

社会開発調査部報告書

No. 2

FINAL REPORT  
ON  
TOPOGRAPHIC MAPPING OF LUMBINI ZONE  
IN NEPAL

NOVEMBER 1993

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FINAL REPORT ON TOPOGRAPHIC MAPPING OF LUMBINI ZONE

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ON  
TOPOGRAPHIC MAPPING OF LUMBINI ZONE  
IN NEPAL

JAPAN INTERNATIONAL COOPERATION AGENCY



1126715 [0]

## PREFACE

In response to a request of His Majesty's Government of the Kingdom of Nepal, the Government of Japan decided to conduct the Topographic Mapping of Lumbini Zone in Nepal and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nepal a study team headed by Mr. Hiroyuki MATSUDA and comprised of members from the International Engineering Consultants Association and Kokusai Kogyo Co., Ltd., from November, 1990 to December, 1992.

The team conducted a field study including aerial photography in close cooperation with the concerned authorities of Nepal.

After the team returned to Japan, such works as aerial triangulation, stereoplotting, compilation, drafting and printing were carried out and original topographic maps on a scale of 1:25,000 and the present report were prepared.

I hope that this report together, with the above maps, will be used effectively for formulating regional development plans and contribute to the promotion of friendly relations between our two countries.

I wish to express our sincere appreciation to the officials concerned in His Majesty's Government of the Kingdom of Nepal for their close cooperation extended to the team.

November 1, 1993



---

Kensuke YANAGIYA  
President  
Japan International Cooperation Agency

October 29, 1993

His Excellency Mr. Kensuke YANAGIYA  
President  
Japan International Cooperation Agency  
Tokyo Japan

Letter of Transmittal

Dear Sir:

In response to your request, we are pleased to formally submit herewith the final report on "Topographic Mapping of Lumbini Zone in Nepal" which has been conducted since F.Y. 1990.

This report generalizes the progress of study and the technical aspect. The study was undertaken by International Engineering Consultants Association in a joint-venture with Kokusai Kogyo Co., Ltd. from November 1990 to December 1993.

The outcome of study was 81 sheets at a scale of 1:25,000 topographic map for Lumbini zone on the basis of the 1:50,000 aerial photographs.

We are convinced that the report would, together with study results, be fully utilized as the basic materials for rural development in Lumbini Zone and contribute to the future development of Nepal.

We wish to express my sincere appreciation to the officials concerned with the Government of Japan for giving their appropriate direction during the study as well as to the officials concerned with His Majesty's Government of Nepal and the Japanese Embassy in Nepal for their close cooperation during the study.

Very truly yours,

松田博幸

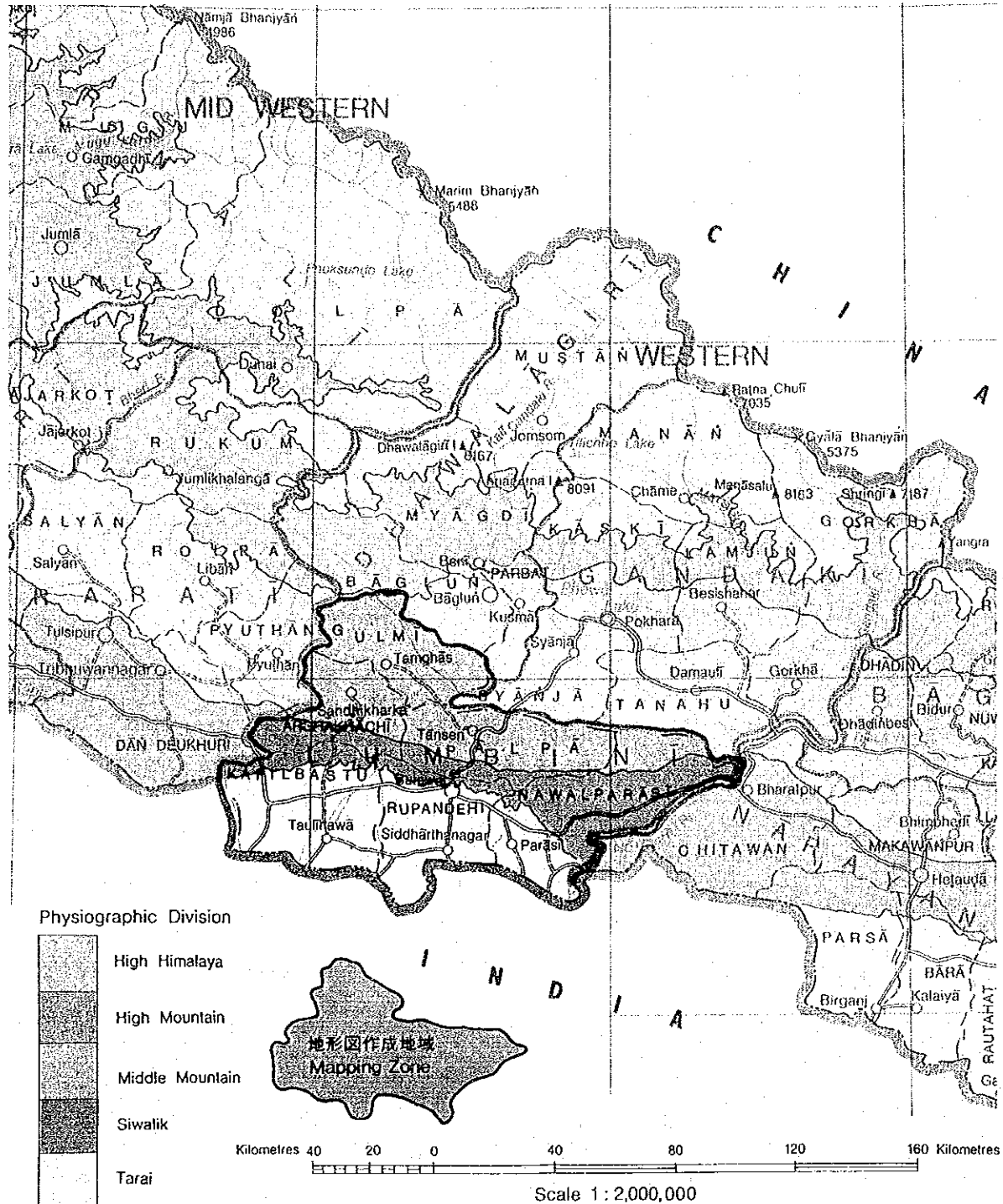
---

Hiroyuki MATSUDA  
Team Leader  
Topographic Mapping of  
Lumbini Zone in Nepal

# ネパール王国

## ルンビニ県地形図作成調査対象地域

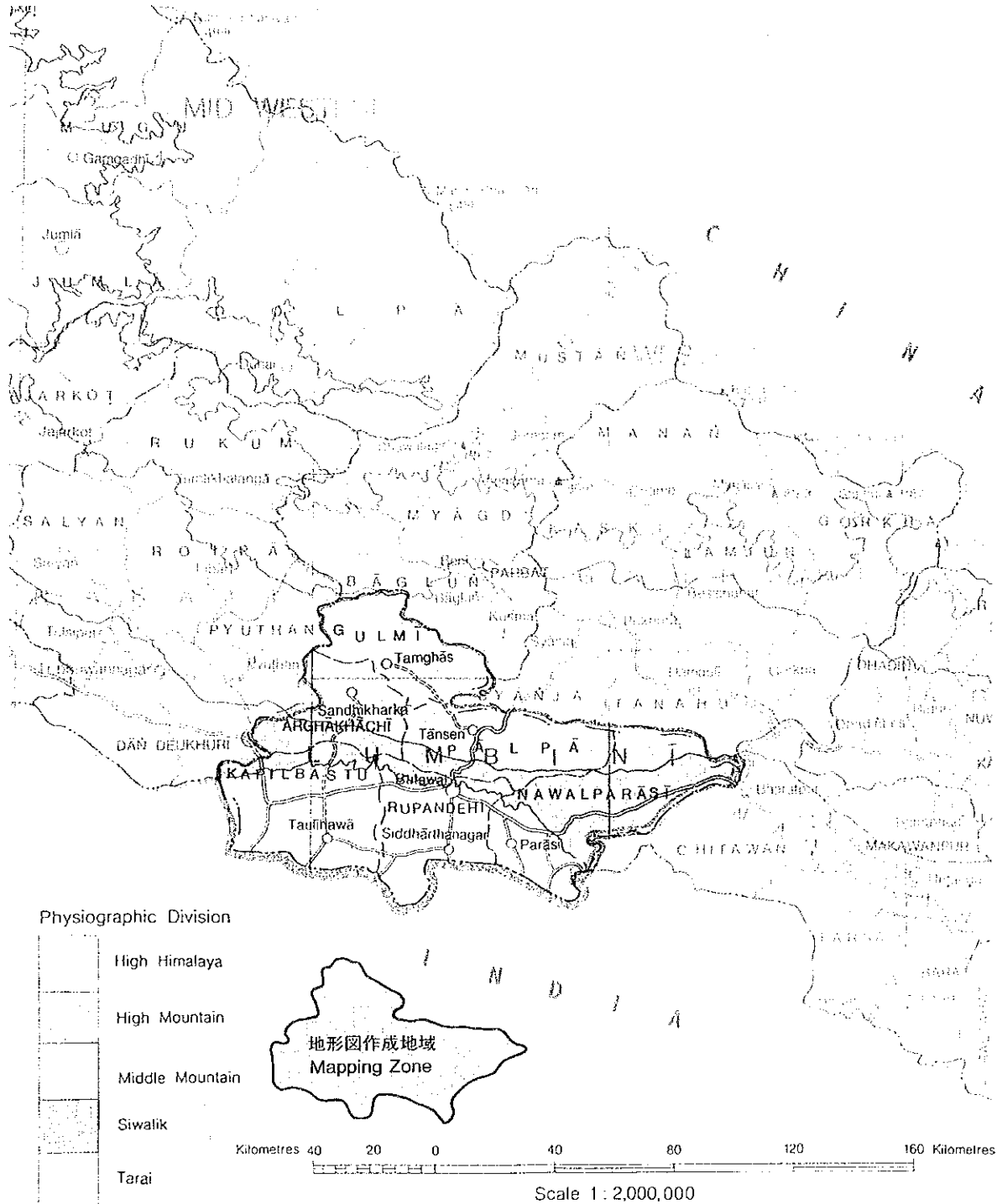
### THE TOPOGRAPHIC MAPPING OF LUMBINI ZONE IN NEPAL



# ネパール王国

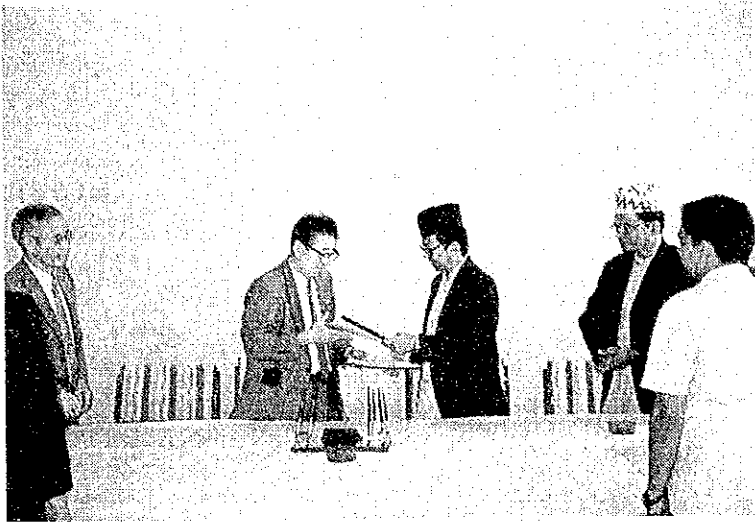
## ルンビニ県地形図作成調査対象地域

### THE TOPOGRAPHIC MAPPING OF LUMBINI ZONE IN NEPAL



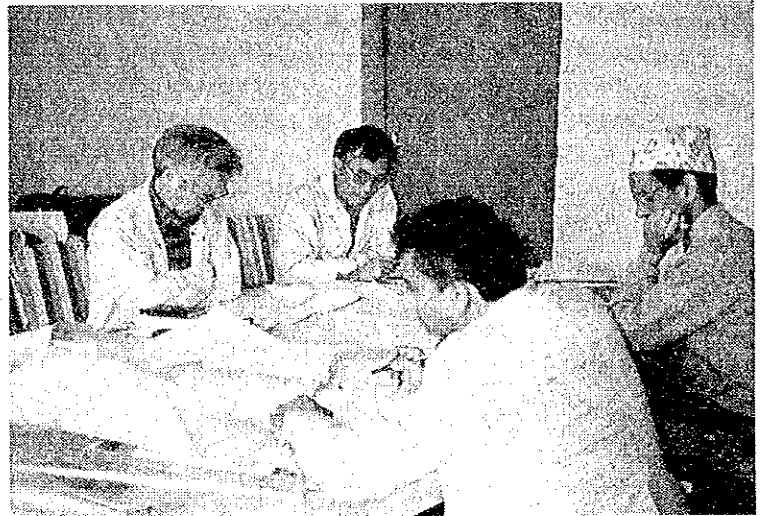




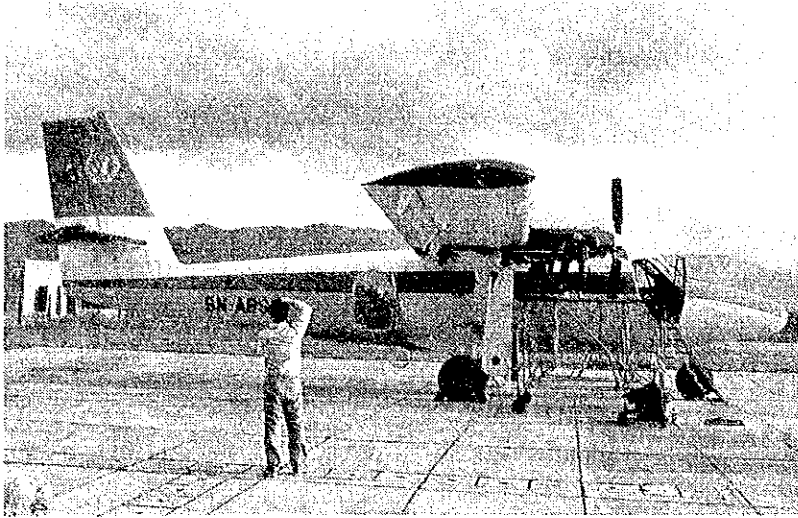


Signing on minutes of discussion, 1990.

Discussion on map symbols and map specification.



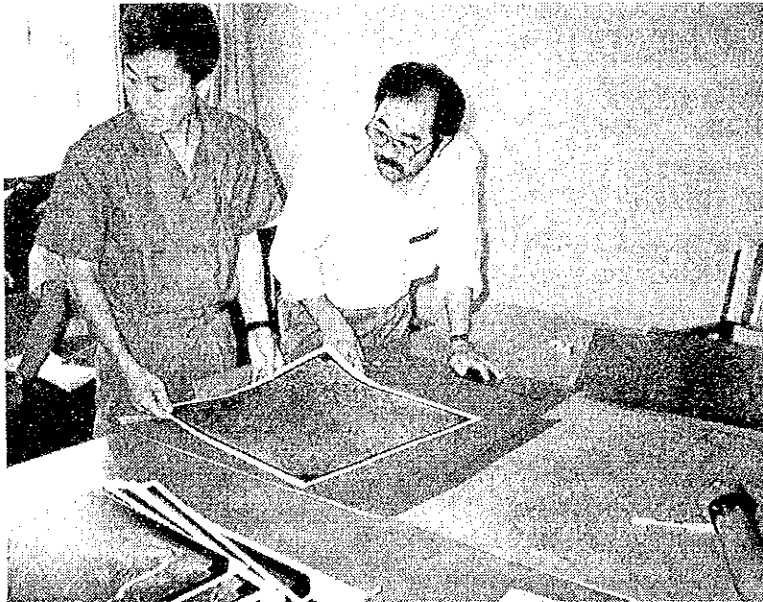
Technical transfer on formulation of annotation documents.



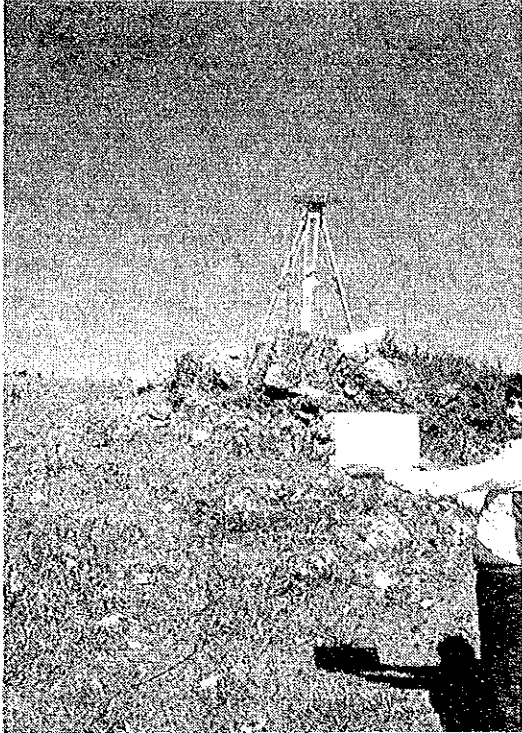
Aircraft (Twin Otter)  
for aerial photography.



Aerial camera  
(Wild RC-10).

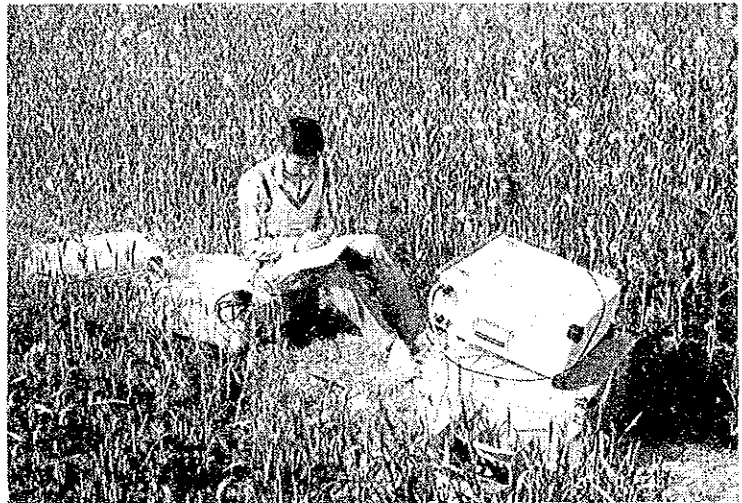


Arrangements for 2-times  
enlargent photos.



GPS observation in the mountainous area.

GPS observation in the Tarai Plain.



Technical transfer on GPS observation.



Helicopter used for access.



Caraban for conveying the instruments.



View of dry field and settlement (at Palpa).



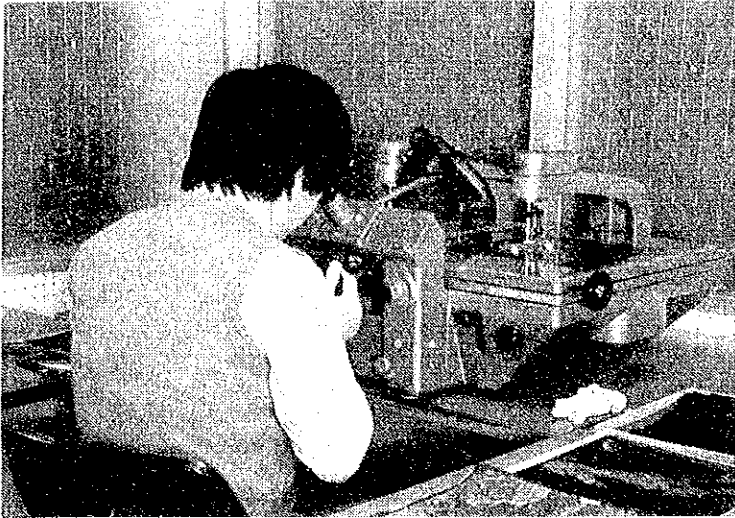
Leveling by  
both way.

Bench Mark burried  
under ground.

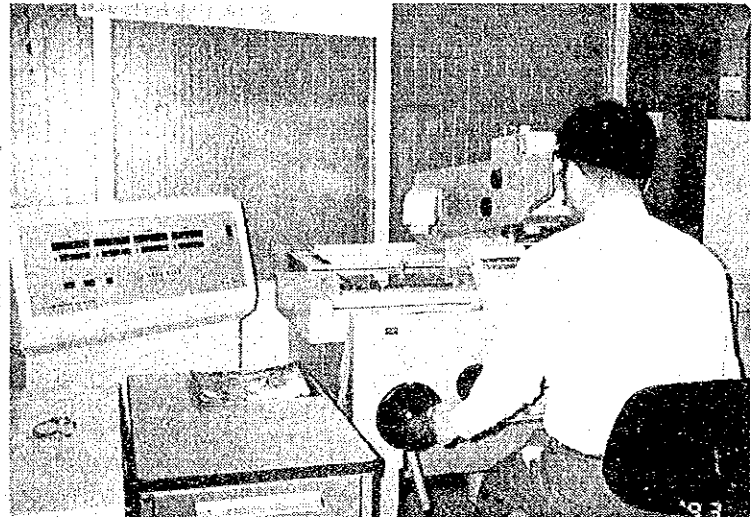


View of Siddhartha Nagar.

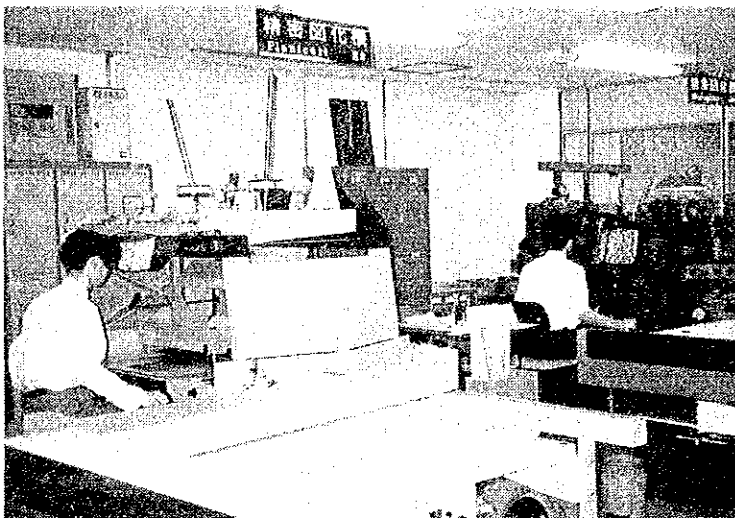




Aerial triangulation.  
Pricking Device  
(PUG-11).



Aerial triangulation  
Stereo Comparator  
(STECOMETER).

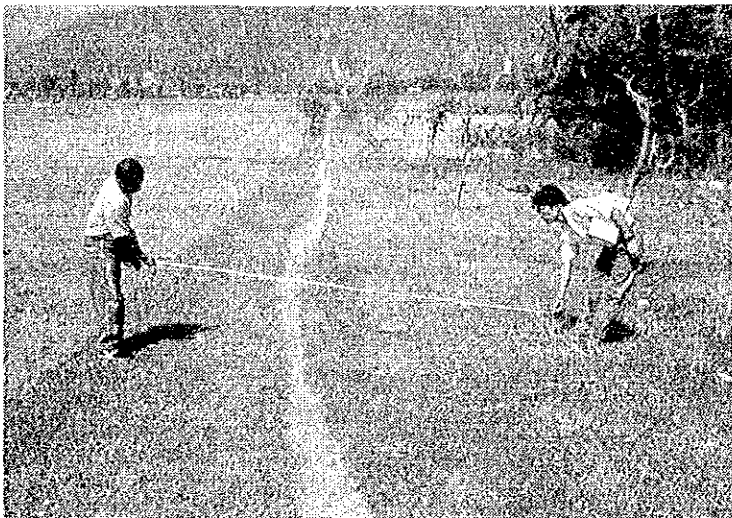
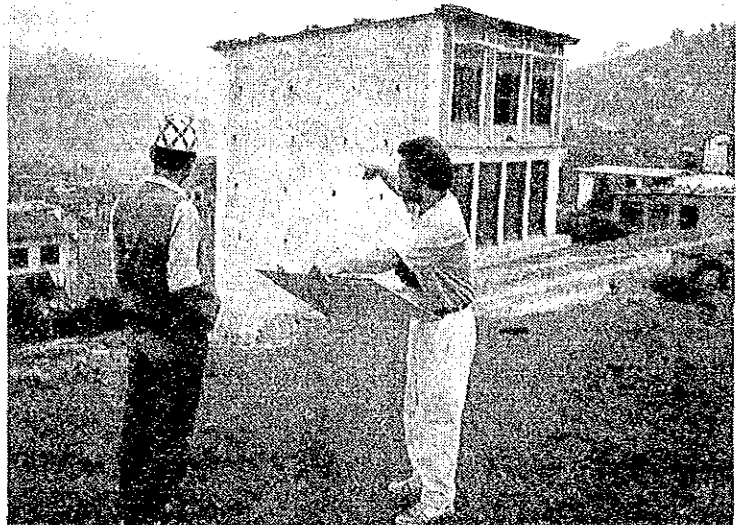


Stereo Plotter  
(STEREO PLOTTER A-8).



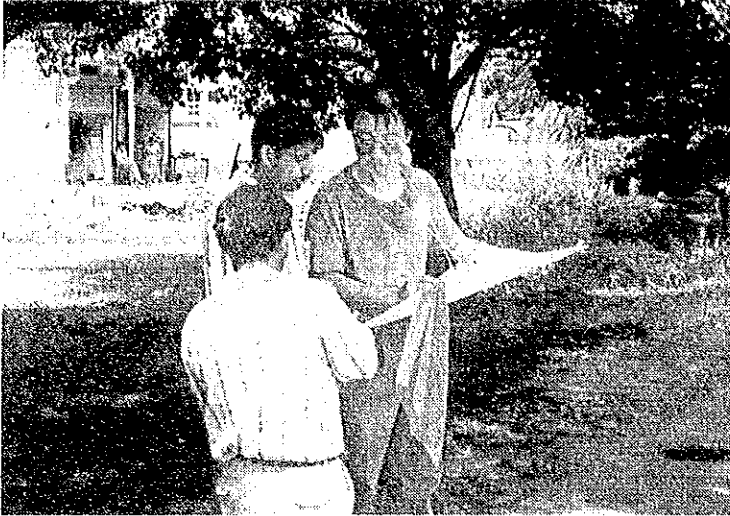
Compilation work.

Exploration by  
counterparts  
(place name).

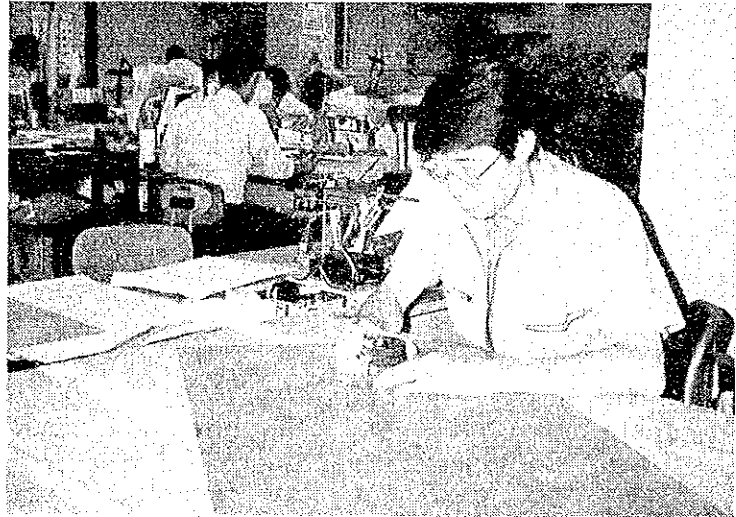


Exploration of  
road width.

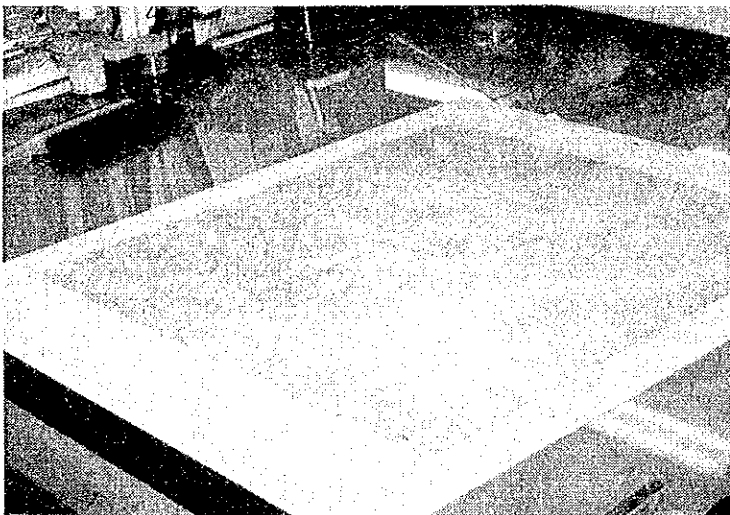




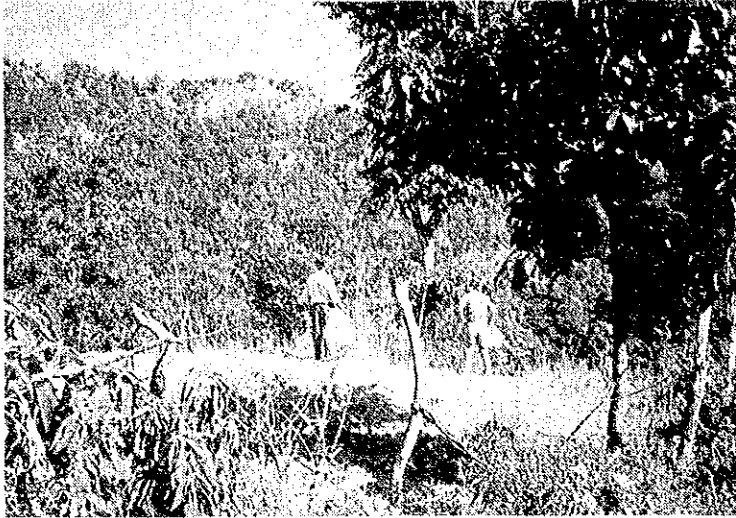
Field identification.



Drafting  
(Scribing).

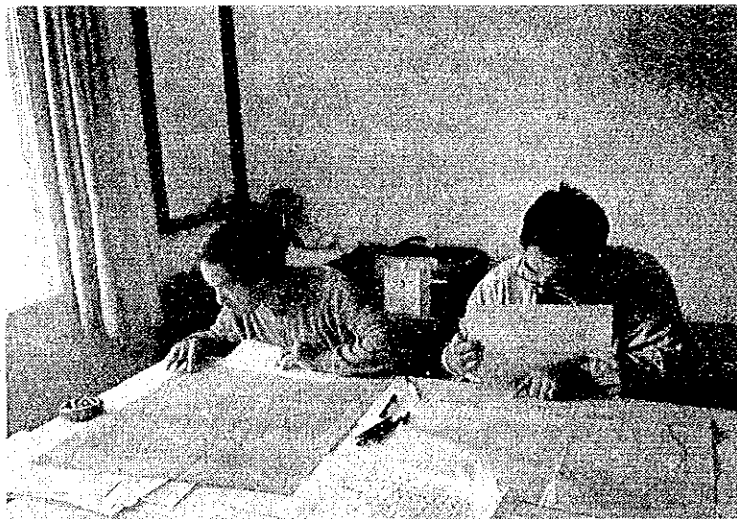
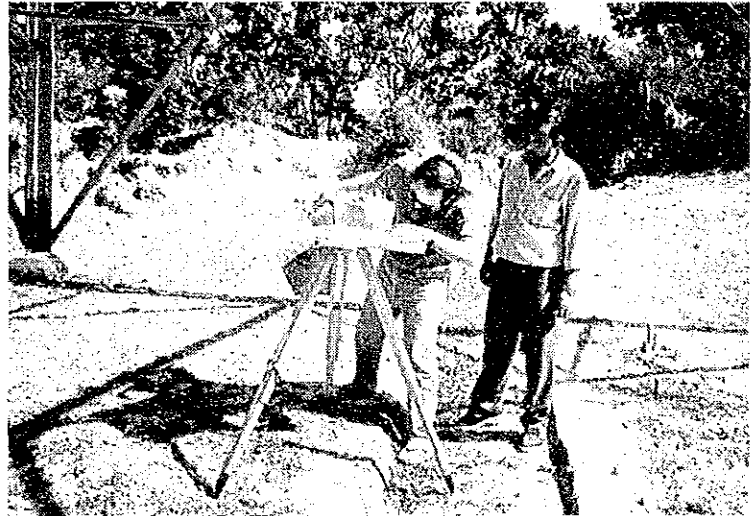


Original manuscript.



Field supplementary survey.

Technical transfer  
Field supplementary survey  
(Plane table survey).



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survey.

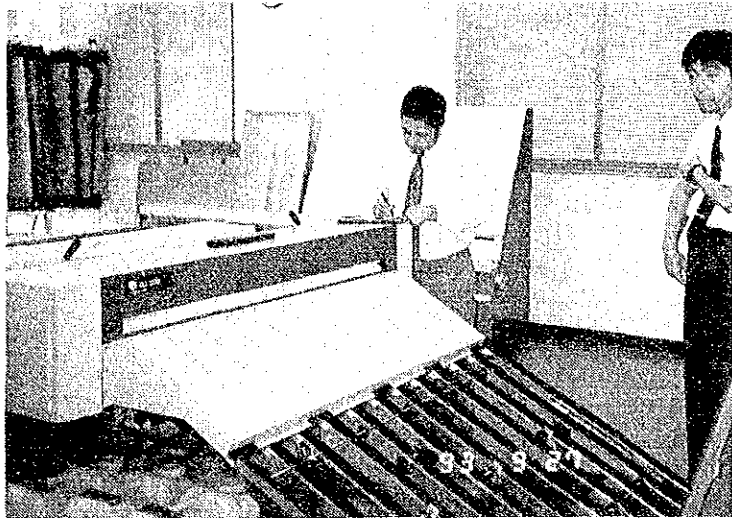


Formulation of  
annotation documents.

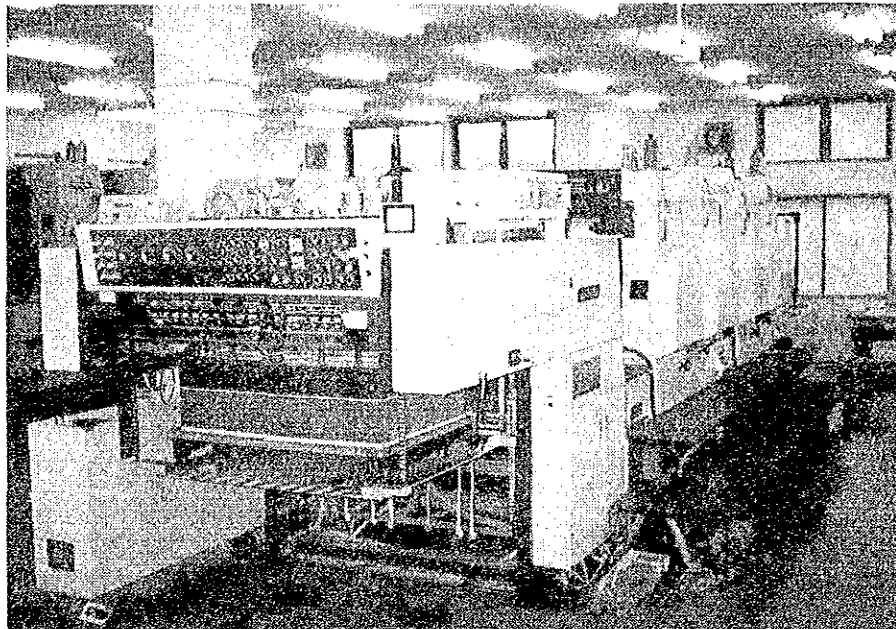
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Supervisory  
Committee Members.



Inspection by  
Supervisory  
Committee Members.



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(Plate Making).



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## 1. OUTLINE OF STUDY

### 1-1 Background of the request

Lumbini Zone, located near the center of Nepal, is an important agricultural area occupied by 9.6% (approximately, 6 millions) of whole population of Nepal.

His Majesty's Government of Nepal has been promoting the following regional development plans to enhance the economic development of Lumbini Zone.

- (1) Irrigation Project
- (2) Groundwater Development Project
- (3) Overall Regional Development Plan (Traffic, Communication, Watersupply, Education, etc.)
- (4) Bridge Construction Project
- (5) Regional Development Plan of City Zones

With these purposes, His Majesty's Government of Nepal requested a technical cooperation programme on the Topographic Mapping of Lumbini Zone to the Government of Japan.

### 1-2 Objectives of the Study

Objectives of the Study are as follows.

- (1) To prepare 1/25,000 topographic maps covering the Lumbini Zone.
- (2) To transfer technology to the counterparts of Survey Department through the implementation of the works,

### 1-3 Outline of the Study Area

Lumbini Zone located near the center of the land of Nepal constitutes a part of the Indian Tarai Plain (altitude approx. 150 m) and the Himalaya Mountains (altitude approx. 1,000~3,000 m). It belongs to subtropical zone with only two seasons, the rainy and dry seasons.

Its industry is mainly agriculture in both Plain and Mountains. In the Plain, where Bhairahawa and Butwal cities are located, the commerce and the food industry are also developed.

The lowland is almost covered with paddy fields, and the mountainous zone is also covered with step-liked dry fields near to the summits without a part of them.

#### 1-4 Scope of the Study

This Study shall cover all of the technical fields of survey and mapping including Aerial photography, Ground control point survey, Pricking, Field identification and Completion, Aerial triangulation, Stereo plotting and Compilation, Drafting, and Map-production.

The main technical specifications to achieve the above mentioned technical objectives are as followed.

**MAIN TECHNICAL SPECIFICATIONS**

ITEMS	CONTENT	APPLICATIONS
FINAL RESULTS	<p>AERIAL PHOTOGRAPH :      WIDE ANGLE(15cm)  SCALE 1 :50,000  APPROX. 9,000km<sup>2</sup>  OVERLAP      60 %  SIDELAP      30 %  CRAB      10 °  TIP AND TILT 3 °</p> <p>TOPOGRAPHIC MAP :      SCALE 1 :25,000  81 SHEETS  APPROX. 9,000km<sup>2</sup>  (Printed Map in English, 5 colors, 1,000s/each)</p>	<p>S/W, INDICATION NOTES,  TECHNICAL MANUAL OF  OVERSEAS SURVEYING</p> <p>S/W, INDICATION NOTES</p>
MAP SYMBOLS	<p>1/25,000 MAP SYMBOLS AND ITS APPLICATION RULE  BY SD.  (Detailed application was discussed between both sides.)</p>	DITTO
SPECIFICATIONS	<p>REFERENCE ELLIPOIDE :      EVEREST 1830</p> <p>PROJECTION :      MODIFIED UTM  (3° zone, Central meridian 84° E Longitude)</p> <p>FORMAT :      12.5km x 12.5km  (on the ground)</p> <p>CONTOUR INTERVAL      MAIN      10m  SUPPLEMENTARY 5m</p>	<p>TECHNICAL MANUAL OF  OVERSEAS SURVEYING</p> <p>S/W, INDICATION NOTES</p> <p>DITTO</p> <p>S/W, TECHNICAL MANUAL  OF OVERSEAS SURVEYING</p>
ACCURACY	<p>MAP ACCURACY :      A CLASS  (Horizontal : 0.5mm)  (Spot height : <math>\Delta h/3</math>)  (Counterline : <math>\Delta h/2</math>)</p>	S/W, TECHNICAL MANUAL OF OVERSEAS SURVEYING
APPLICATION RULE	TECHNICAL MANUAL OF OVERSEAS SURVEYING BY JICA	INDICATION NOTES BY JICA

1-5 Outline of survey activities

Outline of the survey and related activities for topographic mapping of Lumbini Zone were as follows:

Period	Item	Description
Apr. 10, '89	Request	Request for technical cooperation to Japanese Government
Feb. 1 ~ Mar. 5, '90 Feb. 28, '90	Preliminary survey Scope of Work	Discussion on the topographic mapping with SD Agreement on Scope of Work
Jul. 4 ~ Jul. 18, '90 Oct. 24 ~ Dec. 25, '90 Jul. 15 ~ Mar. 24, '91	JICA training 1st year work "	Mr. Buddhi N. Shrestha Discussion on plan of operation, aerial photography Ground control point survey, leveling
Mar. 26 ~ May 3, '91	JICA training	Mr. Punya P. Oli
Jul. 12. ~ Mar. 26, '92 Sep. 11 ~ Nov. 28, '91 Jan. 12 ~ Mar. 11, '92	2nd year work " JICA training	Aerial triangulation, stereo plotting, compilation Field identification Mr. Toya N. Baral
Oct. 9 ~ Dec. 9, '92 Jan. 18 ~ Mar. 3, '93	3rd year work " JICA training	Stereo plotting, compilation, drafting Field completion Mr. Krishna R. Adhikary, Mr. G. K. Karna
May 17 ~ Nov. 1, '93 Sep. 6 ~ Oct. 19, '93	4th year work JICA training	Drafting, printing S. P. Mahara

# Work Schedule

ITEMS	1990(PHASE 1)				1991(PHASE 2)				1992(PHASE 3)				1993(PHASE 4)												
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
AERIAL PHOTOGRAPHY																									
GROUND CONTROL SURVEY																									
LEVELLING PRICKING																									
AERIAL TRIANGULATION																									
FIELD IDENTIFICATION																									
PLOTTING																									
COMPILATION																									
FIELD COMPLETION																									
DRAFTING																									
MAP PRODUCTION																									
INSPECTION																									
ANNUAL REPORT																									
DELIVERY OF GOODS																									

LEGEND :  PREPARATION     FIELD SURVEY     WORK IN JAPAN     DELIVERY

1-6 Outline of implementation work

The work implemented during the topographic mapping was outlined as follows:

Items	Amount of Work		Remarks
	Original Plan	Result	
Aerial photography	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>	1:50,000 16 lines
Ground control point survey			
GPS observation	17 point	20 point	
Pricking	35 point	36 point	
Leveling			
Leveling	200 km	200 km	
Pricking	760 km	760 km	
Aerial triangulation	448 models	501 models	
Field identification	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>	
Plotting	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>	81 sheets
Compilation	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>	∕
Field completion	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>	∕
Drafting	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>	∕
Printing	81 sheets	81 sheets	5-color, 1,000 each

## 1-7 Supervision of Field Work

During the field work, JICA sent the following advisors to Nepal to coordinate technical meeting with SD and for supervision of the field study:

(First year)

Mr. Mitsuo IWASE                      Staff, National Large Scale Mapping Division, Topographic Department, Geographical Survey Institute, Ministry of Construction

Mr. Kazuhide NAGASAWA              Staff, 1st Development Study Division, Social Development Study Department, JICA

(Second year)

Mr. Mitsuo IWASE                      Head, Survey Guidance Division, Planning Department (Geographical Survey Institute)

Mr. Masayuki FUKUMURA              Staff, Hachioji International Training Center (JICA)

(Third year)

Mr. Mitsuo IWASE                      Same as above

Mr. Hiroshi TSUJINO                   Staff, 1st Development Study Division, (JICA)

## 1-8 Outline of Each Year Work

### 1-8-1 First year work (F.Y. 1990)

#### (1) Description of work

##### 1) Outline

In the first year, the aerial photography, ground control point survey, leveling, pricking works necessary for the formulation of the 1:25,000 scale topographic map were carried out.



2) Aerial photography

Aerial photographs were taken at a scale of approximately 1/50,000 using a Twin Otter aircraft chartered from UNDP and a wide angled camera (15 cm focal length, 23 cm × 23 cm photo size).

3) Ground control survey

The existing 17 triangulation stations and leveling routes (700 km) were utilized as ground control points.

Besides, GPS triangulation (16 points) and levelling (200 km) were newly carried out.

Computation and adjustment of existing trigometrial points were carried out.

4) Pricking

The existing 17 triangulation stations and the newly surveyed 17 GPS triangulation stations were pricked. All of the bench marks in the existing levelling route were pricked, and the spot heights in the new levelling route were pricked at every 2 km.

(2) Amount of survey work

Items		Original Plan	Results
Aerial Photography	Coverage	9,000 km <sup>2</sup>	9,000 km <sup>2</sup>
	Scale	1 : 50,000	1 : 50,000
	Courses	16 courses	16 courses
	Sheets	468 sheets	536 sheets
Ground control point survey		17 points	20 points
Leveling		200 km	200 km
Pricking	Control points	35 points	36 points
	Levelling	760 km	760 km

(3) Technical meeting with SD

Technical meetings on the following were conducted with SD during the field survey work.

- 1) Data on road class and name.
- 2) Data on transmission, telephone and telegraph lines.
- 3) Data on under ground canal.
- 4) Geographical names.
- 5) River names.
- 6) Sample of marginal information and legend.
- 7) Sheet titles (map name) and sheet codes / number.
- 8) Meanings of colors applied for printing.

(4) Period of survey work in Nepal

Field work

(Headquarters)	24 October, 90 ~ 25 December 90 15 January, 91 ~ 24 March, 91
(Aerial Photography)	24 October, 90 ~ 25 December 90
(Photo Processing)	24 October, 90 ~ 25 December 90
Ground control survey (including Pricking)	15 January, 91 ~ 24 March, 91
Leveling (including Pricking)	15 January 91 ~ 15 March, 91

## (5) Formation of study team in Nepal

Name	Assignment	Duration
Mr. Hiroyuki MATSUDA	Leader	24 Oct. ~ 3 Nov., 90 10 Mar. ~ 24 Mar., 91
Mr. Takehiko HIRANO	Deputy Leader	24 Oct. ~ 25 Dec., 90 15 Jan. ~ 20 Mar., 91
Mr. Mamoru MURATA	Mapping Planner	24 Oct. ~ 25 Dec., 90 15 Jan. ~ 24 Mar., 91
Mr. Tomoharu YOKOTA	Chief Surveyor	15 Jan. ~ 24 Mar., 91
Mr. Kazuhiro ISHIZUKA	Chief Surveyor	15 Jan. ~ 24 Mar., 91
Mr. Tadaji KURATA	Mechanical Engineer	8 Nov. ~ 25 Dec., 90 15 Jan. ~ 24 Mar., 91
Mr. Hayato TASHIRO	Cameraman	24 Oct. ~ 25 Dec., 90
Mr. Torahiko SUZUKI	Navigator	24 Oct. ~ 25 Dec., 90
Mr. Seisho TSUNODA	Photographer	24 Oct. ~ 25 Dec., 90
Mr. Masashi SUZUKI	Ground Control Survey and Pricking	15 Jan. ~ 24 Feb., 91
Mr. Yukio KOIKE	"	15 Jan. ~ 24 Feb., 91
Mr. Hironao TSUSHIMA	"	15 Jan. ~ 24 Feb., 91
Mr. Shizuya TAKAYANAGI	"	15 Jan. ~ 24 Feb., 91
Mr. Masato KIKUCHI	"	15 Jan. ~ 24 Feb., 91
Mr. Issei NAGUSA	"	15 Jan. ~ 24 Feb., 91
Mr. Takashi TAKEMOTO	"	15 Jan. ~ 24 Feb., 91
Mr. Masashi SUZUKI	"	15 Jan. ~ 24 Feb., 91
Mr. Katuyuki KONDO	Ground Control Survey Leveling and Pricking	15 Jan. ~ 24 Mar., 91
Mr. Hideki HIGASHI	"	15 Jan. ~ 24 Mar., 91
Mr. Tsuyoshi SEINO	"	15 Jan. ~ 24 Mar., 91
Mr. Toshiaki KANEDA	"	15 Jan. ~ 24 Mar., 91
Mr. Hiroshi ITO	"	15 Jan. ~ 24 Mar., 91
Mr. Kazunori OBA	"	15 Jan. ~ 24 Mar., 91

(6) Cooperation of counterparts of SD

Headquarters	Mr. Punya P. Oli
Aerial Photography	Mr. Toya N. Baral Mr. Balam K. Basnyat Mr. Mahesh Rayamajhi
Ground Control Survey (including GPS analysis)	Mr. Gajendra K. Karna Mr. Ramkanta Acharya Mr. Chan Syam Sukla Mr. Samod L. Karna
Leveling and Pricking	Mr. Ram B. Manohar Mr. Dhruva MS. Thapa Mr. Segar Rokka

1-8-2 Second year work (F.Y. 1991)

(1) Description of work

1) Outline

Following the first year works, aerial triangulation, field identification and some plotting and compilation were carried out in the second year's work.

2) Field identification

The topographic features, land use, vegetation and other information necessary for terrain representation were identified in the field using the aerial photographs. Administrative boundaries and geographical names were also collected.

3) Aerial triangulation

Aerial triangulation was carried out using the analytical block adjustment method. 501 stereo-models were applied for aerial triangulation.

4) Plotting

Plotting was carried out at a scale of 1 / 25,000 with stereo plotters. As for Projection, UTM (3° zone) was applied. In the case of absolute orientation, height control points within the model scale were used as check points.