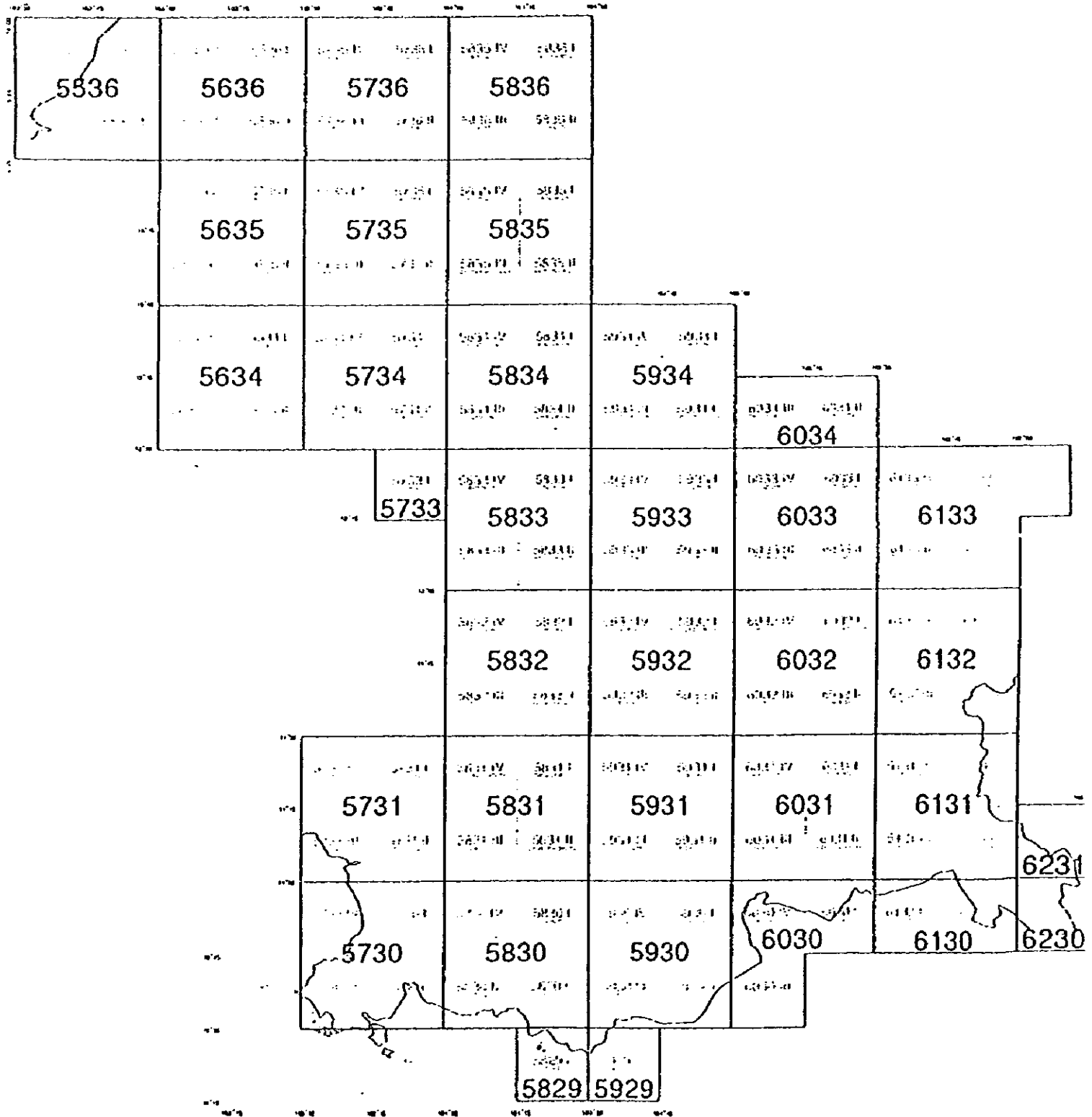
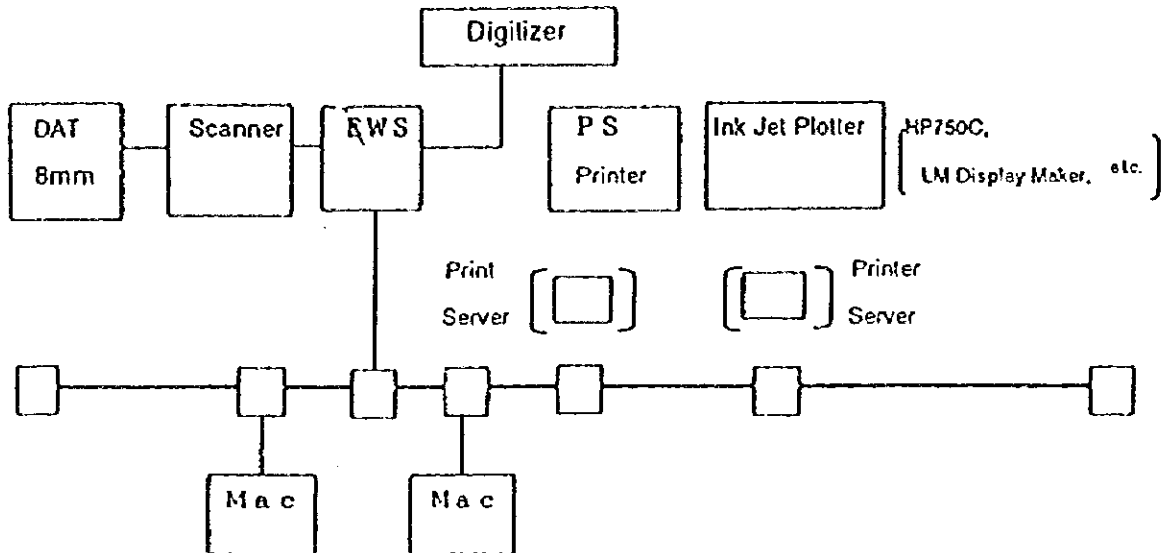


Selected 1:100 000 and 1:50 000 map sheets of Cambodia



Hardware Configuration



Software Configuration

1. ARC/INFO (more than V.7)
2. Illustrator (more than V.5)
3. EPS Converter (more than V.1.3.2) (shareware)
4. RIP Software (Transforming EPS Data into the data for specified plotter)
5. TCP/IP Software (Fetch, etc.)

Legend For Land Use Map of Cambodia
Scale 1:100,000
(using LANDSAT5-TM scale 1:100,000)

Urban, Built-up Areas

- U Cities, towns
 V Villages

Infrastructure

- Ip Airfields, harbors
 Io Others (Playgrounds, stations, schools, etc.)

Agricultural Land

- Ar Paddy fields
 Af Receding rice fields and Floating rice fields
 Au Field crop
 As Swiden agriculture (slash and burn)
 Ao Orchards
 Ap Plantation (Rubber Plantation)
 Av Village garden crops

Grassland

- G Grassland (undifferentiated)
 Ga Abandoned field covered by grass
 Gf Flooded grassland
 Gs Grass savannah
 Gm Grass with termite mounds
 MS Marshes, swamps

Shrub land

- S Shrubland (undifferentiated)
 Sa Abandoned field covered by shrub
 Sf Flooded Shrub
 St Woodlands and scattered trees (C<10%)

Forest Land

- Fe Evergreen broad leaved forest
 Fc Coniferous forest
 Fd Deciduous forest
 Fdo Dry Deciduous (Open) forest
 Fx Mixed forest from evergreen and deciduous species
 Fr Riparian forest
 Fs Bamboo forest and Secondary forest
 Ff Flooded forest
 Fm Mangrove forest (if possible, subdivided into tidal and rear mangrove forests)
 Fp Forest plantations

Other Land Use

- Wl Lakes (>8 ha)
 Wp Ponds (8 ha to <0.5 ha)
 Wr Reservoirs
 Ws Shrimp and Fish farming and Salt pan
 Wo Others (Sea, Bay, etc)

Soils and Rocks

- B Barren lands
 Bs Sand bank
 Br Rock outcrops
 Bo Others (Bare soil, areas after mining, etc.)

Legend For Landform (Geology/Geomorphology) Map of Cambodia
Scale 1:100,000
(using LANDSAT5-TM scale 1:100,000)

- | | | |
|---|---|--|
| 1 | Granitic Rocks | intrusive rocks |
| 2 | Basaltic rocks | intrusive (basalts)
extrusive (lavas) |
| 3 | Metamorphic rocks | |
| 4 | Sedimentary rocks | sandstones
shales
limestones
interbedded sedimentary rocks |
| 5 | Alluvial deposits (will be further subdivided into:) | floodplains
alluvial fans
talus cones
lake beds
deltaic deposits
tidal flats
beach ridges
organic deposits (swamps)
coastal plains |
| 6 | Other materials | residual peneplains with laterite |

Requested Hardware and Software

Annex-5 Page 1 of 2

Item	Description	Qty.
1	Computers (Digitizing, Editing, Analysis)	3
	200 Mhz Pentium Processor (Single CPU) Tower Case PCI Bus, 2 serial, 1 parallel, keyboard, PS2 ball-mouse	x1
	32 MB SIMM	x2
	2.0 GB Harddisk drive (internal)	x2
	CDROM (4x+, internal)	x1
	3.5 inch floppy drive (internal)	x1
	10T Ethernet Card	x1
	Accelerated Video Card w/2MB VRAM	x1
	17" or 20" Color Multisync Monitor	x1
2	Computer (Data Serving/Archiving)	1
	200 Mhz Pentium Processor (Single CPU) Tower Case PCI Bus, 2 serial, 1 parallel, keyboard, PS2 ball-mouse	x1
	32 MB SIMM	x4
	3.8 GB Harddisk drive (internal)	x2
	CD Writer (external/internal)	x1
	Removable Disk Media (MO)	x1
	3.5 inch floppy drive (internal)	x1
	10T Ethernet Card	x1
	Accelerated Video Card w/2MB VRAM	x1
	17" or 20" Color Multisync Monitor	x1
3	Ethernet (10T LAN)	1
	10T Ethernet Hub, 16 or 24 ports	x1
	10T Ethernet Cables (Category 5)	x13
4	Digitizing (Data Input)	2
	A0 size Digitizing Tablet with 16 button puck, power base	x2
5	Printers and Plotters (Monochrome and Color Hardcopy Output)	
	A3/A4 size Laser Printer, PS Level 2, Monochrome, 10T Network Ready	x1
	A3/A4 size Color Ink Jet Printer, 10T Network Ready	x1
	A0 Size Color Ink Jet Plotter, 32-MB RAM, PS Level 2 SIMM	
	10T Ethernet Interface, Stand	x5
	A4/A3 Size Monochrome Copy machine	x1
	A1 Size Color Copy Machine (for map reproduction)	x1
	<i>Paper, Toner and Ink enough for one 1.5 years at average use</i>	

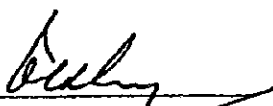
Requested Hardware and Software

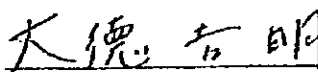
6	PC Related Software		
	Operating System:	Microsoft Windows 95 (E) w/ localized fonts if available	x4
	GIS Software:	ESRI PC ARC/INFO Ver. 3.5	x4
		ESRI ArcView 3.0	x4
	Virus Checking Software	x4	
7	Electrical Power Resources		
	Electrical Power Generator, with adequate capacity to independently supply power for the equipment listed, lighting and air-conditioning for this installation site Power Line Conditioners applicable per machine/peripheral device Surge Suppressers applicable per machine/peripheral device		x1
8	Computer (Topographic Map Layout, Design and Prepress)		2
	Apple Macintosh Power PC (200 Mhz Single CPU) Tower Case, CDROM Drive Apple extended keyboard, Apple Ball Mouse, 10T Ethernet Built-in 4MB Video RAM (VRAM), 3.5 inch floppy disk drive (internal), MacOS 7.6 or greater 64 MB SIMM		x1
	2.0 GB Harddisk drive (internal)		x4
	Removable Disk Media, 3.5 inch Magneto Optical Disk (internal)		x2
	17" or 20" Color Multisync Monitor		x1
			x1
9	Other Macintosh Related Equipment		
	A4 Size 600DPI Flatbed Desktop Scanner		x1
	Apple LocalTalk Network Interface for A0 Inkjet Plotters		x2
10	Macintosh Related Software		
	Adobe Illustrator 6.0 or greater (English)		x2
	Adobe Photoshop 4.0 or greater (English)		x1
	RIP Software (Raster Image Processor, for converting data to Plotter format)		x2
	Virus Checking Software		x2
11	Airphoto Interpretation Equipment		
	Stereo Scopes for Airphoto Interpretation		x6

MINUTES OF MEETING
ON
THE RECONNAISSANCE SURVEY PROJECT
OF
AN EMERGENCY REHABILITATION AND
RECONSTRUCTION
OF
THE KINGDOM OF CAMBODIA

AGREED UPON BETWEEN
THE MINISTRY OF PUBLIC WORKS AND TRANSPORTS
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

PHNOM PENH, DECEMBER 11TH, 1998


H. E. KHY TANGLIM
MINISTER
THE MINISTRY OF PUBLIC
WORK AND TRANSPORTS OF
THE KINGDOM OF CAMBODIA


MR. YOSHIAKI OTOKU
DEPUTY TEAM LEADER
JAPAN INTERNATIONAL
COOPERATION AGENCY

The JICA Study Team (referred to as the Team hereinafter) headed by Mr. Yoshiaki OTOKU, representing the team leader Dr. Yoshitake EGAWA, visited the Kingdom of Cambodia on 3 December 1998 to carry out the third consultation meeting with the team of the Ministry of Public Works and Transports (hereinafter referred to as "MPWT") headed by H.E. Khy Tainglim to discuss the progress of the Reconnaissance Survey Project for Establishment of an Emergency Rehabilitation and Reconstruction in the Kingdom of Cambodia (hereinafter referred to as "the Study") organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA").

The Team was advised that H.E. Khy Tainglim is now the new Minister of the Ministry of Public Works and Transports.

A series of technical discussions and the meetings on the progress of the Study were held with MPWT and the Cambodian Team during the period of 3 to 11 December 1998.

A. The following items were discussed:

1. Progress Report of March 1998 (attached).
The Team presented the Progress Report to MPWT.
2. Production status and completion schedule.
The Team outlined the present status of the Study and gave the production schedule for delivery of products.
3. The Team showed samples of the plotted maps for Topography, Land use, and Geology/Geomorphology.
4. GIS equipment installation.
The Team proposed MPWT about the equipment installation schedule for the technical transfer program, including data management and service system.
5. Maintenance and Operation of the System.
The Team requested MPWT to assign a group in MPWT to be responsible for maintaining and servicing of the system of the equipment and final delivery results.

B. Comments by MPWT and the Cambodian Team

1. MPWT accepted the report.
2. MPWT thanks the team for the good work and the progress in completing the work. The maps are very important for the developing of the country.
3. MPWT agreed to start the installation of the equipment on February 1999 and promised to assign a new unit to become the official counterpart unit, which will be responsible for the maintenance of the GIS and the data bank, and the dissemination of data and maps.
4. MPWT suggested that the GIS equipment be installed in the room adjacent to the present Project office. It is ready for use.

5. MPWT agreed with the legend of the topographic and land use maps and to simplify the Geology/Geomorphology legend as there was no geology verification in the field.

C. MPWT Made four special request for consideration:

1. MPWT requested the Team to provide the equipment at MPWT to be used for the technology transfer of this Study after the completion of the Project. The list of equipment shall be defined during the next meeting.
2. Concerning the printing of the maps, MPWT requests the Khmer edition of 500 pcs. and the Romanize edition of 1,500 pcs.
3. MPWT requested that the aerial photos and imagery be transferred to the MWPT for continuing detailed mapping and verification before march 1999.

D. Comments of the Team

The Study team agreed to convey these requests to JICA headquarters.

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ANNEX -- 1

List of attendants:

Cambodian Representatives:

1. H.E. Khy Tainglim
Minister of the Ministry of Public Works and Transports.
2. Mr. Khun Sokha
Project Assistant Coordinator
3. Mr. Meng Saktheara
Senior Geologist
4. Mr. Teng Peng Seang
GIS expert.
5. Dr. Heng L. Thung
Senior Advisor to CNMC and MPWT.

Japanese Representatives:

1. Mr. Yoshiaki Otoku
Deputy team leader.
2. Mr. Hiroyuki Matsuda
Map Information Planner.
3. Mr. Fujio Ito
Chief Engineer for Mapping.
4. Mr. Hideaki Umeda
Chief Engineer for Geology/Geomorphology.
5. Mr. Myo Thant
GIS Design expert.
6. Mr. Kazushi Endo
Database engineer.

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TECHNICAL DISCUSSION MEMORANDUM

Date: 17 December 1998

After signing the Minutes of meeting, a series of technical discussions and the meetings on the final deliveries of the Study were held between the JICA team and the Cambodian Team during the period of 12 to 17 December 1998.

This memorandum shall be reported to signer of Minutes of meeting dated 11th December 1998. The following items were discussed and agreed by both technical side.

1. Marginal Annotation

The following marginal annotation shall be put on the Maps.

1.1. Topographic Maps

This map was prepared by Japan International Cooperation Agency(JICA) and Ministry of Public Works and Transport(MPWT) under the Technical Cooperation Program of the Government of Japan and the Government of Kingdom of Cambodia.

This Map was produced from SPOT images acquired from November 1996 to March 1997. Ground control was derived from the existing 1:50,000 maps.

Field surveys were not carried out because of security conditions.

Aerial photos from 1992 to 1995, Landsat imagery of 1996 were used for vegetation and infrastructure information.

Village locations and names were generated from the Village Gazetteer and the system of Romanized transcriptions was prepared by the National Geographic Department of Cambodia.

All boundary information was provided by the National Geographic Department of Cambodia. Delineation of International Boundary must not be considered authoritative.

1.2. Land use Maps

This map was prepared by Japan International Cooperation Agency(JICA) and Ministry of Public Works and Transport(MPWT) under the Technical Cooperation Program of the Government of Japan and the Government of Kingdom of Cambodia.

Delineation of land use classes was done initially using the Landsat TM images. Later, water features were correlated using SPOT panchromatic images.

1.3. Geology/Geomorphology Maps

This map was prepared by Japan International Cooperation Agency(JICA) and Ministry of Public Works and Transport(MPWT) under the Technical Cooperation Program of the Government of Japan and the Government of Kingdom of Cambodia.

Delineation of geology/geomorphology classes was done initially using the Landsat TM images and aerial photos.

2. Map symbol of the contour line

MPWT requested that the principle contour line (40m) and intermediate contour (20m) use the same map symbol on the map. The Team agreed.

3. Geology/Geomorphology legend

According to B-5 of M/M, both side agreed to finalized legend for Geology / Geomorphology to respect the geological map being produced by the Department of Geology.

It is agreed that the classification for the 1:500,000 geology/geomorphology map is to include the legend of the deposits (geomorphology) and that the class 17 (rock) will be substituted with the geologic stratigraphic formation classes.

Final legend is attached (attachment 1)

4. Equipment list

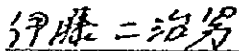
The equipment to be used for the study was discussed and specified (attachment 2)

The team will propose to JICA H.Q.T after their leave.

5. Executive Seminar scenario


It is agreed that a seminar is to be held to introduce the project results to future users the application of GIS.

The seminar will introduce the process of generating the data set and present the project results.



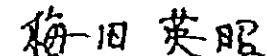
Fujio ITO

Chief Engineer for mapping



Khun Sokha

Project Assistant coordinator



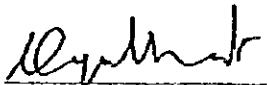
Hideaki UMEDA

Chief Engineer for Geology/Geomorphology



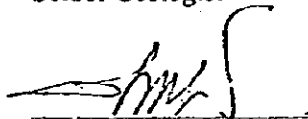
Meng Saktheara

Senior Geologist



Myo Thant

GIS Design expert



Teng Peng Seang

GIS expert

ATTACHMENT I

Geomorphologic/Geologic Map's Legend

Code	Geologic Era	Deposits, Sediments, Rocks
[Unconsolidated material]		
(Remarks : shall be only used existing deposits in study area within following list)		
W	Quaternary	Water
Fp	Quaternary	Floodplain
Af	Quaternary	Alluvial fan
Co	Quaternary	Colluvium(Talus cones)
Pd	Quaternary	Pediment
Lb	Quaternary	Lake bed deposits
Dd	Quaternary	deltaic deposits
Ft	Quaternary	Tidal flats deposits
Br	Quaternary	Beach ridge deposits
Sw	Quaternary	Organic deposits
Va	Quaternary	Volcanic deposits
Cp	Quaternary	Costal Plains deposits
Ta	Quaternary	terrace laterite deposits
Pi	Quaternary	Basaltic plateau deposits

[Sedimentary Rocks]

Draft to be modified

Mesozoic

Jurassic-Cretaceous

Jca	Jurassic-Cretaceous	claystone
JcG	Jurassic-Cretaceous	sandstone
JcG	Jurassic-Cretaceous	conglomerate
J	Jurassic	sandstone
J1-2	Lower-Middle Jurassic	formation
Triassic		
T	Triassic	formation
Tg	Triassic	formation(sandstone and microbreccias)
Tx	Triassic	siltstone, shists and marl

Paleozoic

Permian-Carboniferous

C-T	Upper Carboniferous - Lower Triassic	sandstone
CP	Ouralo - Permian	limestone
P	Permian	limestone

Carboniferous - Devonian

CD	Carboniferous - Devonian	black shists, phtanites, sandstone
----	--------------------------	------------------------------------

Devonian

DHj	Devonian	phtanites
DHx	Devonian	schists and sandstone faces
DHm	Devonian	marl faces
DHcg	Devonian	conglomerate faces
a/DC	Devonian	DC formation covered by a thin layer of old alluvium

Cambrian - Silurian

CScg	Silurian	metaconglomerate
CS2q	Cambrian - Upper Silurian	quartzites
CSq	Cambrian - Silurian	quartzites
CSx	Cambrian - Silurian	schists

Archean

AnteCambrian

Pt	AnteCambrian	formation
----	--------------	-----------

Unknown Geologic Era

C		Hornfelds, meta-arkose and meta-andesites
Ce/Cm/Cog		Skam deposit, Marble, Metamorphic conglomerate

[Igneous Rocks]

Volcanic Rocks

Basic Rocks

B1/B	Quaternary / Pliocene - Quaternary	Basalts
------	------------------------------------	---------

Acidic Rocks

p2/p2b	Jurassic - Cretaceous	Rhyolites
b	Jurassic - Cretaceous	Dacites
p1	Lower-Middle Triassic	Rhyolites
p	Antepremanian	Rhyolites(Old Rhyolites)

Intermediate Rocks

α 1	Jurassic-Cretaceous	Andesites and tuffs
α	Permian	Andesites and their relative rocks

Volcanic sediments

r2t	Jurassic-Cretaceous	volcanic breccias and acidic tuffs
r1t	Devonian	acidic tuffs

Pulvonic Rocks

Q4	unknown geologic Era	High alumina Granite
g3/g3-4	Post Triassic(Late Jurassic - Cretaceous)	Granites/coarse grained Granites
g3-1	Post Triassic(Late Jurassic - Cretaceous)	aplititic Granites, Aplite
g3-2	Post Triassic(Late Jurassic - Cretaceous)	fine grained Granites
g2	Early - Mid Triassic	Granite
g1	Early - Middle Paleozoic	Granite
g/gb	Late Triassic - Early cretaceous(Post Tria unknown geologic Era	Granodiorite undiscriminated Pulvonic rocks
d	Late Cretaceous - Paleogene	Diorite, Gabbro, gabbroic Diorite

[Others]

faults
proposed faults

ATTACHMENT 2 Equipment List

Item	Description	QTY
1.1	Computer (GIS Data Digitizing, Editing, Analyzing) Pentium II 350 Mhz or higher(Windows 95-E should be pre-installed) 128MB RAM 32x Internal CD-ROM Internal FD 6GB HDD 100 Base-T Ethernet 19" Color Monitor 6MB VRAM or more	3
1.2	Computer (Map Preparation) Pentium II 350 Mhz or higher(Windows 95-E should be pre-installed) 128MB RAM 6MB VRAM or more 32x Internal CD-ROM Internal FD 6GB HDD 100 Base-T Ethernet 19" Color Monitor(SONY)	2
1.3	Computer (Image Processing) Pentium II 350 Mhz or higher(Windows 95-E should be pre-installed) 256MB RAM 6MB VRAM or more 32x Internal CD-ROM Internal FD 6GB HDD 100 Base-T Ethernet 19" Color Monitor(SONY)	1
2	Computer (NT ARC/INFO Data Serving/Archiving) Pentium II 350 Mhz or higher(Windows NT Ver.4.0 should be pre-installed) 256MB RAM 6MB VRAM 32x Internal CD-ROM Internal FD 10GB HDD 10 Base-T Ethernet 19" Color Monitor(SONY) CD-Writer set (SCSI card included)	1
3	Ethernet 100 Base-TX LAN Hub 8 ports or more Cables	2 14
4	Digitizing Table A0 size	2

Item	Description	QTY
5	Printers and Plotters	
5.01	Laser printer(monochrome) A3/A4 100 Base-T	1
5.02	A3 size Color Inkjet Printer 100 Base-T	1
5.03	A0 size Color Inkjet Plotter 32 SIMM RAM 100 Base-T	2
5.04	A4/A3 Size Monochrome Copy Machine	1
5.05	Paper, Toner and Ink enough for one 1.5 year *for Item 5.01 Toner Cartridge	3
	*for Item 5.02 Black Ink 8 pcs./unit	3
	Color Ink 8 pcs./unit	3
	*for Item 5.03 Ink Cartridge-Black 44ml	15
	Ink Cartridge-Cyan 44ml	15
	Ink Cartridge-Magenta 44ml	15
	Ink Cartridge-Yellow 44ml	15
	High Res. Color Bond Paper A1	9
	Economy Bond Paper A1	12
	Translucent/Tracing A1	6
	High Res. Color Bond Paper A0	6
	Economy Bond Paper A0	8
	Translucent/Tracing A0	4
	*for Item 5.04 A4 size Paper	4
	A3 size Paper	4
	Toner Cartridge	2
	CDR-600MB Media(10 units per Box)	50
6	Softwares	
	GIS Softwares	
	ARC/INFO for Win-NT	1
	TIN for ARV/INFO	1
	GRID for ARC/INFO	1
	NETWORK for ARC/INFO	1
	ARCPress for ARC/INFO	1
	PC-ARC/INFO	3
	ARCVIEW3	4
	AV3 NETWORK ANALYST	1
	AV3 SPATIAL ANALYST	1
	AV3 3D ANALYST	1
	ARCPress for ARCVIEW	1
	ERDAS IMAGE PROFESSIONAL8.3	1
	DTP-Softwares	
	Adobe Illustrator for PC ver 8 or higher	2
	Adobe Photoshop for PC	1

Item	Description	QTY
	Virus checking software for win & NT	6
7.	A3 Scanner(SCSI connect)	1
8	Instillation Item 1-7	1
9	Airphoto Interpretation Equipment Mirror Stero-scope with 3X binocular and table slide bracket	6
10	Electrical Power Resources	
10.1	Silent Generator (45KVA 230/240V AC, 50Hz, 0.8pf)	1
10.2	8KVA Isolated Transformer Power Line Conditioner	1
10.3	Surge Suppressors(3 pins,4 P outlets)	6
10.4	APS Smart-UPS 1000,1KVA UPS	7

MINUTES OF MEETING
ON
THE RECONNAISSANCE SURVEY PROJECT
FOR THE ESTABLISHMENT OF
AN EMERGENCY REHABILITATION AND
RECONSTRUCTION
OF
THE KINGDOM OF CAMBODIA

AGREED UPON BETWEEN
THE MINISTRY OF PUBLIC WORKS AND
TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

PHNOM PENH, MARCH 5th, 1999



H.E. MR. KHY TANGLIM
MINISTER
THE MINISTRY OF PUBLIC
WORKS AND TRANSPORT
THE KINGDOM OF CAMBODIA



DR. YOSHITAKE EGAWA
TEAM LEADER
JAPAN INTERNATIONAL
COOPERATION AGENCY

The JICA Study Team (hereinafter referred to as the Team) headed by Dr. Yoshitake EGAWA visited the Royal Government of Cambodia on 2 March 1999 to carry out the fourth consultation meeting with the team of the Ministry of Public Works and Transport (hereinafter referred to as "MPWT") headed by H.E. Mr. Khy Tainglim to finalize the Reconnaissance Survey Project for the Establishment of an Emergency Rehabilitation and Reconstruction of the Kingdom of Cambodia organized by the Japan International Cooperation Agency (hereinafter referred to as "the JICA").

A series of technical discussions and meetings on the draft final report of the Study were held with MPWT during the period of 2 to 5 March 1999.

The following items were discussed.

- 1) MPWT accepted the outline of the Draft Final Report.
- 2) MPWT agreed with the detail compilations of the Final Report to be left by the Study Team.
- 3) Both sides agreed that on the marginal information of the Topographic Map, the following sentence shall be put in addition to the one already agreed.
"This map is available either in analogue or in digital form at the Ministry of Public Works and Transport."
- 4) Both sides agreed that on the marginal information of the Geology/Geomorphology Map, following sentences shall be put in addition to the one already agreed.
"This map was prepared by the Japan International Cooperation Agency (JICA) and Ministry of Public Works and Transport (MPWT) under the Technical Cooperation Program of the Government of Japan and the Royal Government of Cambodia in conjunction with the Department of Geology and Mines (DGM)."
"This map is available either in analogue or in digital form at the Ministry of Public Works and Transport".
- 5) JICA agreed that the Cambodian government could make copies of the CD-ROM, and distribute them to user agencies who contribute to the development of Cambodia, on the following conditions:
 - ① The list of the distribution shall be reported to JICA Office in Phnom Penh.
 - ② The Cambodian side will take measures to prevent the illegal publication of the CD-ROM.

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6) MPWT shall make copies of paper maps and CD-ROMs at any request from JICA at the reasonable price.

7) MPWT requested the Team to donate the equipment and software that were used in the study to MPWT.

The Team promised to transfer the request to JICA headquarters and required the document on institutional system in MPWT to maintain and manage the GIS.

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ANNEX-1

List of attendants:

Cambodian Representatives:

- 1.H.E.Mr.Khy Tainglim
Minister of the Ministry of Public Works and Transport
- 2.Dr.Khum Sokha
Project Assistant Coordinator
- 3.Dr.Heng L. Thung
Senior Advisor to CNMC and MPWT

Japanese Representatives

- 1.Dr.Yoshitake Egawa
Team leader
- 2.Mr.Fujio Ito
Chief Engineer for Mapping
- 3.Mr.Shinici Masuda
Assistant resident representative of JICA Cambodia Office

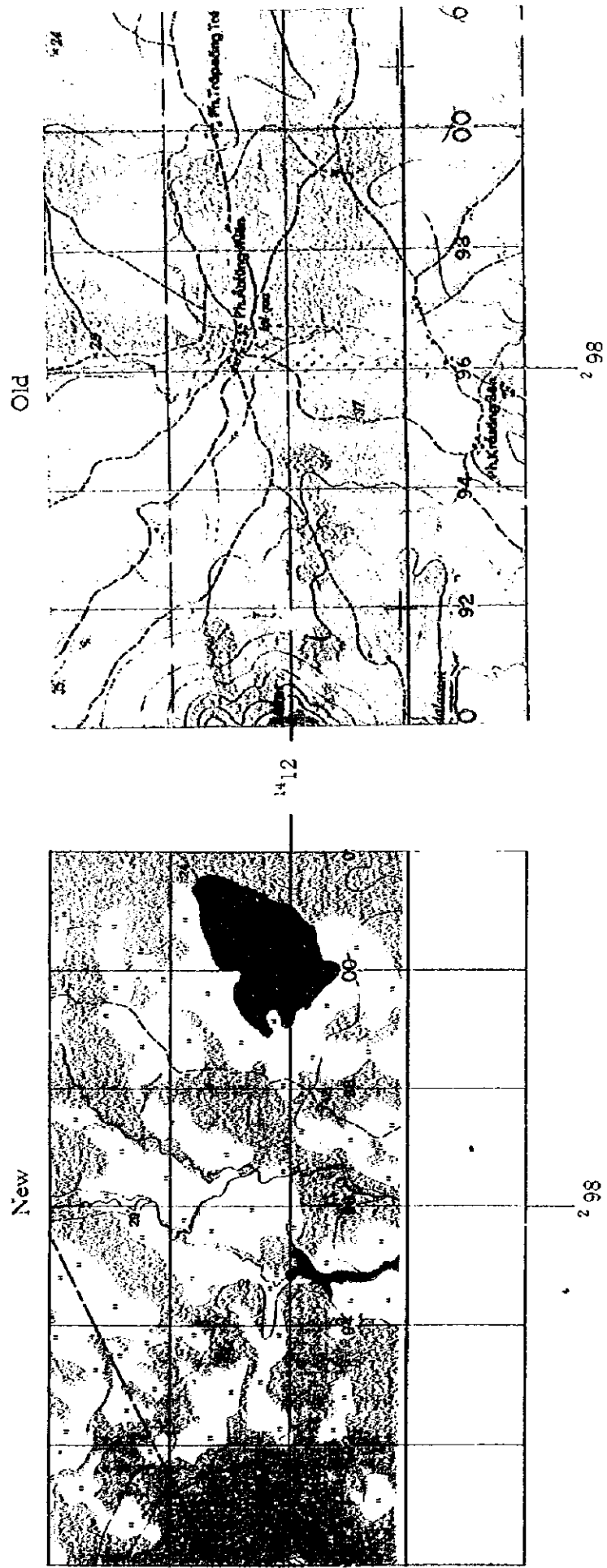
bat

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Appendix II Interpretation of New and Old Topographic Maps

Figure II-1 Comparison of Topographic Maps (1)

Sheet # 5634
 Sheet Name Bat Tam Bang
 Coordinates 12° 46' 10.5" 07'



⊕ dry river

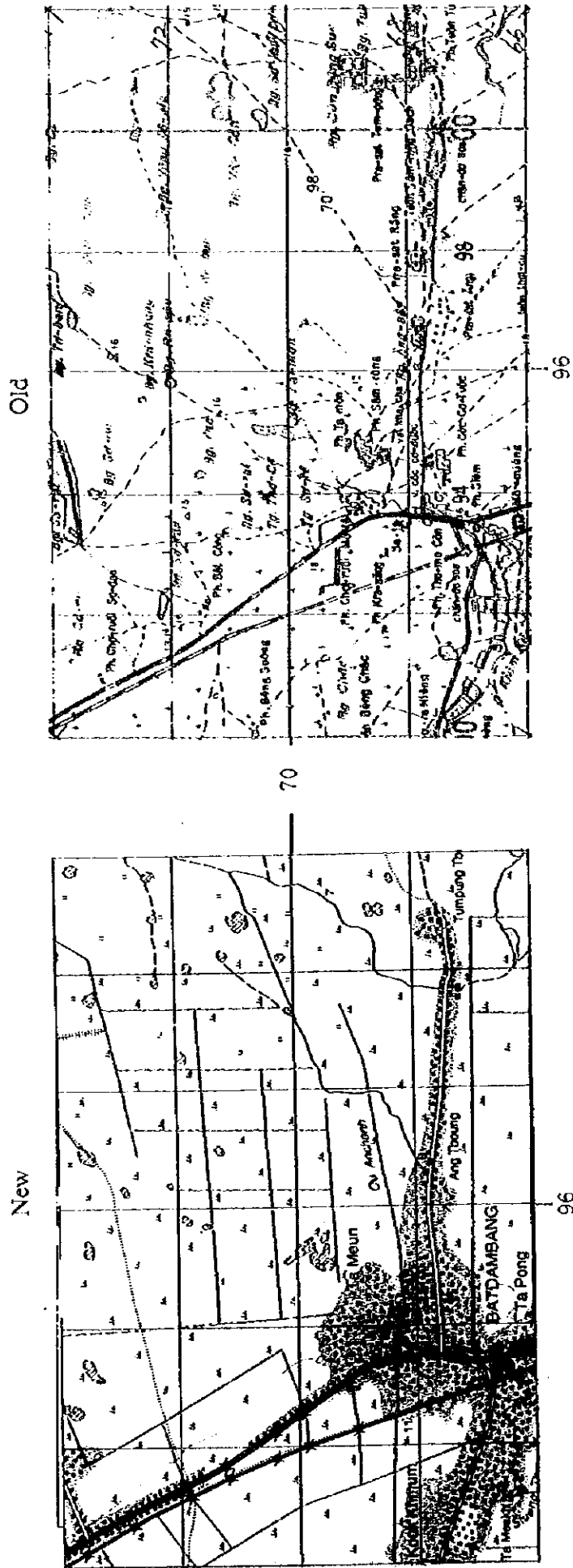
The river (No.52) on the left side of the new sheet does not exist on the old sheet. The river may be dried during the dry season. The road density is reduced, and the land is converted to barren land.

Figure II-2 Comparison of Topographic Maps (2)

Sheet # 5635

Sheet Name Bat Tam Bang

Coordinates 13° 20', 103° 10'



- ⑭ Increase in Canals
- ⑮ Increase in Villages

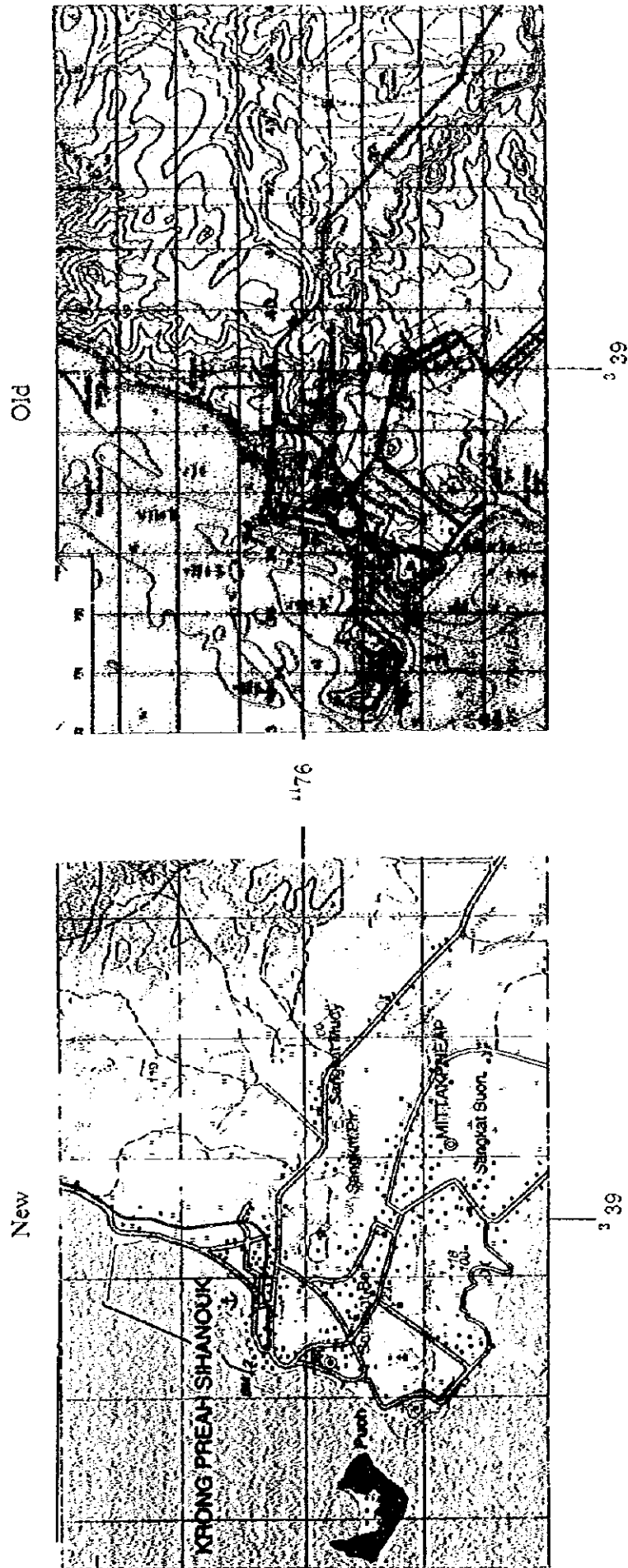
New canals and paddy fields are developed. In the center of the new sheet, new villages are recognized. This may related to the area's farm infrastructure development.

Figure II-3 Comparison of Topographic Maps (3)

Sheet # 5730

Sheet Name Krong Preah Sianou

Coordinates 10° 40', 105° 51'



Ⓟ Port development

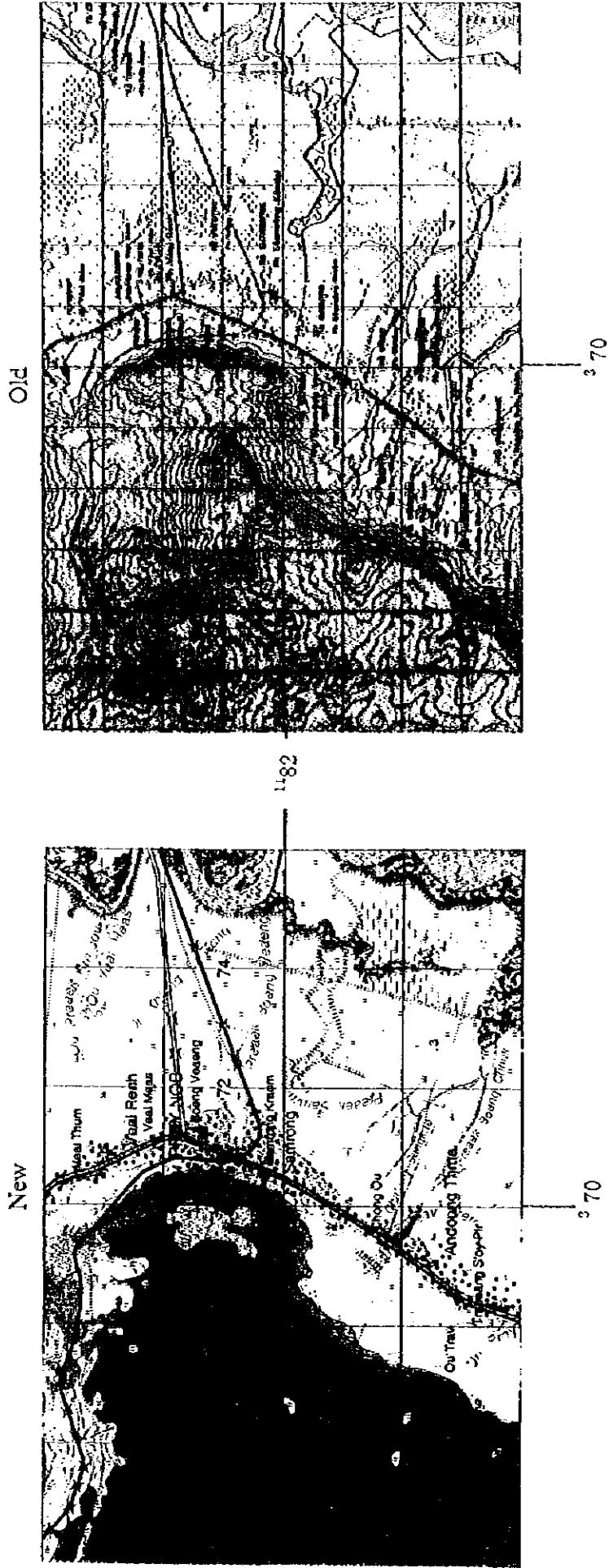
This example show a new sea port development.

Figure II-4 Comparison of Topographic Maps (4)

Sheet # 5730

Sheet Name Krong Preah Sianou

Coordinates $11^{\circ} 30', 105^{\circ} 49'$



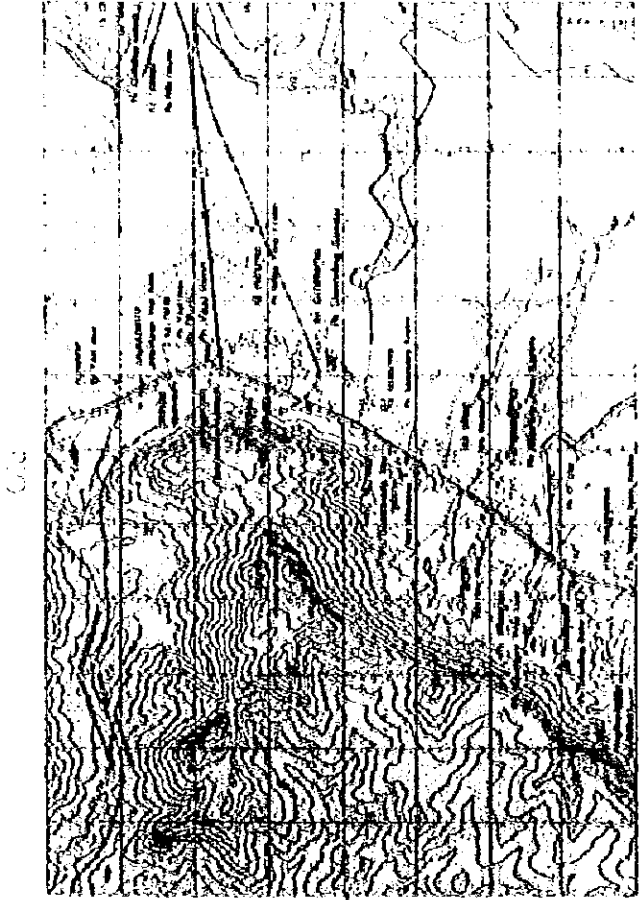
⊙ Railway station, bridges

The upper part of the new sheet shows railway station and bridge development.

1. 1:50,000 Scale
 2. 1:50,000 Scale
 3. 1:50,000 Scale
 4. 1:50,000 Scale



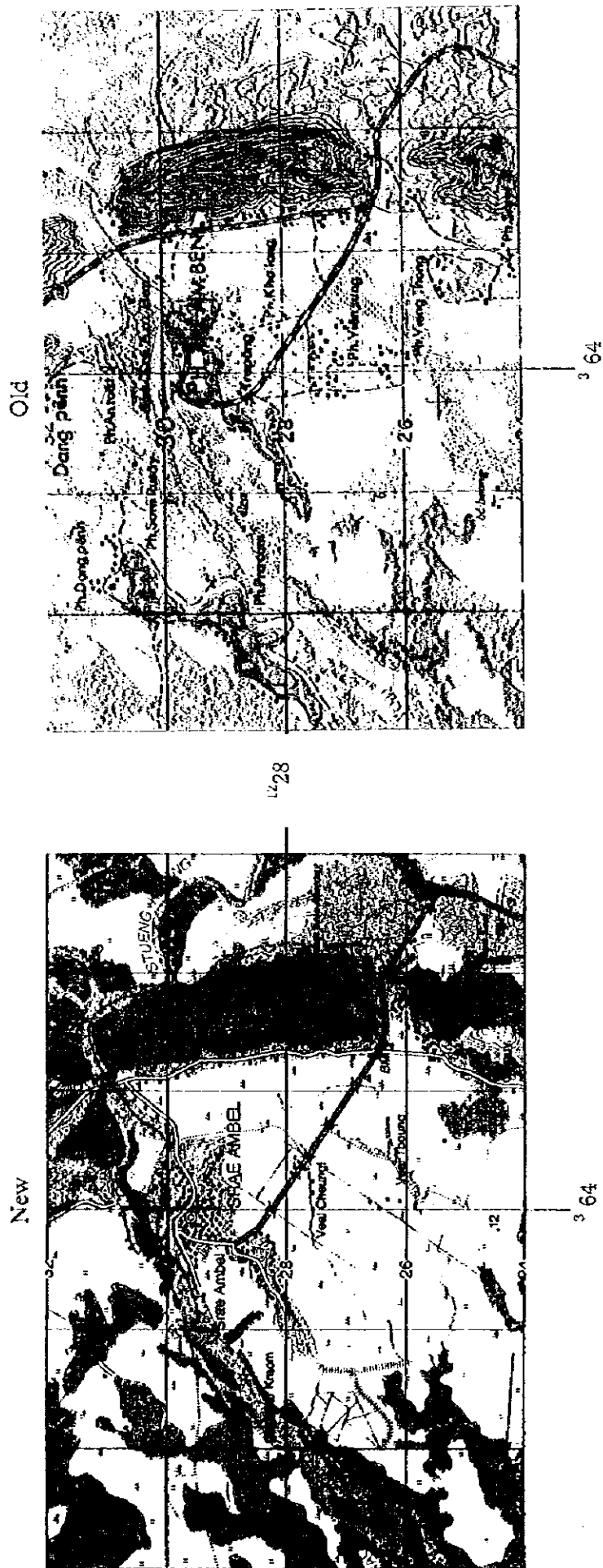
1. Railway station, bridges



2. The upper part of the new steel stocks railway station and bridge development

Figure II-5 Comparison of Topographic Maps (5)

Sheet # 5731
 Sheet Name Xre Am Ben
 Coordinates 11° 06', 103° 46'

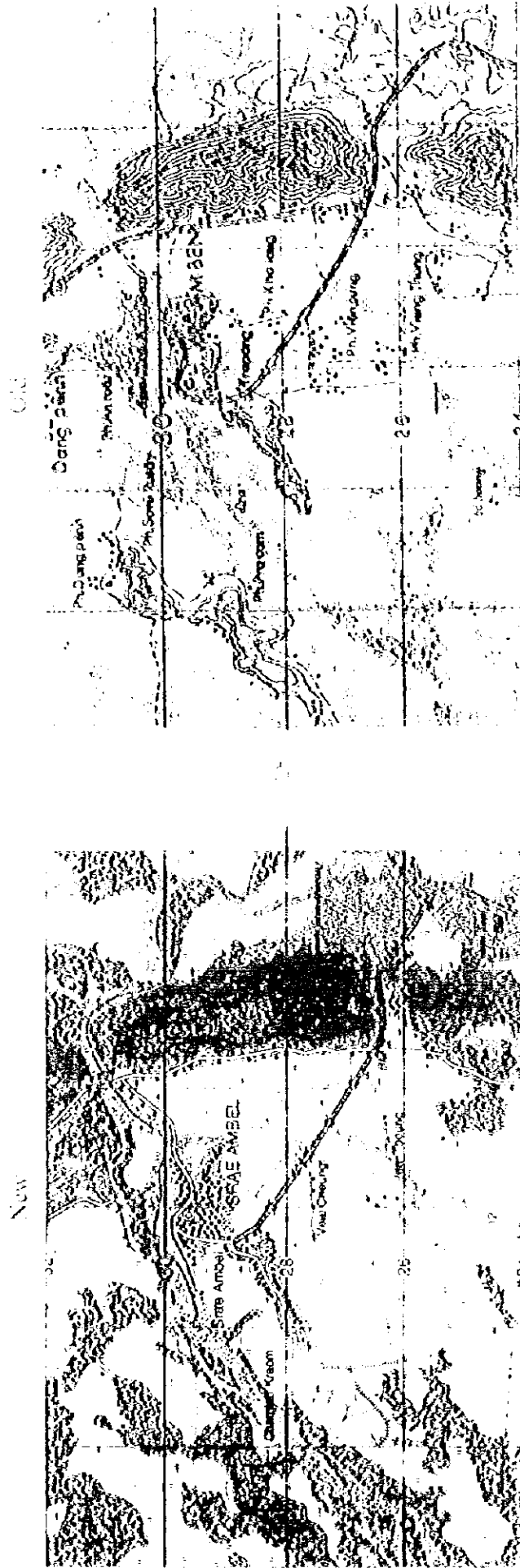


⑤ Bridge development

This example shows new bridge development to an existing road. At the center, slightly lower right, two new bridges (No. 12) are seen. In this area, individual residents are being concentrated to form a village because of canal development.

Figure II-5 Comparison of Topographic Maps (5)

Sheet # S731
 Sheet Name Xie An Ben
 Coordinates 11 06 40E 26



6. Image discrepancy

This example shows a major discrepancy in the ground truth. At the same location, there are two roads (N 12) in view.

At this location, the ground truth shows a road (N 12) in view. However, the image shows a road (N 12) in view.

Figure II-6 Comparison of Topographic Maps (6)

Sheet # 5735
 Sheet Name Xiem Rep
 Coordinates 13° 23', 103° 46'

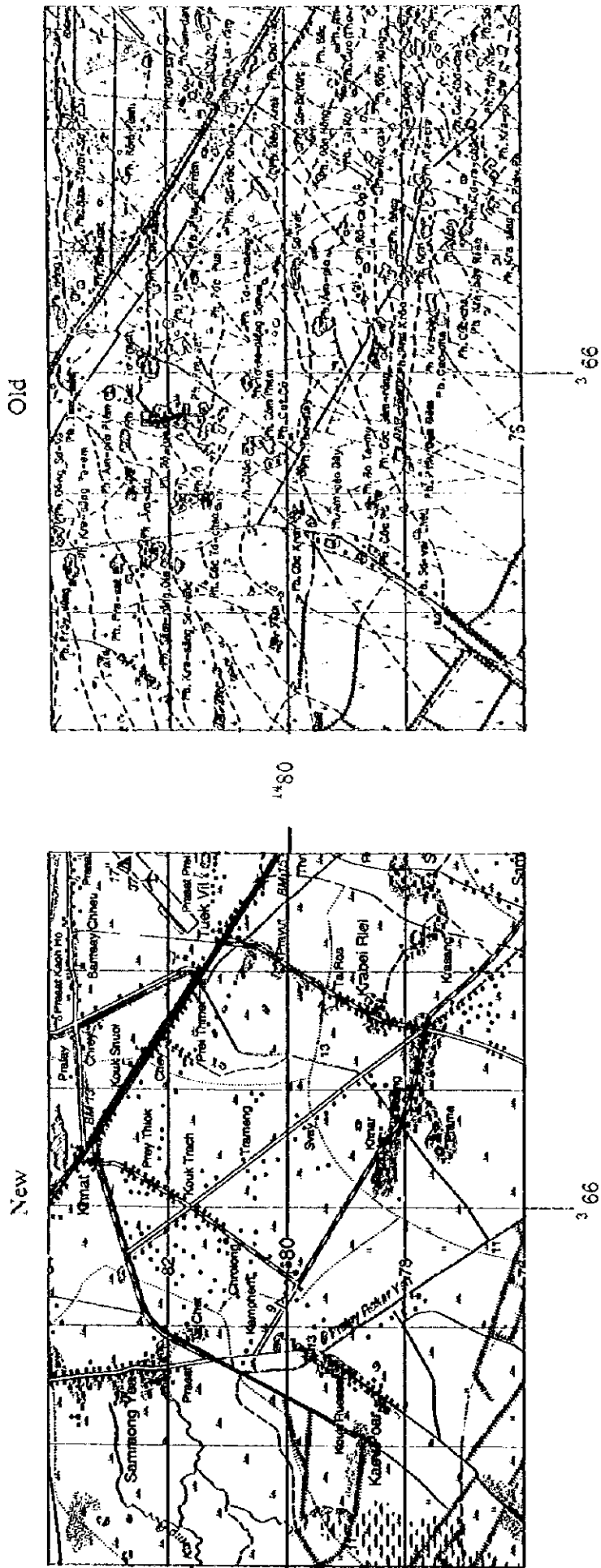
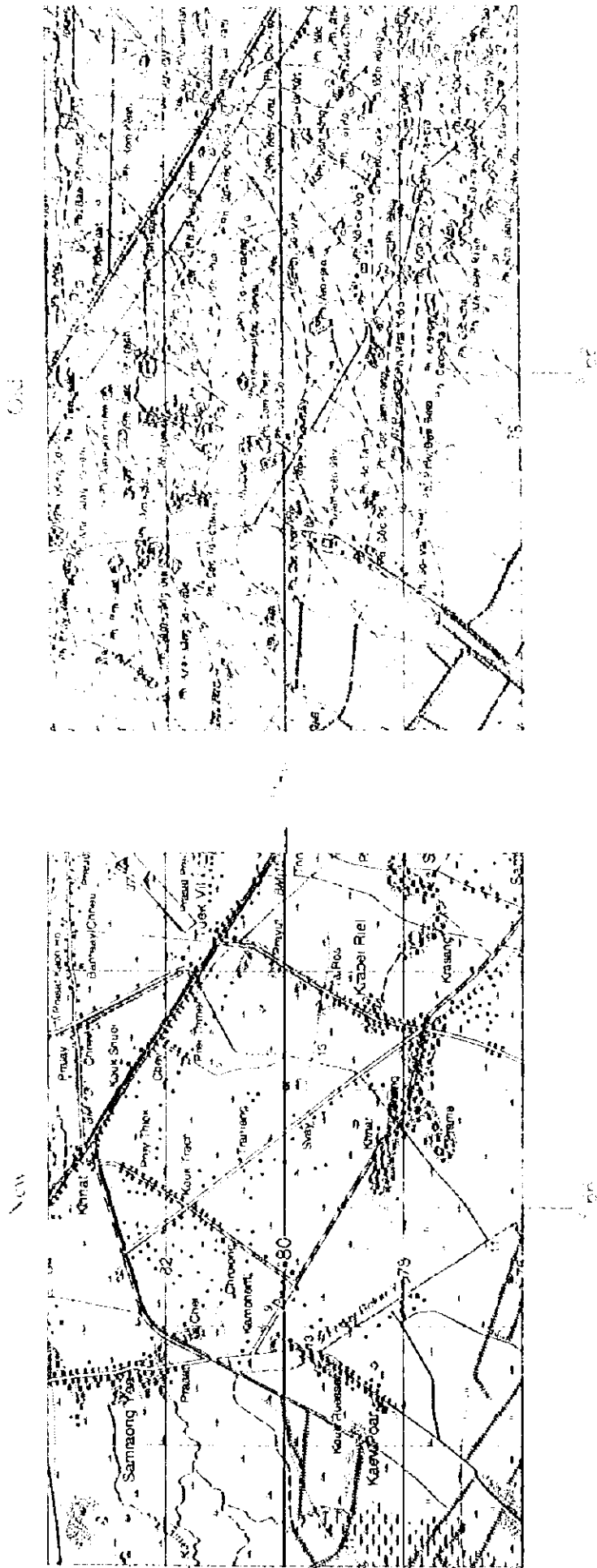


Figure H-6 Comparison of Topographic Maps (a)

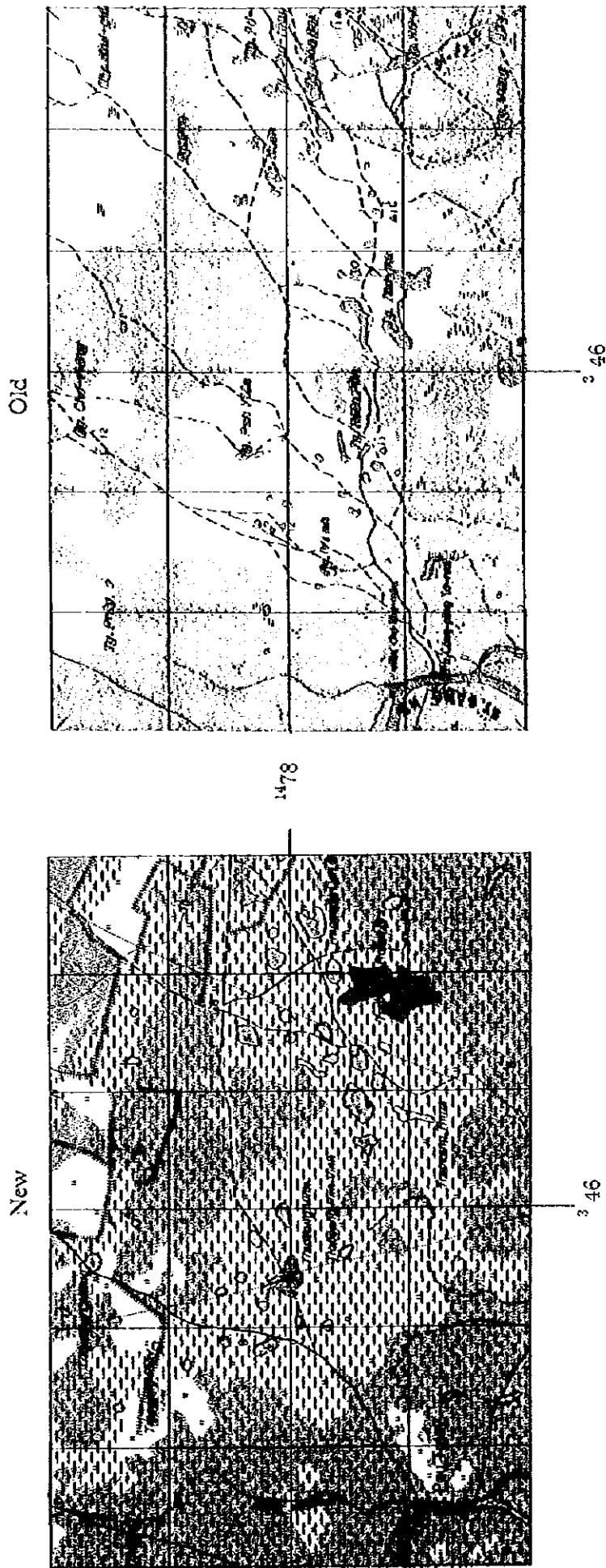
Sheet # 272
 Sheet Name Niem Key
 Coordinates 13° 28' 10" N



- ⊙ School facility development
 - ⊙ Temple
- With an increase in population, school facilities, No. 50, are being developed.
 Also the number of temples are increased

Figure II-7 Comparison of Topographic Maps (7)

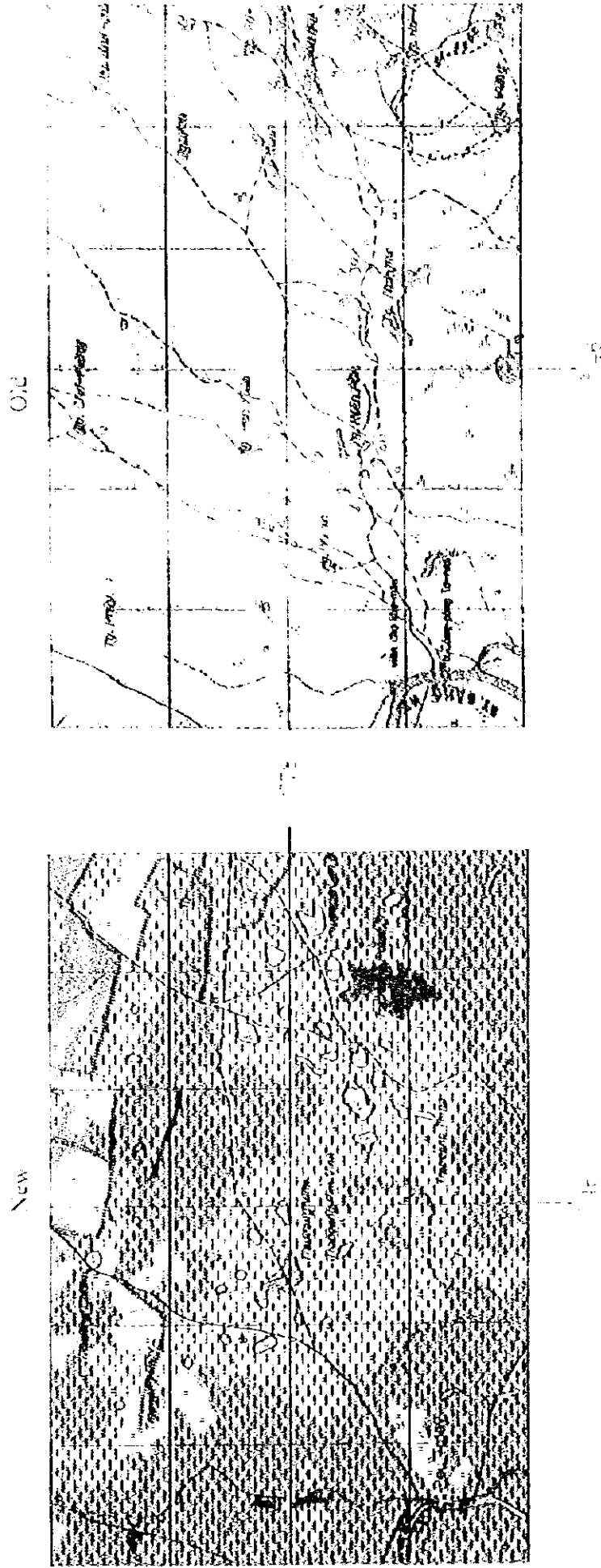
Sheet # 5735
Sheet Name Xiem Rep
Coordinates 13° 23' 103° 34'



⑮ Lakes and ponds
Areas of lakes and ponds are different from year to year because of
difference in weather conditions.

Figure II-7 Comparison of Topographic Maps (7)

Sheet # 5755
 Sheet Name Xiem Rep
 Coordinates 15° 23' 10" 34"



② Lakes and ponds
 Areas of lakes and ponds are different from year to year because of
 difference in weather conditions.

Figure II-8 Comparison of Topographic Maps (8)

Sheet # 5735
 Sheet Name Xiem Rep
 Coordinates 13° 21' 10.5" 41'

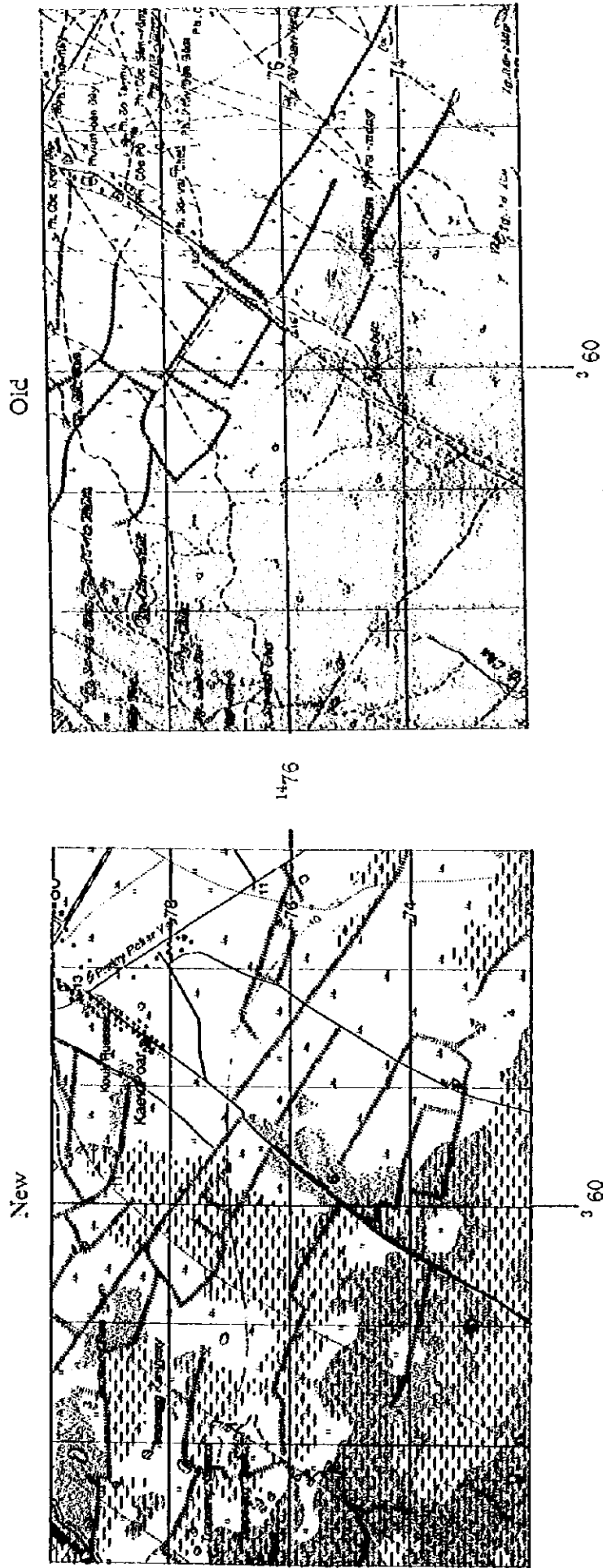
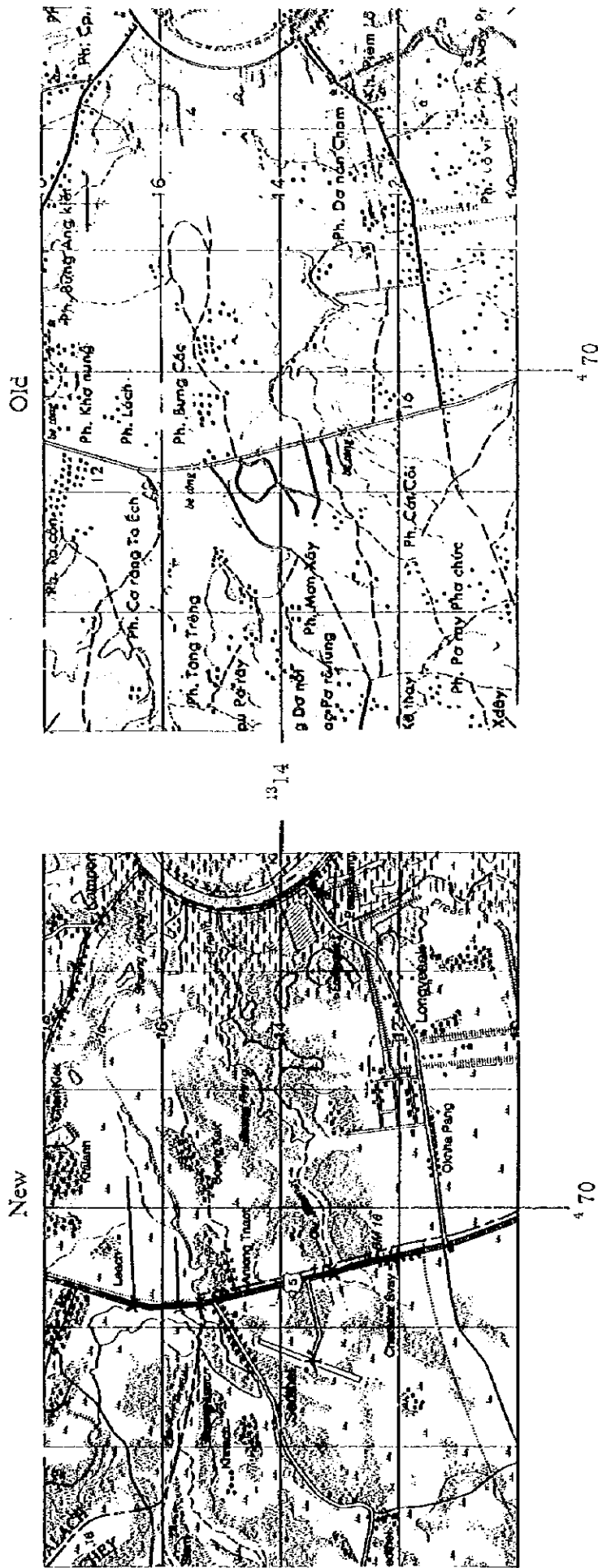


Figure II-9 Comparison of Topographic Maps (9)

Sheet # 5932
 Sheet Name Phnom Penh
 Coordinates 11° 53', 104° 42'

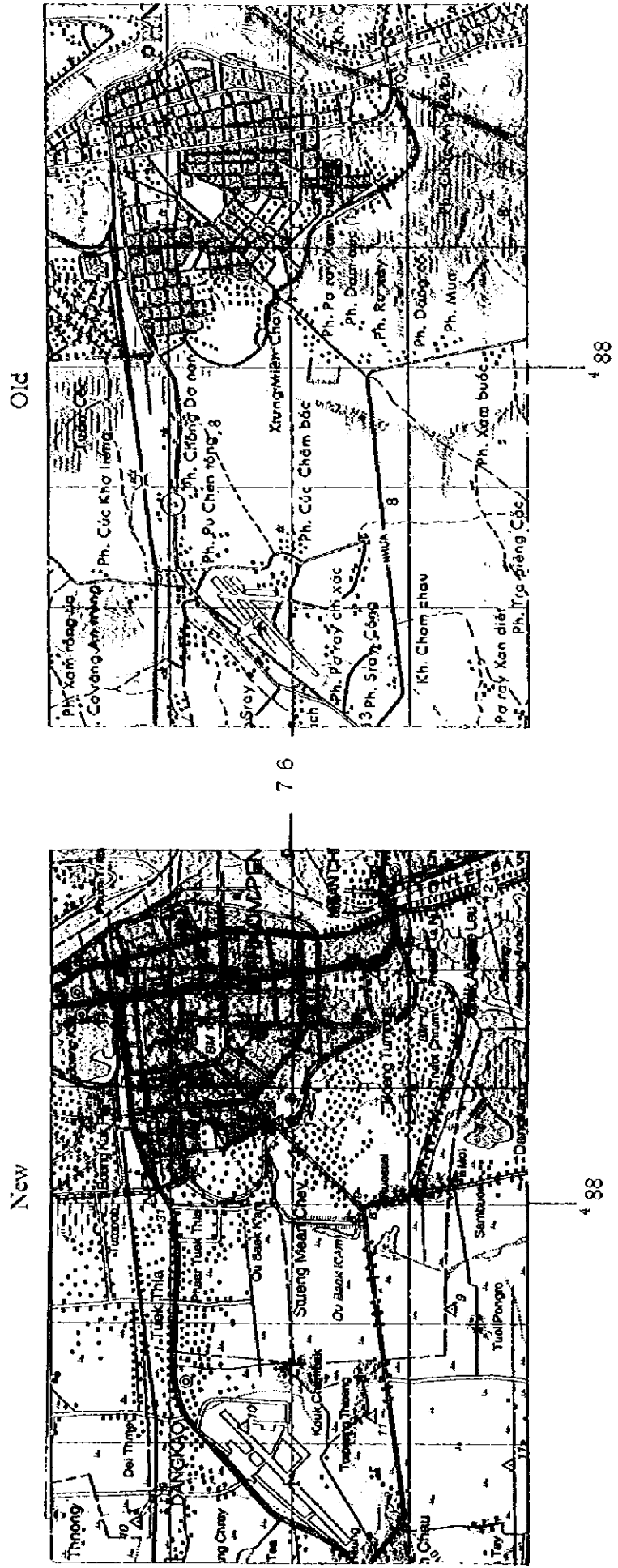


- Ⓐ Air port
- Ⓑ Road

A new air port was developed.
 New roads were developed at the lower right side of the sheet.

Figure II-10 Comparison of Topographic Maps (10)

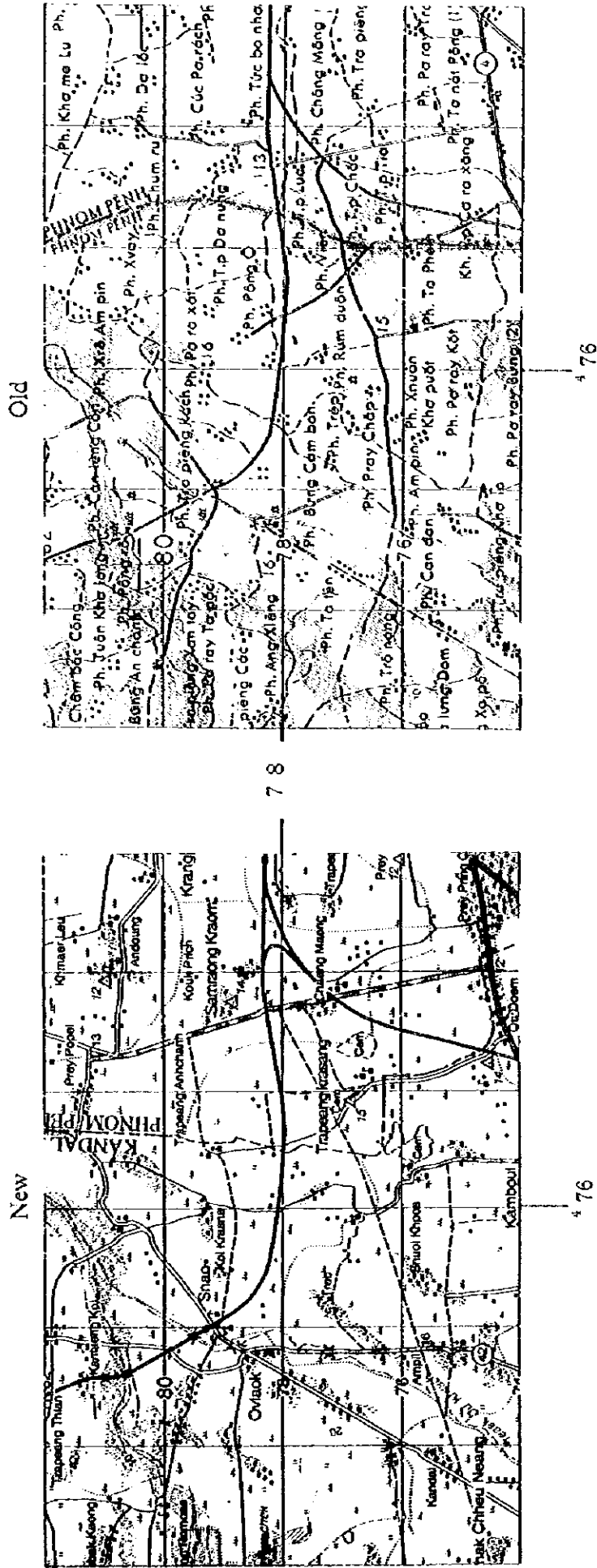
Sheet # 5932
 Sheet Name Phnom Penh
 Coordinates 11° 53', 104° 42'



② Arterial road development A new two-lane road is seen at the lower right side of the new sheet.

Figure II-11 Comparison of Topographic Maps (11)

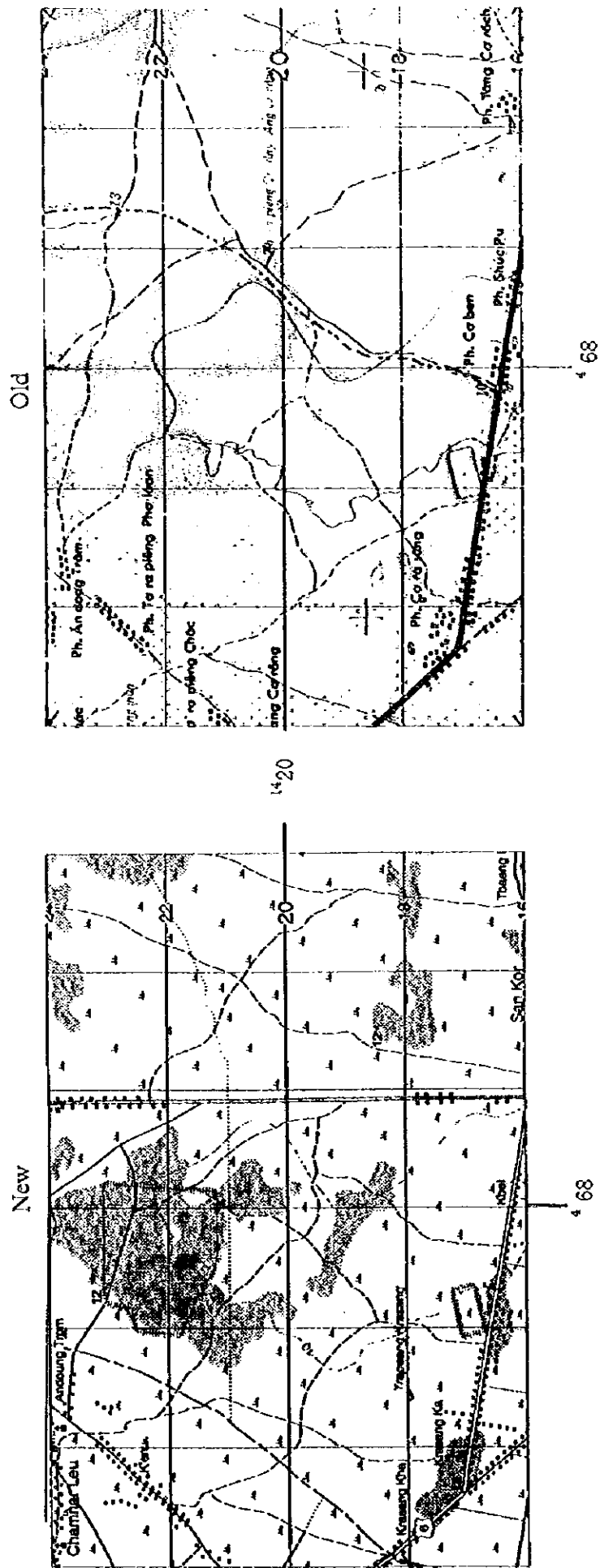
Sheet # 5932
 Sheet Name Phnom Penh
 Coordinates 11° 53', 104° 42'



- ③ Arterial road development
- ④ A new all-weather road with two or more lanes was extended to north.
- ⑤ Unpaved roads for dry season
- ⑥ New unpaved roads, which connect to the arterial road, were developed.

Figure II-12 Comparison of Topographic Maps (12)

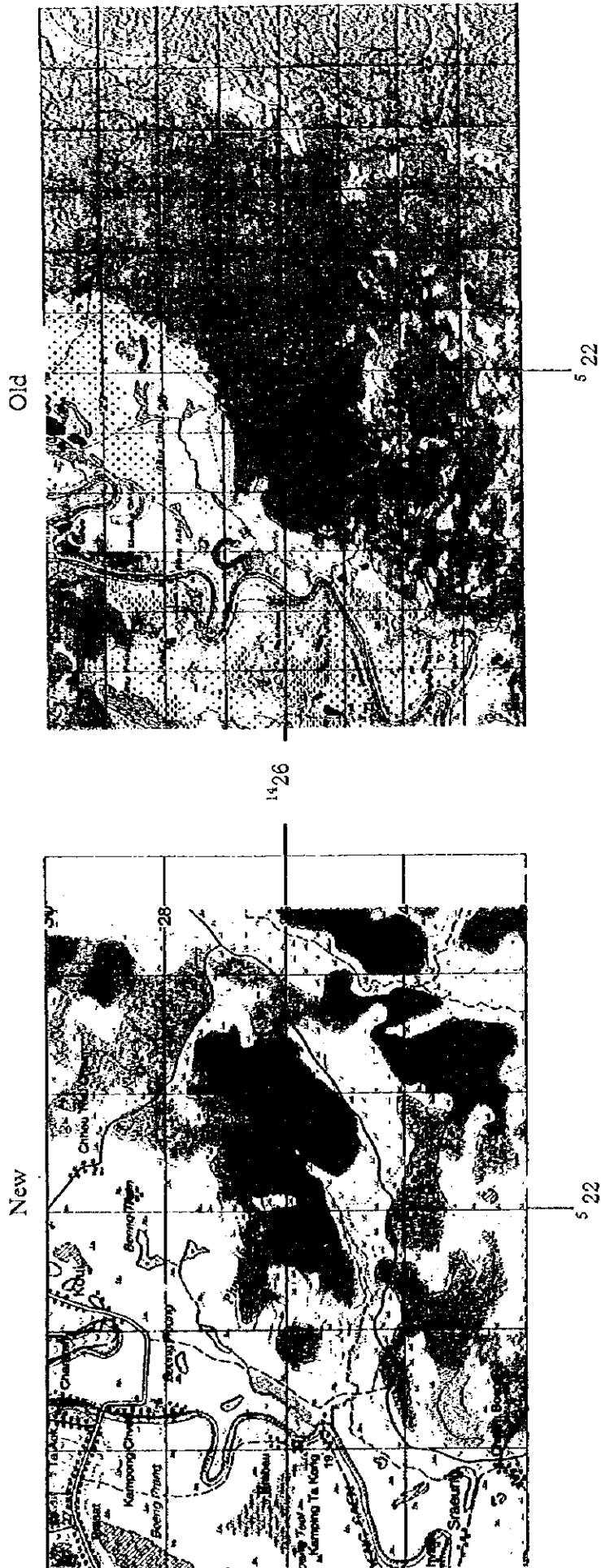
Sheet # 5934
 Sheet Name Krong Pong
 Thom
 Coordinates 12° 51', 104° 41'



① Paths
 Foot paths are extended. Along the extended foot paths, planned village development is seen.
 Areas for paddy fields are increased as canals are being developed.

Figure II-13 Comparison of Topographic Maps (13)

Sheet # 6034
 Sheet Name Santuk
 Coordinates 12° 54', 105° 12'

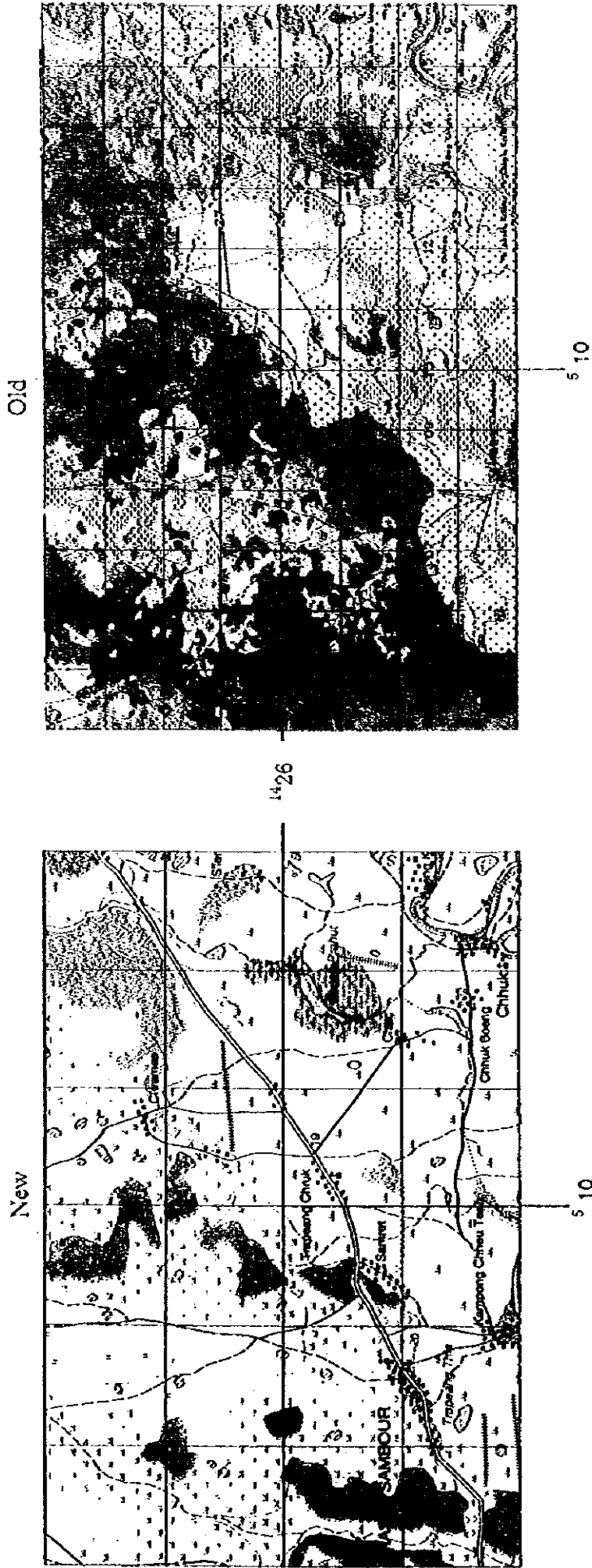


② Road

New roads for light vehicles are seen on the new sheet.

Figure II-14 Comparison of Topographic Maps (14)

Sheet # 6034
 Sheet Name Santuk
 Coordinates 12° 54', 105° 06'



③ Unpaved road

A new unpaved road (double line) is seen. As development continues, more villages and more foot paths and roads are being developed.

Appendix III Application Examples

These examples were studies as exercises by Cambodian counterparts under the guidance of the Study Team. The Team has no responsibility for the conclusions.

III-1 *GIS Application for Agricultural Allocation to Former Pol Pot Soldiers*

III-2 *Analysis Road Alignment Study of Route 5*

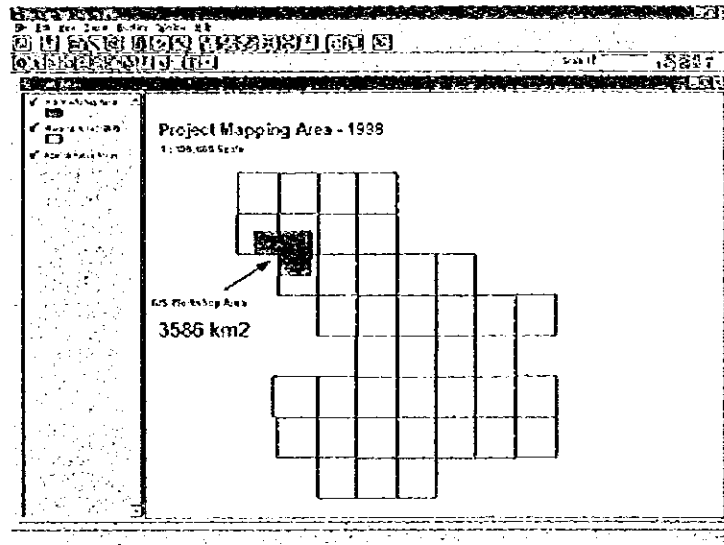
III-3 *Identifying Changes of Topographic Information Using a GIS*



**Agricultural Land Allocation
to Former Pol Pot Soldiers**

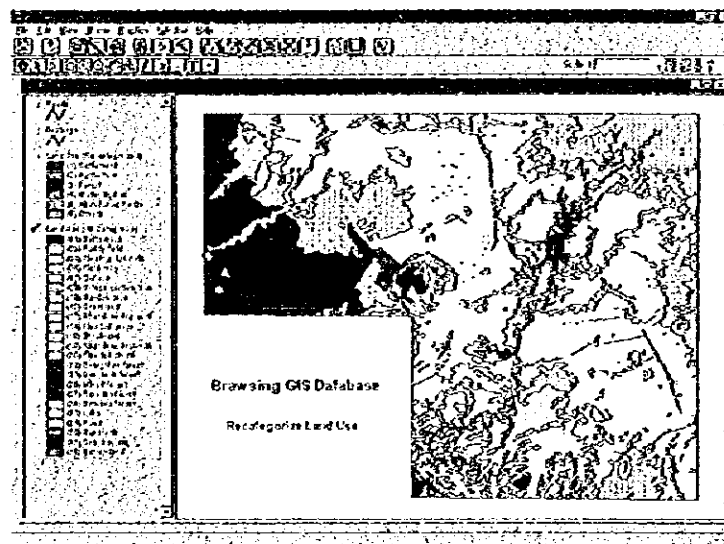
1. GIS Workshop Area

The project mapping area is covered by forty (40) sheets of 1 : 100,000 paper map series. A smaller area is defined as the "GIS Workshop Area" as shown in the figure below, to demonstrate visual analysis of geographic information from the GIS Database.



2. Land Use

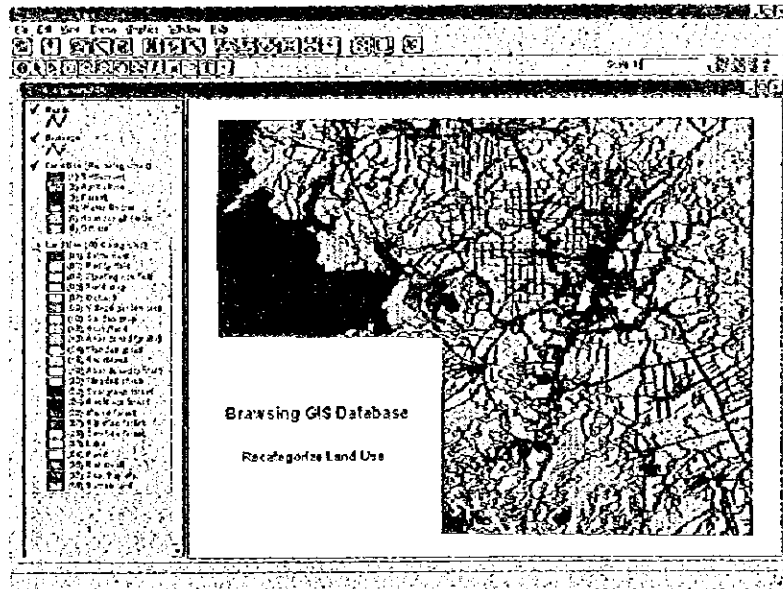
Land Use data are displayed in the figure below. The legend on the left hand side shows that there are 23 out of 40 land use classes within the work shop area.



3. Re-categorizing Land Use

The land use categories in the workshop area could be re-categorized, as shown in the example below. It may help to better understand the pattern of economic activities in this specific area.

Data standardization, meta-data, database design and such belong to the key tasks in GIS, probably because those are the best reference for producing geographic information, as it is attempted to demonstrate in this example.



In the above re-categorized GIS map superimposed by the drainage and road layers it can be observed, how the people in this area are "active" or "not active" (abandoned areas) in agriculture; how the drainage and transport infrastructure are provided for their agricultural activities.

Land Use/Cover in 1996 in The Study Area

Code	Land Use	Area (Km2)	Percentage(%)
1	Settlement	182.96	5.10
2	Agricultural Land	1720.11	47.96
3	Forest Area	443.38	12.36
4	Water Bodies	25.56	0.71
5	Abandoned Fields	1212.94	33.82
6	Others	1.25	0.03
Total		3586.20	100

* Abandoned fields cover 33.82% of the total land in the study area.

* Land that was being used only 47.96% of the total land in the area.

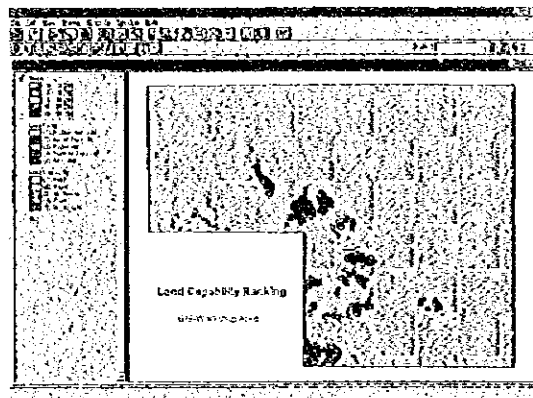
4. GIS Analysis

Available Land for Agricultural Development

Visual (graphical) overlays in above may facilitate identification of the existing regional phenomenon. However, the topological overlays in GIS will provide a new data set, from which users can obtain new information. The "Land Capability Map" in the following example would be a "new information" of such kind.

First, slope data are derived from the DEM, which is generated by using the spot height and contour data. To explain the functioning of "topological overlay" in a simple manner, those slope data are topologically overlaid with the Land-Form data, to produce the "Land Capability Map".

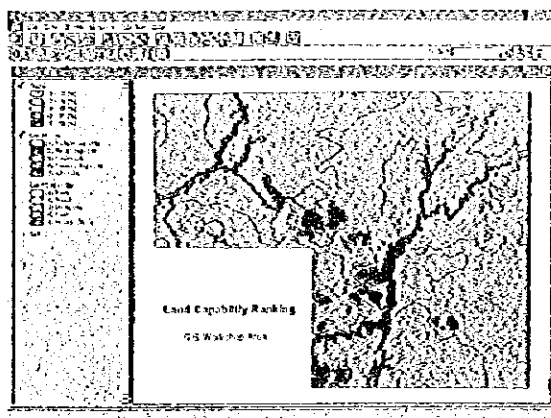
The slope map in below shows that the area is generally flat.



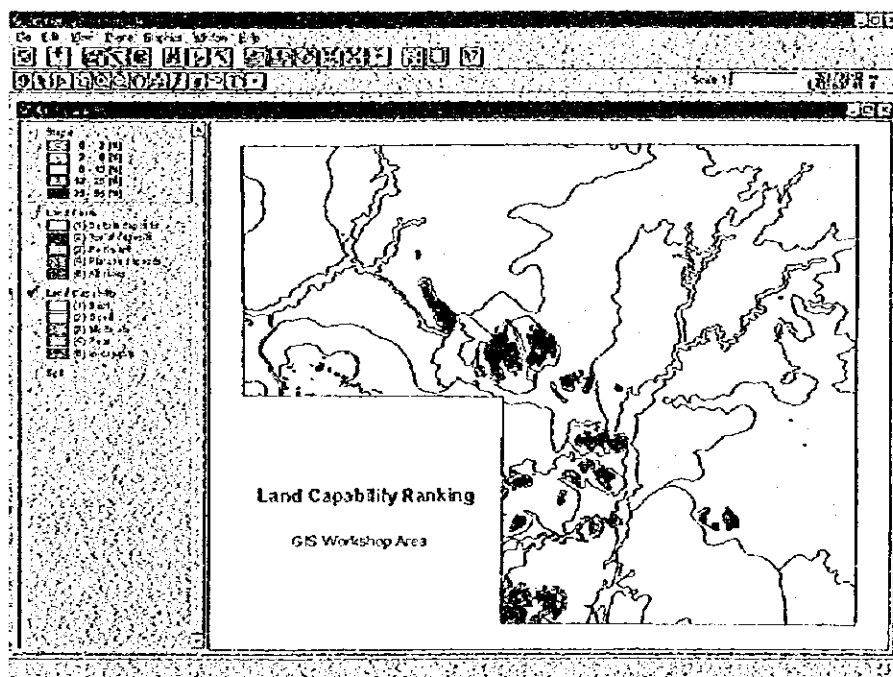
The land form in this area is assumed to influence the capability of land for agriculture.



The result of overlaying those two layers is shown in the figure below.



When the resulting data set is re-categorized, as it has been done with the land use data, then the following "Land Capability Map" can be produced.



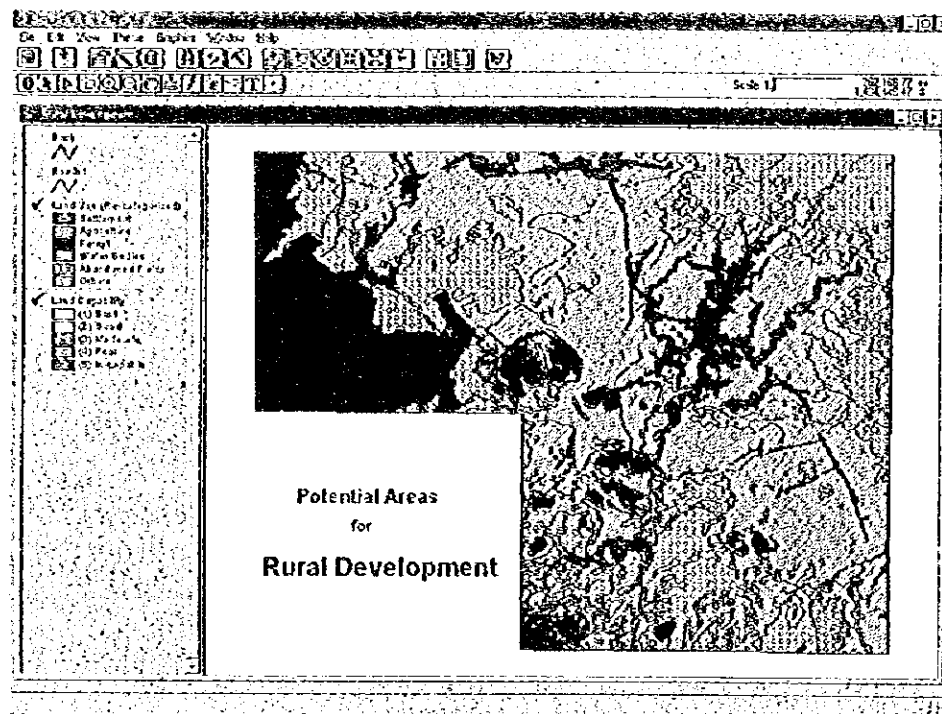
Land Capability in the Study Area

Code	Capability	Area (Km2)	Percentage(%)
1	Most Capable	2518.07	70.14
2	Capable	989.29	27.56
3	Less Capable	23.04	0.64
4	Moderate	2.13	0.06
5	Not Capable	57.62	1.60
Total		3586.20	100

*. 97.7% of the land was capable for agriculture.

Land Availability and Constraints

By overlaying this Land Capability with the Land Use layer, the available areas for development can be identified.



Land Availability in the Study Area

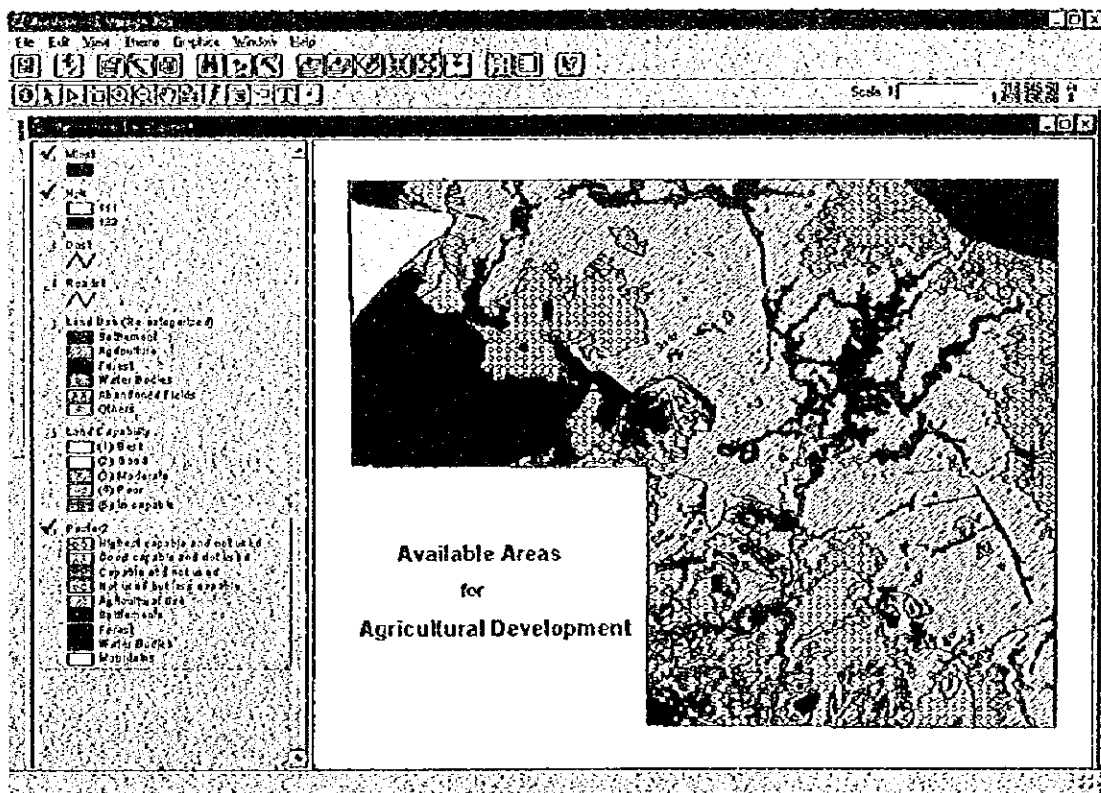
Code	Land Availability	Area (Km2)	Percentage(%)
1	Most Capable But Not Used	652.43	18.17
2	Capable But Not Used	537.84	14.98
3	Less Capable and Not Used	5.95	0.17
4	Moderate and Not Used	1.13	0.03
5	Not Capable and Not Used	26.05	0.73
Total		1190.27	33.15

*. 33.15% was not used at that time though the land was capable.

Assuming that the abandoned areas generally are "available", and the "availability" of land for development could be defined and ranked by considering the agricultural capability of the land.

However, this availability might be constrained, for example by presence of land mines, by environmentally protected areas, and so on. Those constraints can be superimposed on top of the above ranking map, to optically evaluate the land availability.

The figure in below shows such a "Land Availability Ranking" map superimposed by constraining factors, such as land mines and environmentally protected areas.



ANALYSIS ROAD ALIGNMENT STUDY OF ROUTE 5

ANALYSIS OF ROAD ALIGNMET FOR ROAD # 5

1. Objective

Analyze to find new location of a main road connecting Kampong Chhnang provincial center to Bat Dambang provincial center and a road connecting from Pousat provincial center to the newly created road (Fig. 1)

2. Criteria

- The new road has to be the shortest (in distance) from the starting point to its destination. (from Kampong Chhnang to Bat Dambang).
- The road must be on the following condition:
 1. The slope condition (refer to slope ranking in table 1),
 2. Geological condition see table 2, (Pediment Most suitable),
 3. Flood condition from SAR Imagery see table 3, (not flooded area is the best),
 4. Drainage condition see table 4 (the road should cross least stream).

Table. 1

Sloprouge	Friction N°	
0° - 2°	1	Most suitable
2° - 5°	5	
5° - 7°	10	
7° - 10°	20	
10° - 15°	50	
15° - 25°	60	
25° - 45°	100	

Table. 2

Geocode	Land use	Friction N°	
1	Water	10	
2	Flood Plain	2	
3	Alluvial Fans	3	
4	Colluviums	3	
5	Padiments	1	The best
6	Lake Bod	4	
7	Daitas	3	
8	Tidal Flats	5	
9	Beach Ridges	3	
10	Swamps	4	
17	Rock	6	

Table. 3

Lan use	Friction
Flood	100
Not flood	1

Table. 4

Land use	Friction	
River, stream	10	
No river, stream	1	The best

* The analysis is based on Friction number given to each item. The less number is the best condition.

3. Data used

1. Contour line,
2. Spot height,
3. Geology,
4. The flooded Area from SAR imagery in rainy season,
5. Drainage,
6. Provincial Center locations.

4. Software

- ARCINFO. 7, 1, 2
- AECVIEW 2,00
- Idrissi 2.00.

5. Situation of Present Road # 5

1. Road section falling in the flooded areas (Fig. 2),
2. Geological condition for Road # 5 (Fig. 3),
3. Drainage system and Road # 5 (Fig. 4),
4. DEM (Slope) of road alignment analysis area (Fig. 5).

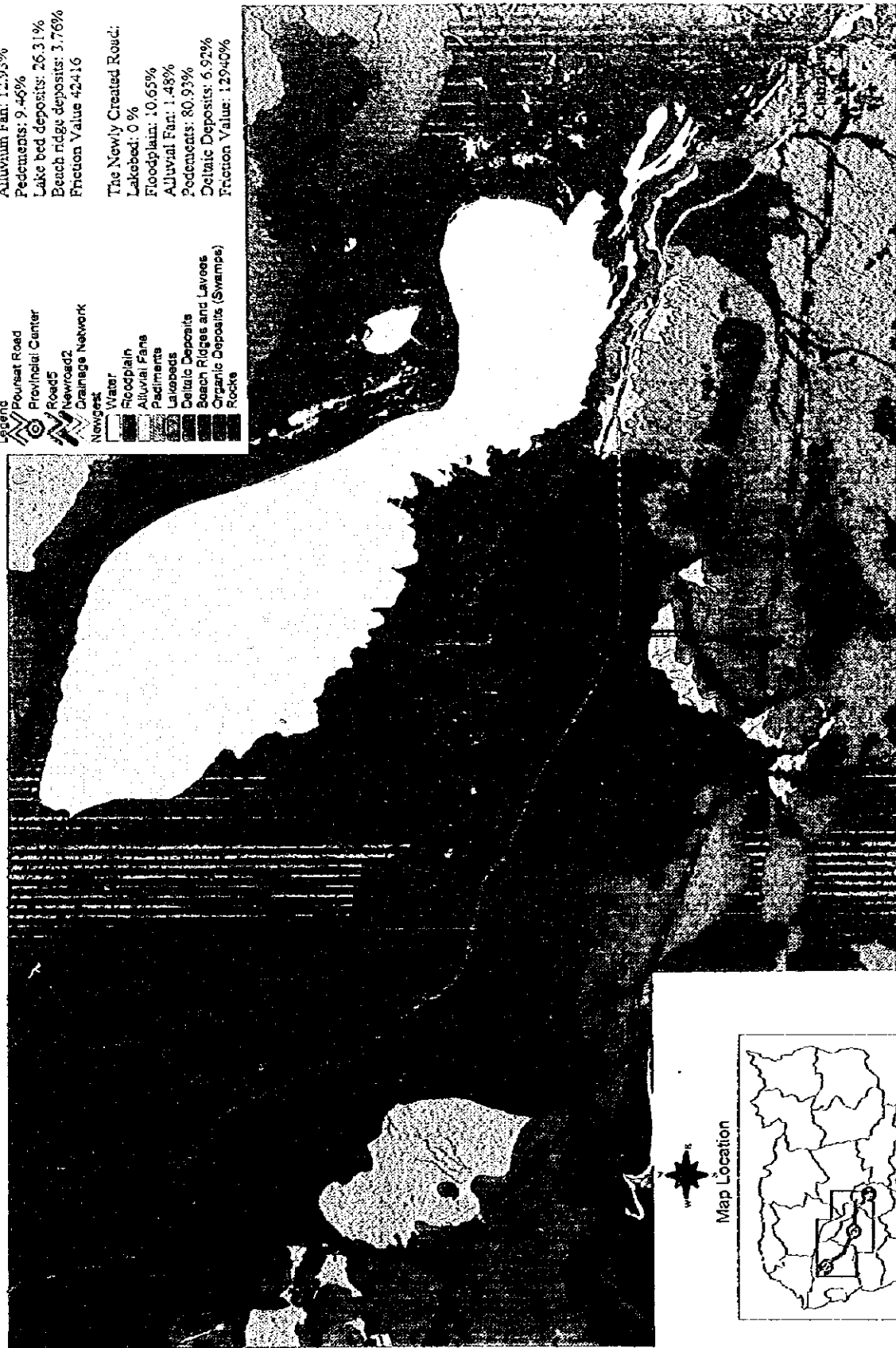
6. Result

Fig. 1 shows the result of the analysis.

7. Methodology

Fig. 6 shows the methodology of this analysis.

Fig 1. The Two New Alignments of The Analyzed Roads

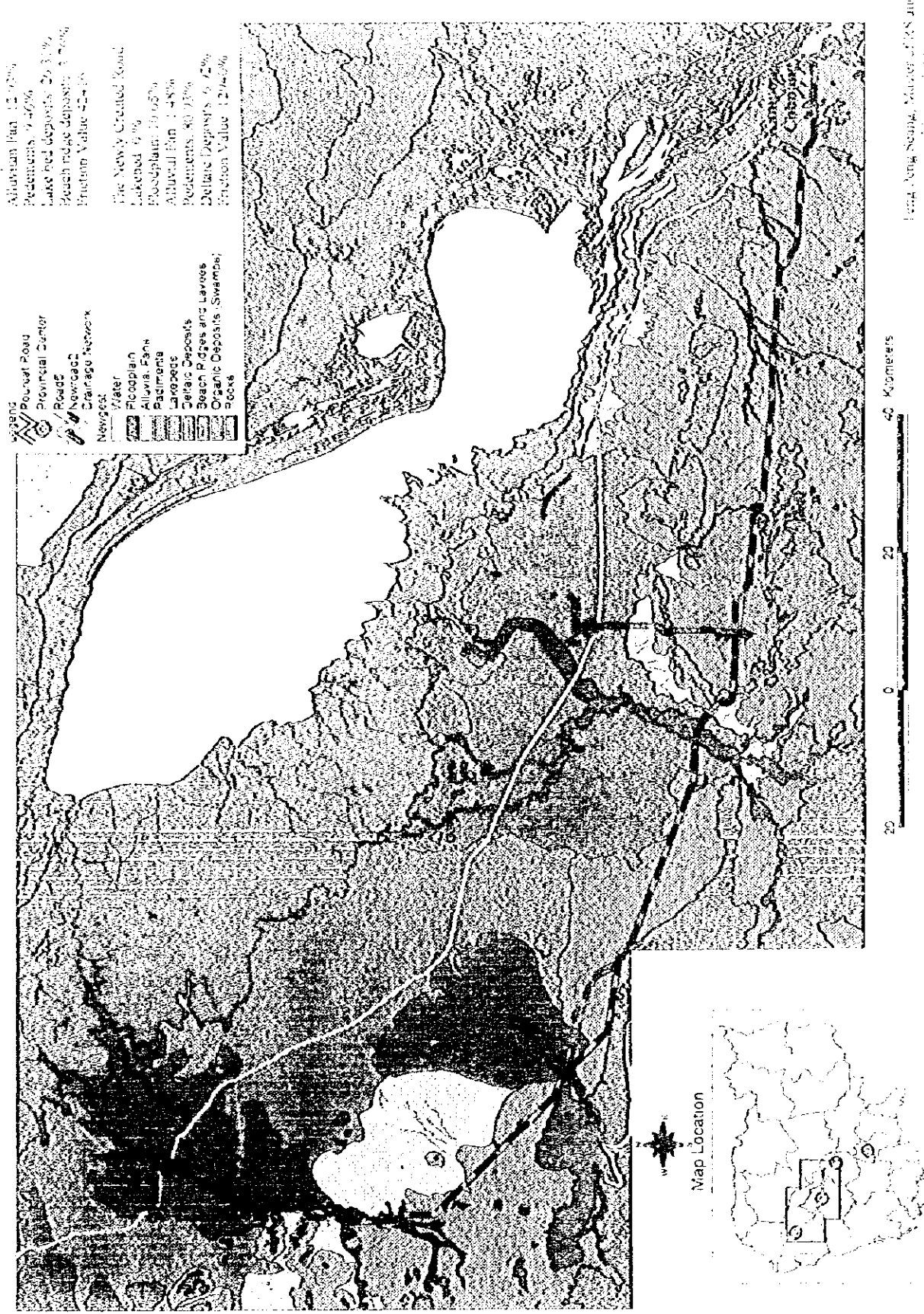


The old road (road 5) runs across:
 Lake bed: 19.34% (38.66 km)
 Floodplain: 2.81%
 Alluvium Fan: 12.93%
 Pediments: 9.46%
 Lake bed deposits: 26.31%
 Beach ridge deposits: 3.76%
 Friction Value 42416

The Newly Created Road:
 Lakebed: 0 %
 Floodplain: 10.65%
 Alluvial Fan: 1.48%
 Pediments: 80.93%
 Deltaic Deposits: 6.92%
 Friction Value: 12940%

- Legend**
- Province Road
 - Provincial Center
 - Road5
 - Newroad2
 - Drainage Network
 - Newgest
 - Water
 - Floodplain
 - Alluvial Fan
 - Pediments
 - Lakebeds
 - Deltaic Deposits
 - Beach Ridges and Levees
 - Organic Deposits (Swamps)
 - Rocks

Fig 1. The Two New Alignments of The Analyzed Roads



Leila, Arif, Saad, Mawer, F. S. and G. S.
February 1999

Fig. 1. The Two View A Simulations of The Analytical Results

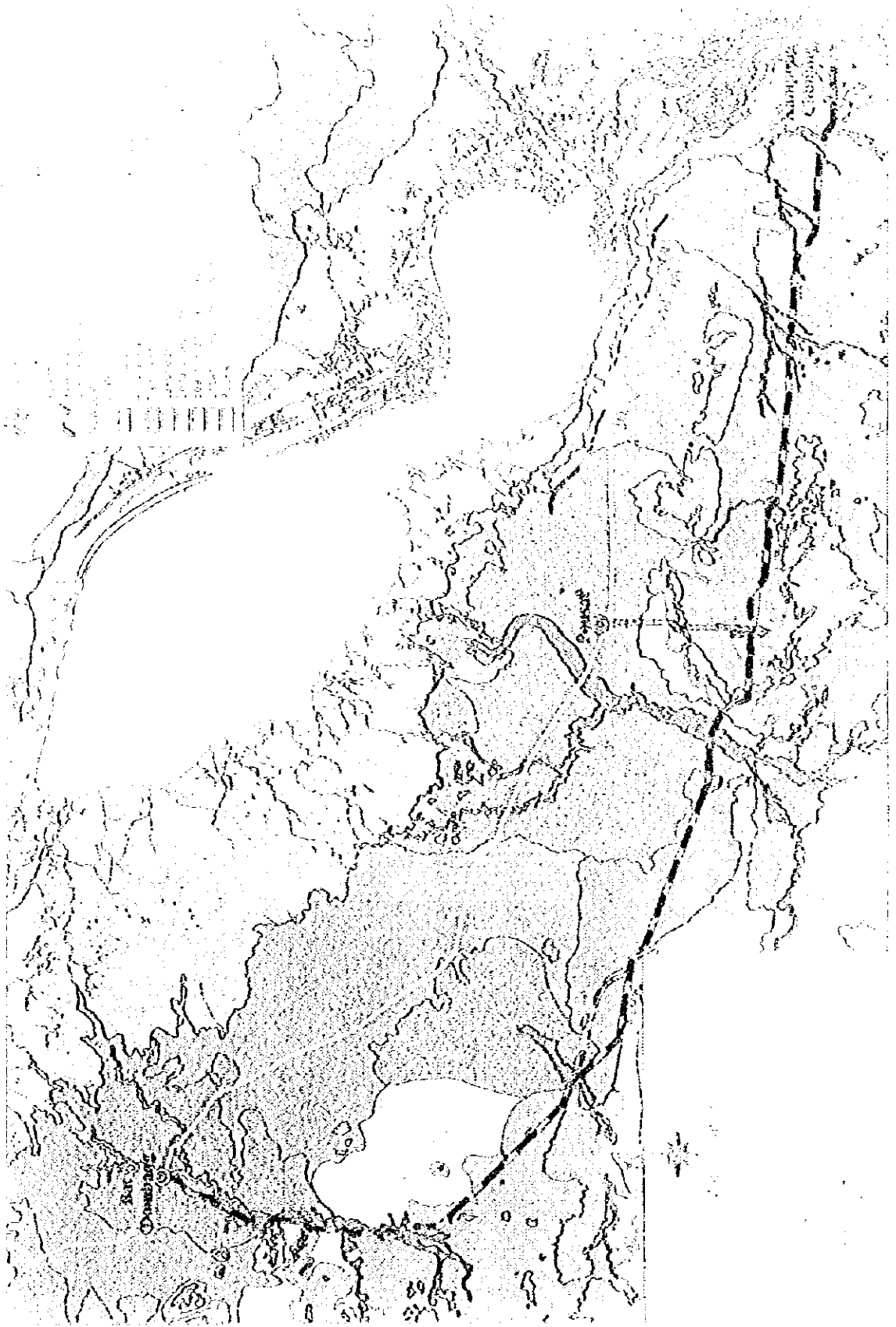
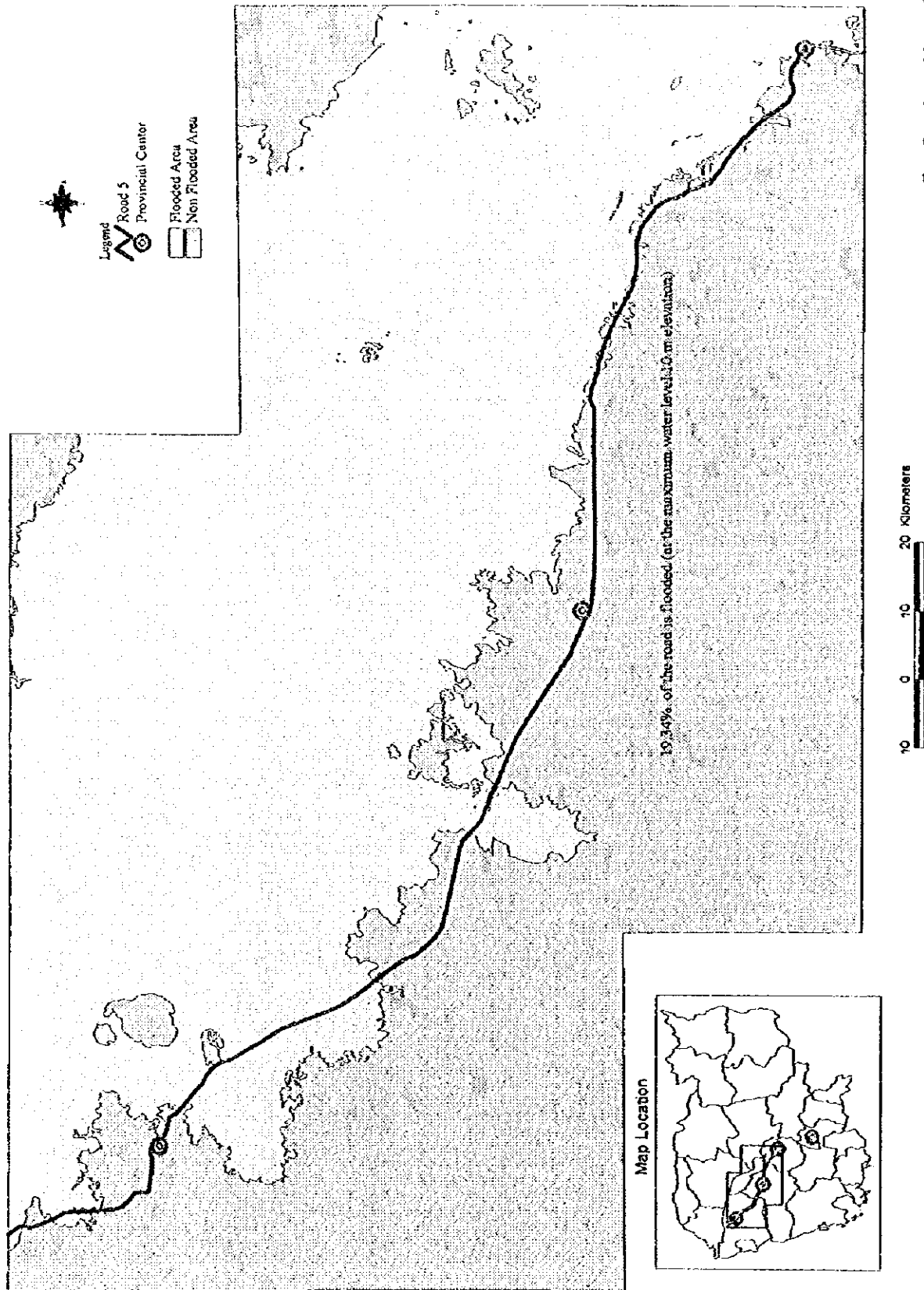


Fig 2. Road section falling in the flooded areas



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February 1999

Fig 3. Geological condition for Road # 5

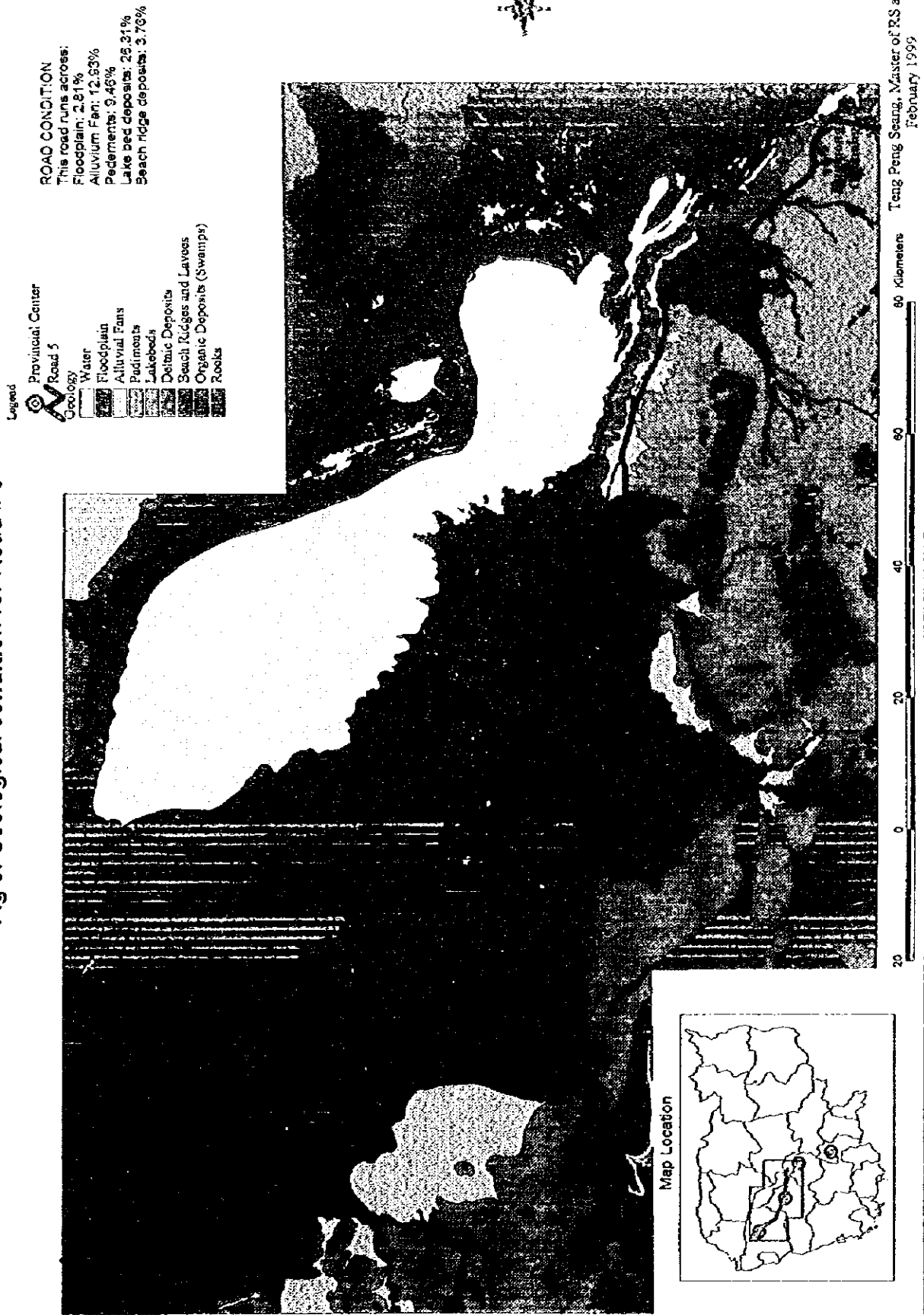


Fig. 3. Geological map of the Polesie

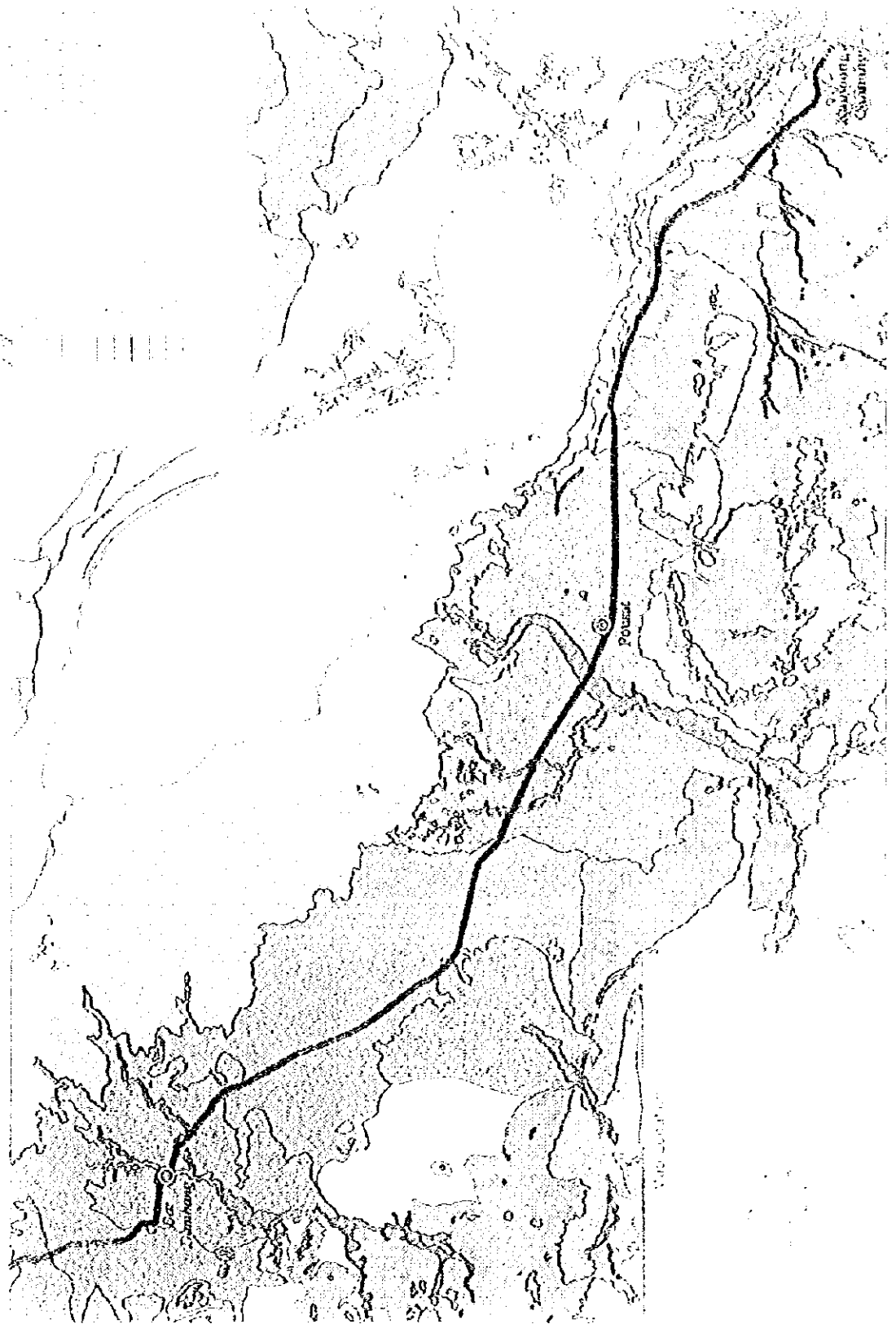
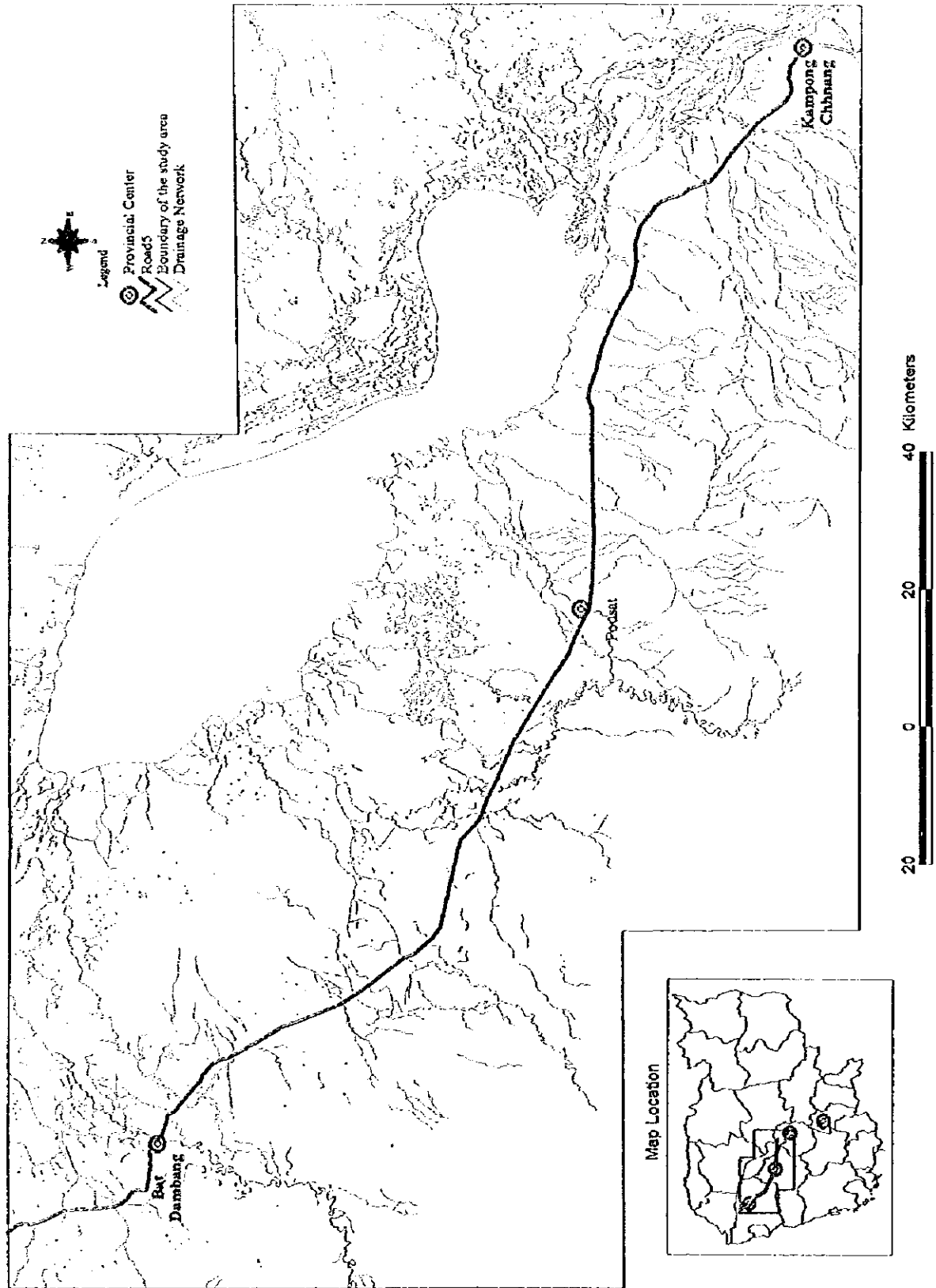


Fig 4. Drainage system and Road # 5



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Fig 5. DEM (Slope Data Source) of road alignment analysis area

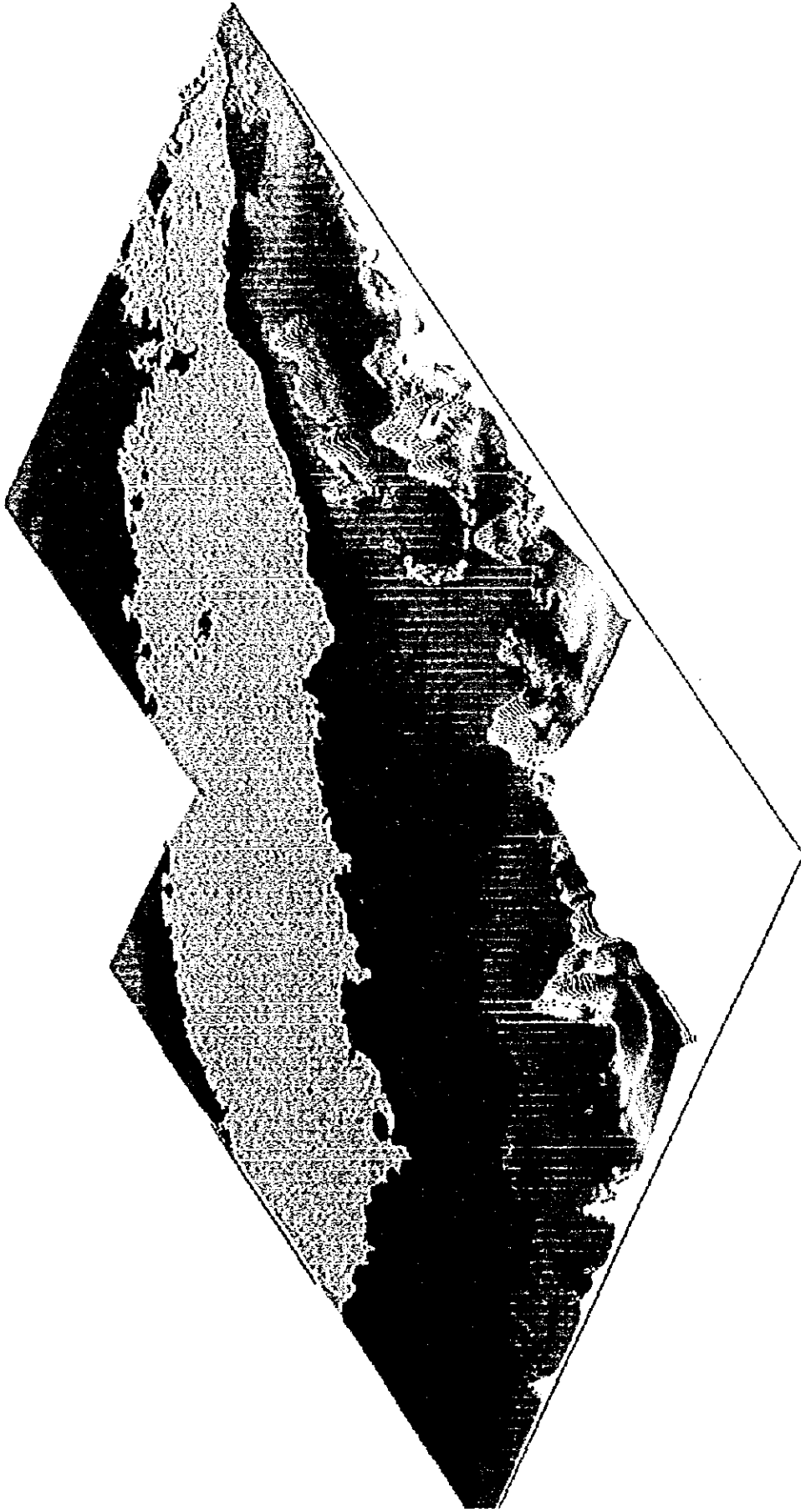
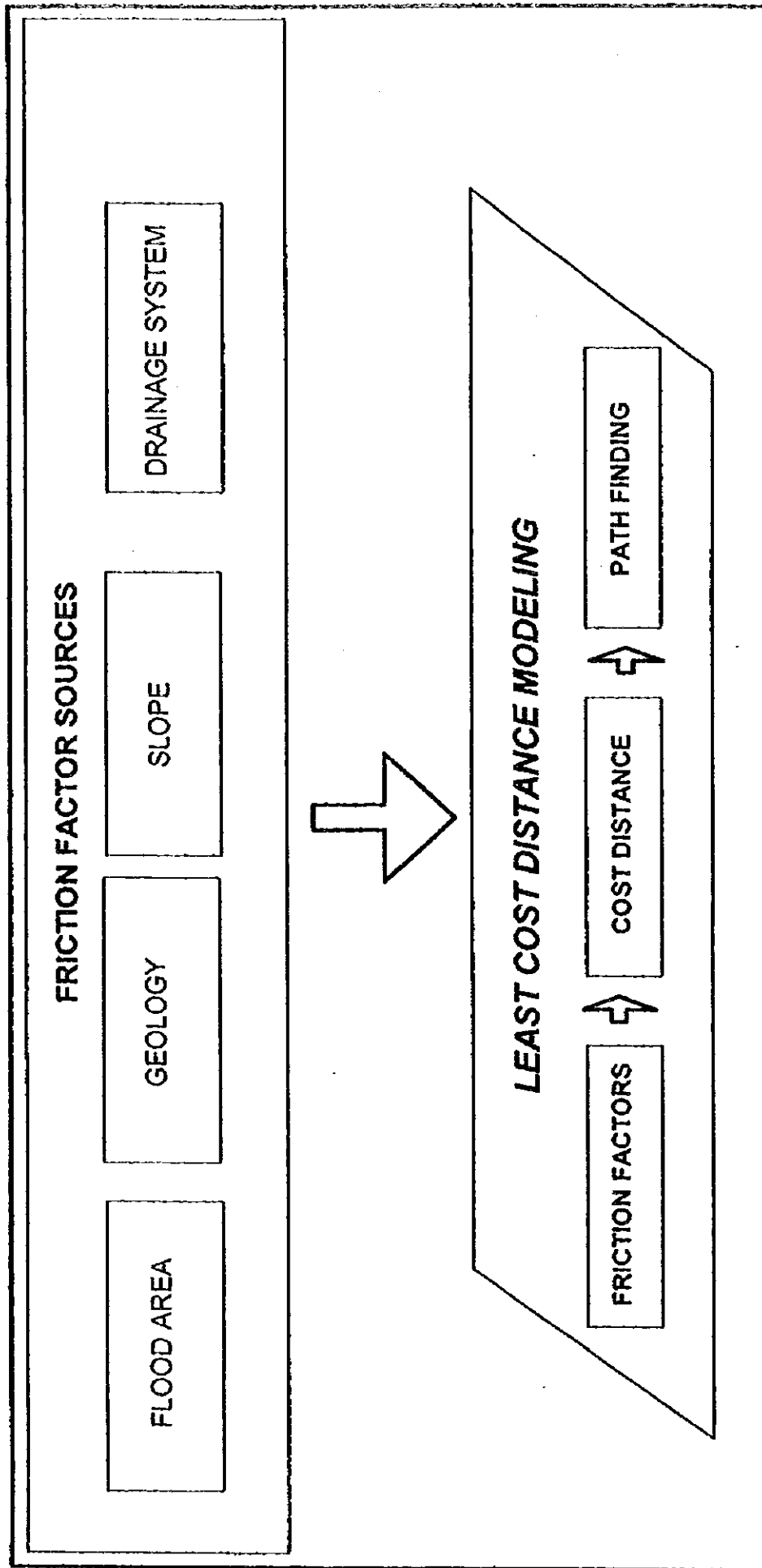


Fig. 6 The methodology of this analysis.



III-3 *Identifying Changes of Topographic Information Using a GIS*

(1) Sample Area

The sample area (3600 km²) includes Bat Tam Bang City, Bat Tam Bang Province, Svay Pao Province, Banan Province, Bavel Province, Southern Bat Tam Bang, Southeast Ack Phum, Sangkae Province, Moung Russei Province.

(2) Study Items

The study focuses on changes of ground features on the number of villages, road and rivers between 1960 and 1996 topographic data.

(3) Study Method

The source data used for this study includes field verification, aerial photographs (photographic scale: 1/25,000) taken in 1992 and 1993 and topographic maps produced by the American Army in 1960 at a scale of 1/50,000.

The topographic map produced in 1960 (L7016) was digitized and reduced to a scale of 1/100,000. Then, the digitized data were compared to the data produced in the Study.

(4) Result

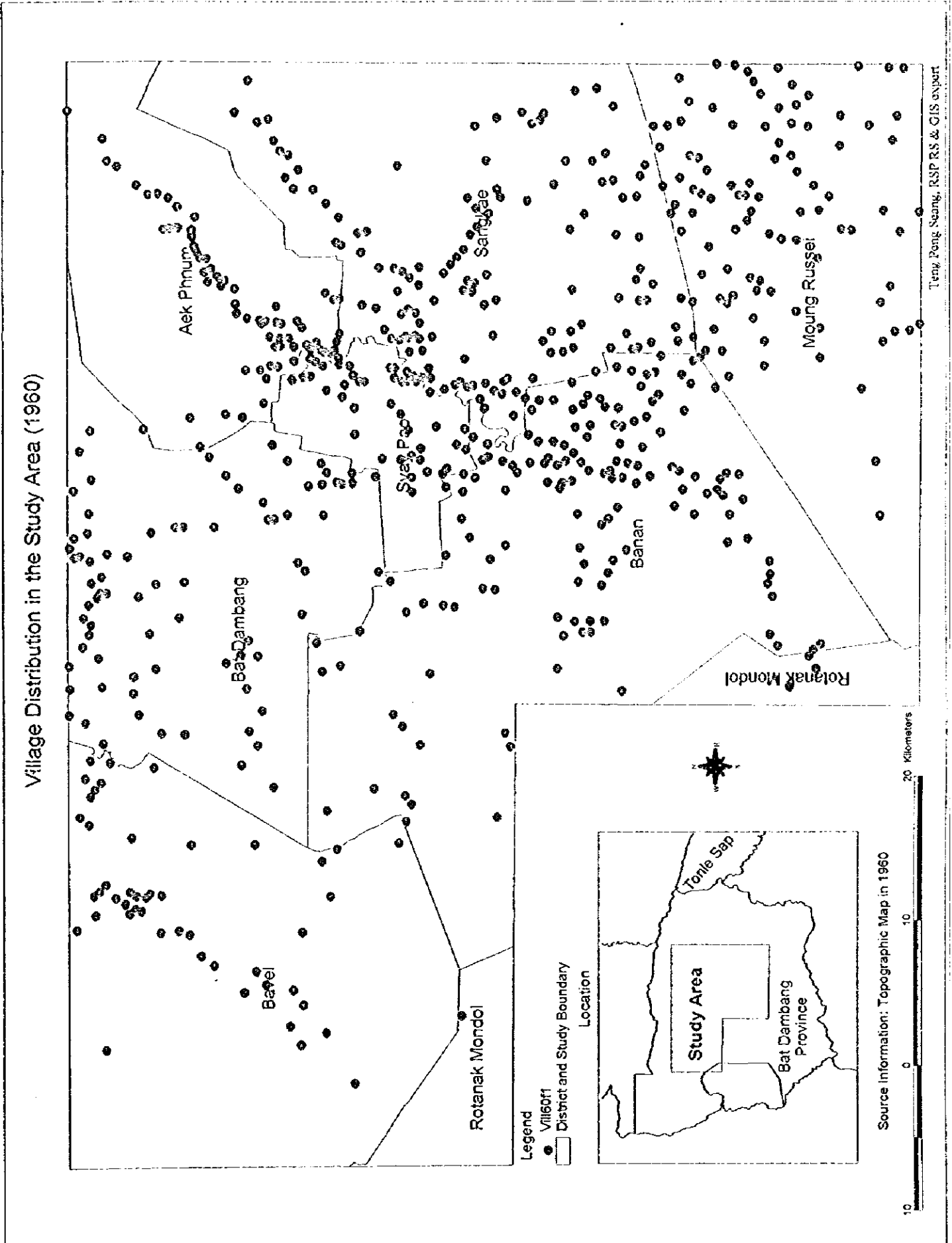
1) Villages

The total numbers of village centers 611 and 352 in 1960 and in 1996, respectively. This means that 256 (42%) village centers were disappeared in 26 years. The reasons seem to be decrease in population and concentration of population. Except in the Svay Pao prefecture, all the numbers of village centers were reduced. The trend is apparent in the Moung Russei Prefecture of which the number of villages was reduced by about 80%. The results are shown in Table III-3-1 and Figure III-3-1.

Table III-3-1 Village Centers (1960, 1996)

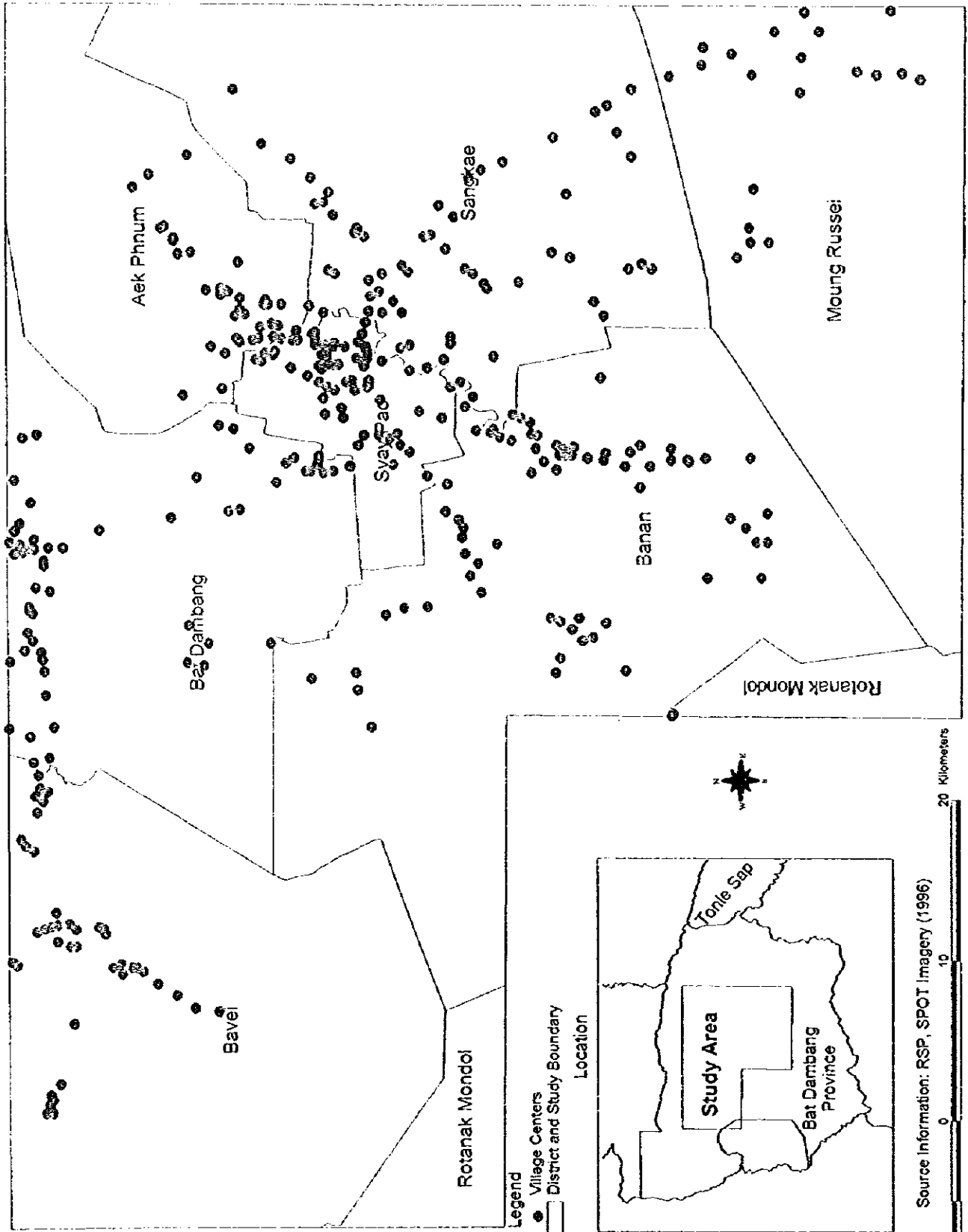
District Name	District Code	1960 Village Center	1996 Village Center	Change (1996-1960)	(%)
Banan	201	142	70	-72	-51%
Batdam Bang	202	79	58	-21	-27%
Svay Pao	203	41	62	21	51%
Bavel	204	47	42	-5	-11%
Aek Phum	205	65	35	-30	-46%
Moung Russei	206	95	20	-75	-79%
Rotanak Mondol	207	5	2	-3	-60%
Sangkae	208	137	63	-74	-54%
		611	352	-259	-42%

Data on the distribution of land mine areas was acquired from SIMC. The data was overlaid onto the village center data. As shown in Figure III-3-3, the village distribution and land-mine-area distribution are separated. By visualizing the raw data, intrinsically, the relationship of the reduction of the number of villages and the land mine distribution can be recognized.



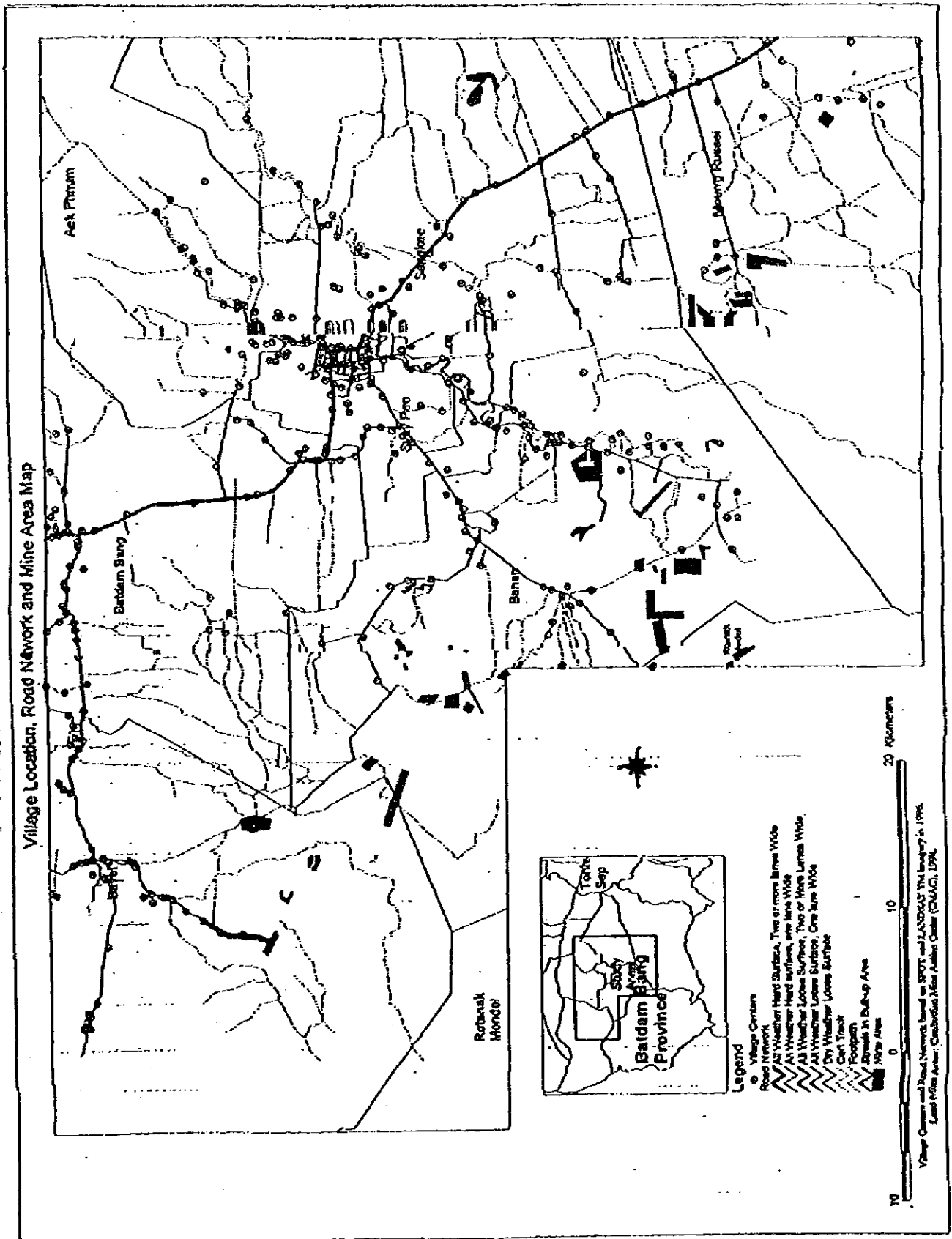
Figures III-3-2 Village Center Distribution (1996)

Village Distribution Centers in the Study Area (1996)



Teng Peng Seang, RSP, RS & GIS Expert

Figures III-3-3 Village Center and Land Mine Areas (1996)



2) Roads

From the following data, development of paved roads is not as fast as roads with other surface types. In Sangkae (208) road development is more intense than in other districts. Reduction in lengths of roads is recognized in some districts. This may be due to destruction by war or unrest. Although it is not a scope of the study, it would be a good GIS research topic to identify the causality of increase and/or decrease in lengths of roads. By overlaying other data, such as areas of intense battles or road maintenance data, it is possible to analyze the data further. Figure III-3-4, III-3-5 shows a sample of GIS output with road data by surface types.

Table III-3-2 Lengths of Roads (1960, 1996)

Road Code	Description	District Code	1960.00	1996.00	Difference
			Length (km)	Length (km)	
1	Hard Surface	202	22.02	22.60	0.58
1		203	13.48	19.94	6.46
1		205	10.92	7.48	-3.44
1		206	24.20	11.01	-13.19
1		208	0.00	24.50	24.50
Sub-total			70.62	85.53	14.91
2	Loose Surface	201	0.00	26.34	26.34
2		202	0.00	14.40	14.40
2		203	0.00	17.47	17.47
2		204	32.24	13.52	-18.72
2		206	0.00	12.47	12.47
2		207	1.91	0.00	-1.91
2	208	0.00	21.54	21.54	
Sub-total			34.15	105.74	71.59
3	Loose Surface (dry weather)	201	29.08	79.21	50.13
3		202	15.14	27.75	12.61
3		203	20.68	11.01	-9.67
3		204	10.34	32.21	21.87
3		205	3.31	13.29	9.98
3		206	12.65	0.00	-12.65
3	208	26.44	48.73	22.29	
Sub-total			117.64	212.20	94.56
Grand Total			222.41	403.47	181.06

201: Banan, 202: Batdam Bang, 203: Svay Pao, 204: Bavel, 205: Aek Phnum, 206: Moung Russei
207: Rotanak Mondol, 208: Sangkac

Figure III-3-4 Roads (1960)

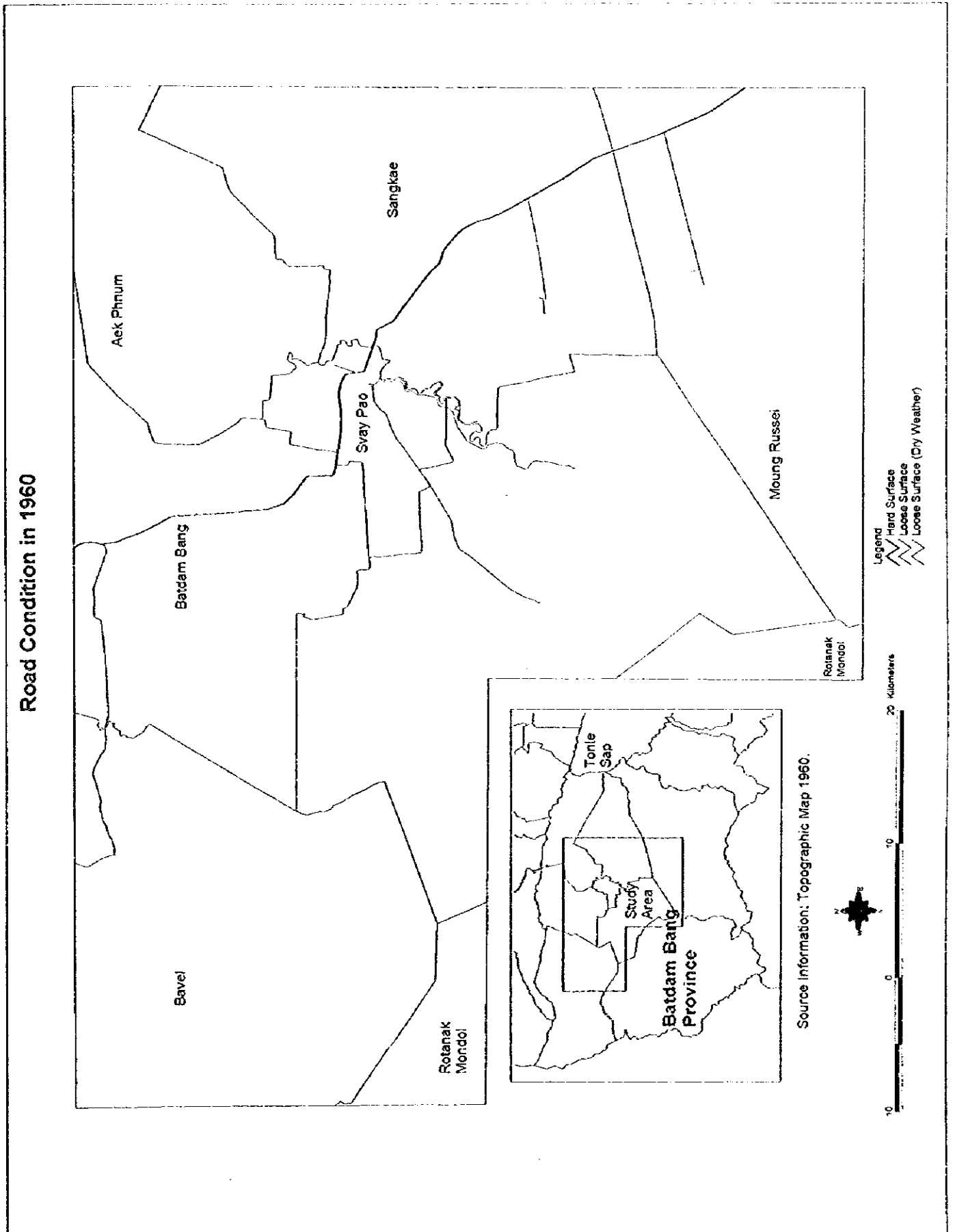
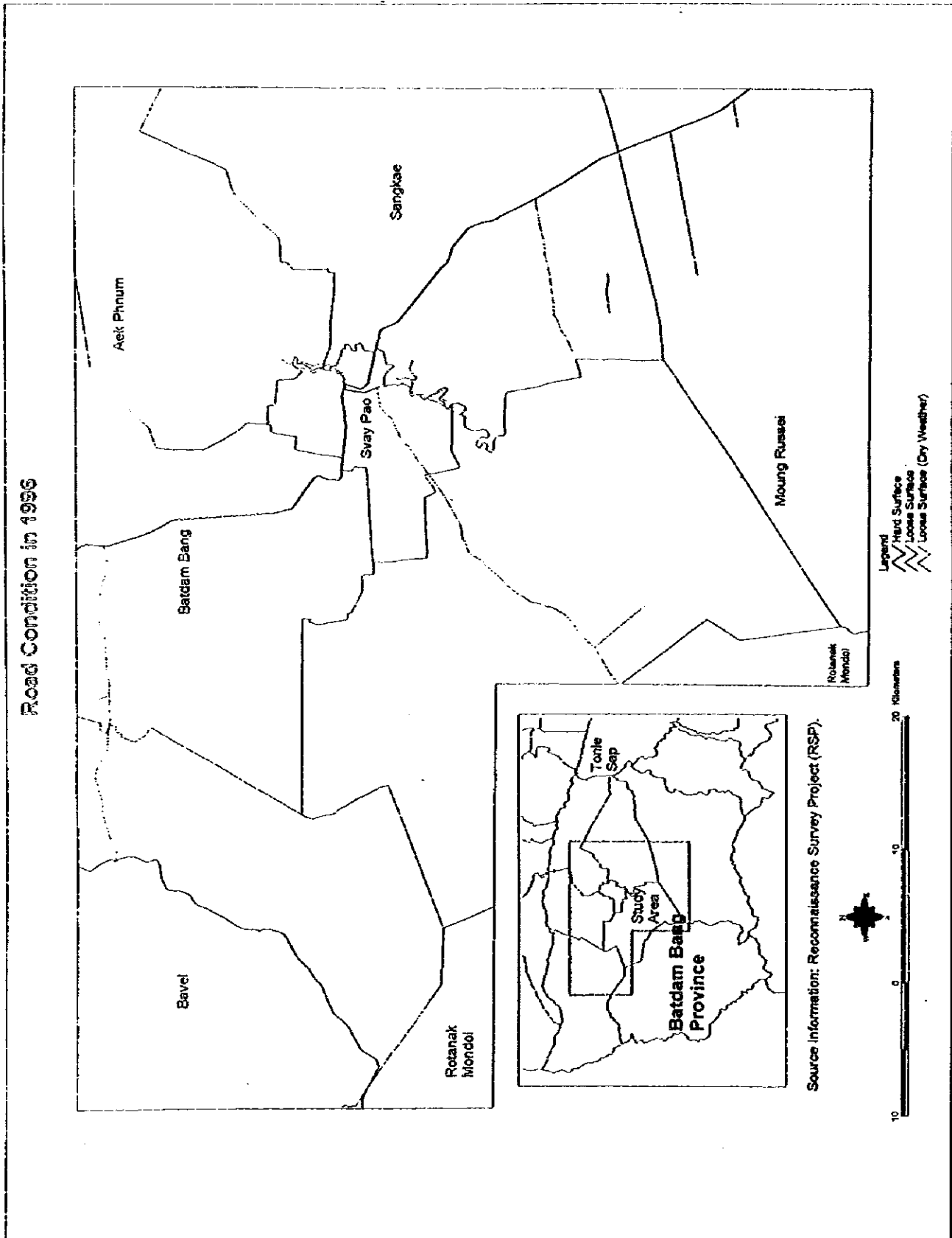


Figure III-3-5 Roads (1996)



3) Canal

The total length of 824.55 km of canals was developed over 26 years. The development is intense in Batdam Bang Province and Svay Pao Provinces. How the canal development affected to the natural water system shall be studied further by overlaying the data on natural water systems in 1960 and 1996.

Table III-3-3 Canal Lengths (1960, 1996)

District Name	District Code	1960	1996	Change (1996-1960)	(%)
		Length1(km)	Length1(km)		
Banan	201	0	102.2	102.2	-
Batdam Bang	202	35.91	388.94	353.03	983%
Svay Pao	203	10.82	102.11	91.29	844%
Bavel	204	2.23	15.21	12.98	85%
Aek Phum	205	11.24	99.18	87.94	89%
Moung Russei	206	0.75	75.19	74.44	99%
Rotanak Mondol	207	n.a.	n.a.	n.a.	
Sangkae	208	10.84	113.5	102.66	90%
合計		71.79	896.33	824.54	1149%

Figure III-3-6 Canal Distribution (1960)

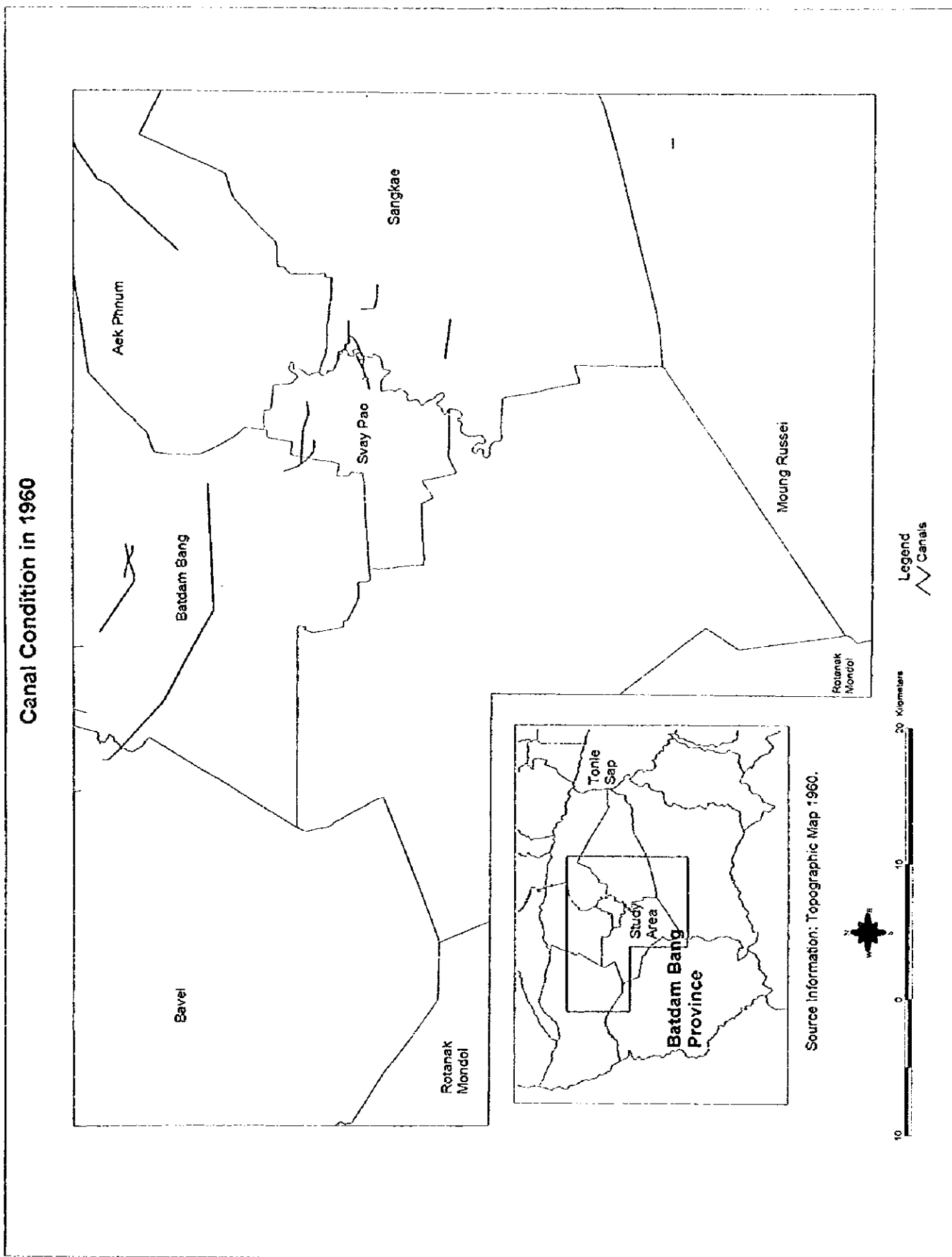


Figure III-3-7 Canal Distribution (1996)

