Japan International Cooperation Agency (JICA)
His Majesty's Government of Nepal

THE DEVELOPMENT STUDY ON INTEGRATED WATERSHED MANAGEMENT IN THE WESTERN HILLS OF NEPAL

FINAL REPORT

VOLUME III APPENDIXES

JANUARY, 1998

JAPAN FOREST TECHNICAL ASSOCIATION (JAFTA)
KOKUSAI KOGYO CO., LTD.

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APPENDIXES

APPENDIX 1 SUMMARY OF OBJECTIVES AND METHODOLOGY OF SURVEYS CONDUCTED UNDER THE STUDY

(1/3)

Item	Objectives	Methodology used	References for further information
Geological Survey	- To clarify the geological and geomorphological conditions of the Model Areas - To obtain basic data for hazard prediction and plan formulation	- Collection of relevant data on geology and geomorphology of the Model Areas. - Actual field work during which such geological and geomorphological features as hardness of rocks, sheared zone, thickness and consolidation of overburden, erosion front, dip slope, permanent springs, seepage zones, etc. were surveyed. - Interpretation of aerial photos and topographical maps to delineate and map the above mentioned features.	III-2 Geological Survey, Progress Report and Main Report on Geological Investigation in the Kaski-Parbat Area of June, 1996 by MREU of Tribhuvan University
Soil Survey	- To prepare soil maps to clarify the distribution of soils and their properties in the Model Areas - To obtain basic data for plan formulation	- Collection of existing data on soils of the area. - Actual field work during which 88 standard soil profiles and a number of simple pits were described based on the FAO-UNESCO's Guidelines for Soil Profile Description, 1977 and 267 soil samples were collected from the profiles for physico-chemical analysis. - Decision on mapping units based on the results of profile survey and soil sample analysis. - Photo interpretation to establish distribution of the mapping units. - Transfer of the mapping units to topographical maps to prepare draft soil maps. - Field verification of the results of photo interpretation and production of final soil maps for 5 Model Areas.	III-3 Soil Survey, Progress Report
Land Use and Vegetation Survey	To understand the conditions as well as issues related to land use and vegetation of the Model Areas, and to obtain the most recent data on land use and vegetation for use in plan preparation.	- Collection of existing data on land use and vegetation of the area. - Field reconnaissance to grasp the land use and vegetation condition of the area in order to establish the legend and the minimum area of a mapping unit. - Photo interpretation to delineate the mapping units. - Transfer of mapping units to topographical maps and preparation of draft land use and vegetation maps. - Field verification of the results of photo interpretation and production of the final land use vegetation maps for 5 Model Areas.	III-4 Land Use and Vegetation Survey, Progress Report

Item	Objectives	Methodology used	References for further information
Climatic and Hydrological Survey	- To understand rainfall pattern and distribution, river system, water resources and water use condition, etc. - To obtain basic data for hazard prediction and plan formulation	- Collection of data on rainfall, river discharge, etc. from related organizations. - Direct measurement of stream discharge and spring discharge in the field using simple method of a calibrated bucket or bottle, etc. for small springs and Q=AV equation for large springs and streams. - Interviewing local inhabitants on water use, water availability, river flooding, etc.	III-1 Climate and III-5-1 Hydrological Survey, Progress Report
Erosion Control and Infrastructure Improvement Survey	- To understand the distribution, causes, impacts, etc. of various types of erosion occurring in the area - To clarify the condition of infrastructure such as footpath, roads, etc. from view point of erosion control - To obtain information for hazard prediction and plan formulation	- Data collection on soil loss by land use and other issues related to erosion and soil conservation. - Field work to measure landslides, gullies, bank erosion sites, etc. and to survey conservation objects, existing countermeasures, immediate causes, etc. - Aerial photo interpretation to prepare landslide and slope failure distribution maps. - Field verification of the results of photo interpretation and preparation of final distribution maps.	III-5 Erosion Control and Infrastructure Survey, Progress Report
Hazard Prediction Survey	- To clarify the level of hazard and its distribution in the Model Areas - To provide data for formulation of hazard mitigation measures	- Collection of data on existing hazard studies in Nepal. - Preparation of maps showing the distribution of factors related to hazard. - Digitizing and overlying the factor maps using GIS. - Assigning proper ratings to each factor depending on whether the factor in question is acting positively (preventing instability) or negatively (creating failure). - Adding the ratings for each factor in meshes established on the factor maps and dividing the total into 3 levels of low, medium and high and preparing the draft hazard maps. - Overlaying the landslide distribution maps on draft hazard maps to check if the majority of existing landslides are within the medium and high hazard zone of the draft maps.	2-2 Erosion Hazard Prediction, Interim Report

Item	Objectives	Methodology used	References for further information
		- Repeating this practice several times (trial and error approach), and when necessary adjusting the ratings, until something like 70-80% of the actual landslides are in medium and high hazard zone of the draft hazard maps. - Spot-checking of the draft hazard maps in the field and carrying out necessary corrections and preparing the final hazard maps.	
Socio-economic Baseline Survey	- To clarify the current socio-economic conditions and the characteristics of VDCs and wards within the five model areas. - To identify the relationship between socio-economic factors and environmental issues (e.g., reduction of forest, landslide, nature of people's participation in development activities, etc.) - To provide opportunities for local people to consider various problems and their solution related to life and environment. - To establish baseline database to measure the effects of the long term assistance being provided by the JICA's "Community Development and Forest/Watershed Conservation Project," and "Greenery Promotion Cooperation Project."	- Household Survey - Household Member Survey - Administrative Survey (to prepare VDC/Ward Profiled)	- IV Socioeconomic Baseline Survey, Progress Report - Socioeconomic Baseline Survey Reports

APPENDIX 2 TOPOGRAPHIC MAPPING

2-1 Aerial Photography

2-1-1 Entrustment of Aerial Photography

JICA Study Team signed subcontracting of aerial photography works to Finnmap on December 19, 1995.

2-1-2 Flight Permission for Aerial Photography

Flight permission from the Mapping Sub-Committee, composed of representatives from 13 governmental agencies, is required for aerial photography. Approval was granted by the Mapping Sub-Committee on December 25, 1995. Further procedures required for airport use were taken at the Airport Agency of the Ministry of Defense.

2-1-3 Flight Period

Aerial photography was carried out according to the following schedule:

January 26, 1996 (10:45 ~ 12:45)

January 29, 1996 (10:35 ~ 14:00)

2-1-4 Aircraft and Specifications for Aerial Photography

The aircraft and specifications used for the photography work are as follows:

(Photography aircraft)

(1) Aircraft : Rockwell Turbo Commander 690A, Call Sign OH-UTI
(2) Camera : WILD RC 30 (Serial No. 5089)
(3) Lens : 15/4UAG-S (Serial No. 13260); focal length: 153.28 mm
(4) Filter : 525 nm
(5) Film : Agfa Pan 50

(Specifications)

(6) Flight Altitude : 4,500 - 5,900 m (M.S.L.)
(7) Photography Scale: 1:25,000

(8) Flight Courses : 12 lines (L-1~L-12)
(9) Overlap : 60%
(10) Sidelap : 30%
(11) Area Coverage : 1,200 km^2 (Study Area)

The orientation map of aerial photography is shown in Appendix Fig. 2-1.

2-1-5 Photo-Processing

Photo-processing was carried out in the photo laboratory of the Surveying Department, while contact prints and positive films were made in the facilities of the Ministry of Forestry and Land Conservation. The photo-processing equipment was as follows.

(1) Film processor : HOPE 134
(2) Developer : Agfa G74c
(3) Contact printer : SP25 dodging printer

2-2 Ground Control Point Survey

2-2-1 GPS Surveying

(1) Monumentation of selected points and installation of air signals

Ground control point survey was conducted prior to aerial photography, thus at the time the control points were monumented, air signals were set using lime and stones. Permanent monuments were established in concrete for new control points. The selected control points were the national triangulation stations (7) previously provided by the Surveying Department. The distribution of points was planned with due consideration of the location of the triangulation stations.

(2) GPS Observation

Since the Study Area is made of steep sloping mountains, GPS measurements were conducted by renting a helicopter and moving from one station to another. Based on the orbital data on GPS satellite visibilities previously obtained, the observation period was set when signals from more than five (5) satellites could be tracked simultaneously. Three sets of GPS receivers were used during a two-hour observation period. Observations were carried out according to the static positioning method.

(3) Analysis and Computation

Observed data were processed with a GPS analysis software (GPSurvey) referenced to the ellipsoid of the WGS-84 geodetic system. The accuracy of points was ascertained by analyzing the baselines between each station surveyed. The Trimnet program in the GPS software for the computation of network average was used to control the vector discrepancies of the existing 7 triangulation stations, by computing the net adjustment of the existing triangulation point coordinates using a fixed station. Finally, the coordinates of the existing 5 triangulation points, whose relative positions are highly accurate, were fixed, the net adjustment was computed with the Everest-1830 ellipsoid, and the coordinates of the control points were obtained. The survey standards used for analysis and computation were as follows:

①	Reference ellipsoid used for GPS	:	WGS-84
②	Ellipsoid adopted in Nepal	:	Everest-1830
③	Projection	:	Corrected UTM projection (Longitudinal width: zones at every 3°) Scale factor of central meridian: 0.9999

The list of ground control points coordinates are in Appendix Table 2-1.

2-2-2 Leveling

Leveling routes of about 100 km were surveyed using existing bench marks, to obtain the orientation of aerial triangulation heights. Spot heights obtained from surveyed existing bench marks were pricked onto the photos. Besides, the heights of accessible control points were measured during leveling. As for leveling accuracy, observation allowance was 6 cm × $\sqrt{L}$, where L = observed distance (in km).

2-2-3 Amount of Survey Work

(1) GPS surveying (Appendix Fig. 2-2)

Existing control points using known points	:	5 points
Existing control points without sing known points	:	2 points
Control points newly established for orientation	:	16 points

(2) Leveling

Length of leveling routes	:	approx. 100 km
Control points where spot height was measured	:	8 points
Control points observed from existing bench marks	:	approx. 40 points

2-2-4 Main Instruments used for Control Point Survey

(1) GPS receivers : Trimble 4000sst, 3 sets
(Serials No.: 3112A01559A, 3129A02104A, 3114A01637A)

(2) Computer : CREO R & D, 1 set

(3) GPS software : GPSurvey (Trimnet-Plus)

(4) Levels : NIKON AE-5, 2 sets

2-3 Field Survey

A field survey was conducted in areas subject to topographic mapping (model areas) to identify or confirm topography, vegetation, planimetric features, and land use, on airphotos. Documents on geographical names and administrative boundaries (districts and VDC) were also gathered. Detailed specifications for the map symbols and annotation standards, marginal information and neat lines of map sheets were decided by the Study Team after holding discussions with the DSC and the JICA experts in the field.

2-4 Plotting

2-4-1 Aerial Triangulation

Aerial triangulation was conducted to determine the planimetric coordinates and elevation of tie points and pass points required for plotting, on the basis of the results of ground control survey.

Analytical method was used for aerial triangulation using the 1:25,000 airphotos (positive films), and adjustment was conducted with the Bundle block adjustment method, which forms the entire plotting area into one block. The volume of work and specifications for aerial triangulation as well as instruments used are listed below.

(Volume of work and specifications)

(1) Number of models : 140 models

(2) Adjustment computation : "Bundle" block adjustment

(Instruments)

(3) Pricking device : PUG-1690
(4) Observation instruments : Stecometer
(5) Computer : FACOM M-760/4

2-4-2 Detailed Plotting and Compilation

The restitution manuscripts were elaborated by plotting the topographic and planimetric features with a precise stereo-plotter. Compilation manuscripts were carried out using the restitution manuscripts and by referring to the field identification results, maps symbols, geographical names, etc. The volume of work and specifications for plotting and compilation, and the instruments used are as follows:

(Volume of work and specifications)

(1) Plotting area : 43,000 ha (model areas)
(2) Plotting scale : 1:25,000
(3) Intermediate contour lines : 20 m
(4) Interval contour lines : 10 m

(Instruments)

(5) Plotting device : Stereo-plotter A-8

2-4-3 Drafting

(1) Drafting of the 1:25,000 Map

The draft map was executed based on the compilation manuscripts, using the scribing method. The scribing method was used for the drafting of contour lines sheets and topographic symbols sheets, while geographical names sheets were prepared by photo-composition.

(2) Drafting of the 1:10,000 Map

The draft map is an enlargement of the negative film of the 1:25,000 draft map to a scale of 1:10,000.

(3) The volume of works and specifications of the draft map are as follows:

(Volume of work and specifications)

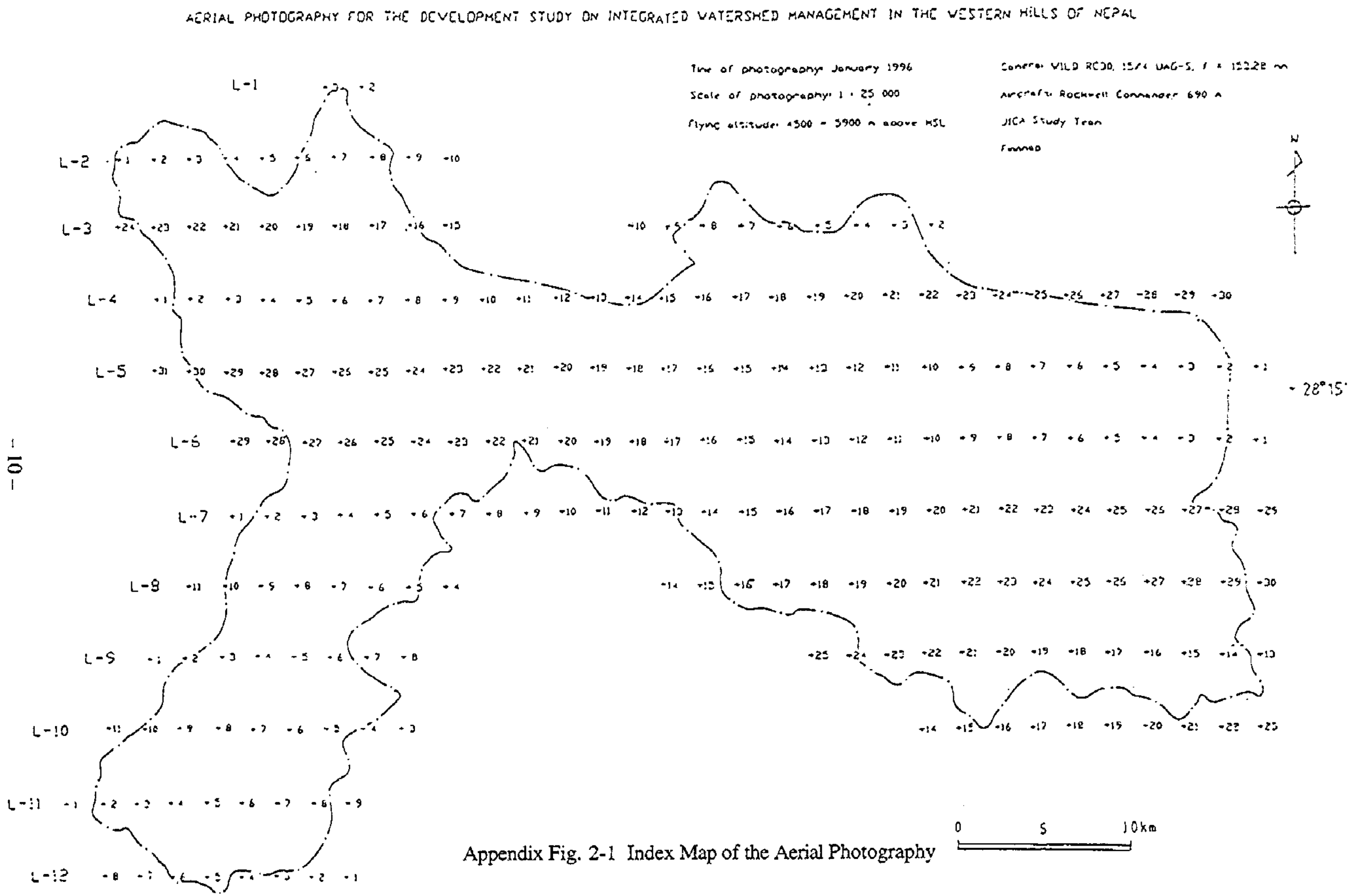
①	Plotting area	: 43,000 ha (model areas)
②	Neat lines	: 0.7 m × 0.5 m
③	Plotting sheets (1:25,000)	: 7 sheets
④	Plotting sheets (1:19,000)	: 34 sheets

2-4-4 Final Results

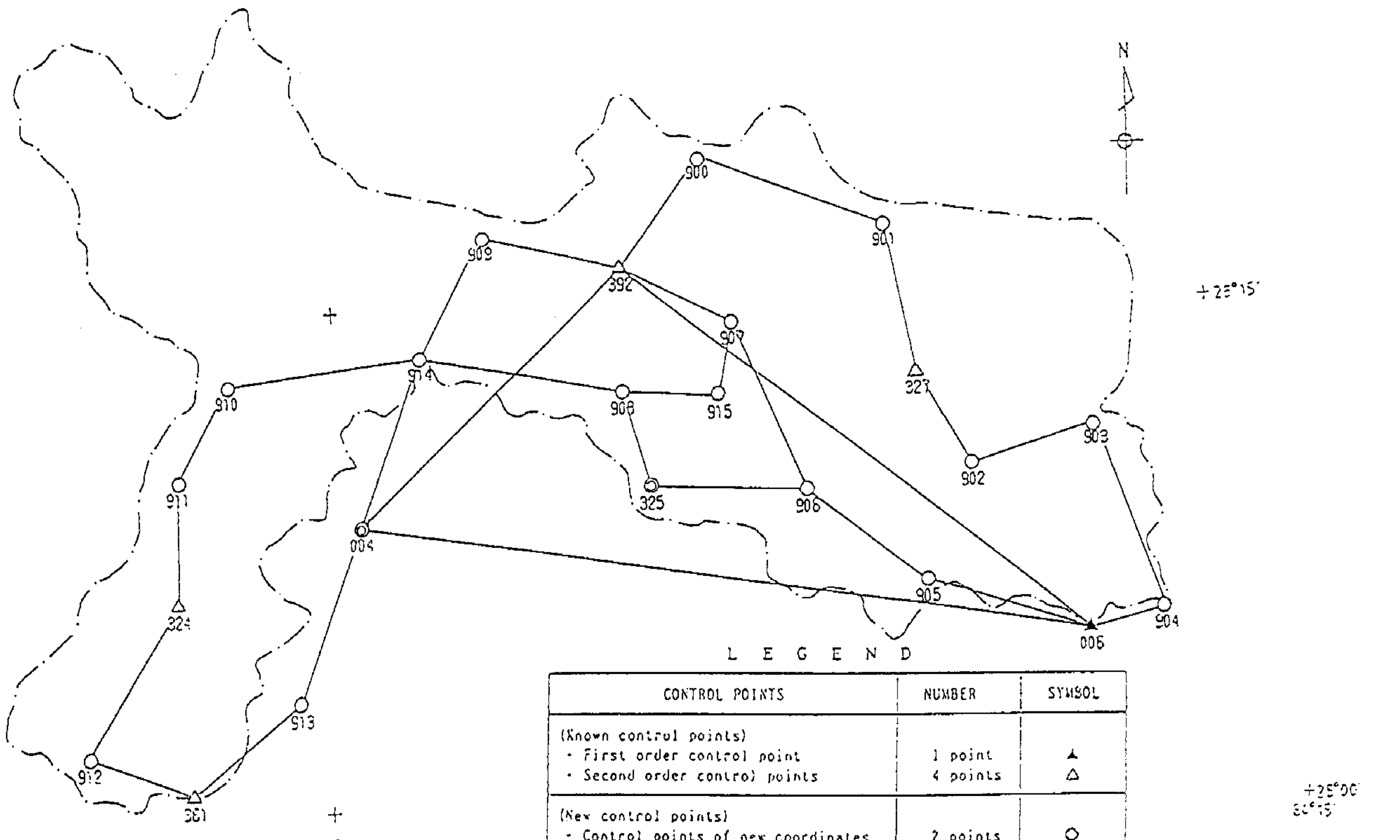
The final results, from aerial photography to plotting, are as follows:

(1)	Negative films	: 1 set*
(2)	Positive films	: 1 set
(3)	Contact prints	: 2 sets*
(4)	Orientation Map (aerial photography)	: 2 sets
(5)	Draft map manuscripts (1:25,000)	: 1 copy each
(6)	Duplicate of the manuscripts	: 1 copy each

* *Delivery of 1 set of negatives and 2 sets of contact prints to the Surveying Department, in conformance to the rules of the Nepalese government.*



Appendix Fig. 2-1 Index Map of the Aerial Photography



LEGEND

CONTROL POINTS	NUMBER	SYMBOL
(Known control points)		
· First order control point	1 point	▲
· Second order control points	4 points	△
(New control points)		
· Control points of new coordinates used existing maker	2 points	◎
· Established control points	16 points	○

Appendix Fig. 2-2 Location Map of the Control Points

Appendix Table 2-1 Coordinates Result of the Control Points

Point	Latitude			Longitude			Northing (m)	Easting (m)	Ele. (m)
004**	28°	08'	41.13"	83°	45'	59.32"	3113,931.39	477,066.47	2,266.63
006**	28	05	01.41	84	11	14.01	3107,160.84	518,397.01	1,281.60
324*	28	06	30.87	83	39	25.44	3109,947.78	466,310.30	2,263.02
325**	28	09	38.26	83	56	01.03	3115,669.46	493,481.93	1,535.75
327*	28	12	46.66	84	05	18.70	3121,469.17	508,688.44	1,418.84
361*	28	00	50.76	83	39	56.81	3099,477.41	467,137.60	1,819.51
392*	28	16	14.38	83	55	04.31	3127,862.01	491,943.22	1,790.42
900	28	19	34.91	83	57	51.20	3134,031.91	496,492.28	1,201.10
901	28	17	20.37	84	04	17.04	3129,892.38	507,002.63	1,737.49
902	28	09	59.35	84	07	08.56	3116,322.37	511,688.59	756.16
903	28	11	06.50	84	11	30.22	3118,398.41	518,821.87	1,135.40
904	28	05	35.60	84	13	53.36	3108,220.73	522,744.57	385.73
905	28	06	34.32	84	05	32.87	3110,009.67	509,083.41	592.01
906	28	09	24.73	84	01	26.19	3115,251.37	502,351.05	719.82
907	28	14	32.89	83	58	57.89	3124,735.72	498,307.29	1,058.57
908	28	12	29.41	83	55	03.65	3120,937.92	491,920.48	1,364.72
909	28	17	19.82	83	50	09.78	3129,884.52	283,920.68	1,722.04
910	28	13	02.11	83	41	11.87	3121,981.55	469,245.76	847.09
911	28	10	11.74	83	39	23.77	3116,745.75	466,283.89	889.09
912	28	02	04.40	83	36	14.00	3101,762.09	461,059.50	1,004.08
913	28	03	28.19	83	43	49.90	3104,307.10	473,514.62	1,582.43
914	28	13	43.79	83	48	03.30	3123,240.67	480,464.02	2,490.57
915	28	12	17.05	83	58	28.42	3120,555.13	497,503.10	816.70

Note: * Known points to fixed coordinates of the existing control points.
** Control points of new coordinates due to the GPS observation on the existing maker.

APPENDIX 3 GIS OPERATION

3-1 Use of GIS in Nepal

3-1-1 Utilization of GIS by Concerned Agencies

For a better understanding of the GIS utilization in Nepal, attention was particularly paid to the software and hardware used by the concerned authorities during the Study.

(1) The Forest Resources Survey Branch

① Software

The Forest Resources Survey Branch use three GIS softwares:

a. ERDAS
b. ARC/Info
c. TOPOS

② Hardware

Detailed components of the hardware used by the Forest Resources Survey Branch are shown in Appendix Table 3-1.

Appendix Table 3-1 Available Hardware at the Forest Resources Survey Branch, Department of Forest

Name of Device	Maker	Quantity	Remarks	
PC EWS	IBM compatible IBM	7 1	CPU: PENTIUM 486 386	(1) (3) (4)
Digitizers	Calcomp	3	A0 size A1 size A3 Desktop	(1) (1) (1)
Plotters		2	Pen Plotter Ink Jet Plotter	(1) (1)
Uninterruptible Power Source		2	UPS Stabilizer	(1) (1)
Remote Sensing Image Processor		1		
Air conditioner		1		

( ) : Number of units

③ Maintenance System

In the past, the maintenance of the GIS system was carried out at the "Mercantile" computer shop in Katmandu. Now, the maintenance of hardwares and softwares is provided by the "OTAR-Kantipath" shop.

④ Main Utilization of GIS

a. Production of the national forest classification map (scale: 1:500,000) and database.
b. Elaboration of the forest classification map and database for forestry projects.
c. Lists and graphs of all thematic maps prepared for reports.
d. Image processing of satellite photos.

(2) ICIMOD (International Center for Integrated Mountain Development)

① Software

The ICIMOD uses ARC/Info GIS software:

② Hardware

Detailed components of the hardware used by ICIMOD are shown in Appendix Table 3-2.

Appendix Table 3-2 Available Hardware at the ICIMOD

Name of Device	Maker	Quantity	Remarks
PC EWS	Compaq IBM	1 1	
Digitizers	HP	1	A0 size (1)
Plotters	HP	1	Color
Uninterruptible Power Source	SANYO	2	UPS (1) Stabilizer (1)
Scanner		1	

( ) : Number of units

③ Maintenance System

Maintenance of GIS system is provided by the "Mercantile" computer shop in Katmandu.

① Main Utilization of GIS

a. Land conservation studies
b. Land use studies

(3) Bagmati Project

① Software

The Bagmati Project uses the following GIS software:

a. ARC/View

② Hardware

Detailed components of the hardware used by the Bagmati Project are shown in Appendix Table 3-3.

③ Maintenance System

Maintenance of the GIS system could not be confirmed.

④ Main Utilization of GIS

a. Watershed management
b. Land use studies

Appendix Table 3-3 Available Hardware at Bagmati Project

Name of Device	Maker	Quantity	Remarks	
PC	HP	1		
Digitizer	HP	1	A3 size	(1)
Plotter	HP	1	A4 size, Color	
Uninterruptible Power Source	SANYO	2	UPS Stabilizer	(1) (1)
Scanner	HP	1	A4 size	(1)

( ) : Number of units

(4) Others organizations

Apart from the three above mentioned agencies, there are two other organizations, albeit smaller in scale, using GIS:

① ADROSC
② TU Dept. of Geography and the National Planning Commission

3-1-2 Problems related with the Introduction of GIS

The following four major problems should be solved prior to the introduction of the GIS system.

(1) Power supply condition

Because of unstable power supply and voltage, and frequent power cuts, an Uninterruptible Power Source (UPS) installation is indispensable for the use of computers.

(2) Parts stock management

Consumptible spare parts of computers shall be stocked in advance, since it takes a lot of time to get them.

(3) Installation environment

Since computers are very sensitive to temperature, humidity, dust and vibrations, a proper environment for computers, similar or better than in existing agencies, shall be arranged.

(4) Maintenance

Since various troubles may arise, a periodical maintenance shall be carried out. According to the results of the field study, the agencies have signed a maintenance contract with the sales agencies of computer manufacturing companies. There are three local companies capable of carrying out maintenance contracts:

① The Mercantile Co., Ltd.
② CAS TRADING Co., Ltd.
③ OTAR-Kantipath Co., Ltd.

3-2 Comparative Examination for the Selection of Computer Type

3-2-1 Comparative examination of software

There are more than a hundred GIS softwares available in the world. The software to be selected should suit the type of business dealt with. The GIS World Sourcebook published every year by the GIS World Company was referred to for the selection. This sourcebook presents the status of GIS softwares in the world. The software to be selected should be useful for the project and must have application results in Japan. Comparative results of the software characteristics are shown in Appendix Table 3-4 below.

Appendix Table 3-4 Comparative Table of GIS Softwares

	Items	ARC/Info		ILWIS	TNTmips	MGE	ERDAS	MapInfo
	Name of Company	ESRI		ITC	M. IMAGE	INTERGR.	ERDAS	MAPINFO
Functions	GIS	●		●	●	●	●	●
	Automatic Plotting	●			●	●		●
	Digitizing	●		●	●	●		●
	Format change	●		●	●	●		●
	Image processing			●	●	●	●	
	Data base	●			●	●		●
	Remote sensing			●	●	●	●	
Degree of difficulty of operation	Data input	△	△	○	○		○	○
	Data base management	△	△	△	△		○	○
	Topographic analysis	△	-	△	○	Not yet studied	×	-
	Bird's view	△	-	△	○		×	-
	Making of DEM	○	-	△	○		×	-
	Ortho data	○	-		○		×	-
	Output	△	△	×	○		○	○
Price		high	high	cheap	cheap	high	high	cheap
Others		EWS	PC	PC	PC	PC, EWS	PC, EWS	PC
Use		difficult		rather easy	very easy	difficult	rather easy	easy

● indicates the functions available; ○ indicates easy operation, △ rather difficult operation, × difficult, and - indicates this operation is not available.

The characteristics of the softwares are as follows:

(1) ARC/Info

This software is used worldwide, even by Nepalese agencies, and is excellent in the creation, matching and building of database. However, this software is handled by a complicated command system which requires 1 or 2 years of training to master. ARC/Info has two versions, EWS and PC, but the PC version does not hold functions for topographic analysis.

(2) ILWIS

ILWIS was developed by ITC, a Dutch institution. Although it operates very well and is in correlation with the purpose of this project, there are problems in its output system.

(3) TNTmips

This software holds all the functions required for the project and is endowed with an easy-to-operate menu system. This software is not only remarkably affordable but has also been recently adopted by Japanese research centers which have been using ARC/Info.

(4) MGE

Currently under study, this software has functions very similar to TNTmips. However, a good training is required to operate this software.

(5) ERDAS

This is an image processing software which cannot perform topographic analysis.

(6) MapInfo

This software allows the production of database on social conditions, but cannot conduct topographic analysis.

3-2-2 Selection of Software

From the above results, the TNTmips software has been selected as suitable for the present project based on the following grounds: ability to handle a great volume of data; favorably priced; excellent operation; operable on PC.

3-2-3 Hardware System

The hardwares required for the input and editing of data, image processing, and various types of output, which were also requested by the Soil Conservation Department, are detailed in Appendix Fig. 3-1.

(1) Personal Computer

The PC will run the software.

(2) Digitizer (A3 size)

The digitizer is an input device for the production of figure database. The appropriate size of document to be input, such as cartographic data, is A3.

(3) Hard drive

A hard drive for PC shall be installed to supplement the PC extension memory, which is likely to be insufficient for the building of the database required in this project.

(4) 3.5 inches MO disks

The MO disk is a memory device that facilitates the storing and handling of large volume of information.

(5) Digitizer (A1 size)

A1 digitizer is designed to produce database from large map sheets, e.g. soil conservation or topographic maps.

(6) A3 Monochrome Scanner

This scanner is required to transform into data cartographic information, such as data on social condition, used into reports.

(7) Color Scanner

Color scanner inputs data from colored pictures, or soil conservation and topographic maps.

(8) Color ink jet printer

Color ink jet printer prints analysed results on A0 or A1 size paper.

(9) Printer by sublimation process

This printer will be used to print documents such as area calculation tables or data classification.

(10) Printer (A4 size)

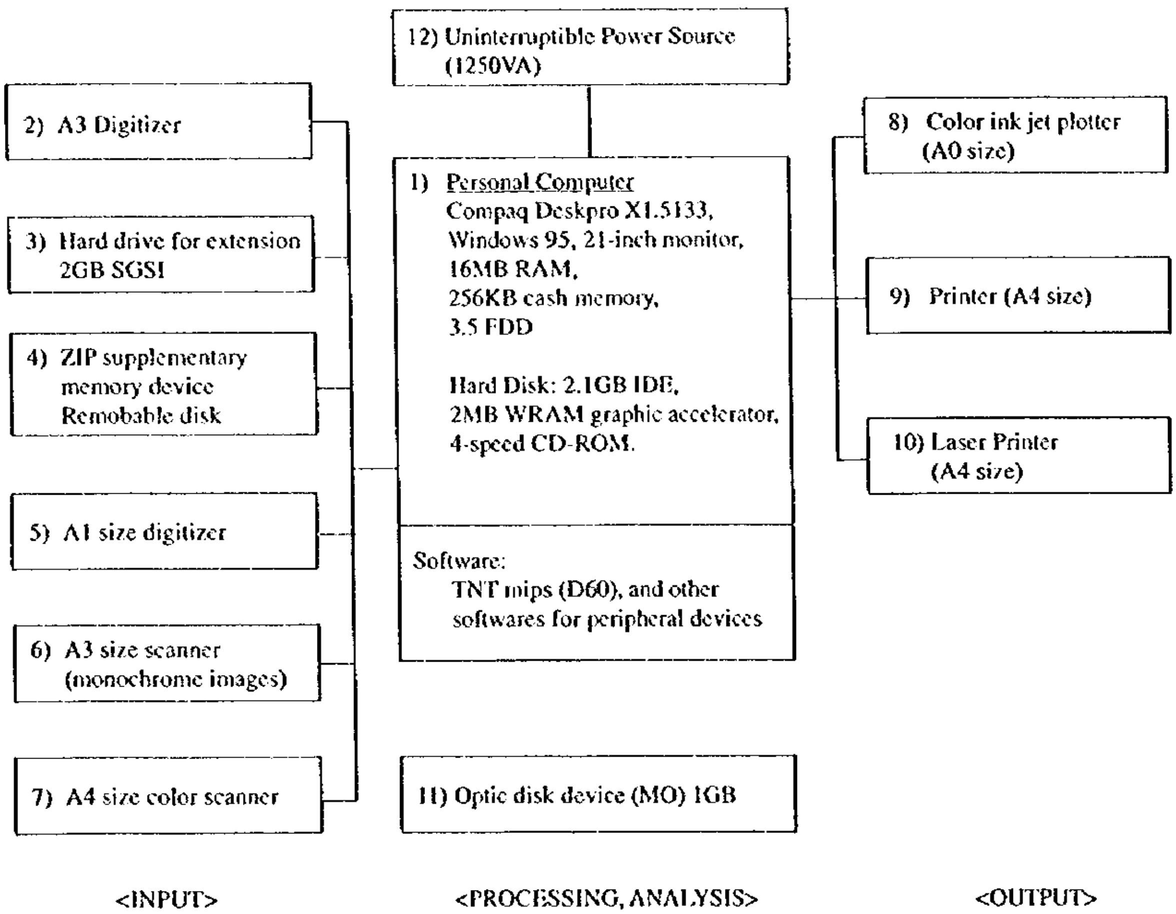
Used for A4 color printing of documents published into reports.

(11) MO disk device

Input and output of data.

(12) Uninterruptible Power Source

UPS is required to improve the stability of power supply and prevent damages to computers.



Appendix Fig. 3-1 Structure of the GIS System

3-2-4 Request from the Nepalese Soil Conservation Department

During the field study, the Soil Conservation Department requested the following hardware to cope with the use of GIS system.

(1) PC AT386DX (1GBHD), with a 17-inch SVGA color monitor

(2) PC AT386DX (300 MBHD), with a 14-inch color monitor, or PC of a higher standard

(3) Uninterruptible power source

(4) Digitizer (big size: 1 unit; A3 size: 1 unit)

(5) Color scanner 1 set

(6) Plotter 1 set

(7) Color printer 1 set

3-2-5 Selection of Hardware

(1) Personal Computer

From the viewpoint of maintenance, a comparative evaluation of personal computers widely used outside of Japan in terms of performance, value, and possibilities of expansion was conducted. Three types of PCs were compared: IBM, COMPAQ and GATEWAY (see Appendix Table 3-5).

Appendix Table 3-5 Type of Computers

Items	IBM	COMPAQ	GATEWAY
Functions	○	○	○
Stability	○	△	○
Value	High	Medium	Low
Maintenance	○	○	△
General Evaluation	△	○	△

○: Good; △: Rather difficult.

The functions and performance of the 3 PCs are almost the same. However, IBM is slightly high-priced, while COMPAQ, which used to be low-priced, cannot be considered now as inexpensive. Although GATEWAY is a low cost computer, maintenance is difficult because support services are only available in America, whereas there are IBM and COMPAQ representatives in Nepal. COMPAQ has also a branch company in India. Accordingly, from the overall evaluation of the different PCs, COMPAQ was selected as the hardware to be used with the TNTmips software, with due consideration to computer maintenance.

(2) Other hardware

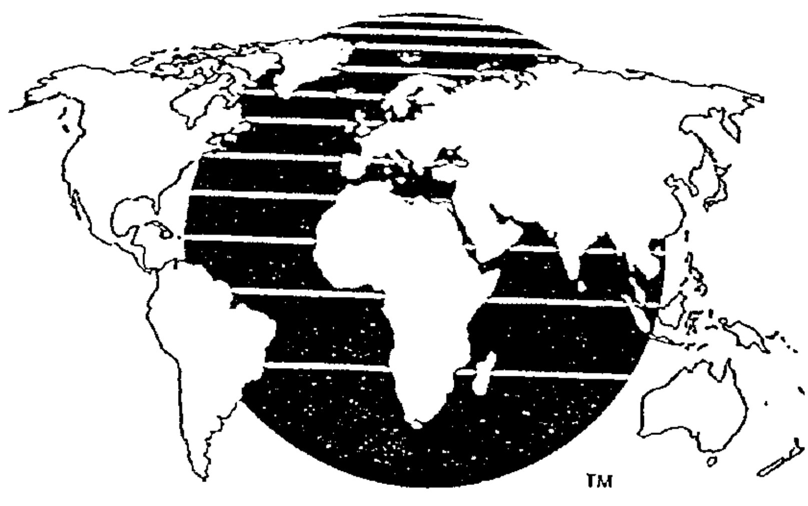
Hardware selection was made in consideration of maintenance and the wide utilization in Japan as well as in foreign countries. Hardware proved to be suitable for TNTmips users was recommended.

3-3 Use of GIS in This Plan

3-3-1 Introduction

To provide basic data for the formulation of Intergrated Watershed Management Plan in Western Hills of Nepal, GIS will be used for ① Creation of Hazard Maps and Socioeconomic Condition Diagrams; and ② Construction of a Digital Database.

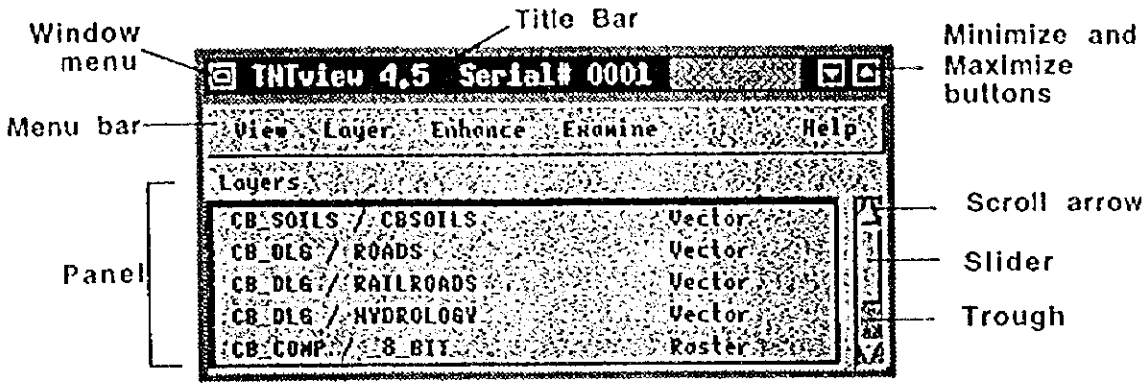
TNTmips was mainly used in the workflow of this project. Subject diagrams were scanned into digital databases using scanners and digitizers. Then overlay method, index method and matrix method was executed to create hazard maps and compute the area of concern.



TNTmips Initial Startup Display

3-3-2 Major TNTmips Functions

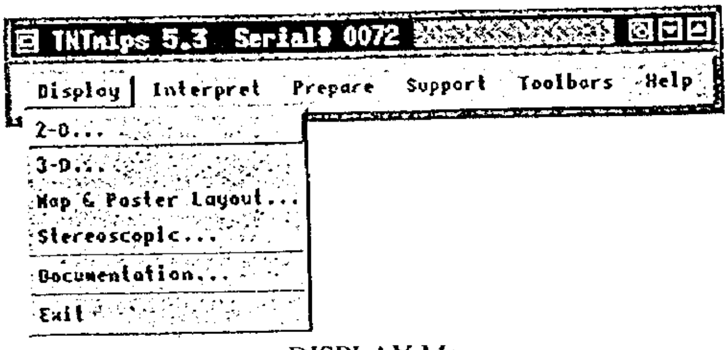
The TNTmips Main Menu consists of the following major functions: DISPLAY, INTERPRET, PREPARE, SUPPORT and HELP.



Main Menu

(1) DISPLAY Menu

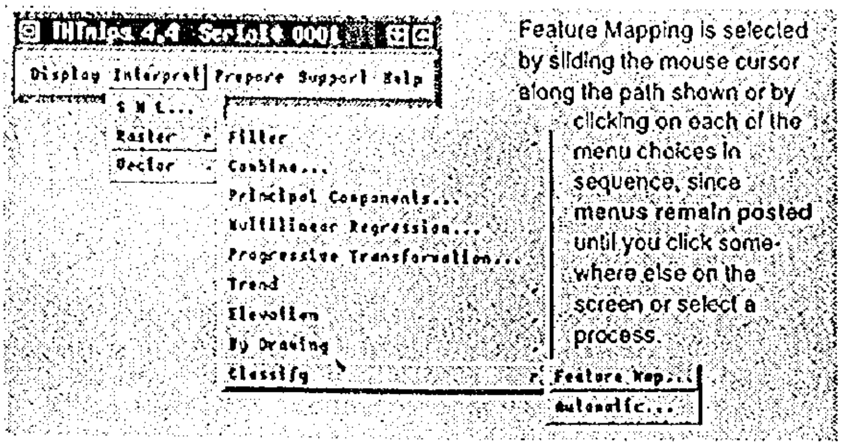
The main functions of the DISPLAY Menu include 2D, 3D, Map & Poster Layout, Stereoscopic, TNT View, Documentation and Exit. Major functions of DISPLAY are created and printed out in either color or monochrome, however, this choice will vary according to the format of data processed such as: Raster, vector, CAD, TIM, database or text.



DISPLAY Menu

(2) INTERPRET Menu

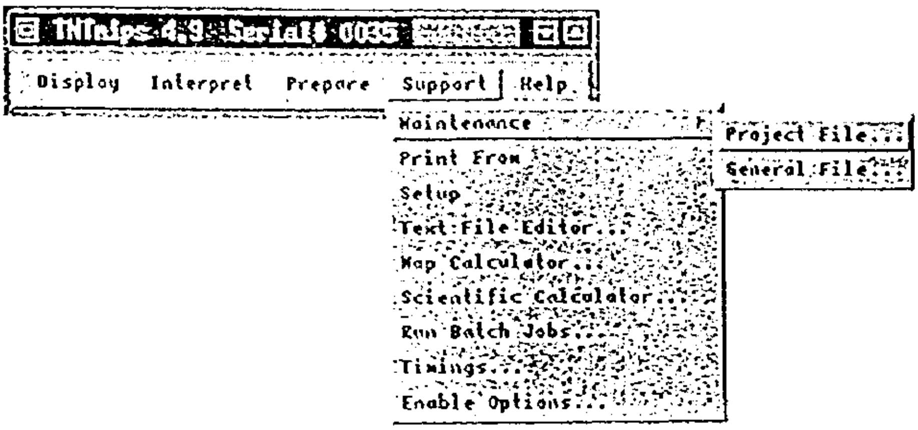
The main functions of the INTERPRET Menu is mainly used to visually (Manual) or automatically read (interpret) the data. Data processing formats include SML (Spatial Manipulation Data), Raster, Vector and TIN.



INTERPRET Menu

(3) SUPPORT Menu

The SUPPORT Menu mainly provides the user and programmer with utilities. There are 7 utilities provided in this menu: Maintenance (Correct and Maintenance Data), Print Format, Setup, Text File Editor, Map Calculator, Scientific Calculator, Run Batch Jobs, Timing (Speed Adjustment), and Option.



SUPPORT Menu

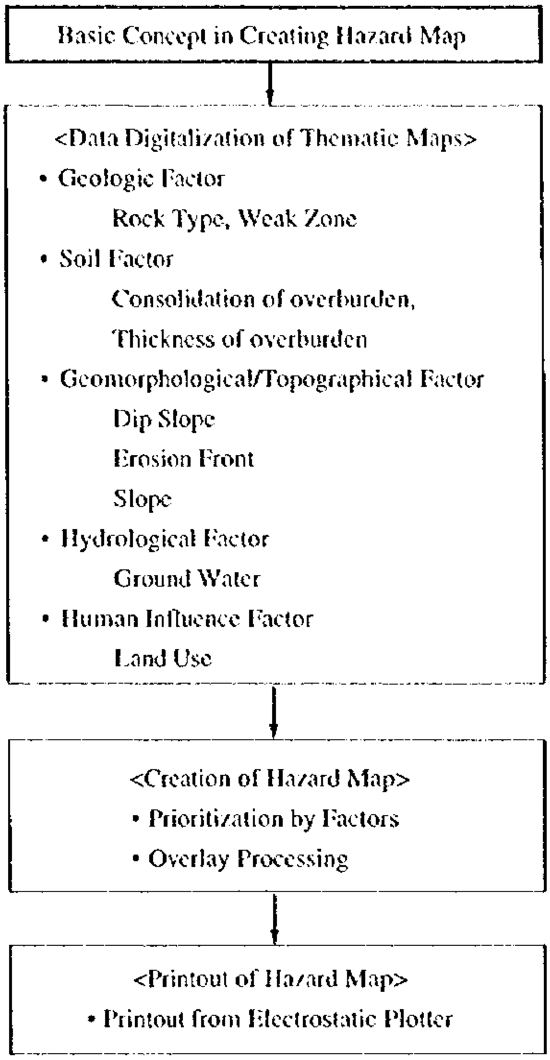
3-3-3 Creation of Hazard Maps

(1) Basic Concept in Creating Hazard Maps

① The object was to create a hazard map for every Model Area. Trial and error was repeated for the model area (North Parbat, in this case), in which the information would be applied to all regions.

② Major topics covered in the hazard map included landslide, as well as causative and inductive factors of collapse. The elements were then separated into Geological, Geomorphological/Topographical, Hydrological, Land Use and other elements that were prepared in form of a digital database.

③ The workflow in creating the hazard map is illustrated in Appendix Fig 3-2.

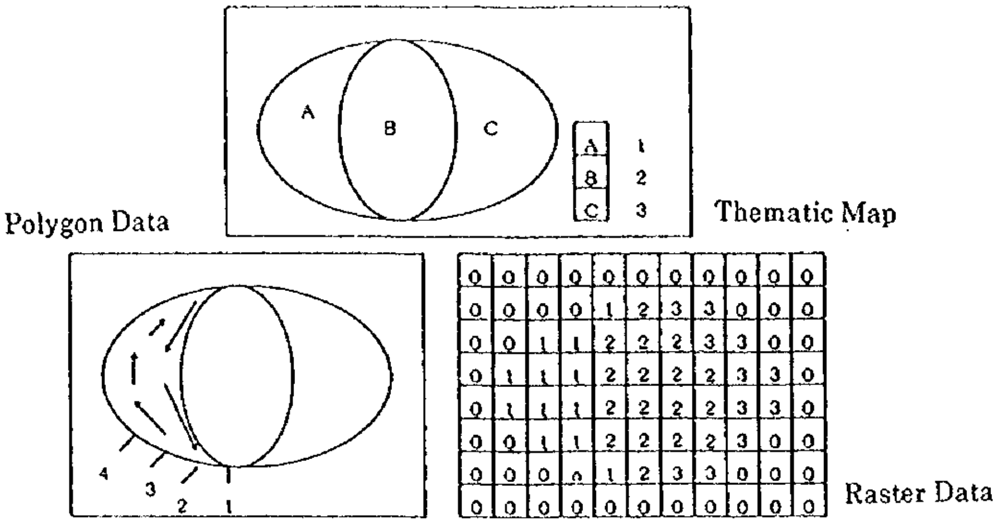


Appendix Fig. 3-2 Flowchart in Creating Hazard Maps

(2) Review of Modes to Input Subject Diagram

① Basic concept in creating digital data of subject diagram

The basic concept in creating digital data of the subject diagram entails conversion of analog information found in the various diagrams, into numeric information (digital data). The basic concept of data digitalization is shown below.



Data Digitization Concept of Subject Diagram

Pictures are stored and processed in a computer's memory by either of two methods: raster graphics and vector graphics. Raster-type graphics maintain an image as a matrix of independently controlled dots, while vector graphics maintain it as a collection of points, lines, and arcs. These coordinates can be attained by measuring the X-Y matrixes of category A, using a digitizer. In raster graphics, the computer's memory stores an image as a matrix, or grid, of individual dots, or pixels (picture elements; finer mesh size). Each pixel is encoded in the computer's memory as one or several bits, i.e. binary digits. An 8-bit pixel can represent any of 256 different colors or shades of gray, since the 8th power of 2 equals 256 and is converted into binary digits between 0-255.

② Arrangement of subject diagram

The subject diagram required to create a hazard map are inherent of various factors that range from diagram size (scale), category type and quantity, display format, diagram material and so on. Thus, the factors were arranged to make it easier to input/read (converting analog information of diagram and other data into digital graphics) the information with the digitizer and scanner.

③ Review of input method

The input method of each subject diagram was reviewed according to the final purpose of the diagram, diagram size (scale), category type and quantity, display format, diagram material and so on. The details of this subject diagram was that it would be a scale of 1/25000 the original as a topographical blueprint, that is complete with categories and indications that would be penciled in directly on the topography map.

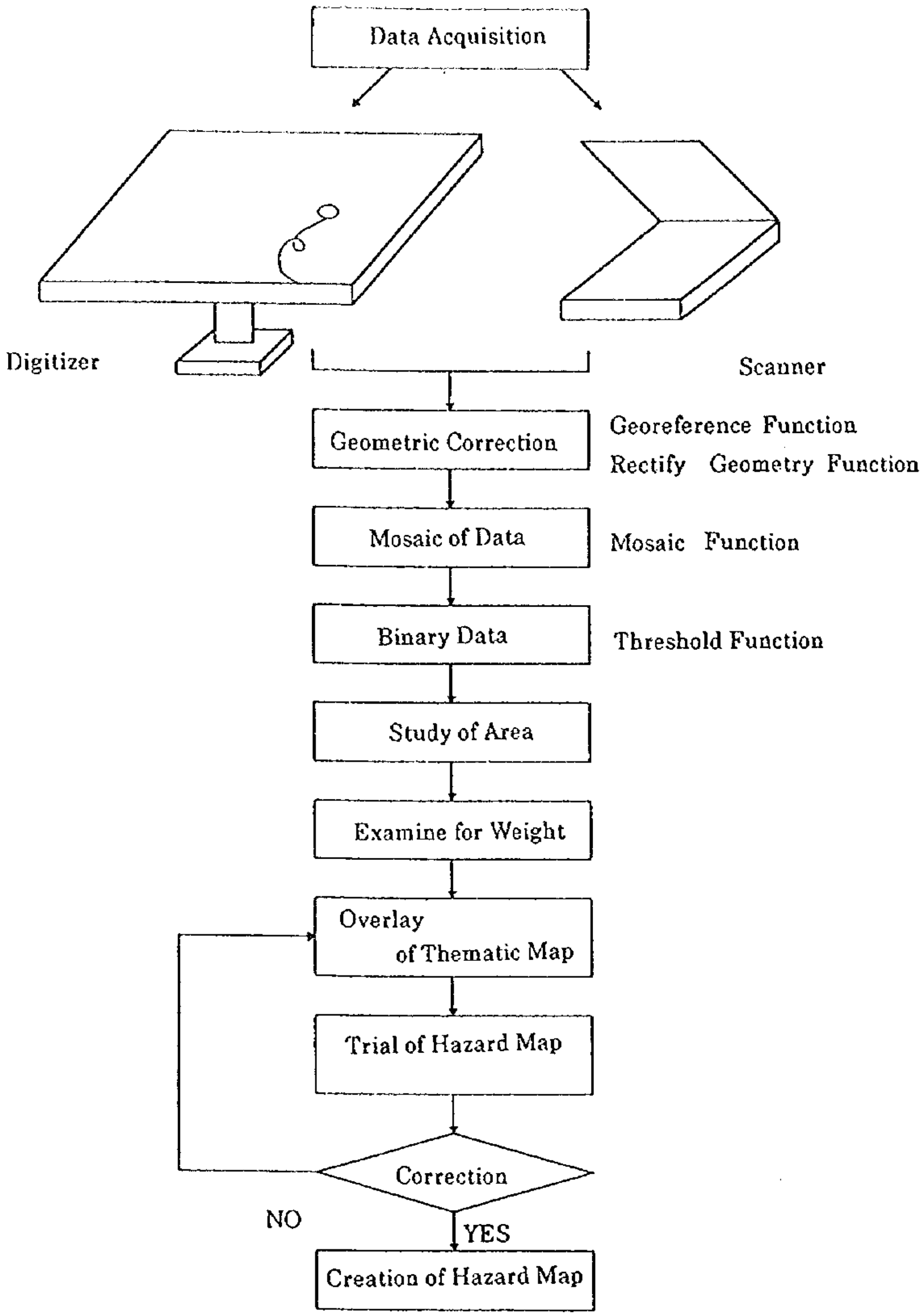
Generally speaking, input using a digitizer is recommended when the category types of the subject diagram tend to be fairly large and the categories of the overall diagram are rough. However, digitizer input is also a choice when considering the efficiency and degree of corrections required when the categories are extremely fine, on the other hand.

The problem area of scanning is that there is a need to prepare (pretreat or post-treat) the topographical map to be input, since the target item to scan (contoured elevation lines, in this case) tend to come with other unnecessary information (for example, road, symbol, elevation, altitude, place name, etc.) that must be erased prior to or after scanning. For this reason, there is a need to trace the elevations to create a diagram, or scan and correct the topographical map containing all that information by erasing the unnecessary indications, as well as connecting the elevation lines not shown on the display.

On the other hand, when using a digitizer, the X-Y matrixes of each polygon category and category are numerically converted (for example, category A, B, C would be category 1, 2, 3...) and input (within binary digits 0-255). The tablet is then finely moved on the polygon line to read the data. In this case, there is a need to carefully read the data without creating gaps between neighboring polygons.

(3) Input of Subject Maps (Data Digitalization)

This next section describes the procedures to input the subject diagram. (Appendix Fig. 3-3)



Appendix Fig. 3-3 Flow Chart for Creation of Hazard Maps

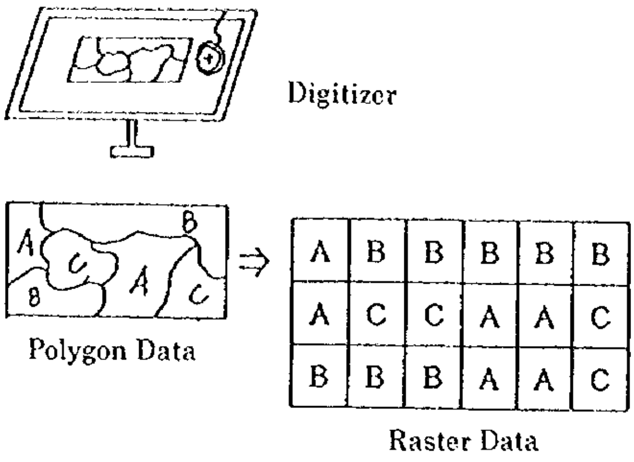
① Scanner input (Scanning)

Scanning entails the procedure to set the target diagram on the scanner, and then to convert the analog data shown on the diagram into digital data at a voluntarily set scanning pitch. At this time, there is a need to set the scanning pitch so that the line reproduction of the scanned image appears smooth on the display. An excessively high scanning pitch will result in interrupted dotted lines and may inhibit creation of a smooth polygon when displayed on the monitor. On the other hand, a low scanning pitch may take too much time to process. When considering the need for positional correction and accuracy (no difference) it is thus, important to set an appropriate scanning pitch prior to scanning.

In this study, we scanned contoured elevation diagrams to create slope category maps. The scanner was set to a scale of 1/25000 of the topographical map, at a scanning pitch of 400 bpi (bits per inch) to convert the analog information into digital data. Thereafter, noise picked-up in the digital diagram and all unnecessary indications were erased, while line disconnections were duly corrected by connecting them. Since scanning allows for relatively similar positioning with other subject diagrams, we made topographic positional corrections through matrix conversion by measuring the base points of several priorly set points that were specified for matrix correction purposes.

② Digitizer input

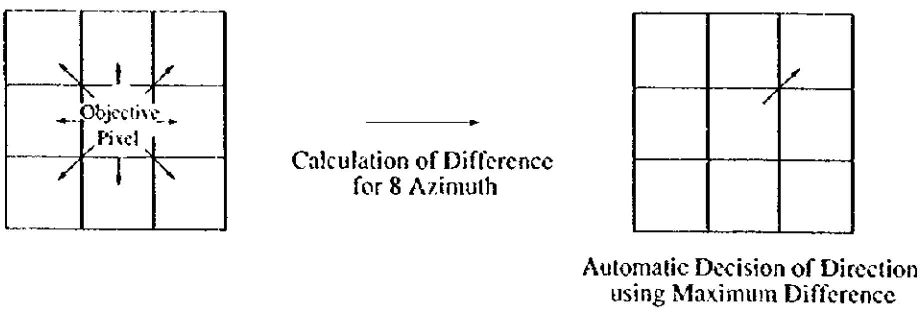
Input with the digitizer involves pasting the subject diagram (blueprint paper, etc.) on the digitizer. The base points on the diagram are then measured according to the parameters of the matrix to create a uniform matrix. Then the tablets are moved according to each polygon to record the X-Y matrixes and categories. At this time, the user visually verifies the polygon input shown on the display, and makes any corrections when necessary.



Concept of Digitizer Input

③ Creation of slope category maps

Slope maps were created in a 50 m-pitch DEM (Digital Elevation Model) by digitally scanning contoured elevation data. Thereafter, TIN TNTmips was employed to compute the slope angles for each pixel. These slopes were then categorized and summarized in slope category maps.



Concept in Creating Slope Category Maps

④ Display of Subject Maps (Digital Data)

The subject maps prepared in form of digital data was tinted in voluntary colors according to category and then displayed on the monitor.

⑤ Creation of Hazard Maps

Each category was ranked according to importance and then overlaid to plot the digital data of the subject maps on the hazard maps. Overlaying, in general, can be categorized as employment of the three methods, INDEX method, OVERLAY method and MATRIX method.

a. INDEX Method

INDEXing requires each item (soil, slope, geology, etc.) and category (slope 0-5°, 6-10°, etc.) to be ranked for evaluation based on total number of points. Example 1 of Appendix Fig 3-4 indicates the slope priority as 2.

b. OVERLAY Method

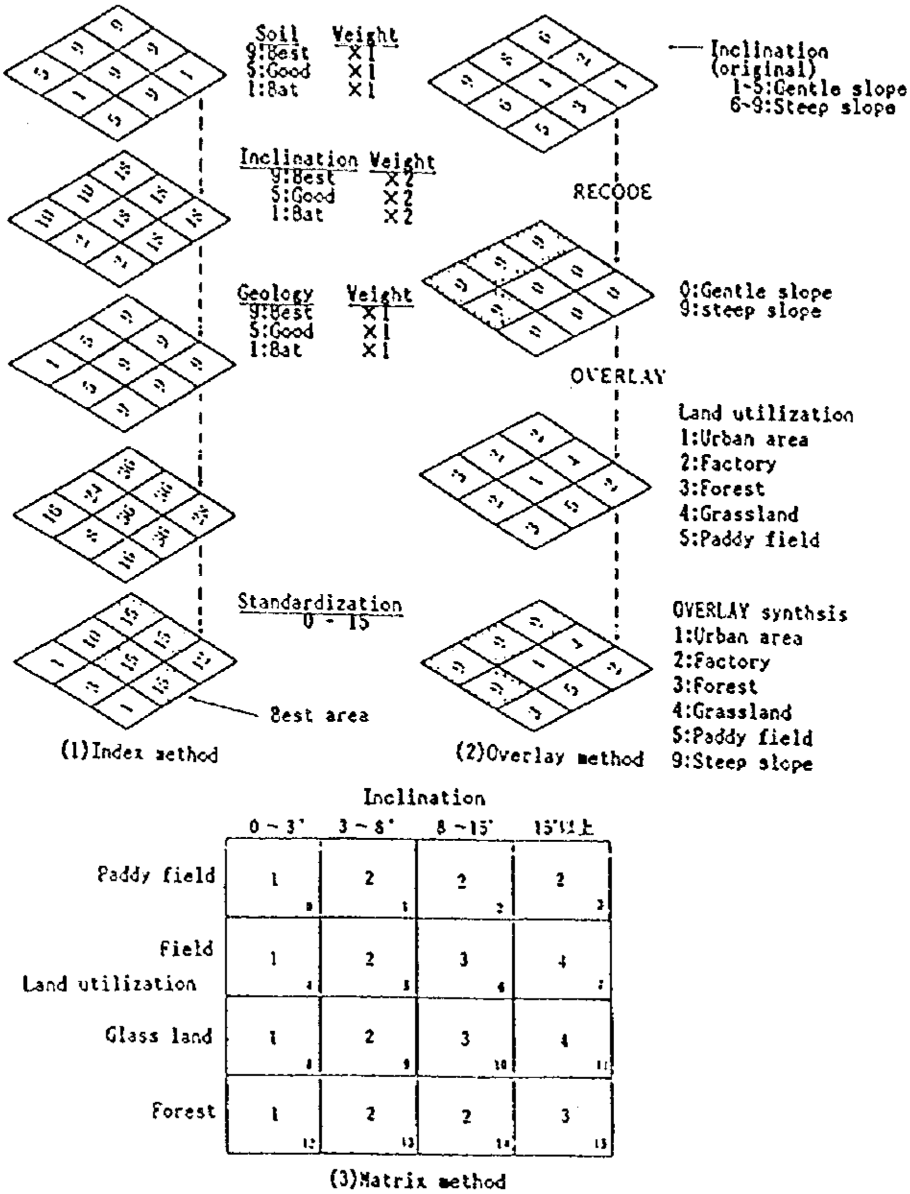
OVERLAYing is executed for a specific category of the data to be overlaid. Example 2 of Appendix Fig. 3-4 inserts a steep slope.

c. MATRIX Method

MATRIXing, as shown in example 3 of Appendix Fig. 3-4, processes 2 items (land use and slope) to create a matrix according to each angle category. A numeric value is then set for each matrix and overlaying is executed based on these parameters.

In this report, the subject maps were largely categorized into natural and social conditions. Natural conditions were then broken down into geology, geomorphology/topography, hydrology and other natural factors for stratified overlaying. A hazard map was created mainly using the OVERLAY method. The MATRIX method was employed to compute the area that was combined with the control units upon computation. The hazard maps created were then printed out by Model Area with a electrostatic plotter at a scale of 1/25000 of the original size.

All subject maps and digital data of the hazard maps was then backed-up on an MO (magneto optical disk). The size of the subject maps was within a 1-10 MB (megabyte) range, thus, making it possible to save the entire data on one 128MB or 230MB MO disk.

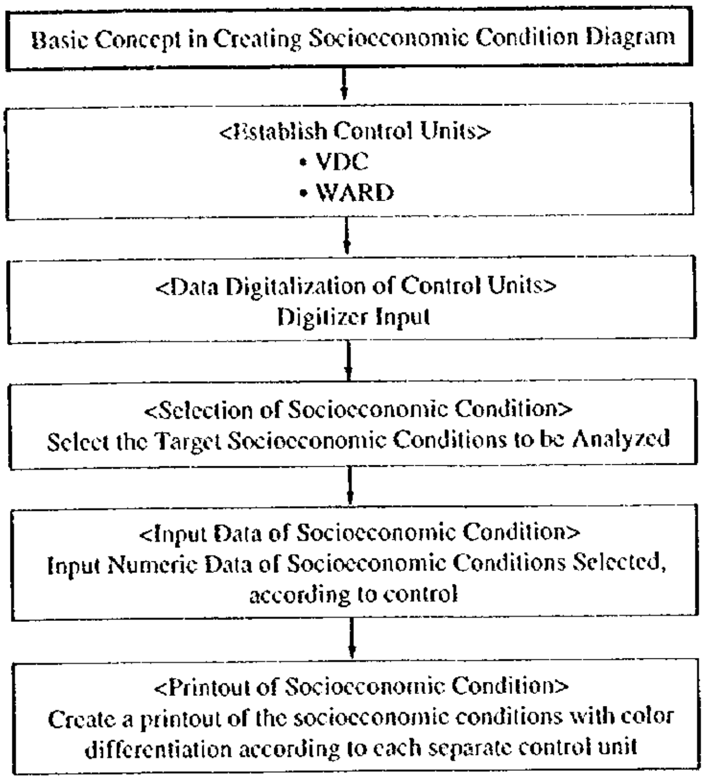


Appendix Fig. 3-4 Conceptual Diagram of Overlay Processing

3-3-4 Creation of Socioeconomic Condition Diagrams

The diagram of socioeconomic conditions consisted of various conditions of control units (VDC and WARD, in this case), and was created as information to establish a plan. This information was then saved along with the digital data. (Appendix Fig. 3-5)

The governmental category of the control units of the survey area was represented in VDC and WARD. Thus, such governmental categories were input with a digitizer. Various socioeconomic conditions of the control units were then input in graph format (Lotus, Excel and other equivalent graph formats), based on the information collected. Then, each socioeconomic condition diagram were separated, based on the maximum and minimum values, and colored in different tints.



Appendix Fig. 3-5 Flow chart in Creating Socioeconomic Condition Diagram

3-4 The Approach in Using GIS

GIS is a computerized system that makes use of digital mapping information and database on various mapping coordinates and telegraphic information (e.g. statistics, records), for city and regional research, policy analysis and formulation of plans. The various systems that make use of GIS are as follows:

(1) Maintenance and Management System

- Road Maintenance System

  This system is used to manage information on road structures and auxiliary facilities, and information relevant to underground infrastructure network. It is also used for planning the periodic preservation of roads, formulating countermeasures against accidents, planning of new roads, as well as the individual management of waterworks, electricity and telephone network.

- River Management System

  This is a system utilized to manage information relevant to river management, e.g. use of bridges, riverbeds, revetments. It is also used in planning the periodic preservation of rivers and as a warning system for rainfall conditions and natural calamities.

- Forest Management System

  This system is used to manage information on forests, cultivated tree species and forest type, the organized conduct of felling and reforestation activities, planning of roads for shipment, and the means of shipment.

(2) Disaster Countermeasure Simulation System

- Earthquake Damage Forecast System

  This system establishes the scale of the earthquake as well as the damage to be inflicted on the ground and buildings, and is used to inform the public of any calamity and train them in the conduct of countermeasures against such calamities.

- River Flooding Forecast System

  Through this system, river shape and large scale rainfall amount are assumed to determine the extent of damages that river flooding may cause, which are then used as a basis for the formulation of countermeasures,

(3) Mapping Based on Satellite Images

This system produces maps using image data obtained from landsat and spot satellite surveys, and aerial photos. It enables the production of a land use map of a wide area where a field survey is quite difficult to carry out. This system can produce planning maps that contain data based on existing maps, new information and plans, and topographic maps for environmental protection. (This system is used together with CAD.)

(4) Others

Taxation management system for houses, buildings and lot number, and car navigation system using GPS.

It is very important that the objectives of the user regarding the use of GIS be identified to produce a system that is in accordance with the user's needs.

APPENDIX 4 TNT mips OPERATION MANUAL

4-1 Basic Operation

The Map and Image Processing System (TNTmips®) software is equipped with various functions, such as data compilation and the updating of old data. Some of the functions can be operated similarly. The following explains the basic operation of these functions:

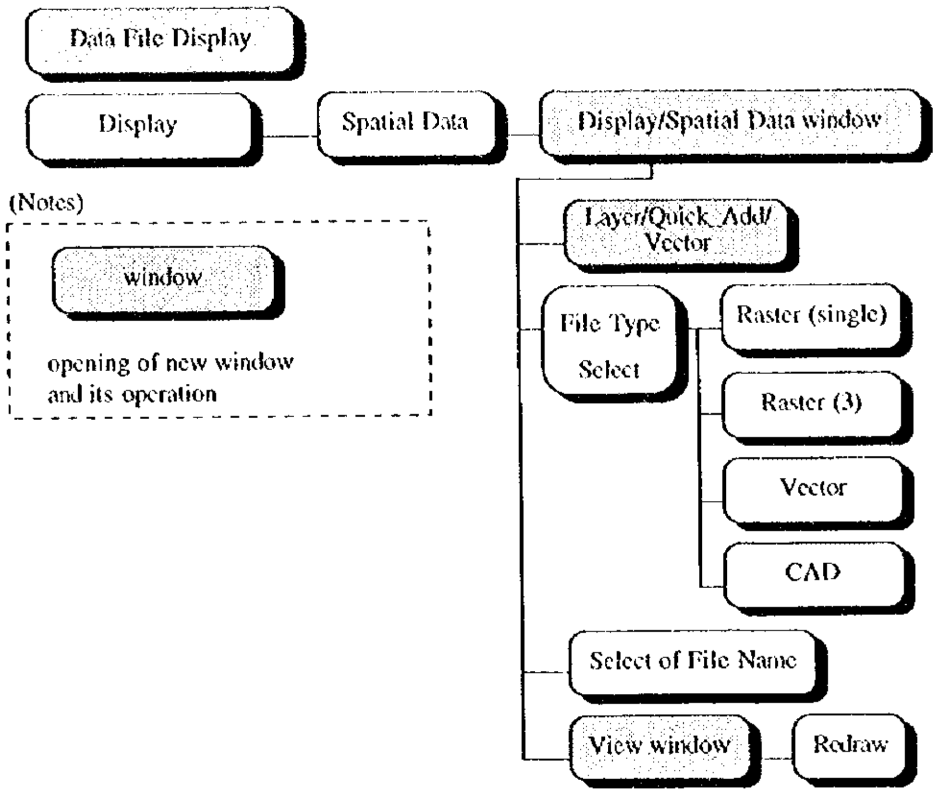
4-1-1 Starting TNTmips

The use of OS and other softwares is initiated by starting Windows95.

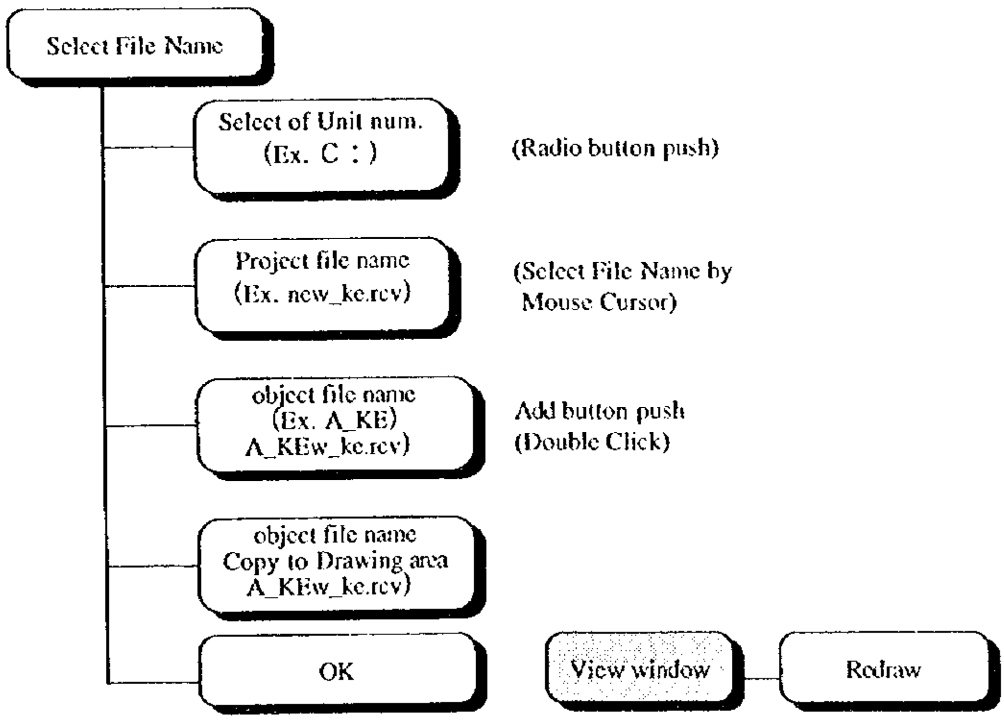
① With the mouse, click on the start button and a group of commands will be displayed on the left side of the screen. Click on the "program" and names of different softwares will be displayed again on the left side of the screen. To start off the operation of the desired program, click on the desired software. If a shortcut function for the desired program has been prepared and is initially displayed on screen, directly click on the "short cut function" to start off the program.

② Upon starting the TNTmips program, 6 large commands are displayed on screen and under each command is a program with the function desired. The methods on how to operate the programs are explained in the operation guidebook according to their order of appearance on screen. A pulldown menu containing the commands appears onscreen. To operate the command desired, click on it with the mouse.

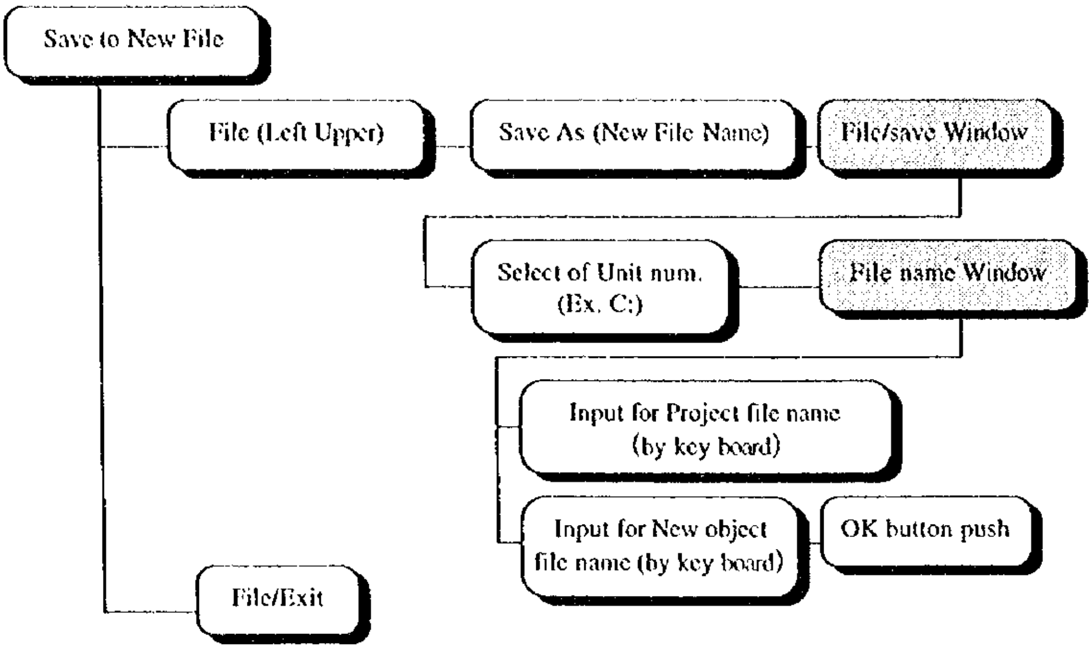
4-1-2 Display Functions



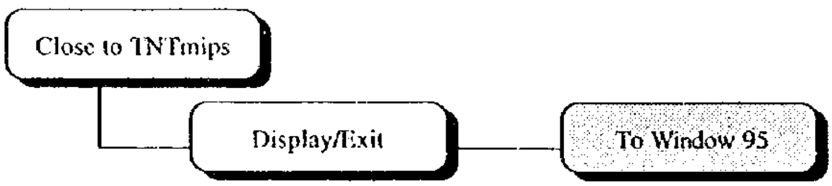
4-1-3 Select File



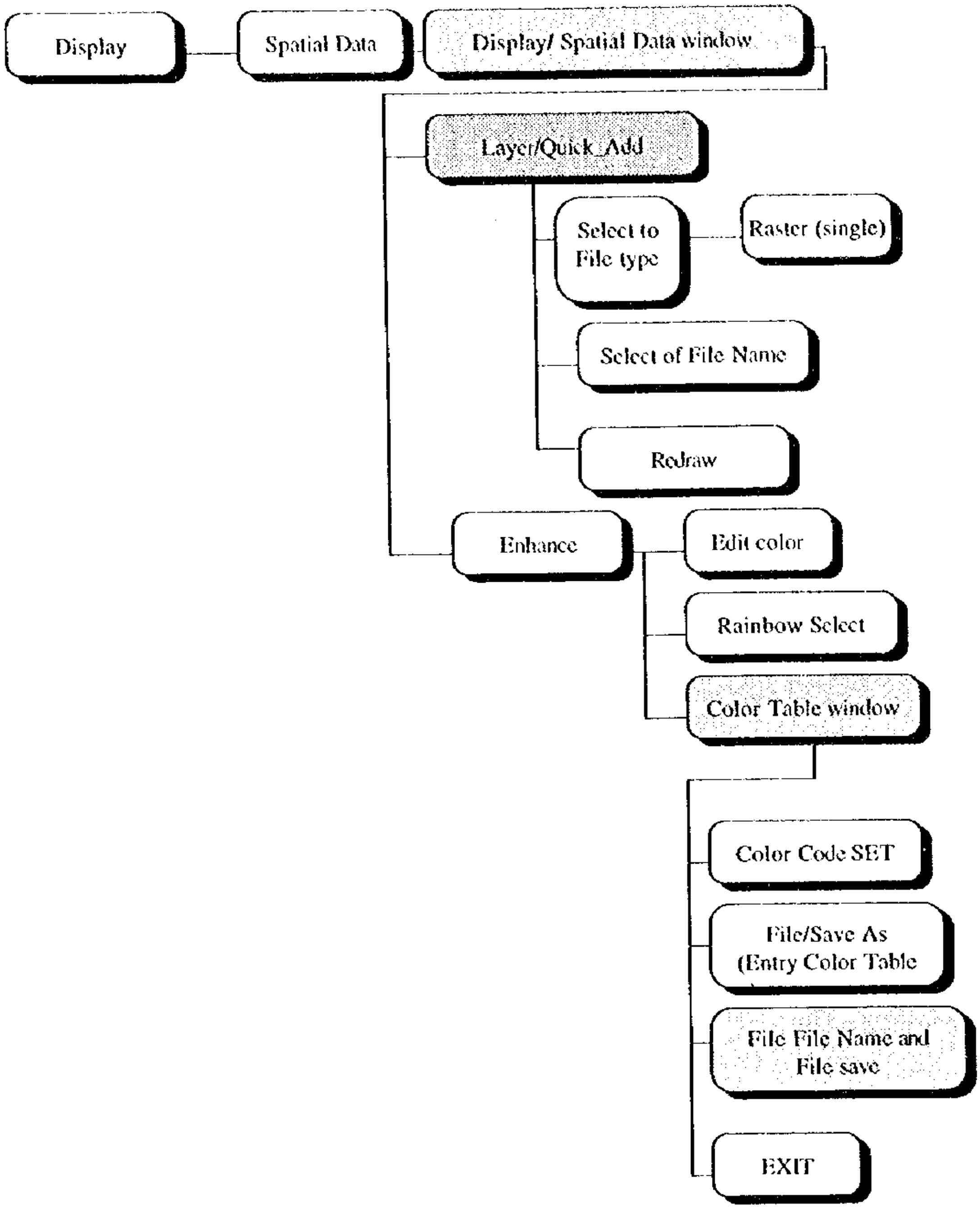
4-1-4 Enter to New File and Save File



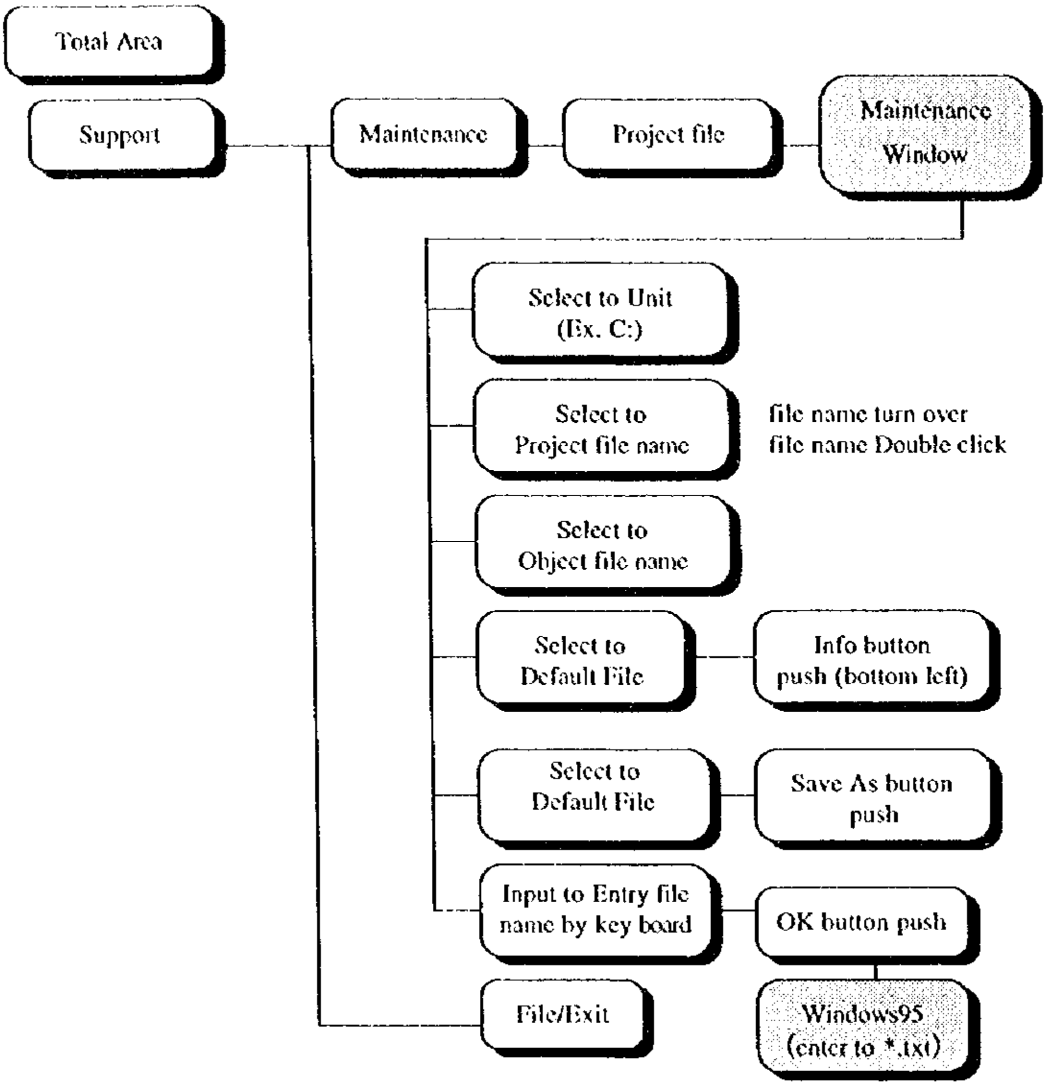
4-1-5 End



4-1-6 Formulation of Color Tables



4-1-7 Total Area



** Use to Word pat
Microsoft Word
Microsoft Excel

4-2 Thematic Mapping

4-2-1 Data Input and Production

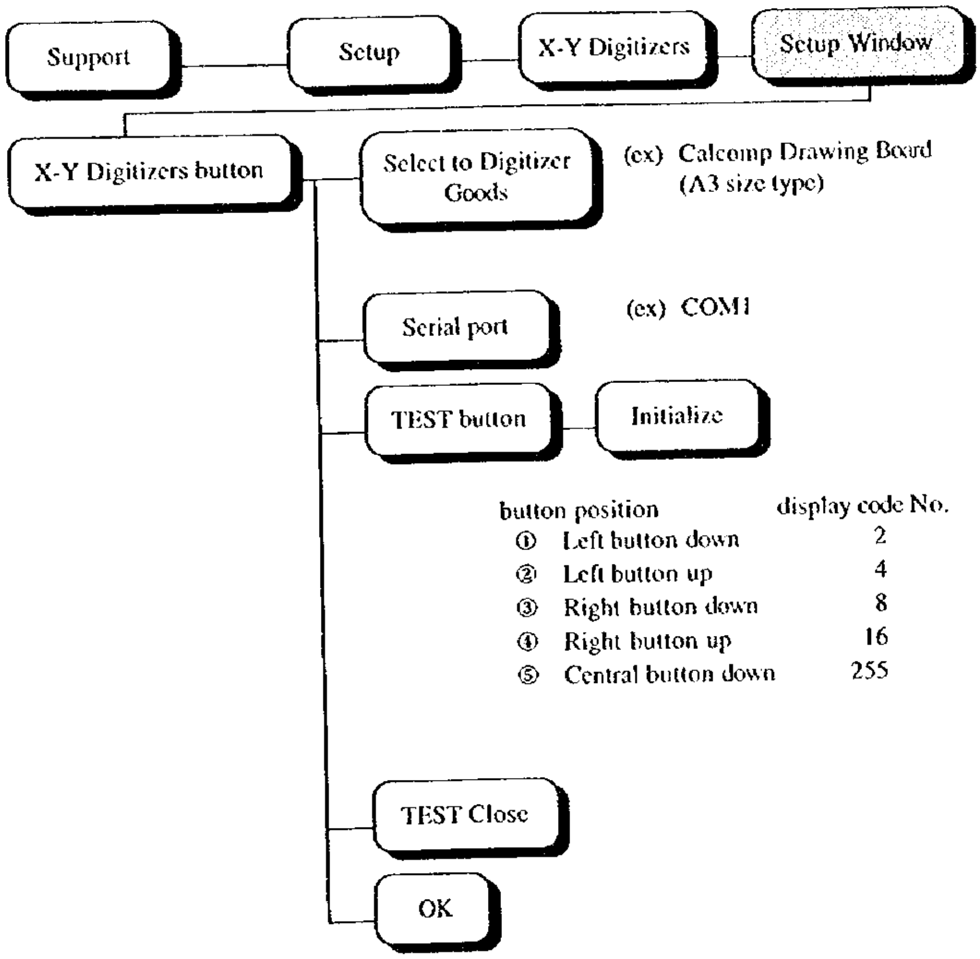
(1) Input of Mapping Data

Mapping data are entered either with the use of a scanner or a digitizer. However, it is necessary to initially turn on the power of the scanner or digitizer before turning on the power of the main computer. The input method is chosen based on the items to be entered and the state of the map. The current work at hand involves the scanning of the slope classification map (contour data). Other thematic maps were made using a digitizer. The operation of the input equipment is explained below.

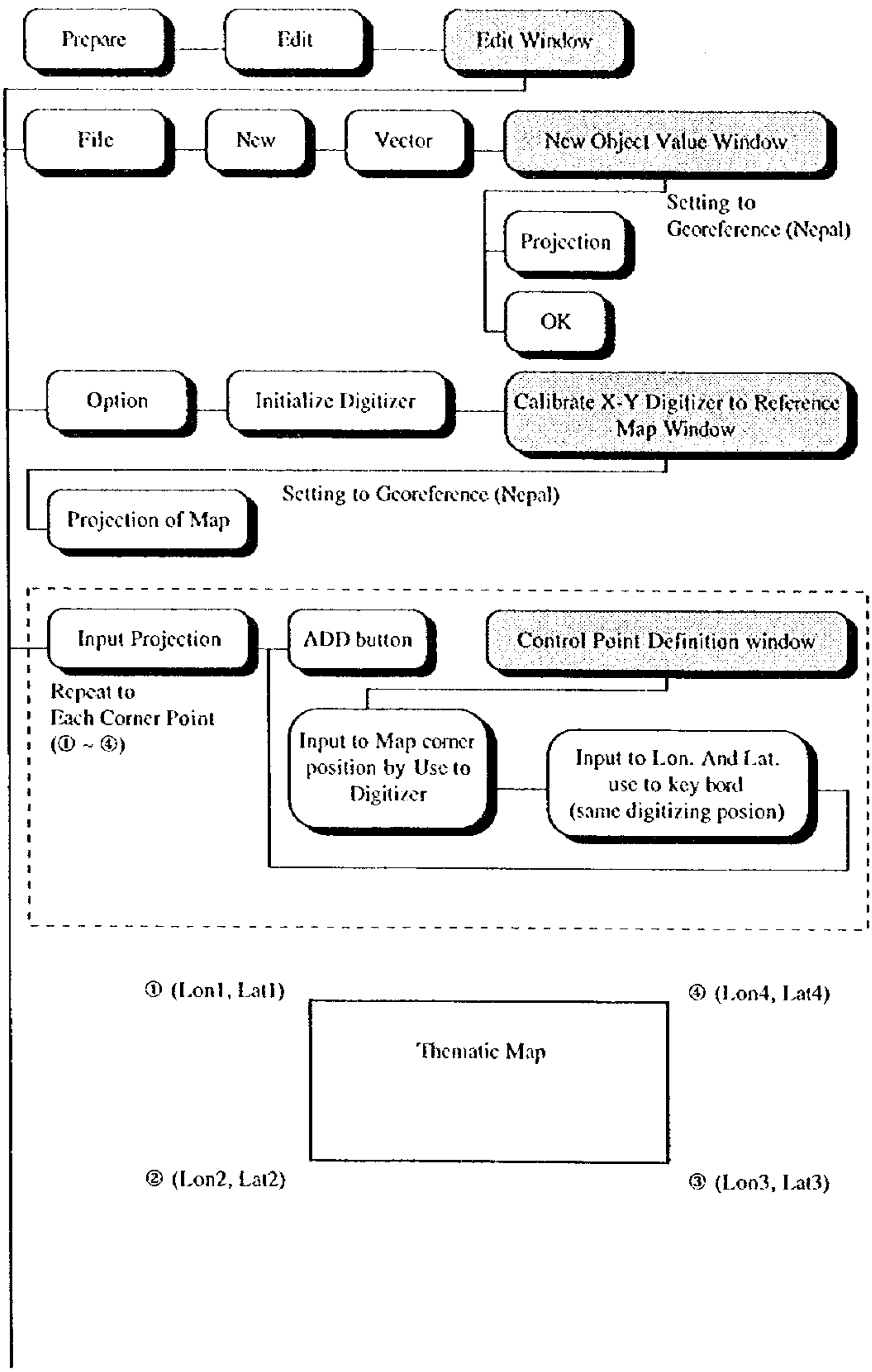
1) Input by using a digitizer

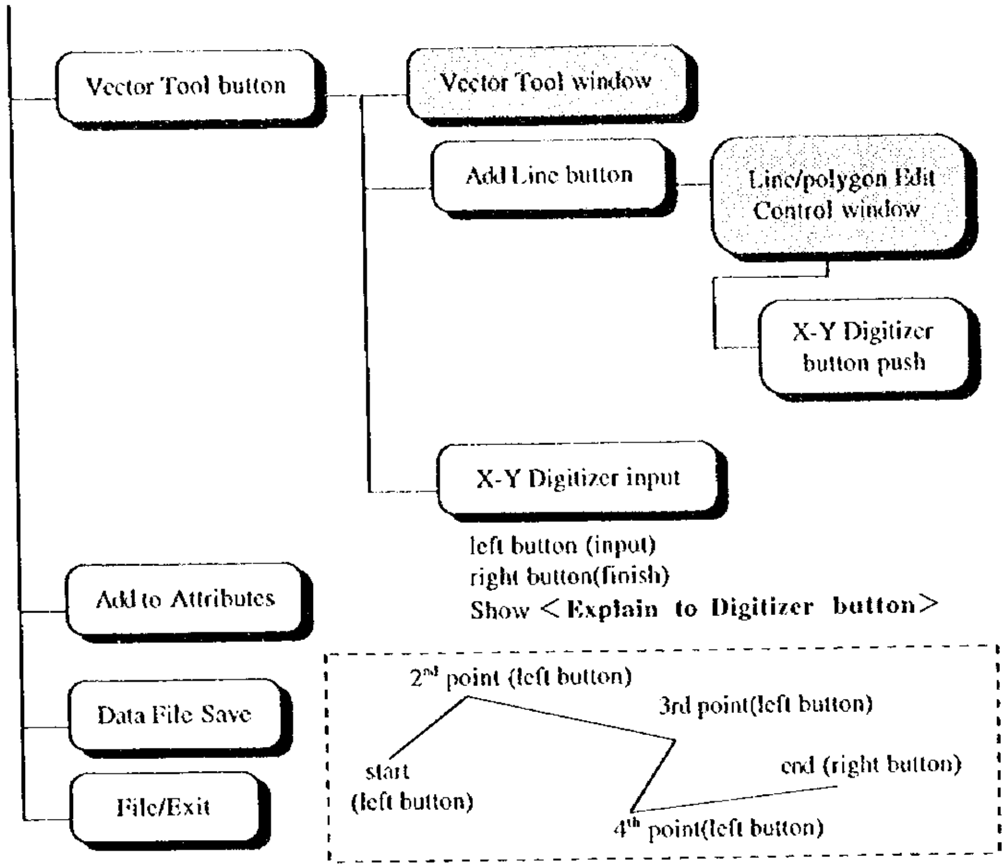
Input is carried out according to ① and ②

① Initialization of the digitizer



② step. Input Data





sample of input for digitizer

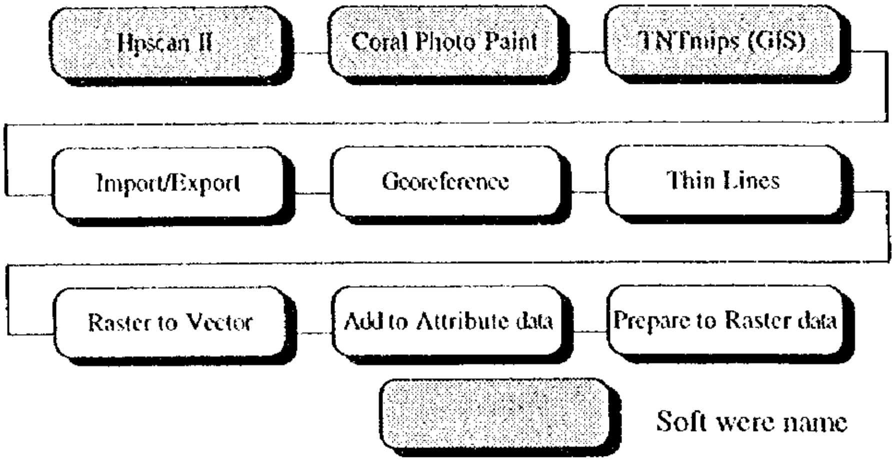
<Definition of buttons>

Add Start, Add End	Command for the input of lines chosen according to the direction of the line (vector). The default is to conclude a line with "Add End", which refers to the first point as the starting point and the last as the end point. In contrast, "Add Start" refers to the first point as the end point and the last point as the first point. Lines are categorized to classify external and internal sections.
Insert Vertex	Used to insert a median point when making a line
Drag Vertex	Used to move the median point when making a line
Delete Vertex	Used to delete the median point when making a line
Move	Used to move the line drawn.
Draw	One of the input modes. Push the left button down and with your hand on the button move the cursor of the digitizer. A series of points are entered according to the movement of the cursor.
Stretch	One of the input modes. Upon pushing the left button down, the line extends like an elastic band according to the desired scale.
Clear	Command used to terminate line drawing operations
Close Polygon	Used to make the start point and end point the same (Polygon)
Snap to: Element	Used for snapping to the closest figure elements (lines, nodes, point)
Line	Used for snapping to the closest line
Node	Used for snapping to the closest node point.
Point	Used for snapping to the closest point.
None	When snapping is not to be carried out.
Snap Type: Add Vertex	When the snap function is used, this command is used to leave the last point as a median point.

Snap Type: Move Vertex	This command is used to move the median point, after this point has been registered.
Snap	Used to carry out snap functions
Manual	Used to register coordinates directly from the key board
X-Y Digitizer	Used to register coordinates directly from the digitizer. If the Manual cannot select the X-Y Digitizer, controls shall be conducted with the mouse cursor.
Add	Used to enter any line drawn (function is similar with the right button of the digitizer cursor).

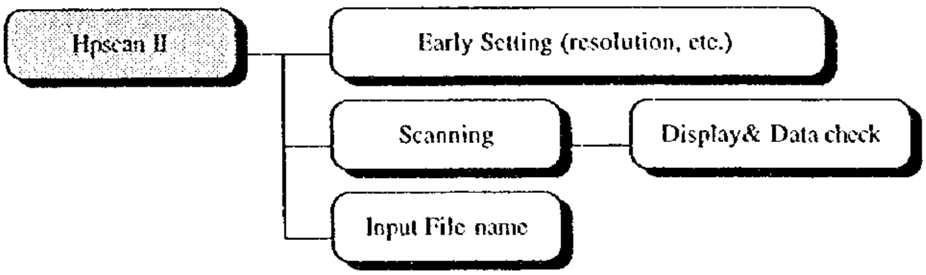
2) Input by Using a Scaner

New Map data make in order to same steps

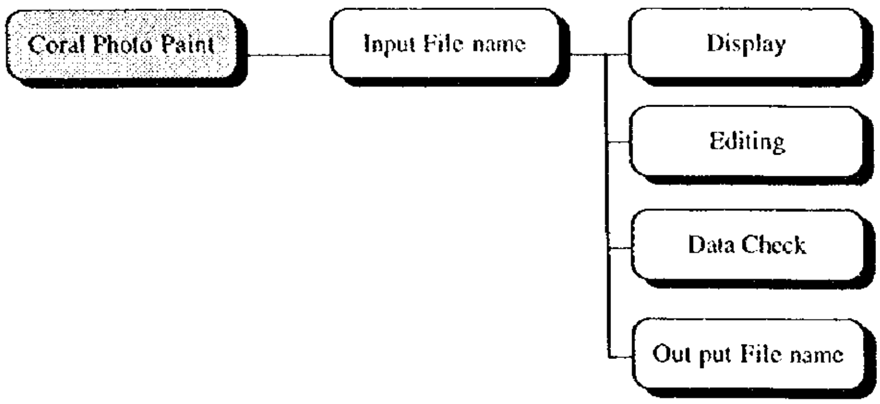


① step Scanning

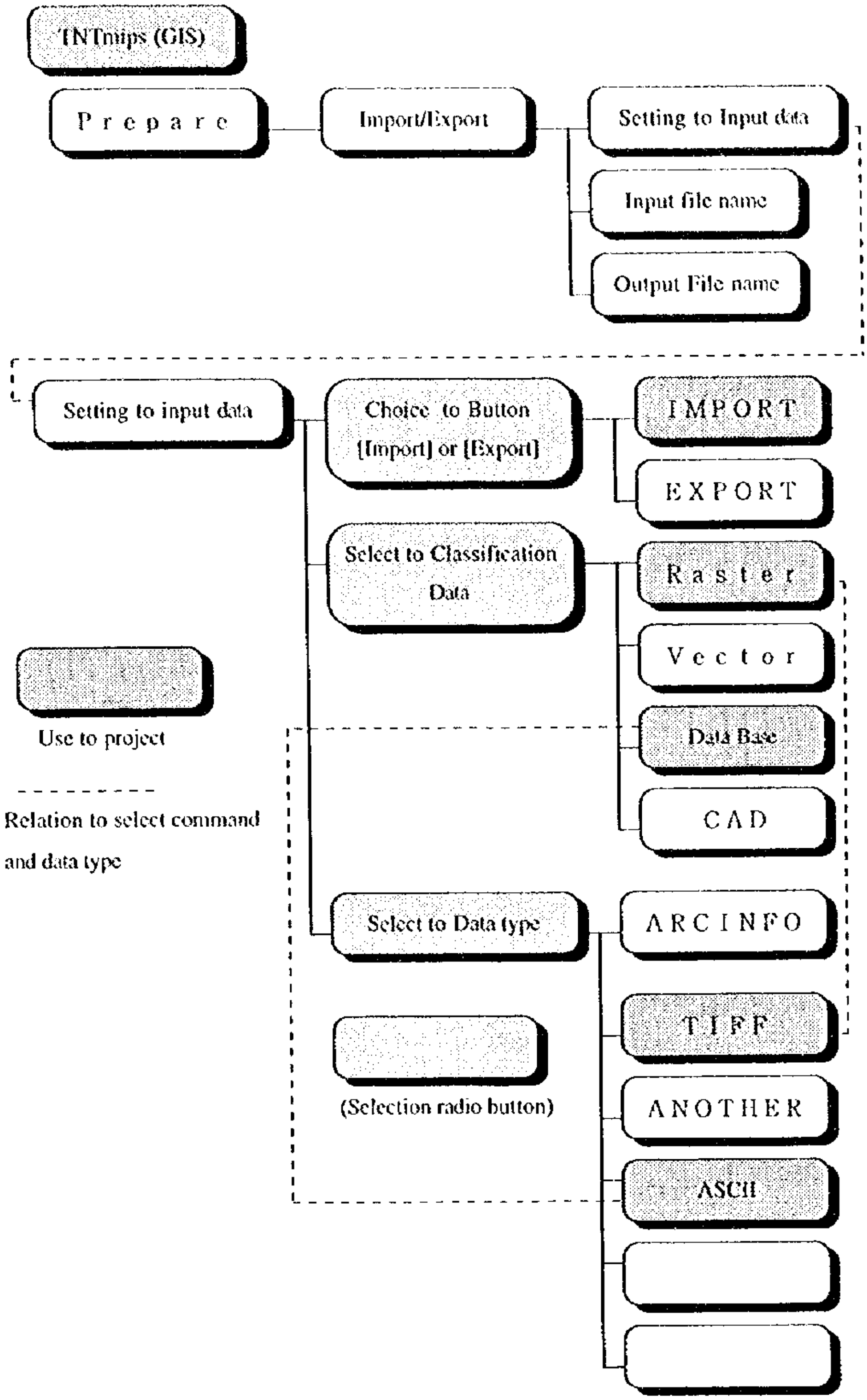
300DPI、 Unit name



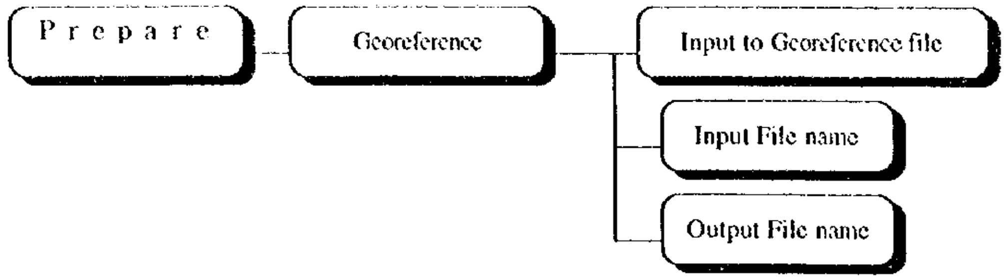
② step. Data Editing (edit, erase, add)

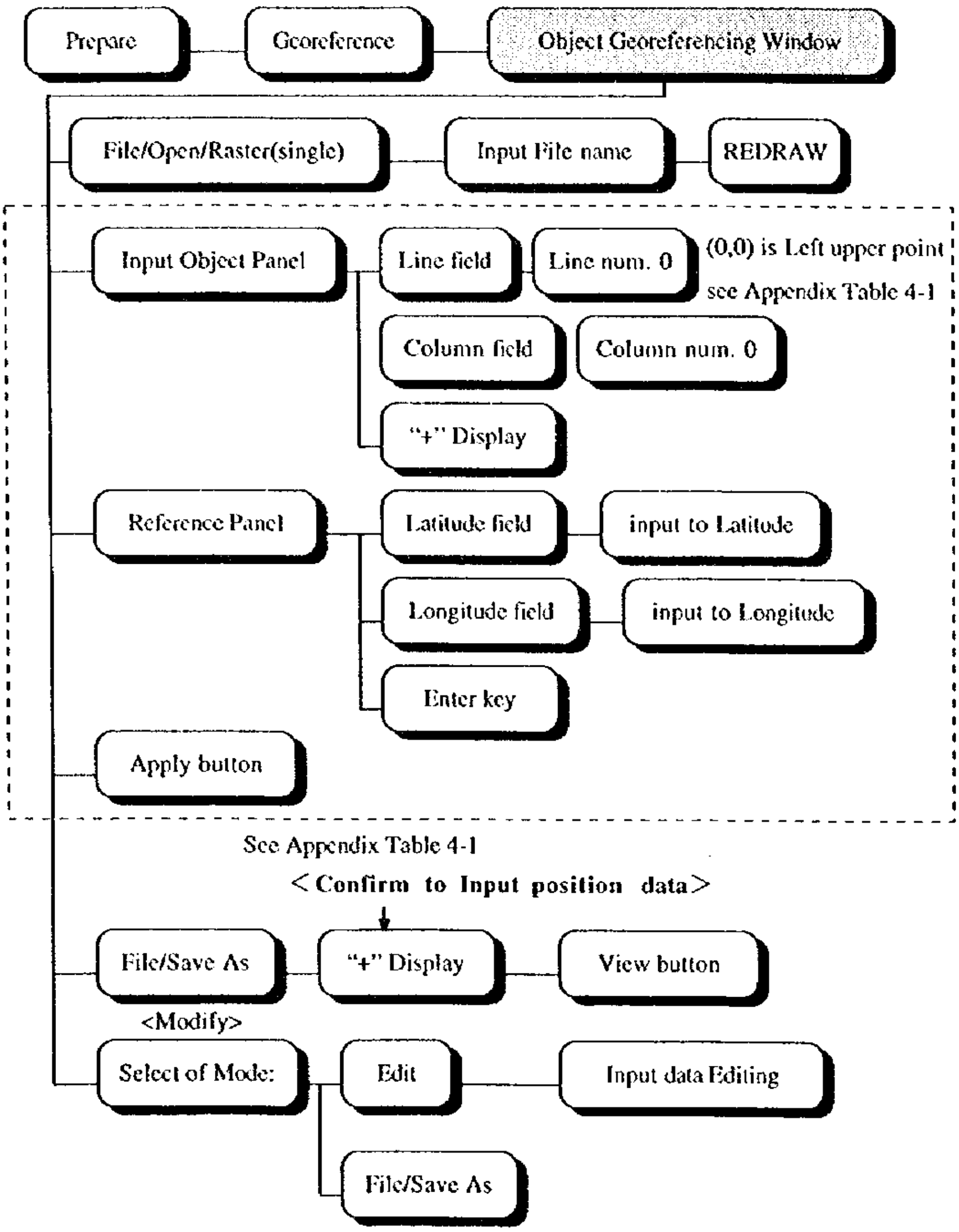


③ Database to TNT mips



④ step Setting to Georeference





Appendix Table 4-1 Coordinates of 4 corner point and Mesh count for Each Model area

(1) Parbat North

No	North	East	line col
1	3,122,500.0	464,500.00	0, 0
2	3,110,000.0	464,500.00	500, 0
3	3,110,000.0	479,500.00	500, 600
4	3,122,500.0	479,500.00	0, 600

(2) Parbat South

No	North	East	line col
1	3,110,000.0	462,000.00	0, 0
2	3,097,500.0	462,000.00	500, 0
3	3,097,500.0	472,000.00	500, 400
4	3,110,000.0	472,000.00	0, 400

(3) Kaski North

No	North	East	line col
1	3,137,000.0	490,000.00	0, 0
2	3,119,500.0	490,000.00	700, 0
3	3,119,500.0	510,000.00	700, 800
4	3,137,000.0	510,000.00	0, 800

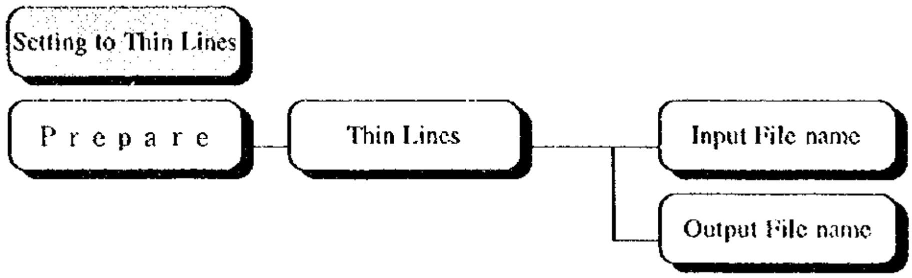
(4) Kaski West

No	North	East	line col
1	3,129,500.0	480,000.00	0, 0
2	3,112,000.0	480,000.00	700, 0
3	3,112,000.0	500,000.00	700, 800
4	3,129,500.0	500,000.00	0, 800

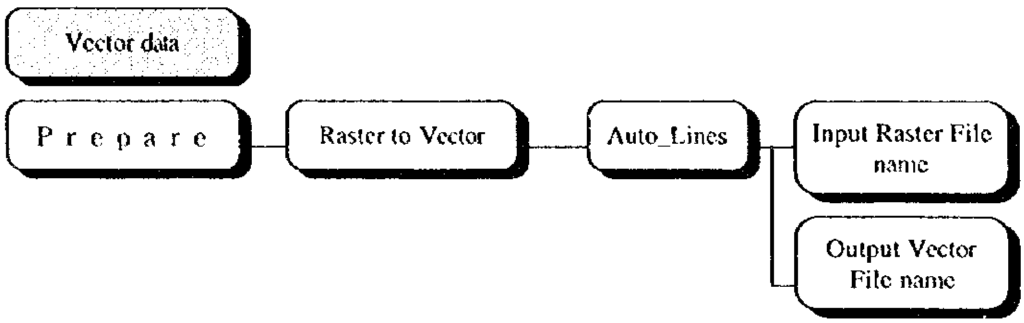
(5) Kaski East

No	North	East	line col
1	3,118,500.0	509,500.00	0, 0
2	3,106,000.0	509,500.00	500, 0
3	3,106,000.0	524,500.00	500, 600
4	3,118,500.0	524,500.00	0, 600

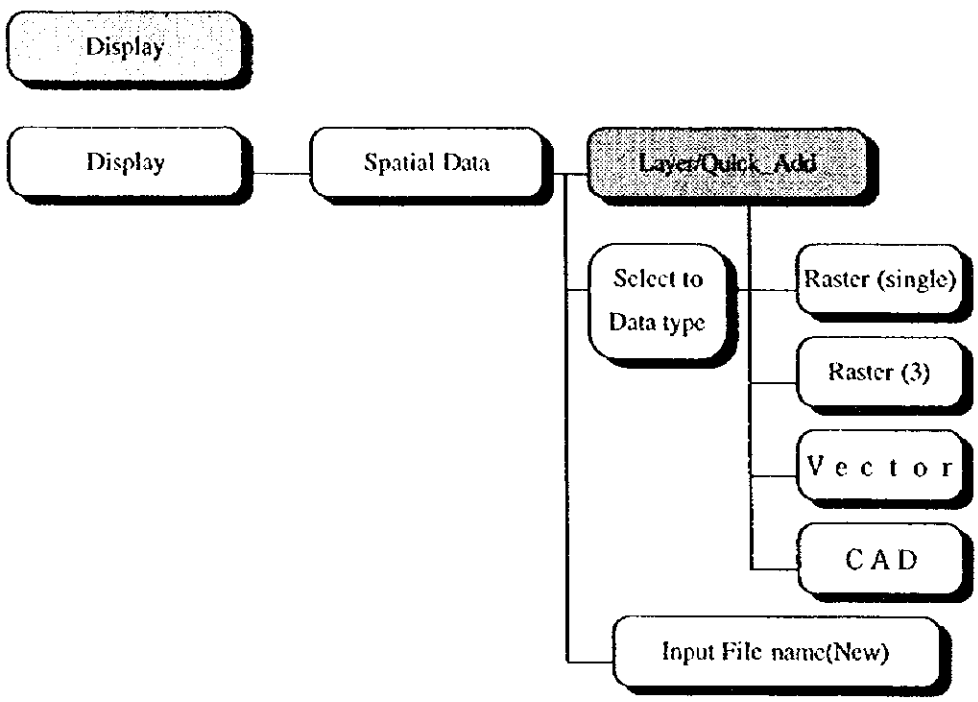
⑤ step. Setting to Thin Lines



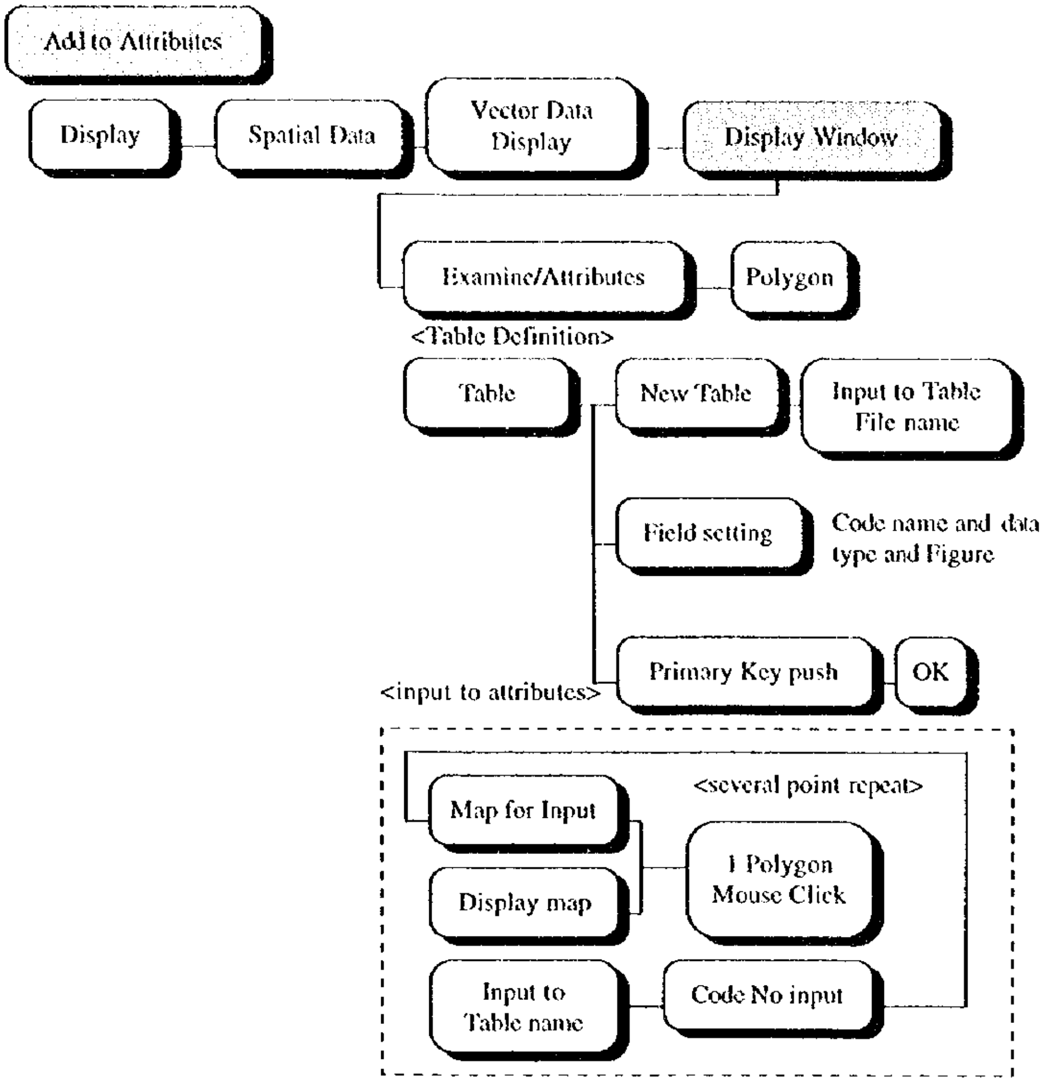
⑥ step Prepare to Vector data



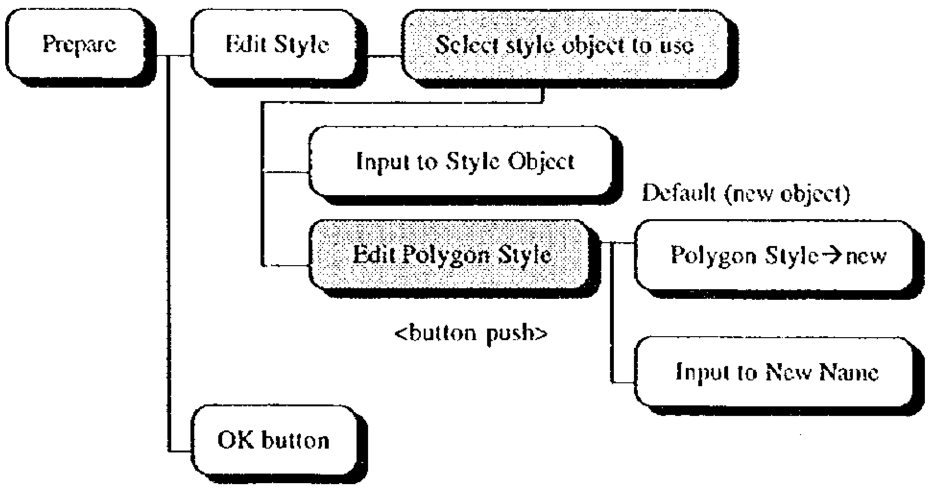
⑦ step Confirm to New Data



⑧ step Add to Attributes data



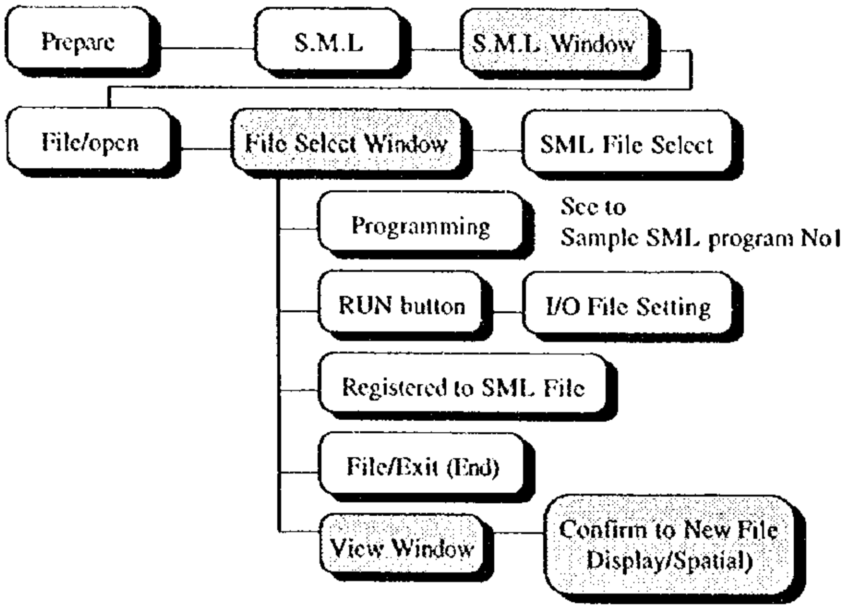
⑨ step Setting to Style Object



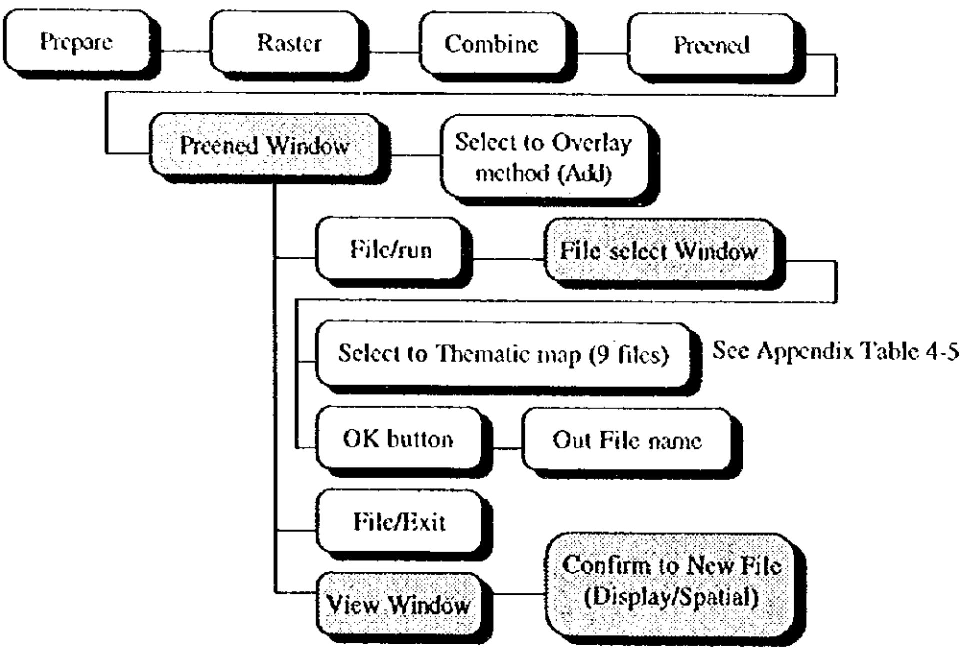
4-3 Hazard Map Production

To produce hazard maps, 9 thematic maps for each of the model areas will be produced in raster format. The thematic maps will be produced using the superposition functions of TNTmips. As for changes in the RATE of the thematic maps, data revision will be carried out using the Spatial Manipulation Language (SML) function of TNTmips (see Table 2 for the titles of thematic maps).

4-3-1 Data Formulation and Compilation



4-3-2 Overlay Method



```
#### Sample SML Program  No1  Change to Thematic data
clear()
GetInputRaster(R)    <------------------------------  Input file
GetOutputRaster(R1$,lins,cols,"16-bit unsigned") <----------Output file
                                   ^------------------  Output style
for each R[row, col] begin <------ Start
  if ( R[row, col] == 5 ) then  <---- Old data "5"  change to  New data "0"
     R1$[row, col] = 0
  else
  if (R[row, col] == 10 )  then
     R1$[row, col] = 10
  else
  if (R[row, col] == 20 )  then
     R1$[row, col] = 15
  else
  if (R[row, col] == 30 )  then
     R1$[row, col] = 20
  else
  if (R[row, col] == 35 )  then
     R1$[row, col] = 25
  else
  if (R[row, col] == 255 )  then
     R1$[row, col] = 255
 end     <-------------------------  Program End

 CreatHistogram(R1$)
 CreatPyramid(R1$)
 CloseRaster(R1$)
 CloseRaster(R)
```

4-3-3 File Required for Display

Files entered for the project and those made through the project are shown in Tables 3-8. Files related to SML will only be used for representation.

Appendix Table 4-2 Relation between File name and Model area

Abbreviated Title	Model Area Name
ke,KE · · ·	kaski_east model area
kn,KN · · ·	kaski_north model area
kw,KW · · ·	kaski_west model area
pn,PN · · ·	parbat_north model area
ps,PS · · ·	parbat_south model area

Appendix Table 4-3 Relation between Thematic File name and Code name

Code	Thematic Name	Code	Thematic Name
A	Rock Type	F	Erosion front
B	Weak Zone	G	Land use
C	Consolidation of overburden	H	Slope
D	Thickness of overburden	I	Hydrology
E	Dip slope		

Appendix Table 4-4 Thematic map data (before Edit data)

1. Project File name: Kaski_East.rev (Object file name)		2. Project File name: Kaski_North.rev (Object file name)	
(1) A_KE	(6) F_KE	(1) A_KN	(6) F_KN
(2) B_KE	(7) G_KE	(2) B_KN	(7) G_KN
(3) C_KE	(8) H_KE	(3) C_KN	(8) H_KN
(4) D_KE	(9) LANDKE	(4) D_KN	(9) LANDKN
(5) E_KE		(5) E_KN	

3. Project File name: Kaski_West.rev (Object file name)		4. Project File name: Parbat_North.rev (Object file name)	
(1) A_KW	(6) G_KW	(1) A_PN	(6) G_PN
(2) B_KW	(7) F_KW	(2) B_PN	(7) H_PN
(3) C_KW	(8) LANDKW	(3) C_PN	(8) F_PN
(4) D_KW	(9) H_KW	(4) D_PN	(9) LANDPN
(5) E_KW		(5) E_PN	

5. Project File name: Parbat_South.rev (Object file name)	
(1) A_PS	(6) F_PS
(2) B_PS	(7) G_PS
(3) C_PS	(8) H_PS
(4) D_PS	(9) LANDPS
(5) E_PS	

Appendix Table 4-5 Thematic map data (After edit data)

1. Project File name: new_ke.rev (Object file name)		2. Project File name: new_kn.rev (Object file name)	
(1) new_aa	(5) f_R1_	(1) f4_R1_	(5) new_bbbb_R1_
(2) new_bb	(6) new_g_ADD	(2) h1_R1_	(6) new_h_ADD
(3) c_R1_	(7) new_h_ADD	(3) new_cR1_	(7) kn_landuse
(4) d_R1_		(4) new_aaa_R1_	

3. Project File name: new_kw.rev (Object file name)		4. Project File name: new_pn.rev (Object file name)	
(1) c_R1_	(5) new_aa	(1) c_R1_	(5) new_bb
(2) d_R1_	(6) new_bb	(2) d_R1_	(6) new_g_ADD
(3) f_R1_	(7) new_g_ADD	(3) f_R1_	(7) new_h_ADD
(4) h_R1_		(4) new_aa	

5. Project File name: new_ps.rev (Object file name)	
(1)c_R1_	(5)new_bb
(2)d_R1_	(6)new_g_ADD
(3)f_R1_	(7)new_h_ADD
(4)new_aa	

Appendix Table 4-6
Thematic map data (Another)

1. Project File name: NEPAL.rev (Object File name)	
(1) KN_WET1(I)	(9) kw_all_ADD
(2) KW_WET1(I)	(10) ps_all_ADD
(3) PN_WET1(I)	(11) PN_DOJ (soil)
(4) PS_WET1(I)	(12) KE_DOJ (soil)
(5) KE_WET1(I)	(13) PS_DOJ (soil)
(6) KN_ALL_ADD	(14) kn_newdoj (soil
(7) ke_all_ADD	(15) kw_newdoj (soil
(8) pn_all_ADD	

Appendix Table 4-7
Hazard maps (Final)

1. Project File name: newhazrd.rev (Object File name)	
(1) kn_hazard	(11) kn_land
(2) ke_hazard	(12) kw_land
(3) kw_hazard	(13) pn_land
(4) ps_hazard	(14) ps_land
(5) ke_mask(mas	(15) pe_hzADD
(6) kn_mask(mas	(16) kw_hzADD
(7) kw_mask(mas	(17) kn_hzADD
(8) pn_mask(mas	(18) pn_hzADD
(9) ps_mask(mas	(19) ps_hzADD
(10) ke_land	(20) new_kn_land

Appendix Table 4-8 Land Area of Site Classification and Land Use Improvement Plan

1. Project File name: richi.rev (Object File name)		2. Project File name: tochikzn.rev (Object File name)	
(1) pn_richiR2_	(9) kw_newrh	(1) ke_ADD	(10) ps_kaitoADD
(2) kn_richiR2_	(10) pn_newrh	(2) kn_ADD	(11) land_ADD
(3) ke_richiR2_	(11) ps_newrh	(3) kw_ADD	(12) new_kn_kzn_ADD
(4) kw_richiR2_	(12) ke_kaizen	(4) pn_ADD	(13) kn_lnd_haz_ADD
(5) ps_richiR2_	(13) kn_kaizen	(5) ps_ADD	(14) ke_lnd_haz_ADD
(6) kn_newR2_	(14) kw_kaizen	(6) ke_kaitoADD	(15) kw_lnd_haz_ADD
(7) ke_newrh	(15) pn_kaizen	(7) kn_kaitoADD	(16) pn_lnd_haz_ADD
(8) kn_newrh	(16) ps_kaizen	(8) kw_kaitoADD	(17) ps_lnd_haz_ADD
		(9) pn_kaitoADD	

Appendix Table 4-9 SML file

File name	Abstract of Procedure
Hazard1.sml	Thematic Data change to ratting
Richi.sml	classication data
Newkaizen.sml	Planning data

4-4 Plan Map Production

Plan maps shall be made based on established conditions for existing thematic maps, hazard maps and soil maps. Using existing registered maps, new plan maps will be made. A land classification map was made using the slope classification map and soil map, and a land use map was made based on the zone classification map, soil and hazard maps.

4-4-1 Land Classification Map Production

Based on the conditions stipulated in the table below, the land classification map was made using the soil map and slope classification map.

Appendix Table 4-10 Land Classification Data

Soil Type	Soil Data Code	Slope Data (rating)		
		~0.5	1.5	0~
Dystric/Butric/Calcaric Fluvisols	1	3	2	1
Calcaric Fluvisols	2	2	2	1
Dystric Regosols	4	3	2	1
Calcaric Regosols	3	2	1	1
Dystric Leptosols	5	2	1	1
Rendzic Leptosols	6	3	3	2
Butric Cambisols	7	3	2	2
Dystric Cambisols	8	3	2	2
Humic Cambisols	9	3	3	2
Haplic Luvisols	10	3	3	2
Haplic Luvisols/Alisols	15	3	2	2
Haplic Alisols	12	3	2	1
Haplic Acrisols	11	2	2	1
Othes	13,14	1	1	1

(1) Data Compilation

Using the data shown in Appendix Table 4-10 and SML, the land classification map under classification codes 1 to 3 was made.

The classification map was made in the following order:

① Start the SML and open the SML Program registered.

② Create a file on new land classification codes in accordance with data specified in soil and slope table.

③ Check syntax. After confirming the absence of syntax anomalies, save the file either by clicking on File/Save or File/Save As functions.

④ Click on the button on the upper left screen, then click on the "RUN" and push "enter".

⑤ According to the Program, select the file on soils then the file on slope classification.

⑥ Then input the newly made file on site classification using the keyboard.

⑦ After completing the set up of required files, the scale of the model area and the conditions of the data for output will be displayed on the screen. After confirming the displayed data, push the "OK" button.

⑧ As soon as the word "Execute" is displayed onscreen, press enter. After completing the process, press the "OK" button on the WINDOW that opens to end the program.

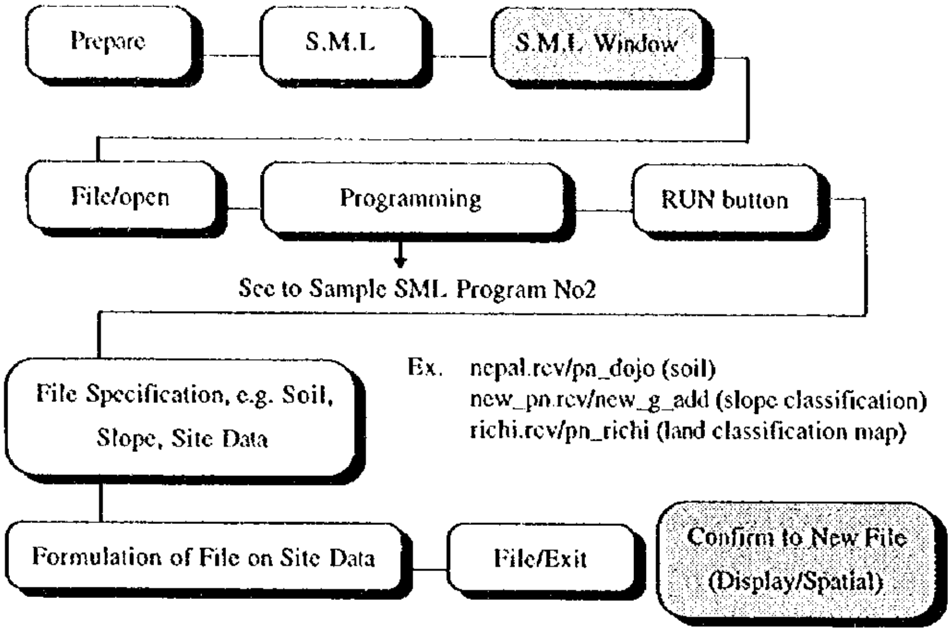
Example of similar files: (Parbat Model Area)

1. nepal.rvc/pn_dojo (soil data)
2. new_pn.rvc/new_g_add (slope classification data)
3. richi.rcv/pn_richi (land classification data)

⑨ After completion of the land classification map, open the file created through Display/2D/Layout/Quick_Add/Raster (Single) and display on the screen.

⑩ Confirm the contents of the data just created using the Examine/RawData and colored table.

⑪ In case of anomalies, start from ① and repeat the process over again, inspect the program, restart it and create a file.



Land Classification Formulation Method

Sample SML Program No2 Prepare to Land Area of Land Classification

```
clear()
GetInputRaster(R,lins,cols,"8-bit unsigned")  <------  Soil data(input)
GetInputRaster(R1,lines,cols,"16-bit unsigned")  <------  Slope data(input)
GetOutputRaster(R2$,lins,cols,"8-bit unsigned")  <--  Land Area of Land Classification
                                                       (output)

for each R[row, col] begin  <---- Program Start
    R2$[row, col] = 0  <----  All Data "0"
    if (R[row, col] < 1 ) then  <----  Input Data < 1
        R2$[row, col] = 255        Output data "255" high value (outside of
                                                              model area)

    else
    if (R[row,col] == 13 or R[row, col] == 14 ) then
        R2$[row, col] = 1          <----  Soil 13、or 14 then File new code
    else                                   "1"
    if (R1[row, col] <= 5 and R[row, col] == 1 ) then
        R2$[row, col] = 3          <----  Soil code "1" and Slope code
    else                                  Less "5" then new file code "3"
    if (R1[row, col] <= 5 and R[row, col] == 9 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 4 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 6 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 8 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 12 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 15 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 7 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 10 ) then
        R2$[row, col] = 3
    else
    if (R1[row, col] <= 5 and R[row, col] == 2 ) then
        R2$[row, col] = 2
    else
```

```
if (R1[row, col] <= 5 and  R[row, col] == 3 ) then
     R2$[row, col] = 2
else
if (R1[row, col] <= 5 and  R[row, col] == 5 ) then
     R2$[row, col] = 2
else
if (R1[row, col] <= 5 and  R[row, col] == 11 ) then
     R2$[row, col] = 2
else
if (R1[row, col] == 15 and R[row, col] == 3 )  then
     R2$[row, col] = 1
else
if (R1[row, col] == 15 and R[row, col] == 5 ) then
     R2$[row, col] = 1
else
if (R1[row, col] == 15 and R[row, col] == 6 ) then
     R2$[row, col] = 1
else
if (R1[row, col] == 15 and R[row, col] == 7 ) then
     R2$[row, col] = 3
else
if (R1[row, col] == 15 and  R[row, col] == 9 ) then
     R2$[row, col] = 3
else
if (R1[row, col] == 15 and  R[row, col] == 10 ) then
     R2$[row, col] = 3
else
if (R1[row, col] == 15 and  R[row, col] <= 2 ) then
     R2$[row, col] = 2
else
if (R1[row, col] == 15 and  R[row, col] == 4 ) then
     R2$[row, col] = 2
else
if (R1[row, col] == 15 and  R[row, col] == 8 ) then
     R2$[row, col] = 2
else
if (R1[row, col] == 15 and  R[row, col] == 15 ) then
     R2$[row, col] = 2
else
if (R1[row, col] == 15 and  R[row, col] == 11 ) then
     R2$[row, col] = 2
else
if (R1[row, col] == 15 and  R[row, col] == 12 ) then
     R2$[row, col] = 2
else
if ( R1[row, col] >= 30 and R[row, col] <= 6 ) then
```

```
        R2$[row, col] = 1
    else
    if ( R1[row, col] >= 30 and R[row, col] == 11 ) then
        R2$[row, col] = 1
    else
    if ( R1[row, col] >= 30 and R[row, col] == 12 ) then
        R2$[row, col] = 1
    else
    if ( R1[row, col] >= 30 and R[row, col] == 7 ) then
        R2$[row, col] = 2
    else
    if ( R1[row, col] >= 30 and R[row, col] == 8 ) then
        R2$[row, col] = 2
    else
    if ( R1[row, col] >= 30 and R[row, col] == 9 ) then
        R2$[row, col] = 2
    else
    if ( R1[row, col] >= 30 and R[row, col] == 10 ) then
        R2$[row, col] = 2
    else
    if ( R1[row, col] >= 30 and R[row, col] == 15 ) then
        R2$[row, col] = 2


    end        <----     Program End

CreatHistogram(R2$)
CreatPyramid(R2$)
CloseRaster(R2$) <----     File Close
CloseRatere(R1)
CloseRaster(R)
```

4-4-2 Land Use Improvement Plan Map Production

The map of the land use improvement plan was formulated based on the Hazard Map, Land Classification and land use codes shown in Appendix Table 4-11 below.

Appendix Table 4-11 Matrix for the Formulation of the Map for Land Use Improvement

Land Use \ Site \ Hazard		200	200	200	100	100	100	0	0	0
	Site	30	20	10	30	20	10	30	20	10
Forests	1	231 (1)	221 (1)	211 (1)	131 (2)	121 (1)	111 (1)	031 (2)	021 (2)	011 (1)
Shrubbery	2	232 (1)	222 (1)	212 (1)	132 (2)	122 (1)	112 (1)	032 (2)	022 (2)	012 (1)
Grassland	3	233 (5)	232 (5)	213 (5)	133 (3)	123 (4)	113 (4)	033 (3)	023 (3)	013 (4)
Fields	4	234 (7)	224 (7)	214 (7)	134 (6)	124 (7)	124 (7)	034 (6)	024 (6)	014 (7)
Paddies	5	235 (8)	225 (8)	215 (8)	145 (8)	125 (8)	125 (8)	035 (8)	025 (8)	015 (8)

Note: upper level - calculated value after completion of overlay
lower level ( ) - Planning Improvement Data Code

(1) Method of Formulation

① Conversion of Hazard Map Data

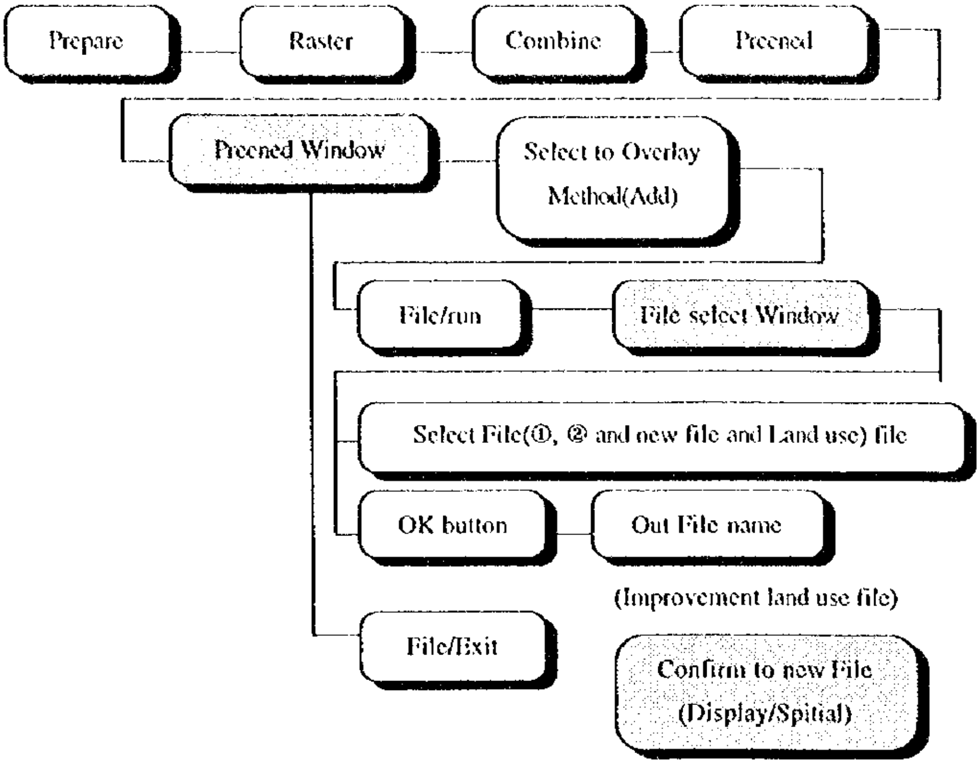
Data on hazard map such as LOW, MEDIUM, and HIGH, will be converted to "0", "100", and "200", respectively.

② Conversion of Land Classification Data

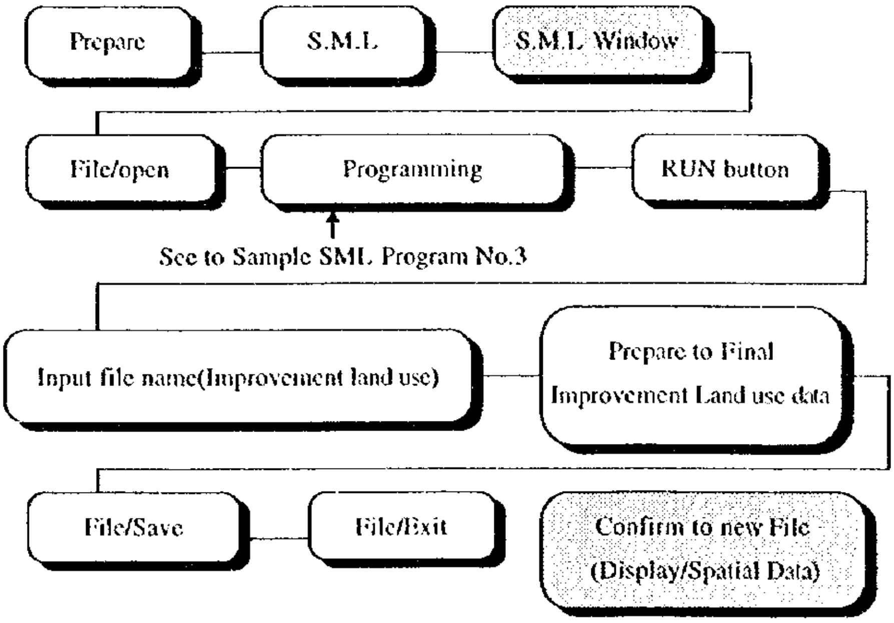
Data on site classification such as 1, 2, and 3, will be converted to "10", "20", and "30", respectively. ① & ② are conducted using the Prepare/SML function.

③ Formulation of Land Use Improvement Plan Data

Overlay the land use data with data produced in ① & ② to create new data for land use improvement. New data is then presented as in Appendix Table 4-11 above.



Final Planning Data



Sample Program No3 Prepare Land use Improvement data

```
clear()
GetInputRaster(R)  <-- Overlay File(hazard map Land use map Site Classification )
GetOutputRaster(R2$,lins,cols,"8-bit unsigned") <-- Improvement Land use File

for each R[row, col] begin

    if (R[row, col] == 255 ) then      Out Model Area move to
        R2$[row, col] = 255  <--       high value data"255"
    else
    if (R[row,col] == 231 or R[row, col] == 221 or R[row, col] == 211 ) then
        R2$[row, col] = 1              Overlay data 232 or 221 or 211
                                       code "1" move to Final Data
    else
    if (R[row, col] == 111 or R[row, col] == 121 or R[row,col] == 11 ) then
        R2$[row, col] = 1
    else
    if (R[row, col] == 131 or R[row, col] == 31 or R[row, col] == 21 ) then
        R2$[row, col] = 2
    else
    if (R[row, col] == 233 or R[row, col] == 223 or R[row, col] == 213 ) then
        R2$[row, col] = 3
    else
    if (R[row, col] == 123 or R[row, col] == 113 or R[row, col] == 13 ) then
        R2$[row, col] = 3
    else
    if (R[row, col] == 133 or R[row, col] == 33 or R[row, col] == 23 ) then
        R2$[row, col] = 4
    else
    if (R[row, col] == 135 or R[row, col] == 35 or R[row, col] == 25 ) then
        R2$[row, col] = 5
    else
    if (R[row, col] == 15 or R[row, col] == 115 or R[row, col] == 125) then
        R2$[row, col] = 6
    else
    if (R[row, col] == 215 or R[row, col] == 225 or R[row, col] == 235 ) then
        R2$[row, col] = 7
```

```
else
 if (R[row, col] == 134 or R[row, col] == 34 or R[row, col] == 24 ) then
      R2$[row, col] = 8
else
 if (R[row, col] == 234 or  R[row, col] == 224 or R[row,col] == 214 ) then
      R2$[row, col] = 9
else
 if (R[row, col] == 124 or  R[row, col] == 114 or R[row, col] == 14 ) then
      R2$[row, col] = 9
else
 if (R[row, col] == 12 or R[row, col] == 22 or R[row,col] == 32 ) then
      R2$[row, col] = 10
else
 if (R[row, col] == 112 or R[row, col] == 122 or R[row,col] == 132 ) then
      R2$[row, col] = 10
else
 if (R[row, col] == 212 or R[row, col] == 222 or R[row,col] == 232 ) then
      R2$[row, col] = 10



end

CreatHistogram(R2$)
CreatPyramid(R2$)
CloseRaster(R2$)
CloseRaster(R)
```

4-5 Socioeconomic Information

4-5-1 Database Construction

(1) Formulation of Ward Map Data

Ward Boundary Map (polygon data) shall be made and entered using either a scanner or digitizer, following the same procedure used for entering data of the thematic maps. Through the project, polygon data was formulated out of the raster ward data using the Prepare/convert/raster to vector/Auto_line. (VDC.rcv)

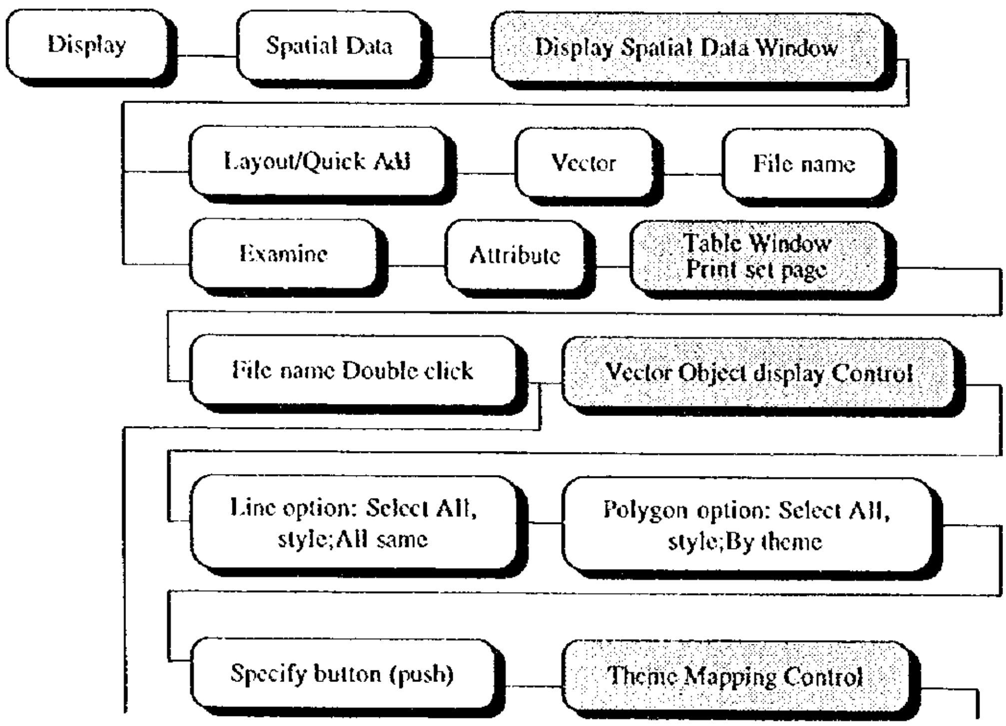
(2) VDC Data Formulation

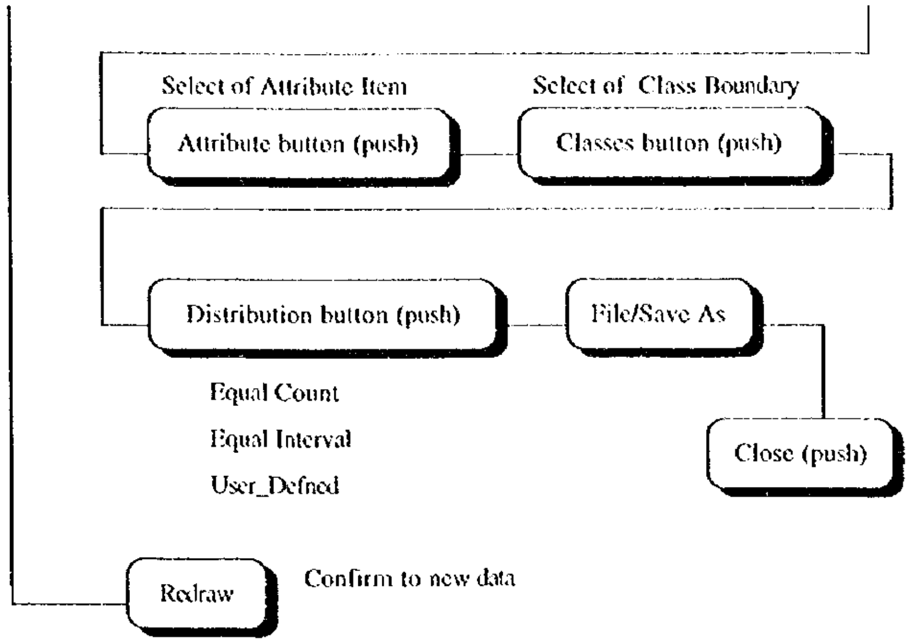
Display ward data using the Prepare/Edit/Layout/Quick_Add/Vector function. With the Delete function, erase all lines except for the VDC boundary lines. (The same applies to the formulation of data of the project area.)

(3) Socioeconomic Statistics

Data of socioeconomic statistics prepared with Excel is stored on a CSV floppy disc, and formulated as related information by using the Import, Database, Text within the Prepare/Import Export function. The form is determined based on the data's relevance to the figure data file.

4-5-2 Screen Display




Select of Attribute Item
Select of Class Boundary
Attribute button (push)
Classes button (push)
Distribution button (push)
File/Save As
Equal Count
Equal Interval
User_Defned
Close (push)
Redraw
Confirm to new data

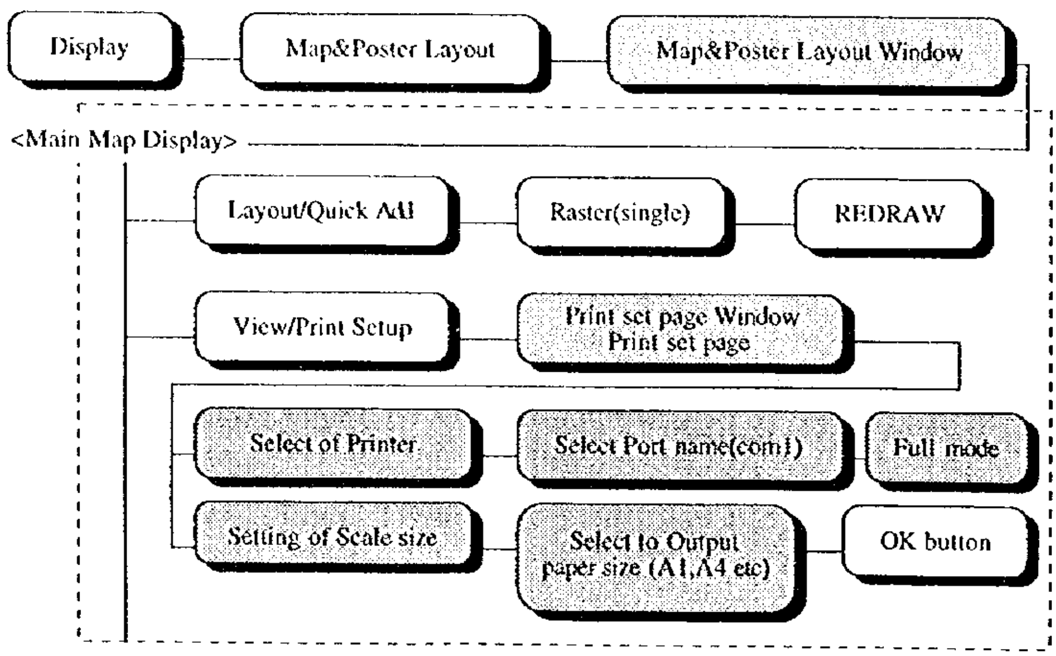
4-6 Output Operations

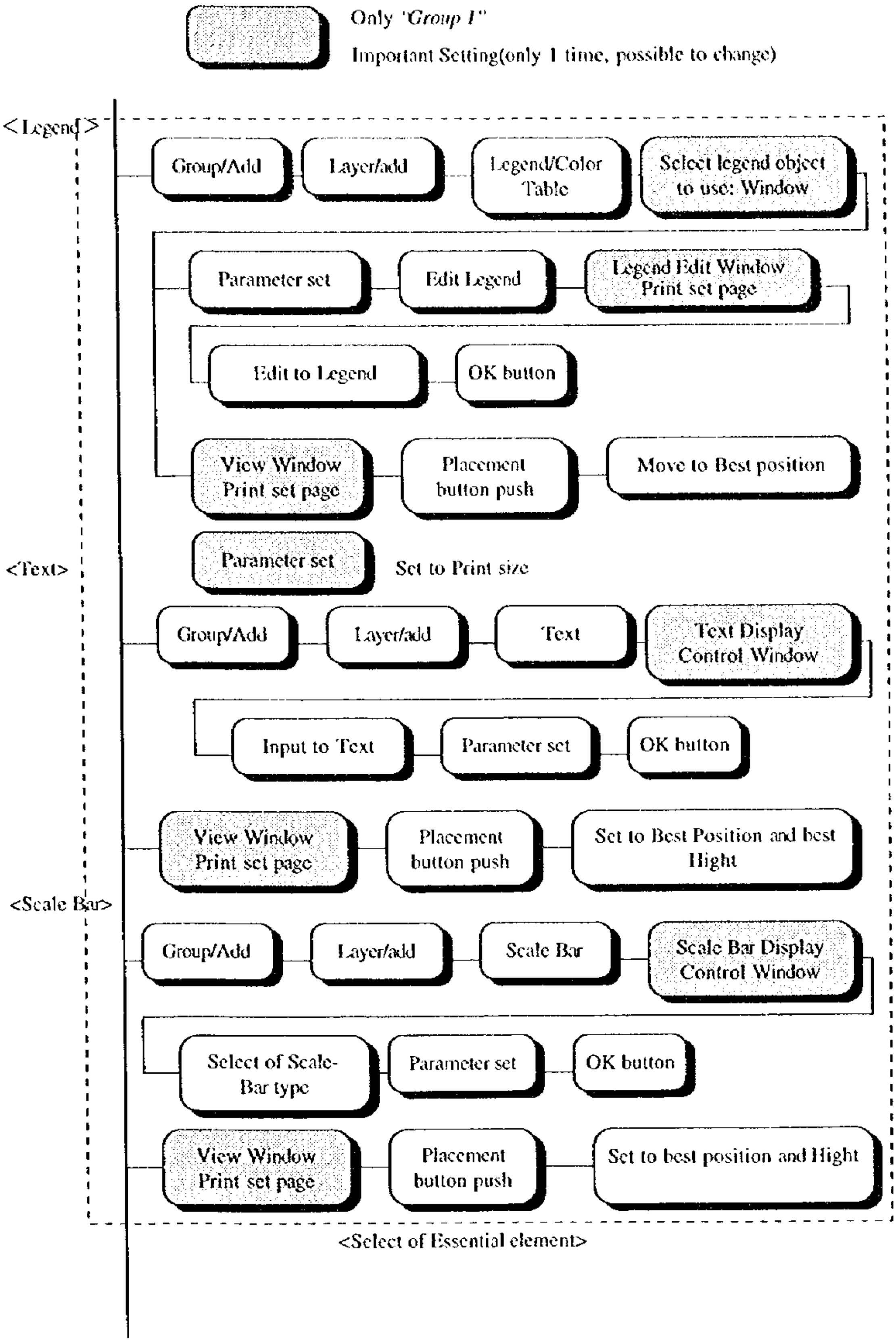
The output of data using a printer or plotter is carried out by indicating the figure or map for output on the screen then selecting other factors to be shown on the screen with the mouse. Next, establish the desired position and size, save the data as a file and click the print function for output.

The process involves initially selecting the drawing or map for output. In case the display shows the overlay of raster data and vector data, first indicate the raster data and then the vector data on top of it. Superimposing raster data with another raster data is unfavorable. Turn off HTML interpreter to display underlines. Next, with the mouse, select the command to determine the appropriate location and size of other elements such as text of title and legends, for printing. Each element shall be managed as a group; changes in size and position can be made in groups. Also, the designation of the first drawing is done using the "Layer/Quick_add function. The grouping in this phase is established as "Group 1".

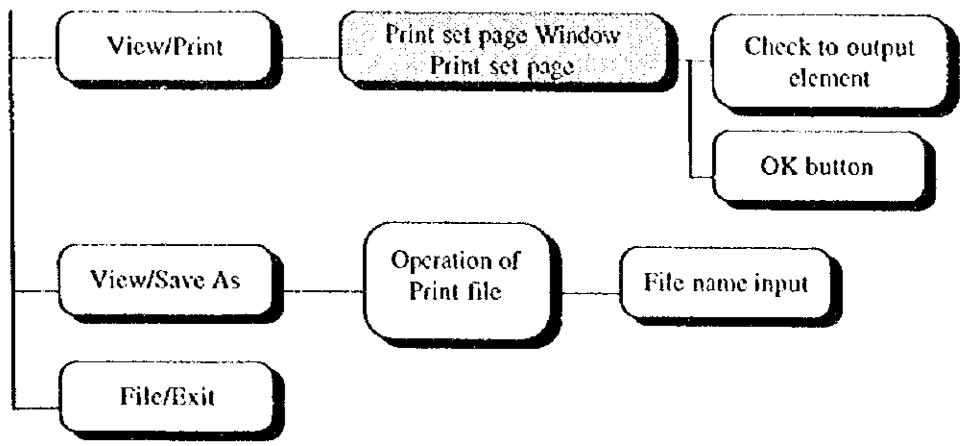
Next, when displaying relevant drawing elements such as legends and titles, use the "Group/add" function and then the "Layer/add" function for the display of element names typed on the screen. When the output layout on the screen is completed, click the "Print" command. Press "OK" button to end program after a message appears onscreen to notify the user that printing is completed. To save the drawing layout on the screen click "File/Save" or "File/Save As". By clicking the "File/Open" command, the saved file can be accessed whenever desired.

Sample of Output Formulation





<Select of Essential element>


View/Print
Print set page Window
Print set page
Check to output element
OK button
View/Save As
Operation of Print file
File name input
File/Exit