops	5,615	0	582	6,197	59,010	0	5,559	64,569	313	63,881	6,469	70,663	0	0	0	0
7	Pineapple/Sugarcane	1,297	0	0	1,297	0	0	0	0	0	5,340	510	5,850	0	0	0	0
8	Shifting land	0	0	0	0	22,212	0	1,102	23,314	0	856	307	1,173	0	0	0	0
9	Coffee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Rubber	0	0	0	0	45,690	0	1,566	48,256	0	61,548	1,587	50,135	0	0	0	0
11	Cashew	0	0	0	0	14,173	0	572	14,745	0	34,100	2,124	36,224	0	0	0	0
12	Mulberry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Custodian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Fruit trees	169	0	0	169	4,484	0	113	4,577	0	0	0	0	0	0	0	0
15	Mangrove forests	0	0	0	0	1,922	0	6,390	7,412	0	0	0	0	0	0	0	0
16	Evergreen forests	539	0	7,353	7,892	16,925	0	8,799	25,724	3	12,222	3,080	15,305	0	0	0	0
17	Plantation forests	0	0	0	0	0	0	0	0	0	769	127	896	0	0	0	0
18	Bush/Grass	19,864	0	12,051	31,879	4,709	0	3,916	8,625	0	1,760	557	2,926	0	0	0	0
19	Salt pans	0	0	0	0	141	0	685	826	0	0	0	0	0	0	0	0
20	Bare land	145	0	1	146	948	0	1,408	2,396	0	5,594	1,093	6,687	0	0	0	0
21	Settlement/Orchards	0	0	0	0	197	0	939	1,136	0	30,860	1,355	32,215	0	0	0	0
	SUB TOTAL	28,786	0	19,691	48,737	196,218	0	31,457	227,875	1,228	286,334	29,662	317,224	0	0	0	0

## Taking into Account the Present Land Use (Upland Crops) (2/2)

No.		PRESORT LAND USE	No. 1 (ha)				No. 2 (ha)				No. 3 (ha)				No. 4 (ha)			
			Suitable	Acronately suitable	Non arable	TOTAL	Suitable	Acronately suitable	Non arable	TOTAL	Suitable	Acronately suitable	Non arable	TOTAL	Suitable	Acronately suitable	Non arable	TOTAL
1	Agriculture Land	Triple irrigated rice	1,485	2,094	0	3,579	5,913	0	1	5,914	0	0	0	1,311	13,203	75	14,549	
2		Double irrigated rice	128	1,331	0	1,459	37	0	0	37	0	0	0	55	976	72	1,103	
3		Single irri. + rainfed rice	0	0	0	0	0	0	0	2,769	133	19	2,912	0	0	0	0	
4		Annual Crops	4,590	17,743	0	22,333	22,015	1	26	22,042	10,930	100	1	11,031	5,468	1,631	38	7,127
5		Single irri./rainfed rice + Upland crop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6		Upland crops	36,426	17,886	87	52,188	20,511	444	214	21,269	4,256	3,393	52	8,201	5,720	5,231	1,614	12,565
7		Pineapple/Sugarcane	10,442	757	0	11,199	0	0	0	0	0	0	0	0	0	0	0	0
8		Shifting land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9		Coffee	72	0	0	72	0	0	0	0	0	0	0	0	0	0	0	0
10		Rubber	985	0	0	985	0	0	0	0	0	0	0	0	0	0	0	0
11		Perennial 'Crops	Cashew	14,973	2,398	223	18,094	881	0	0	881	0	0	0	0	0	0	0
12			Mulberry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13			Guineon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14			Fruit trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Forestry Land	Mangrove forests	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
16		Evergreen forests	30,038	9,028	11,002	49,068	1,825	14,124	36,420	52,280	2,951	399	2,667	5,907	22	9,909	10,166	
17		Plantation forests	0	0	0	0	173	0	0	173	0	0	0	0	0	0	0	
18		Bush/Grass	6,171	4,094	290	10,555	37,795	8,688	18,376	59,559	15,322	2,484	4,200	22,026	23,020	1,024	20,217	44,261
19	Other Land	Salt pans	0	0	0	0	311	0	0	311	0	0	0	0	0	0	0	
20		Bare land	12	390	0	402	544	78	102	724	0	0	0	303	384	1,397	2,024	
21		Settlement/Orchards	1,039	58	101	1,197	1,010	0	137	1,147	399	17	0	416	1,974	107	2,123	
		SUB TOTAL	104,261	55,079	11,612	171,052	91,116	23,345	50,276	164,737	37,916	6,570	7,051	51,537	96,281	33,551	69,967	

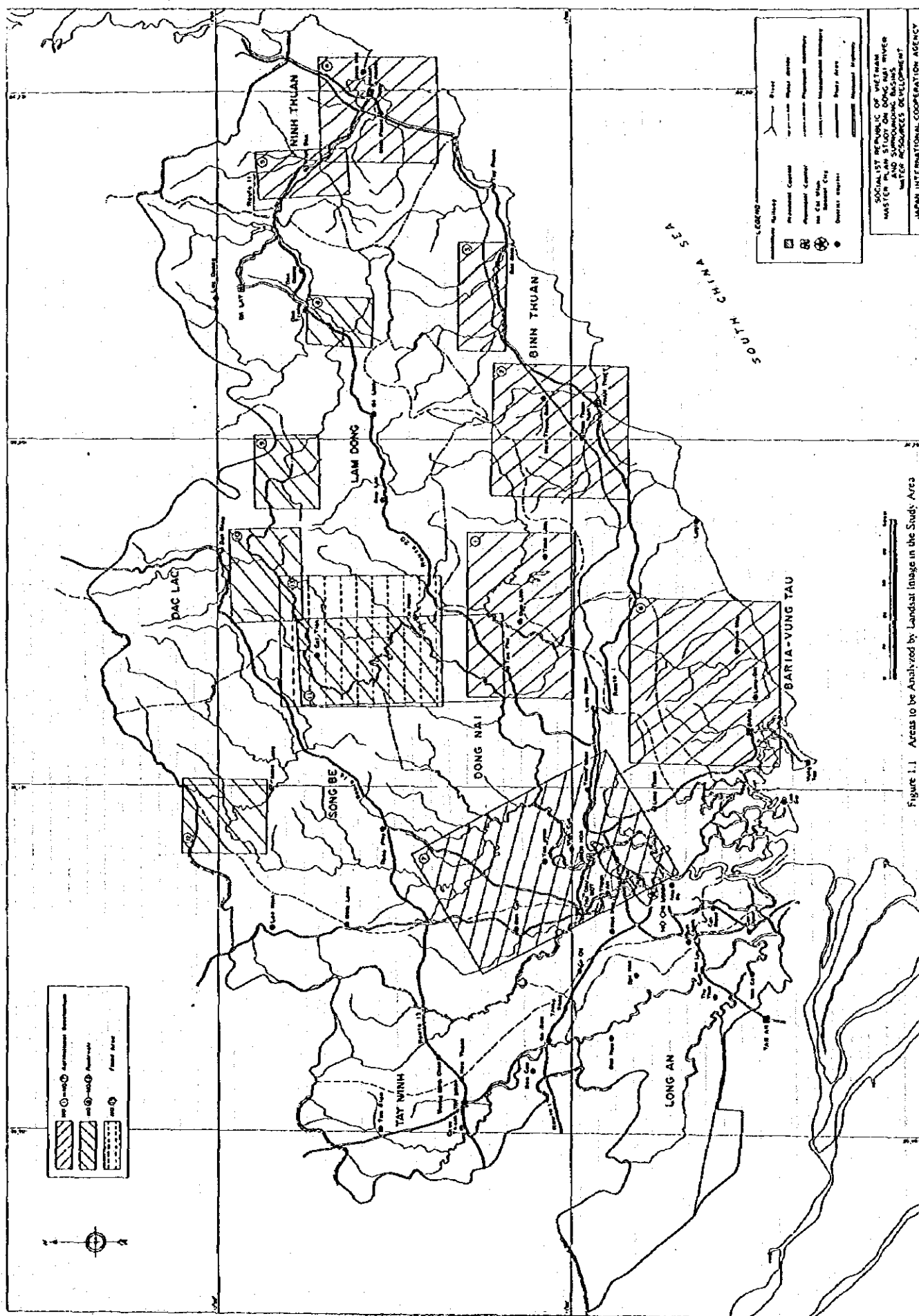
No.	PRESENT LAND USE	No. 5 (ha)			No. 6 (ha)			No. 7 (ha)					
		Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL	Suitable	Moderately suitable	Non suitable	TOTAL
1	Triple irrigated rice	998	0	0	998	6,587	8	11	6,606	1,202	7,016	876	9,094
2	Double irrigated rice	0	0	0	0	0	0	0	0	847	4,434	181	5,462
3	Single irri. + rainfed rice	159	0	0	159	5,876	28	0	5,904	4,585	746	44	5,375
4	Annual Crops	0	0	0	0	13,264	363	158	13,785	21,883	10,416	10,967	43,266
5	Single irri./rainfed rice + Upland crop	0	0	0	0	0	0	0	0	3,008	16,160	387	19,555
6	Upland crops	5,615	319	263	6,197	59,010	2,587	2,972	64,569	60,947	3,246	6,469	70,662
7	Pineapple/Sugarcane	1,287	0	0	1,287	0	0	0	0	3,165	2,174	510	5,850
8	Shifting land	0	0	0	0	22,212	774	328	23,314	895	0	307	1,173
9	Office	0	0	0	0	0	0	0	0	0	0	0	0
10	Rubber	0	0	0	0	46,690	1,218	348	48,256	61,348	0	1,587	63,193
11	Cashew	0	0	0	0	14,133	429	143	14,745	32,008	2,092	2,124	38,224
12	Mulberry	0	0	0	0	0	0	0	0	0	0	0	0
13	Cinnamon	0	0	0	0	0	0	0	0	0	0	0	0
14	Fruit trees	169	0	0	169	4,464	97	16	4,577	0	0	0	0
15	Mangrove forests	0	0	0	0	1,022	0	6,390	7,412	0	0	0	0
16	Evergreen forests	599	685	6,668	7,892	16,925	4,059	4,740	25,794	12,295	0	3,080	15,303
17	Plantation forests	0	0	0	0	0	0	0	0	0	769	896	1,271
18	Rush/Grass	19,864	6,044	5,871	31,879	4,709	1,634	2,882	8,625	1,543	225	557	2,325
19	Salt pans	0	0	0	0	141	0	685	826	0	0	0	0
20	Bare land	145	1	0	146	948	11	1,437	2,396	5,594	0	1,093	6,687
21	Settlements/Orchards	0	0	0	0	197	0	939	1,136	21,252	9,608	1,351	32,215
	SUB-TOTAL	98,786	2,149	12,904	113,839	196,218	10,408	21,049	227,875	231,404	56,117	29,664	317,922

### Table 3.1 Land Classification of Area No. 8 to No. 12

No.	PRESENT LAND USE	No. 8		No. 9		No. 10		No. 11		No. 12	
		Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
1	Annual Crops	Triple irrigated rice									
2		Double irrigated rice						17	0.0		
3		Single irri. + rainfed rice									
4		single rainfed rice									
5		single irri./rainfed rice + Upland crops									
6	Agriculture Land	Upland crops	359	0.2				1,201	1.0		
7		Pineapple/Sugarcane						6,888	5.5		
8		shifting land									
9		Coffee									
10		Rubber									
11	Perennial Crops	Cashew									
12		Mulberry									
13		Cinnamon									
14		Fruit trees									
15		Mangrove forests									
16	Forestry Land	Evergreen forests	1,217	0.7	3,347	1.8	1,179	2.3	6,160	5.0	2,700
17		Plantation forests									
18	Other Land	Bush/Grass	810	0.5	67	0.0	6	0.0	2,762	2.2	334
19		Salt pans									
20		Bare land	107	0.1	390	0.2			891	0.7	633
21		Settlement/Orchards	47	0.0					639	0.5	0
		SUB TOTAL	2,550	1.5	3,804	2.0	1,185	2.3	18,558	14.9	3,667
22	Water bodies	125	0.1	634	0.3	537	1.0	633	0.5		
23	Road										
24	Railroad										
	TOTAL	2,675	1.6	4,439	2.3	1,722	3.3	19,191	15.4	3,667	71.7









## **ATTACHMENT-1**

- **False Colour Image**
- **Land Use Map**
- **Soil Classification Map**
- **Geomorphologic Classification Map**
- **Land Evaluation Maps (Paddy Field and Upland Crops)**

**for the Selected Seven Irrigation Potential Areas.**

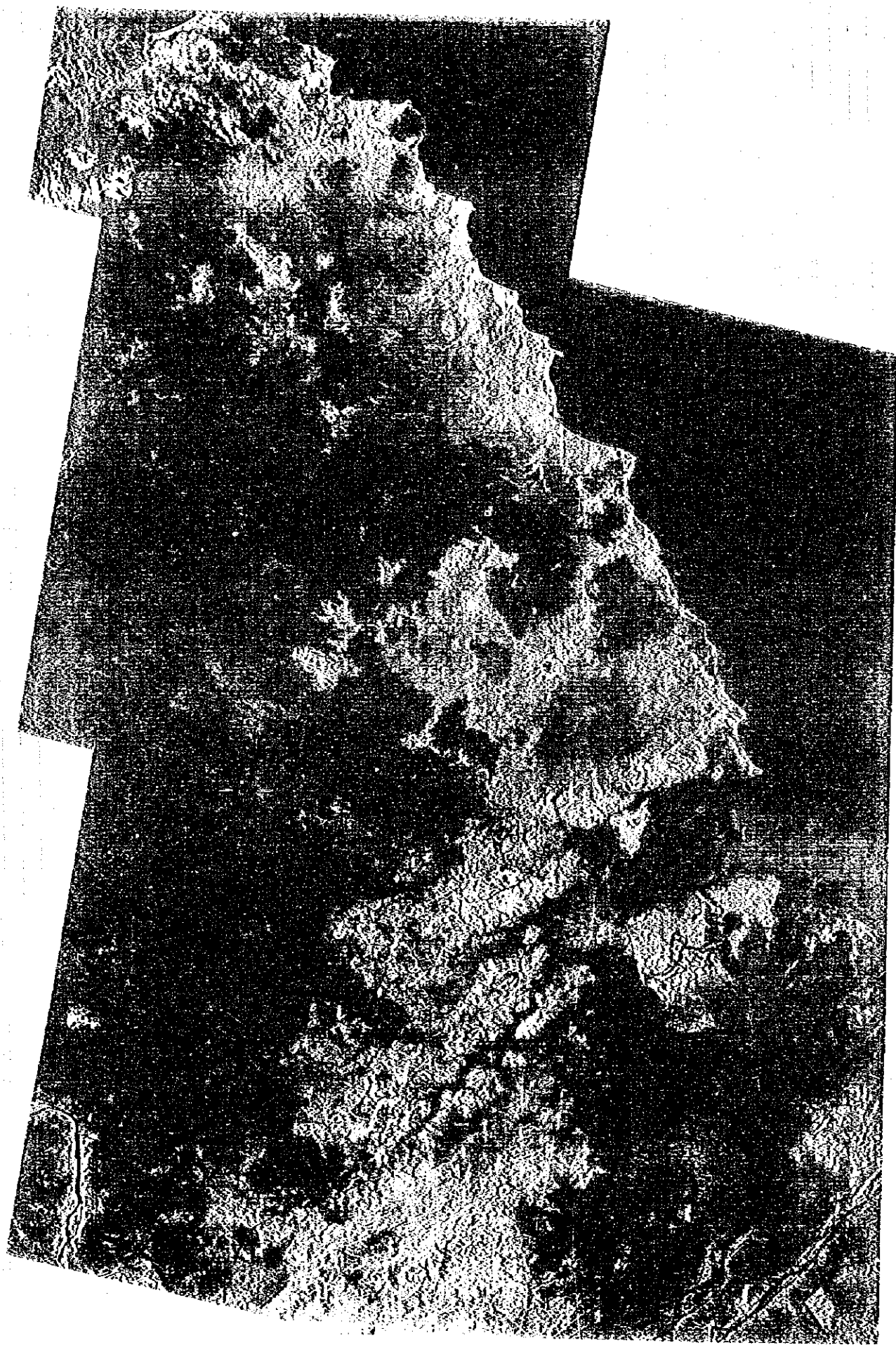
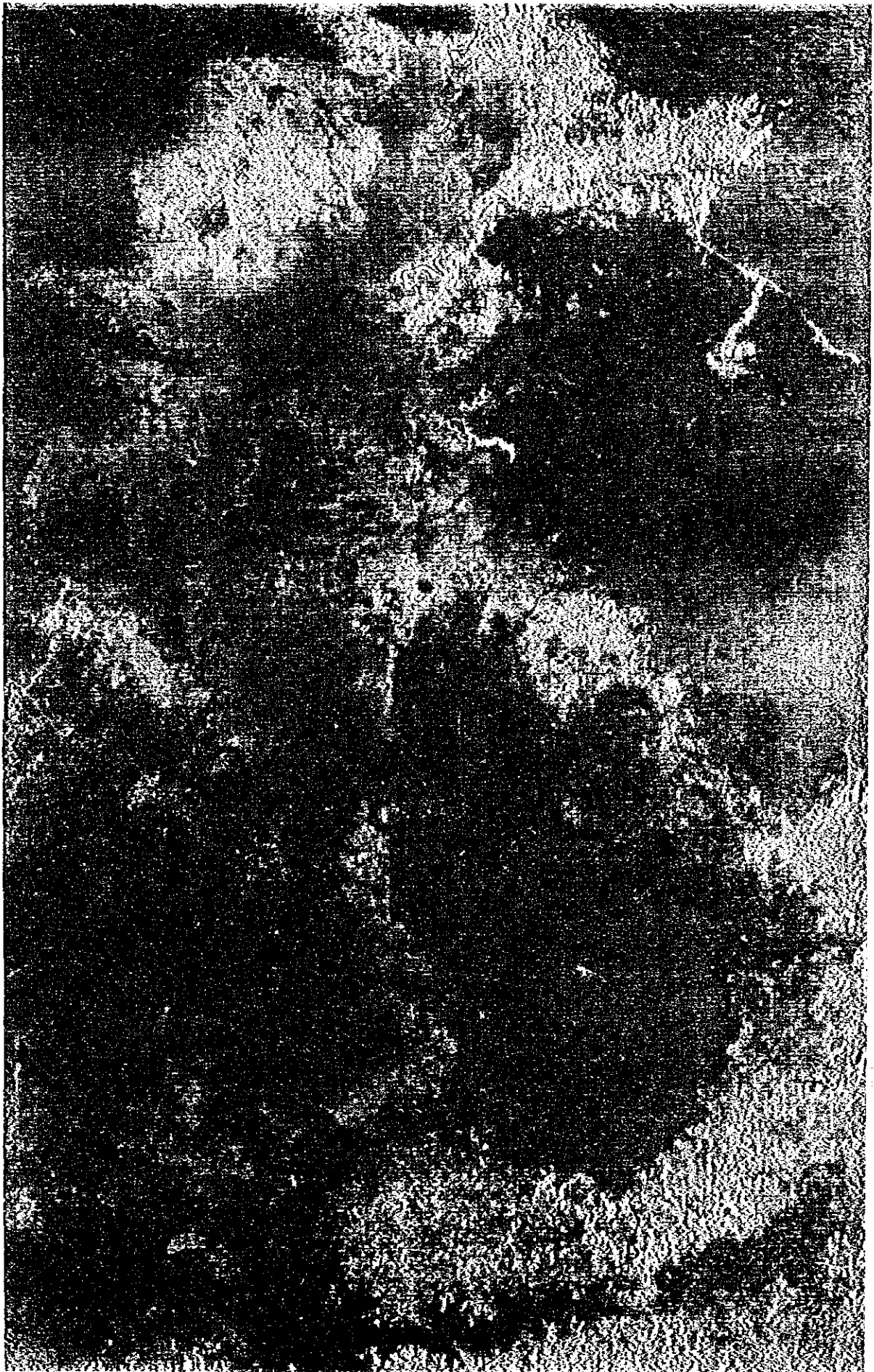
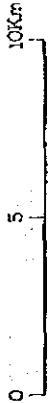
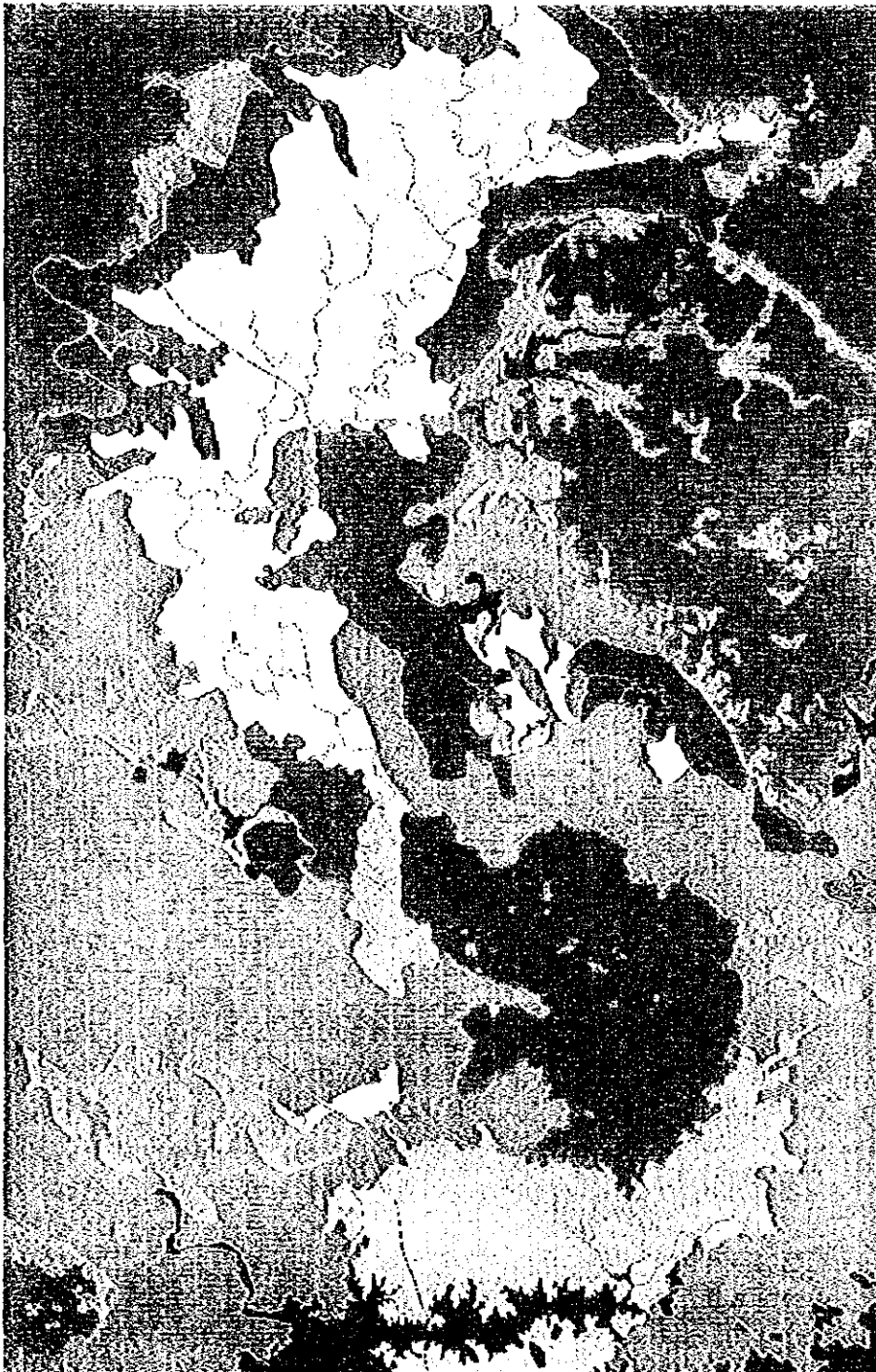


Figure 1.2 False Colour Images of Landsat Shot for the Study Area



False Colour Image for Area No. 1





Triple irrigated rice
Double irrigated rice
Single irr. + rainfed rice
Single rainfed rice
Single irr. / rainfed rice + Upland crops
Upland crops
Sugarcane
Shifting land
Coffee
Rubber
Cashew
Mulberry
Cinnamon
Fruit trees
Mangrove forests
Evergreen forests
Plantation forests
Bush/Grass
Salt pans
Bare land
Settlement/Orchards
River/Lake/Stream
Road, Railroad

0 5 10 15Km

Land Use Map for Area No. 1



Soil Classification Map for Area No. 1

Marine sandy soils
Yellow sand dune soils
Poor sand dune soils
Improve same - potential acid sulphate soils
Slightly saline soils
Medium saline soils
Potential acid sulphate soils
Actual acid sulphate soils
Actual deposited alluvial soils
Underdeposited alluvial soils
Mottled alluvial soils
Cheric alluvial soils
Alluvial soils of streams
Swampy soils
Grey soils on old alluvium
Grey soils on acid igneous
Brownish-grey soils in semi-acid acid
Dark topsoil on volcanic tuff and ash
Black topsoil on basalt
Red-brown topsoil on basic and neutral igneous rocks
Yellow-brown soils on basic and neutral igneous rocks
Yellowish soils on claystones and metamorphic rocks
Dark-yellow soils on acid igneous
Light-yellow soils on sandstones
Yellow-brown soils on alluvial
Yellowish soils transformed by water erosion
Humic yellow-brown soils on claystones and metamorphic rocks
Caliche soils
Eroded rocky soils
Wetland soils
Road, Railroad



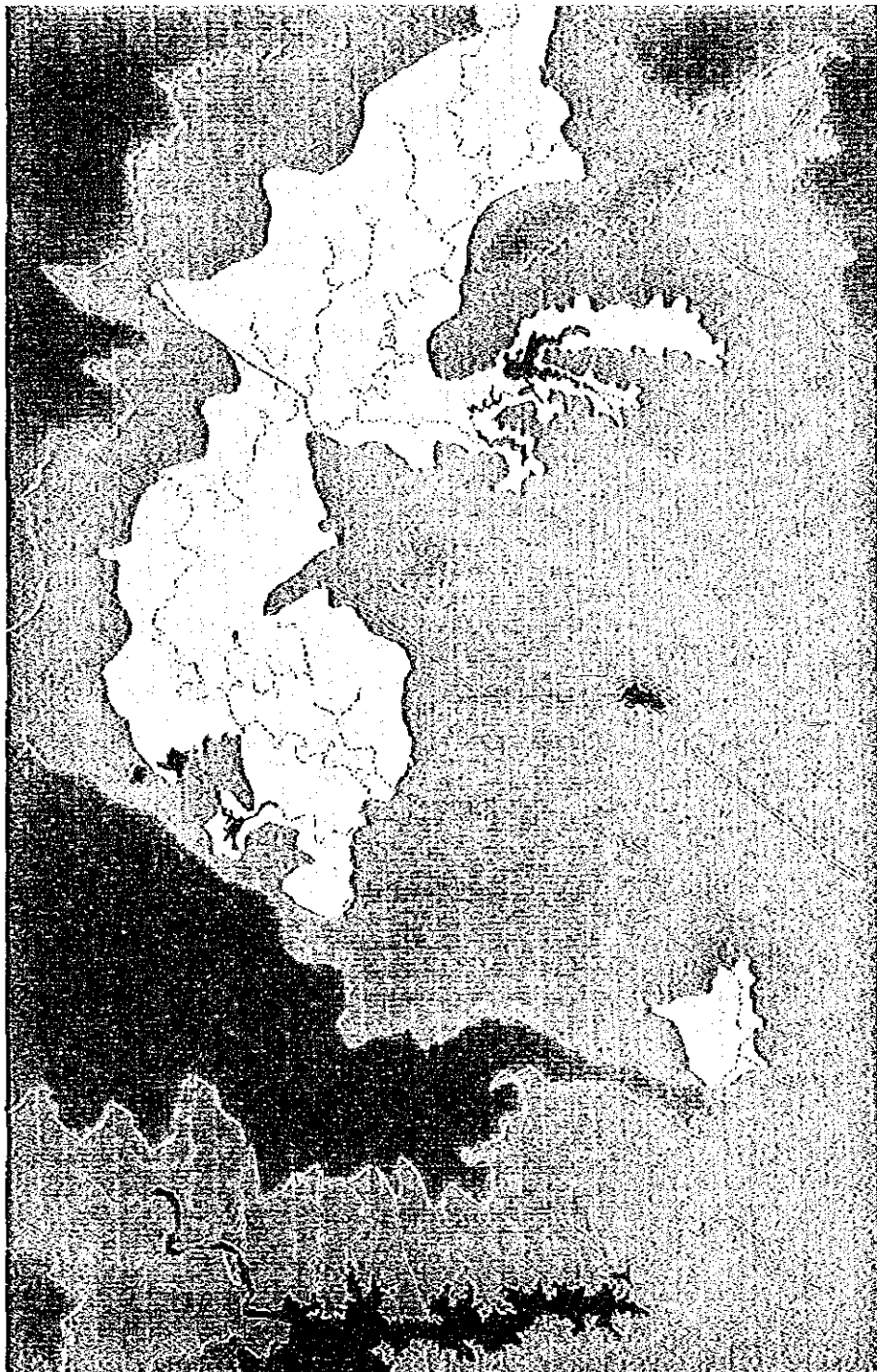


Sand and gravel bars
Low terrace
Higher terrace
Very gentle slopes
Gentle slopes
Modelling
Highly dissected
Depression
High position, non-dissected
Gently rolling
Highly dissected
Mooreland to steep slopes
Steep to very steep slopes
Tidal swamp
Water bodies
Road, Railroad

0 5 10 15 Km

Geomorphologic Classification Map for Area No. 1

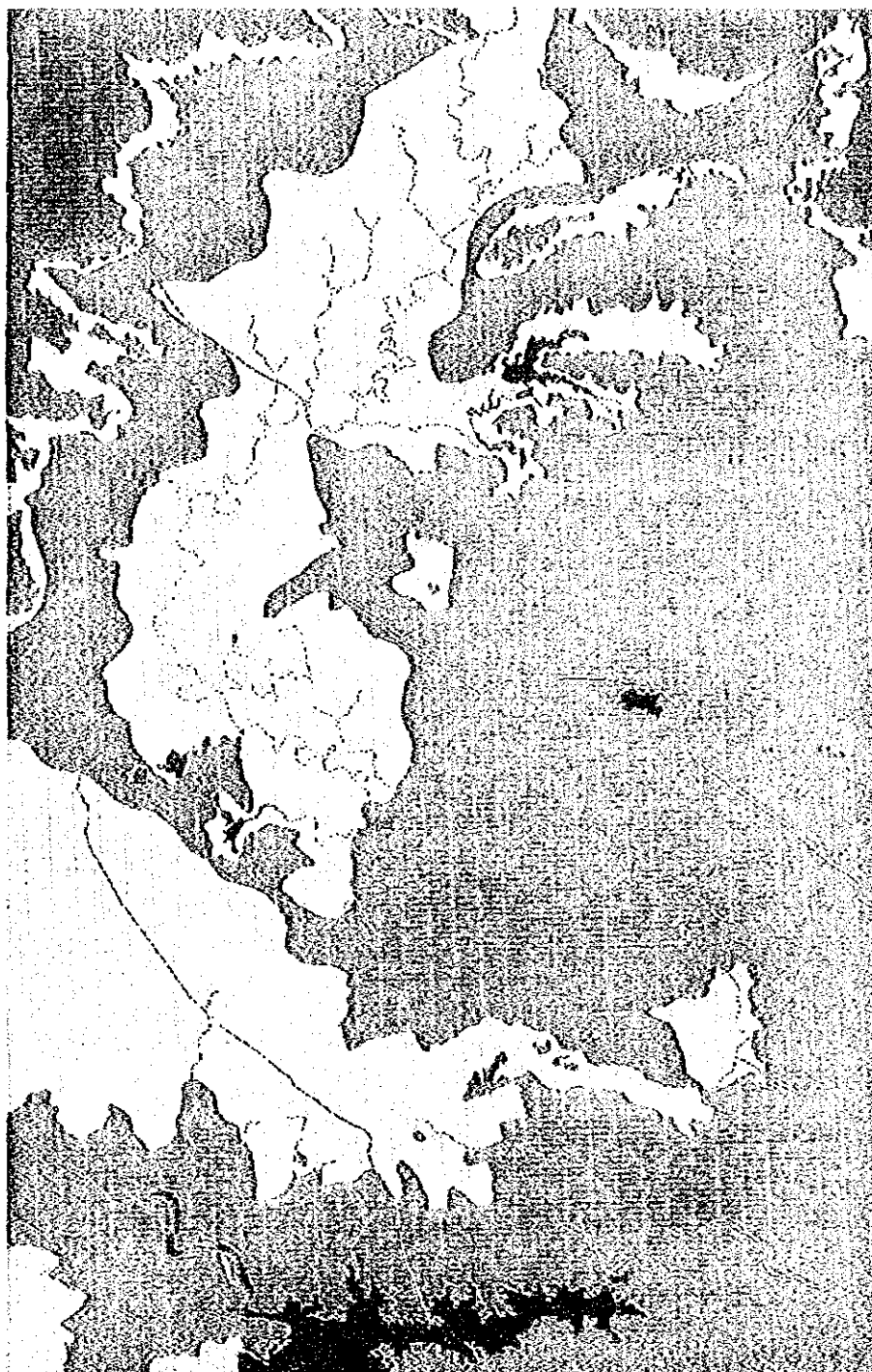




Surface	Surface
Moderately Saline	Moderately Saline
Non-Arable	Non-Arable
Water Bodies	Water Bodies
Road, Drainage	Road, Drainage

0 5 10 15km

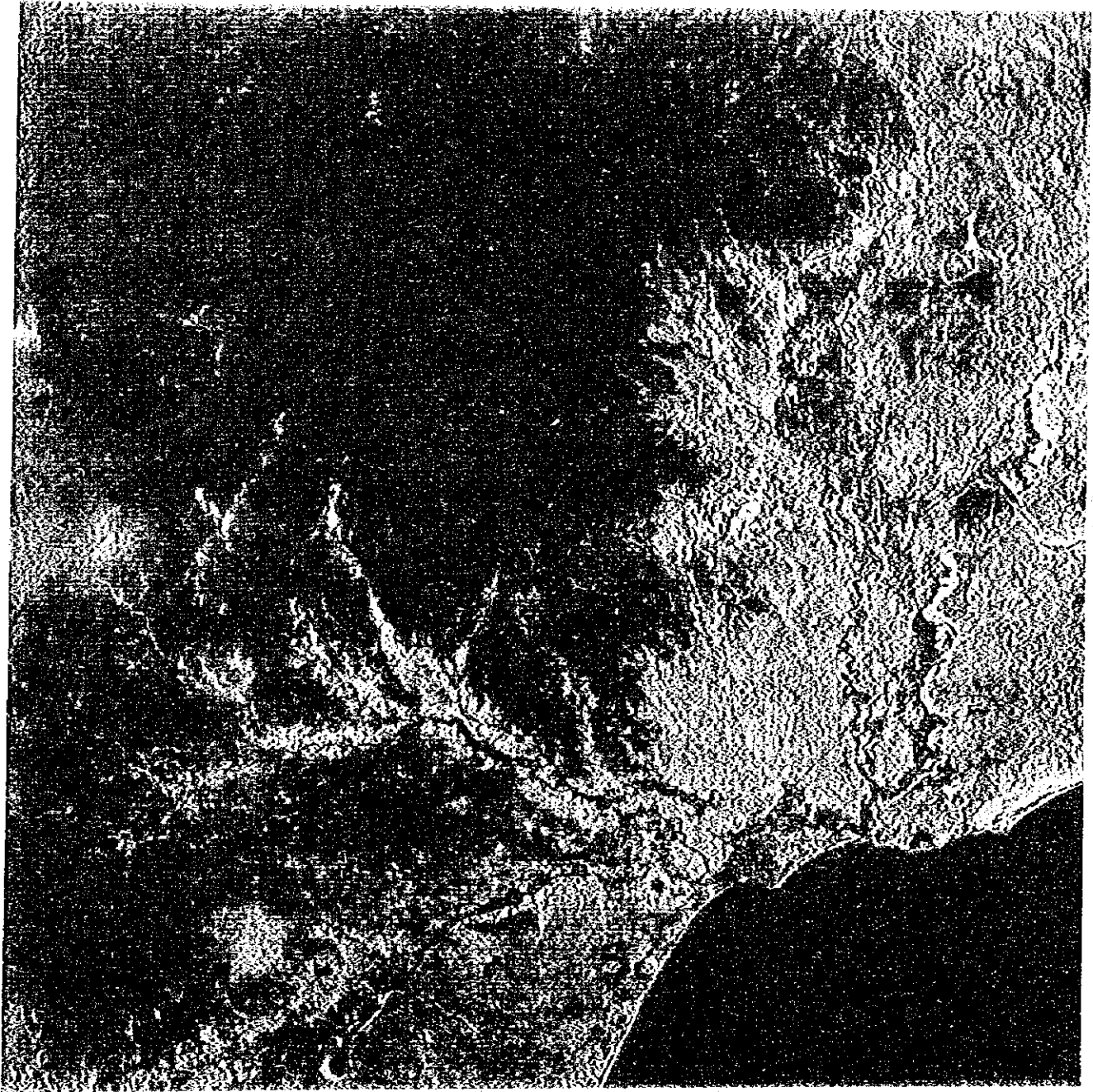
Land Evaluation Map for the Paddy Field of Area No. 1



Very Suitable
Moderately Suitable
Non-Suitable
Water Bodies
Road, Railroad

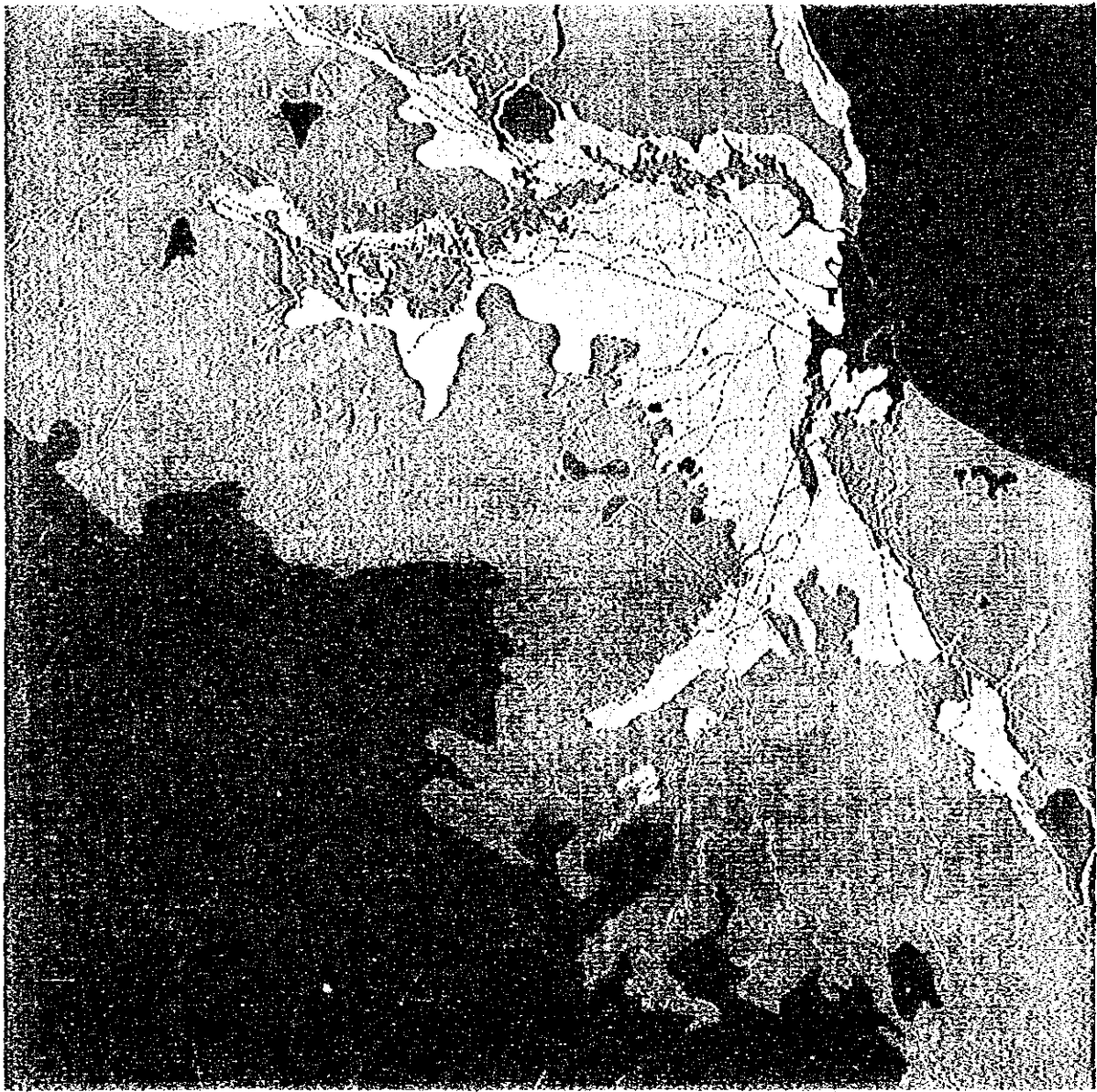


Land Evaluation Map for the Upland Crops of Area No. 1



0 5 10Km

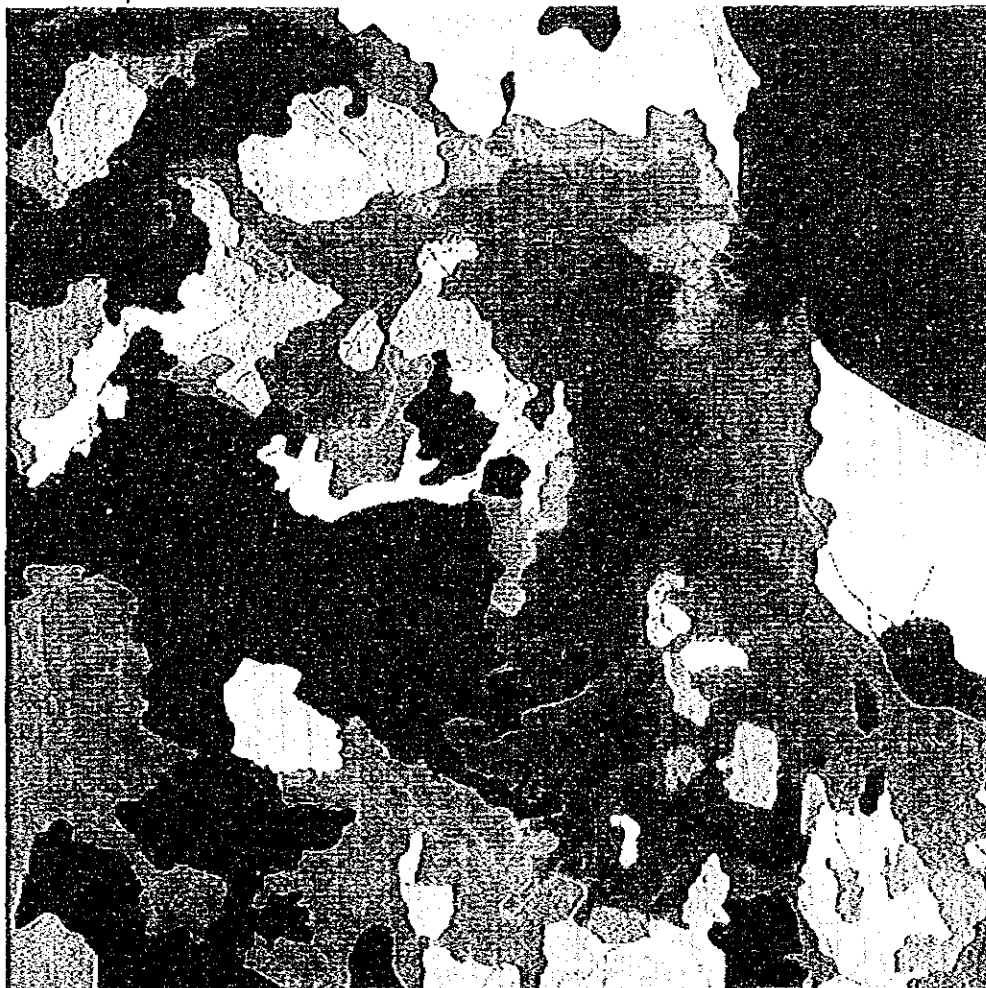
False Colour Image for Area No 2



Triple irrigated rice
Double irrigated rice
Single irr. + rainfed rice
Single rainfed rice
Single irr. / rainfed rice + Upland crops
Upland crops
Sugarcane
Shifting land
Coffee
Rubber
Cashew
Mulberry
Cinnamon
Fruit trees
Mangrove forests
Evergreen forests
Plantation forests
Bush/Grass
Salt pans
Bare land
Settlement/Orchards
River, Lake, Stream
Road, Railroad



Land Use Map for Area No. 2



[Pattern]	Yellow sandy soils
[Pattern]	Yellow sand dune soils
[Pattern]	Red sand dune soils
[Pattern]	Manrove saline - potential acid sulphate soils
[Pattern]	Shrubby saline soils
[Pattern]	Alluvial saline soils
[Pattern]	Potential acid sulphate soils
[Pattern]	Actual acid sulphate soils
[Pattern]	Annual deposited alluvial soils
[Pattern]	Undeposited alluvial soils
[Pattern]	Mottled alluvial soils
[Pattern]	Cyclic alluvial soils
[Pattern]	Alluvial soils of streams
[Pattern]	Sandy soils
[Pattern]	Grey soils on old alluvium
[Pattern]	Brownish-grey soils in semi-arid areas
[Pattern]	Black, tropical soils on volcanic tuff and ash
[Pattern]	Black, tropical soil on basalt
[Pattern]	Red-brown soils on basic and neutral igneous rocks
[Pattern]	Yellow-brown soils on basic and neutral igneous rocks
[Pattern]	Yellow-red soils on clarkites and metamorphic rocks
[Pattern]	Red-yellow soils on acid igneous
[Pattern]	Light-yellow soils on sandstones
[Pattern]	Yellow-brown soils on alluvial
[Pattern]	Yellow-red soils transformed by peaty ground
[Pattern]	Humic yellow-red soils on clarkites and metamorphic rocks
[Pattern]	Calcareous soils
[Pattern]	Eroded rocky soils
[Pattern]	Water bodies
[Pattern]	Road, Railroad

15Km

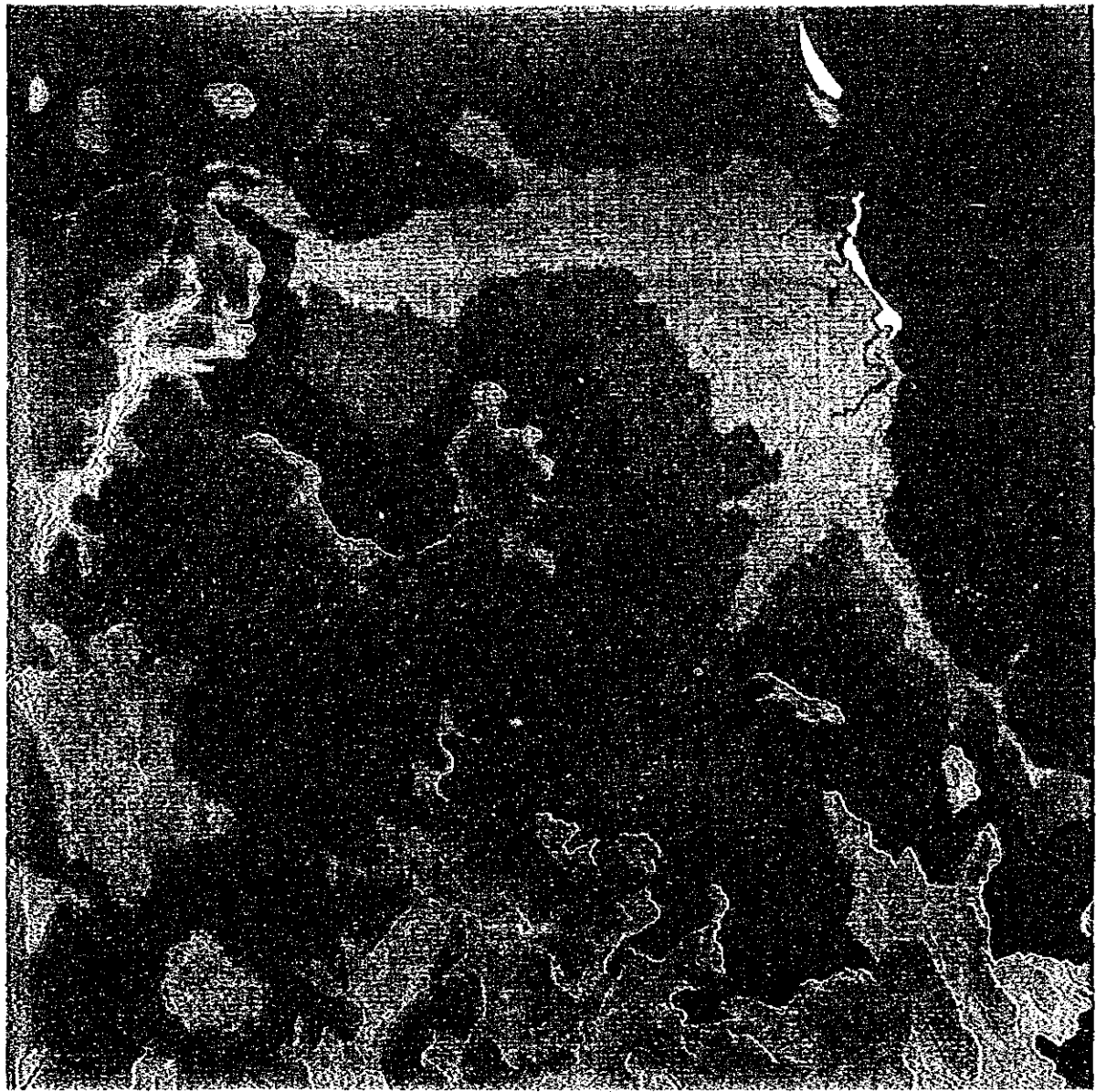
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Soil Classification Map for Area No.2





	Sand and Gravel bars
	Low terrace
	Higher terrace
	Very gentle slopes
	Gentle slopes
	Undulating
	Highly dissected
	Depression
	High position, non-dissected
	Gently rolling
	Highly dissected
	Moderate to steep slopes
	Steep to very steep slopes
	Tidal swamp
	Water bodies
	Road/Railroad



Geomorphologic Classification Map for Area No. 2



	Suitable
	Moderately Suitable
	Non-Arable
	Water bodies
	Road, Railroad



Land Evaluation Map for the Paddy Field of Area No.2