5) Compilation

Map compilation was executed in accordance with the symbols and specifications agreed between the study team and SD. Sheet size of the compiled topographic maps was 12.5 km × 12.5 km on the ground, and the number of final sheets were 81.

(2) Amount of survey work

Items	Work Volume	
	Plan	Results
Aerial Triangulation	448 models	501 models
Field Identification	Approx. 9,000 km^2	Approx. 9,000 km^2
Plotting	3,500 km^2	3,500 km^2
Compilation	32 sheets	32 sheets

(3) Technical meetings with SD

Technical meetings with SD were held prior to and at the end of the field identification work. The outline of these technical meetings were as follows:

1) Boundaries and Geographical Names

Some administrative boundaries and geographical names were also collected by the Nepalese counterparts and submitted to the study team.

2) Map symbols, specifications, marginal information, printing colors and others, were discussed and finalized on the materials provided by both sides.

(4) Period of survey work

Field Work

(Headquarters)	11 September - 28 November, 1991
(Field identification)	15 September - 28 November, 1991

Home Office Work

Aerial Triangulation	17 July - 10 September, 1991
Map Plotting and Compilation	29 November - 26 March, 1992

(5) Formation of study team in Nepal

Name	Assignment	Duration
Mr. Hiroyuki MATSUDA	Leader	11 Sept. - 30 Oct., 1991 14 Nov. - 28 Nov., 1991
Mr. Takehiko HIRANO	Deputy Leader	11 Sept. - 28 Nov., 1991
Mr. Mamoru MURATA	Mapping Planner	11 Sept. - 28 Nov., 1991
Mr. Tadaji KURATA	Mechanical Engineer	11 Sept. - 28 Nov., 1991
Mr. Tomoharu YOKOTA	Chief Surveyor	11 Sept. - 30 Oct., 1991
Mr. Masashi SUZUKI	Surveyor	15 Sept. - 28 Nov., 1991
Mr. Katsuyuki KONDO	"	15 Sept. - 28 Nov., 1991
Mr. Hideki HIGASHI	"	15 Sept. - 28 Nov., 1991
Mr. Toshiaki KANEDA	"	15 Sept. - 28 Nov., 1991

Name	Assignment	Duration
Mr. Shizuya TAKAYANAGI	Assistant Surveyor	15 Sept. - 28 Nov., 1991
Mr. Nobuyoshi SANUKI	"	15 Sept. - 28 Nov., 1991
Mr. Katsushige HIRATA	"	15 Sept. - 28 Nov., 1991
Mr. Tsuyoshi SEINO	"	15 Sept. - 28 Nov., 1991
Mr. Kenichi NOZAKI	Surveyor	15 Sept. - 10 Oct., 1991

(6) Cooperation of counterparts of SD

Project Director	Mr. Punya P. Oli
Survey Officer	Mr. Dilip Kumar Verma
Survey Officer	Mr. Shashi Kant Jha
Survey Officer	Mr. Krishna Kant Chaudhary
Survey Officer	Mr. Bhoja Raj Bastola
Surveyor	Mr. Ghan Shyan Shukla
Surveyor	Mr. Ram Bilash Manohar
Surveyor	Mr. Rama Kant Acharya
Surveyor	Mr. Dhirendra Prasad Dev
Surveyor	Mr. Ram Shrestha Kapad
Surveyor	Mr. Dhruva Narayan Sing Thapa
Surveyor	Mr. Biswanath Bhandari

1-8-3 Third year work (F.Y. 1992)

(1) Description of work

1) Outline

Following the first and second year works, the third year works involving the remaining plotting and completion works, field completion and some drafting, were carried out.

2) Stereo plotting of 5,500 sq.km

Stereo plotting was carried out in the remaining area at a scale of 1 : 25,000 using the stereo plottings in Japan. UTM (3 degree zone) was applied for the projection.

3) Compilation (5,500 sq.km)

Map compilation was executed in accordance with the symbols and specifications agreed upon by the Study Team and SD in 1991. The sheet of the compiled topographic maps were 12.5 km × 12.5 km on the ground and the amount of sheet number were 81.

4) Field completion (9,000 sq.km)

Topographic features, landuse, vegetation, etc., which could not be properly identified on the aerial photographs were identified and plotted on the field completion sheets.

SD provided authorized administrative and geographical names, as well as administrative boundaries, and, handed over the above materials indicated on the duplicate compilation maps to the Study Team. Each compilation map were verified by SD's authorized officer.

5) Drafting

The drafting of the 1 : 25,000 map was carried out by scribing, based on the compilation manuscripts. The color separation plates were prepared by photo-processing based on the compilation manuscripts and field identification results.

(2) Amount of work

Items	Amount of Work
Plotting	5,500 sq.km, 49 sheets
Compilation	5,500 sq.km, 49 sheets
Field Completion	9,000 sq.km, 81 sheets
Drafting	3,500 sq.km, 32 sheets

(3) Technical discussions

The Marginal information and Legend, the Meanings of Color applied for Printing, Lettering Size and Style, List of Sheet Names and Numbers which had been already finalized, were revised, corrected and confirmed on the materials provided by both sides.

(4) Period of work

Plotting	June 1992 - Aug. 1992
Compilation	Jul. 1992 - Sep. 1992
Field completion	Oct. 1992 - Dec. 1992
Drafting	Jan. 1993 - Mar. 1993

(5) Formation of the Study Team in Nepal

Name	Assignment	Duration
Hiroyuki MATSUDA	Leader	Nov. 3 ~ Nov. 22, 1992 Dec. 4 ~ Dec. 19, 1992
Takehiko HIRANO	Deputy Leader	Oct. 13 ~ Dec. 19, 1992
Ryoichi HASHIMOTO	Mapping Planner	Oct. 9 ~ Dec. 19, 1992
Tomoharu YOKOTA	Chief Surveyor	"
Tadaji KURATA	Mechanical Engineer	"
Katsuyuki KONDO	Surveyor	Oct. 16 ~ Dec. 19, 1992
Yasuo ISHIGURO	"	"
Toshiaki KANADA	"	"
Shizuya TAKAYANAGI	"	"
Nobuyoshi SANUKI	"	"
Tsuyoshi SEINO	"	"

(6) Cooperation of counterparts of SD

Project Director	Mr. S.P. Mahara	
Survey Officer	Mr. G.K. Karna	Annotation, etc.
Cartographer	Mr. V.K. Neupane	Annotation, etc.
Survey Officer	Mr. H.M. Tumbahangfe	Field Completion
Survey Officer	Mr. S.S. Saha	Field Completion

Asst. Surveyor	Mr. R.H. Khatri	Field Completion
Asst. Surveyor	Mr. M.S. Aryal	Field Completion

(7) Responsible officers of SD assigned for the Study

Mr. Ram N. Singh	Director General, Survey Department
Mr. S.P. Mahara	Project Director, (Officers assigned for annotation and boundary)

1-8-4 Fourth year work (F.Y. 1993)

(1) Description of work

1) Outline

In the fourth year, indoor works such as drafting (for the remaining area subject to the third year works), plate making and printing were conducted.

2) Drafting

Based on the original manuscripts of 1 : 25,000 topographic maps, 5-color separation drafting was conducted for the remaining area by scribing.

3) Plate making

Image printing was made on PS plates for each color using the final drafting sheets, and proof prints were then made by offset method. After checking the proof prints, the composite negative films necessary for map production were made for each color.

4) Printing

Printing was conducted by using offset method.

(2) Amount of work

Items	Amount of Work
Drafting	5,500 km^2, 49 sheets
Plate making	9,000 km^2, 81 sheets
Printing	9,000 km^2, 81 sheets 1,000 each sheet

(3) Period of work in Japan

Drafting	18 May ~ 31 July, 1993
Plate making	1 July ~ 31 August, 1993
Printing	1 September ~ 30 September, 1993

2. TECHNICAL REPORT

2-1 Aerial Photography

2-1-1 Flight Plan

Aerial photography was meant to cover 9,000 km^2 of Lumbini Zone. The photographic scale was set approximately at 1 : 50,000 and a wide angled camera was used in consideration of multi-purpose utilization of the aerial photographs and lesser restriction on use of the stereo plotter.

Flight lines was set in NW=SE direction with 60% overlap and 30% side lap, as a standard, totaling 16 courses in consideration of the shape of the objective area and its topographic features.

2-1-2 Base for Aerial Photography

Kathmandu Airport was used as the base for aerial photography. In the flight, the security officers of the Royal Nepal Army (RNA) were present at the time of the aerial photography.

2-1-3 Aircraft and Camera

An aircraft, Twin Otter N9-ABS, was chartered from UNDP/ICAO Air Transport Project for all aerial photography works. A camera brought from Japan and with the following details:

Camera Type	:	Wild RC-10 No. 3293
Lens Number	:	UAG 11 3135, F=153.79 mm
Magazine Number	:	No. 3387, 3388

2-1-4 Photographic Work

Test flights were made on November 7, 1990 and full-scale aerial photography commenced in November 8, 1990.

Flight Record is shown in Table-1 below, and Photo Index Map is shown in Fig.-1.

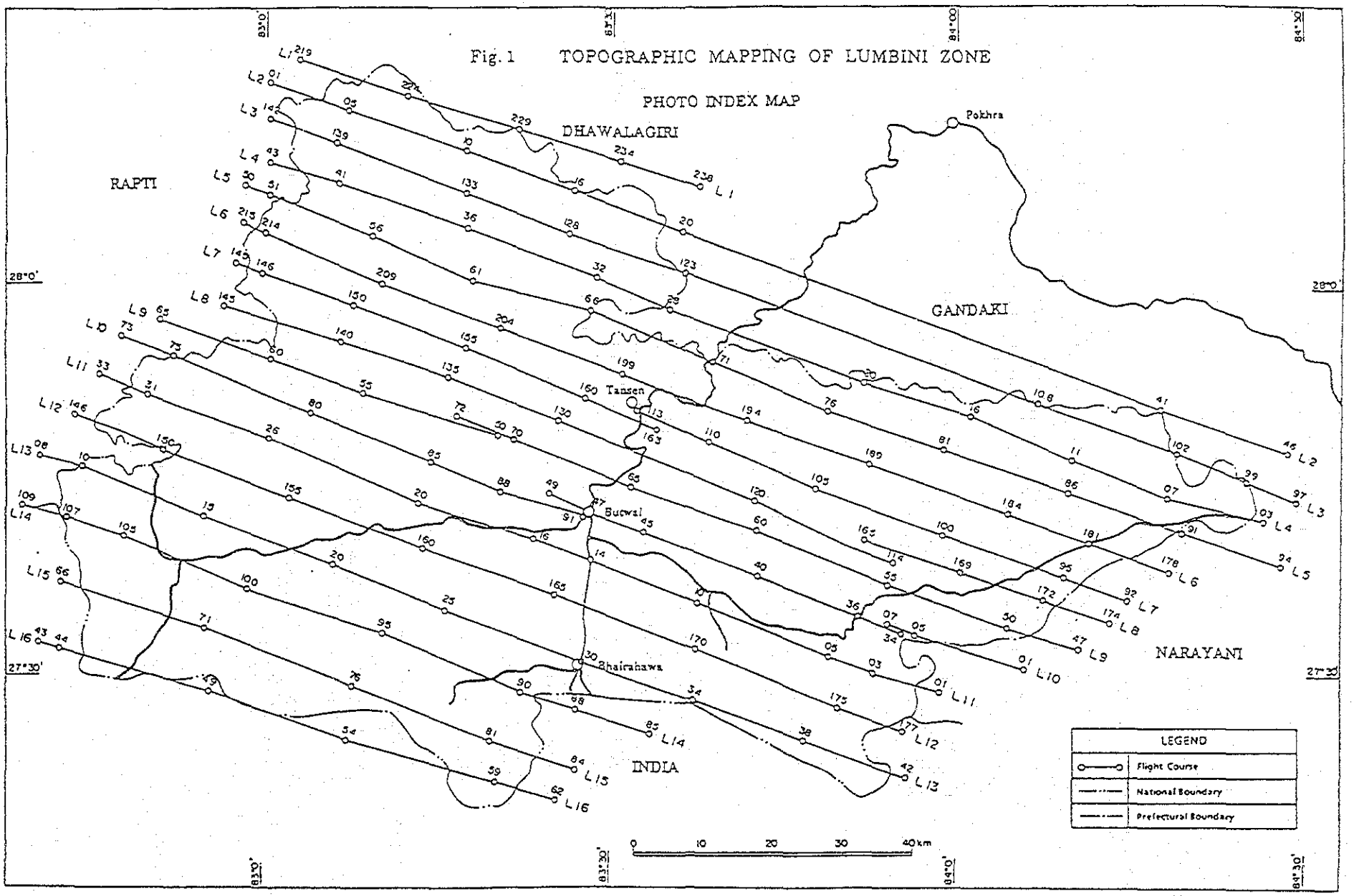


Fig. 1 TOPOGRAPHIC MAPPING OF LUMBINI ZONE

Table-1. Flight Records

Date	Time	Flight Hours	Photo-Lines
November 8, '90	09:55 ~ 12:24	2 h 29 m	L10C, 13, 16
13	10:06 ~ 12:49	2 h 43 m	L4, 5, 3, 7A, 8B
15	9:56 ~ 13:05	2 h 38 m	L6, 1, 2, 9B, 10A
16	10:14 ~ 11:52	1 h 38 m	L7B, 8A, 12
26	12:09 ~ 12:44	0 h 35 m	L11
27	10:00 ~ 10:17	0 h 17 m	L10B
28	10:21 ~ 10:36	0 h 15 m	L9A
December 9	10:47 ~ 11:51	1 h 04 m	L15, 14

2-1-5 Photo Processing

The development of exposed films, the printing and enlargement were conducted at SD's laboratory using instruments at Baneshwor. The films were developed principally on the day they were taken to inspect the photographs.

The instruments and materials used were as follows:

Film developing machine	:	Zeiss FE - 120
Contact printer	:	Zeiss KG - 30
Film type	:	DX 2405
Emulsion number	:	No. 716-21
Developer	:	Fuji
Paper	:	Fuji

2-1-6 Printing and Inspection

Flights were made again, when the need arose, after the photographs were printed and checked.

Items to be inspected are as follows:

(1) Overlap and side lap
(2) Cloud, cloud shadow, uneven development
(3) Deviation of flight line
(4) Halation
(5) Smoke of field fire

2-1-7 Amount of Work

Film roll	4 rolls
Flight lines	16 lines
Photographs	536 photos
2-times enlargement	1 set
4-times enlargement	1 set

Number of photographs per line is shown in Table-2.

Table-2. Number of Aerial Photographs per Line

Course No.	Counter No.	Roll No.	Photo No.	Number
1	219 ~ 237	9011	1 ~ 19	19
2	01 ~ 20, 33 ~ 46	9012	1 ~ 20, 33 ~ 46	34
3	97 ~ 113, 122 ~ 142	9011	1 ~ 17, 26 ~ 46	38
4	02 ~ 44	9011	1 ~ 43	43
5	51 ~ 94	9011	1 ~ 44	44
6	178 ~ 215	9011	1 ~ 38	38
7A	145 ~ 163	9011	1 ~ 19	19
7B	92 ~ 113	9012	1 ~ 22	22
8A	114 ~ 145	9012	1 ~ 32	32
8B	165 ~ 174	9011	1 ~ 10	10
9A	50 ~ 63	9013	1 ~ 14	14
9B	48 ~ 72	9012	1 ~ 25	25
10A	74 ~ 91	9012	1 ~ 18	18
10B	34 ~ 49	9013	1 ~ 16	16
10C	02 ~ 07	9010	1 ~ 6	6
11	01 ~ 32	9013	1 ~ 32	32
12	147 ~ 177	9012	1 ~ 31	31
13	09 ~ 42	9010	1 ~ 34	34
14	85 ~ 109	9013	1 ~ 25	25
15	66 ~ 83	9013	1 ~ 18	18
16	44 ~ 61	9010	1 ~ 18	18
Total		4		536

2-2 Ground Control Survey

2-2-1 Planning and Implementation

In the planning stage, 17 points were selected to be newly observed and installed on the 1 : 50,000 topographic maps. However, 3 more points were added during the implementation stage in consideration of the topographic features of the study area, and a total of 20 ground control points were newly installed.

Observations were carried out by using the GPS method on 6 existing 1st order triangulation points.

Besides, one existing second order triangulation point planned only to be pricked as a ground control point was observed to examine the accuracy of existing survey results in accordance with the special request of SD.

Furthermore, the net adjustment of all 2nd order triangulation points inside the study area was conducted, because of the absence of adjusted survey results.

2-2-2 GPS Observation

Ground control survey was carried out using the GPS differential method in which observations were conducted simultaneously on 3 points. Time zone of observation was selected whenever GPS receivers catch more than 4 sattelites.

The distribution of points and their Observation Network are shown in Fig.-2.

2-2-3 Main Equipments

Trimble 4000 SL	3 pcs
Toshiba J 3100 SGT	1 pc
WILD T 2	1 pc
YHP 3808 A	1 pc
Topcon GUPY GTS-10	1 pc

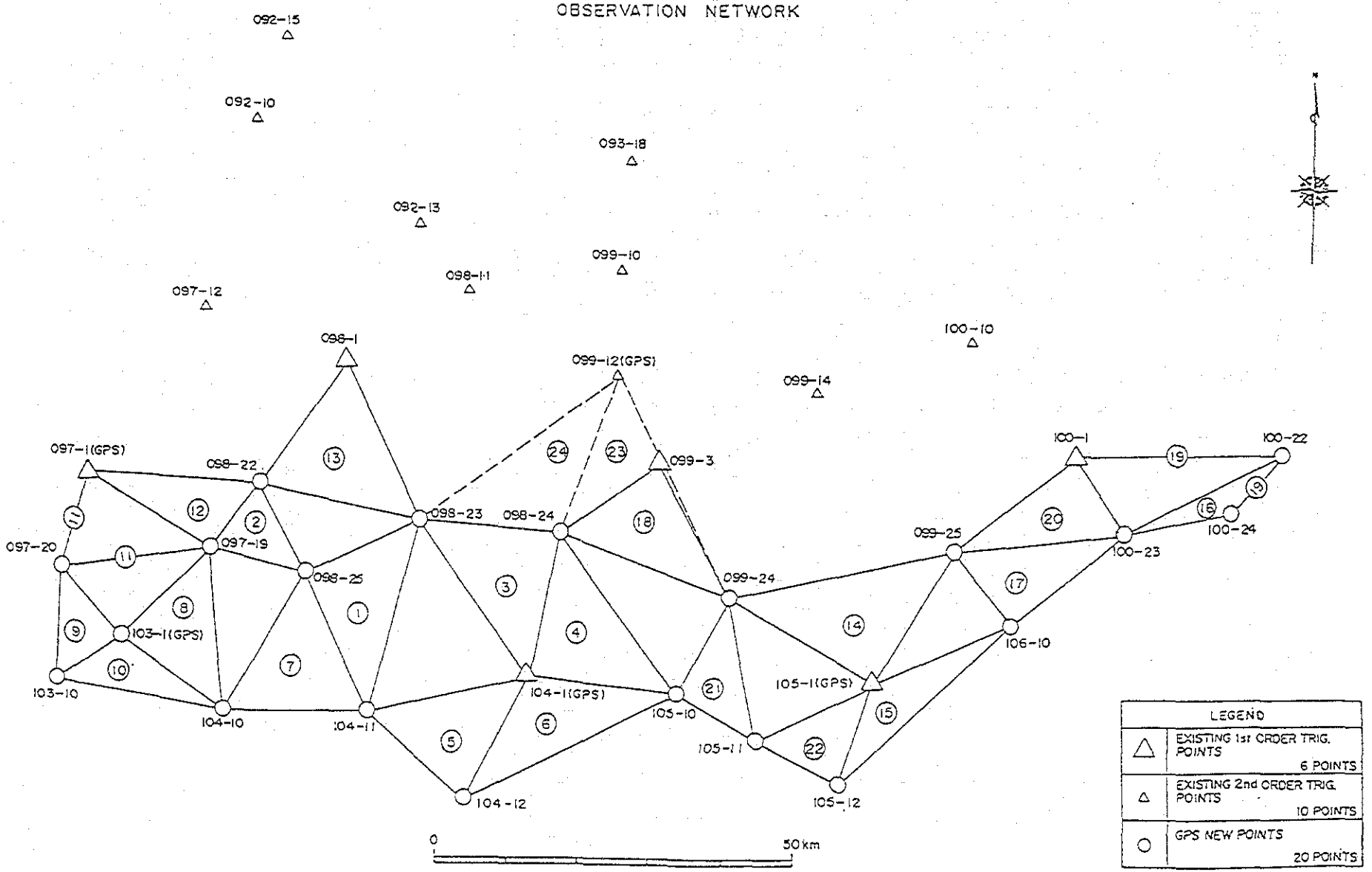
2-2-4 Inspection of GPS Observation Results

In order to determine the quality of the observation value, the following inspections were carried out.

Fig.-2

TOPOGRAPHICAL MAPPING OF LUMBINI ZONE

OBSERVATION NETWORK



(1) Closing error on the WGS-84 ellipsoid single triangulation

The closing error of the WGS-84 ellipsoid single triangulation was calculated in order to determine the quality of the observation value. The results are shown in Table-3.

Table-3. Closing Error of Single Triangulation

Trig. No.	ΔX	ΔY	ΔZ	Trig. No.	ΔX	ΔY	ΔZ
1	m -0.002	m -0.003	m +0.015	13	m -0.157	m +0.038	m -0.037
2	+0.005	+0.015	+0.011	14	+0.004	+0.013	+0.001
3	-0.006	-0.023	-0.012	15	+0.001	-0.004	-0.014
4	-0.007	-0.053	-0.063	16	±0.000	+0.001	±0.000
5	+0.001	-0.004	-0.006	17	±0.000	+0.002	-0.001
6	+0.005	-0.001	-0.014	18	-0.110	+0.087	+0.147
7	+0003	+0.003	+0.031	19	-0.001	-0.004	-0.002
8	-0.013	±0.000	+0.015	20	+0.002	-0.003	-0.015
9	-0.008	-0.012	-0.013	21	-0.002	-0.004	+0.005
10	±0.000	+0.002	-0.015	22	+0.002	-0.004	+0.007
11	+0.221	+0.370	+0.088	23	-0.010	+0.024	+0.010
12	+0.007	+0.002	+0.001	24	-0.001	-0.016	-0.046

(2) Comparisons of Sides observed twice

There were 13 sides, observed twice for survey implementation. A comparative inspection was conducted on these sides and the results are shown in Table-4.

Table-4. Comparison of GPS Observation Results

Side Name	1st Observation	2nd Observation	Difference
	m	m	m
097-19 - 098-22	10,977.9992	10,977.9724	0.0268
103-1(GPS) - 103-10	10,610.2131	10,610.1677	0.0454
103-1(GPS) - 104-10	17,114.7963	17,114.7853	0.0110
098-25 - 104-11	20,759.1833	20,759.2265	0.0432
098-23 - 098-24	19,465.0563	19,465.0369	0.0194
104-1(GPS) - 104-12	19,294.6207	19,294.6084	0.0123
104-1(GPS) - 105-10	20,502.2859	20,502.2362	0.0497
104-1(GPS) - 098-24	19,871.1795	19,871.2453	0.0658
098-24 - 099-24	25,227.343	25,227.3137	0.02976
105-1(GPS) =105-12	15,142.3592	15,142.3464	0.0128
099-25 - 100-23	22,928.4334	22,928.4309	0.0025
106-22 - 100-24	10,377.5516	10,377.5278	0.0238
098-24 - 099-12(GPS)	22,764.0438	122,764.1124	0.0686

(3) Inspection of the center angle

The observation network was organized by 6 traverse forms, whereby the inspection of the center angle was based upon. The limitation was based on "JICA's Specifications of Geodetic and Photogrammetric Surveying Overseas (3rd order control point survey)", and the computation method is as indicated below:

$$2'' \sqrt{\Sigma D^2 \psi} + 4'' \sqrt{n}$$

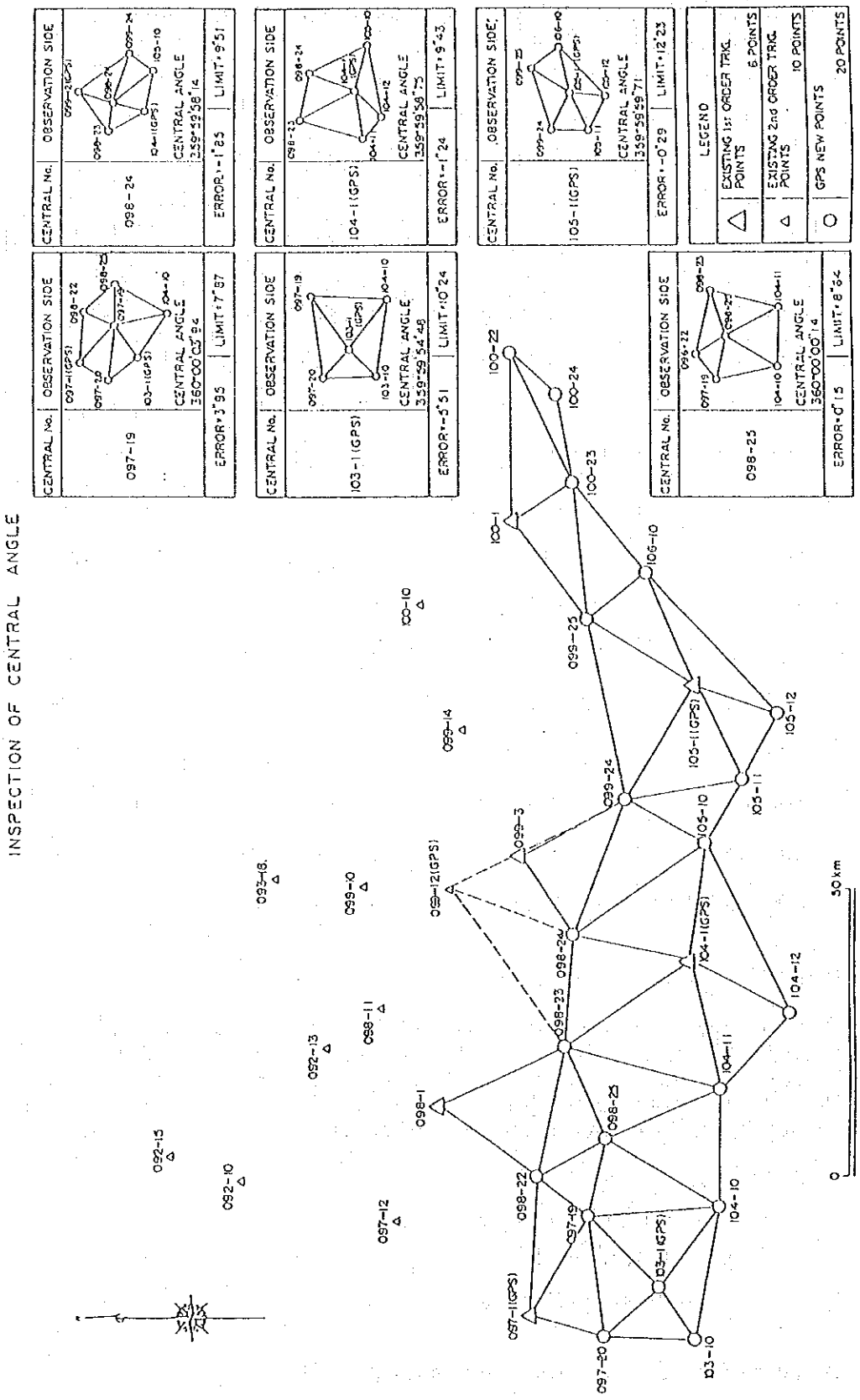
n : Numbers of observed angle

$D^2 \psi = 6 \tan^2 \psi /2$

ψ : Included angles

Inspection of Center Angle are shown in Fig-3.

Fig.-3. Topographical Mapping of Lumbini Zone/Inspection of Central Angle



2-2-5 Precise Computation

(1) Precise computation factors

The factors used for precise computation are as follows:

Spheroid	:	Everest	1830
Coordinate of origin	:	N	0 m
		E	500,000 m
Scale factor	:	0,9999	
Coordinate system	:	Modified UTM Zone No. 44.5	

(2) The results achieved from the GPS survey and the existing 1st order triangulation points were compared.

In order to determine the 1st order triangulation points which were the known points, No. 097-1 was temporarily fixed. After the direction from No. 097-1 to No. 100-1 was determined, Net Adjustment was conducted using the factors mentioned above.

The Computation Results of Vector are shown in Fig.-4.

(3) The final net adjustment computation

The final net adjustment computation was conducted using 3 points (No. 098-1, No. 099-3, No. 100-1) as given points, and other 3 existing points (No. 097-1, No. 104-1, No. 105-1) were excluded to use them as given points to enhance accuracy.

The net adjustment and the standard deviation result was:

Coordinate 1."08 (allowance 3."5)

Furthermore, the Accuracy Obtained from Final Net Adjustment and Final Results of Ground Control Points are shown respectively in Table-5 and 6.

2-2-6 Adjustment of 2nd order triangulation points

As net adjustment of the survey results of 2nd order triangulation points necessary for ground control survey were not conducted yet in the study area, their computation was to be adjusted.

Caluculation of 2nd order Triangulation Points is shown in Appendix.

Fig.-4

TOPOGRAPHICAL MAPPING OF LUMBINI ZONE

VECTOR OF EXISTING 1st ORDER TRIG. POINT RESULTS AND GPS OBSERVED RESULTS

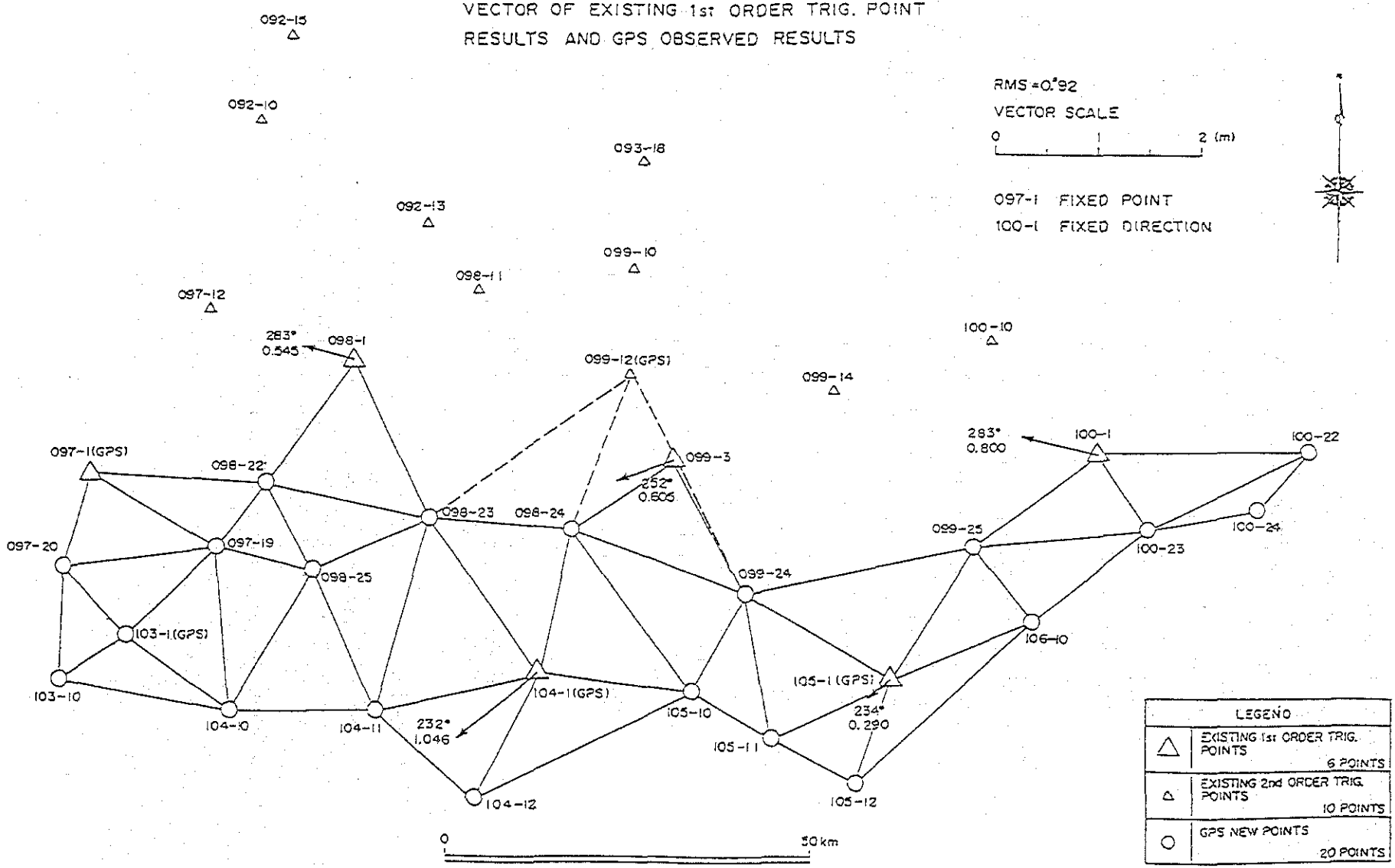


Table-5. Accuracy Obtained from Final Network Adjustment Computation of Ground Control Survey

Point Name	M_X [m]	M_Y [m]	M_S [m]
098-1	0.000	0.000	0.000
099-3	0.000	0.000	0.000
100-1	0.000	0.000	0.000
097-1	0.137	0.090	0.163
097-19	0.084	0.074	0.112
097-20	0.144	0.088	0.168
098-22	0.069	0.071	0.099
098-23	0.057	0.060	0.083
098-24	0.060	0.050	0.078
098-25	0.074	0.075	0.105
099-12	0.075	0.112	0.135
099-24	0.061	0.073	0.095
099-25	0.093	0.075	0.120
100-22	0.283	0.075	0.293
100-23	0.051	0.068	0.085
100-24	0.259	0.081	0.272
103-1	0.118	0.091	0.149
103-10	0.147	0.108	0.182
104-1	0.065	0.079	0.102
104-10	0.091	0.106	0.139
104-11	0.076	0.095	0.122
104-12	0.076	0.105	0.130

M_X: Mean Square Error of X - Coordinate
M_Y: Mean Square Error of Y - Coordinate
M_S: Mean Square Error of Position

Table-5. Accuracy Obtained from Final Network Adjustment Computation of Ground Control Survey

Point Name	M_X [m]	M_Y [m]	M_S [m]
105-1	0.078	0.075	0.108
105-10	0.078	0.075	0.109
105-11	0.070	0.078	0.105
105-12	0.073	0.088	0.114
106-10	0.099	0.090	0.134

M_X: Mean Square Error of X - Coordinate
M_Y: Mean Square Error of Y - Coordinate
M_S: Mean Square Error of Position

Table 6-1. Final Results of Ground Control Points

St. Name	Latitude (B) Longitude (L)	North (N) East (E)	Elevation	Remark
098-1	d m s 27 53 28.1456 83 09 54.1520	m 3,086,090.294 417,807.790	m 2,275.400	Known Point
099-3	27 45 53.0850 83 36 24.5735	3,071,866.951 461,252.174	1,845.400	"
100-1	27 46 02.4043 84 10 54.7425	3,072,105.082 517,923.332	1,933.400	"
097-1 (GPS)	27 45 18.4706 82 48 19.0523	3,071,311.504 382,245.276	981.000	Elevation from S.D. results
097-19	27 39 44.4050 82 58 31.6767	3,060,878.113 398,933.790	115.028	Elevation by direct leveling
097-20	27 38 21.9357 82 46 2.3674	3,058,527.543 378,374.458	123.646	"
098-22	27 44 27.9500 83 2 34.7714	3,069,551.650 405,663.128	152.168	"
098-23	27 41 50.2705 83 16 5.2090	3,064,546.439 427,826.402	132.536	"
098-24	27 40 55.2250 83 27 52.9831	3,062,752.676 447,207.152	161.161	"
098-25	27 38 3.1660 83 6 27.0778	3,057,661.019 441,938.698	114.164	"
099-12 (GPS)	27 52 19.9898 83 33 3.1158	3,083,793.549 411,780.695	1,491.850	Elevation from S.D. results
099-24	27 35 58.9660 83 42 11.1386	3,053,555.754 470,695.559	133.537	Elevation by direct leveling
099-25	27 39 6.9676 84 0 53.4106	3,059,306.506 501,463.634	190.874	"
100-22	27 45 46.2112 84 28 9.5448	3,071,681.711 546,252.811	203.469	"

Table 6-2. Final Results of Ground Control Points

St. Name	Latitude (B) Longitude (L)	North (N) East (E)	Elevation	Remark
100-23	d m s 27 40 17.1457 84 14 46.3569	m 3,061,490.425 524,284.948	m 168.887	Elevation by direct leveling
100-24	27 41 38.4621 84 23 52.5485	3,064,032.094 539,241.876	188.874	"
103-1 (GPS)	27 33 14.9001 82 51 6.8881	3,048,996.866 386,633.616	108.760	" (Note - 1)
103-10	27 30 4.0092 82 45 44.8862	3,043,206.476 377,742.061	98.449	"
104-1 (GPS)	27 30 25.6559 83 25 12.4657	3,043,396.788 442,718.676	104.586	"
104-10	27 27 47.8227 82 59 31.2542	3,038,809.743 400,386.856	97.309	"
104-11	27 27 46.6038 83 11 33.8471	3,038,627.298 420,223.453	95.391	"
104-12	27 21 15.4213 83 19 35.7917	3,026,509.521 433,388.521	90.281	"
105-1 (GPS)	27 29 43.2582 83 53 59.5611	3,041,962.112 490,108.706	834.200	Elevation from S.D. results
105-10	27 28 51.7194 83 37 32.0073	3,040,427.811 463,002.969	105.142	Elevation by direct leveling
105-11	27 25 23.4754 83 44 9.8756	3,033,991.051 473,909.313	101.140	"
105-12	27 21 59.4789 83 50 57.5893	3,027,694.501 485,097.671	101.149	"
106-10	27 33 40.9676 84 5 26.6480	3,049,276.922 508,958.638	136.331	"

(Note-1) A new point will be established in a favorable site due to bad GPS survey conditions.

2-3 Leveling

2-3-1 Ordinary Leveling

Ordinary leveling covering 200 km was carried out mainly at the flat part of the study area, and all newly installed GPS points were connected to these levelings.

Observation was carried out on two ways as closure and both ways with an error of less than 60 mm $\sqrt{s}$.

All results were confirmed as good and acceptable, and Network of Levelling route and Closing Error of Ordinary Levelling are shown in Fig.-5 and Table-7.

2-3-2 Indirect Leveling

Indirect leveling (observed by distance and vertical angle) was carried out along the side of Tansen-Tamghas Road and Gorusinge-Thada Road. In the former route, 1st order bench mark, 102 - 132, was used as a start point and, on the way, it was connected to the 2nd order Triangulation Point No. 099-12. In the latter route, GPS point 098-22, connected directly to the 1st order bench mark 119-001, was used as a start point.

Indirect routes are also shown in Fig.-5.

2-3-3 Main Equipment

Equipment used in leveling were as follows:

Nikon AE	6 pcs
WILD T 2	1 pc
YHP 3808 A	1 pc
Topcon GUPY GTS-10	1 pc

2-4 Pricking

2-4-1 Pricking of Ground Control Points

The pricking of 36 existing triangulation points and newly installed GPS points were conducted on the aerial photos enlarged eight times. Point description cards were also prepared on the newly installed 20 GPS points.

Fig.-5. Topographic Mapping of Lumbini Zone/Network of Leveling Route

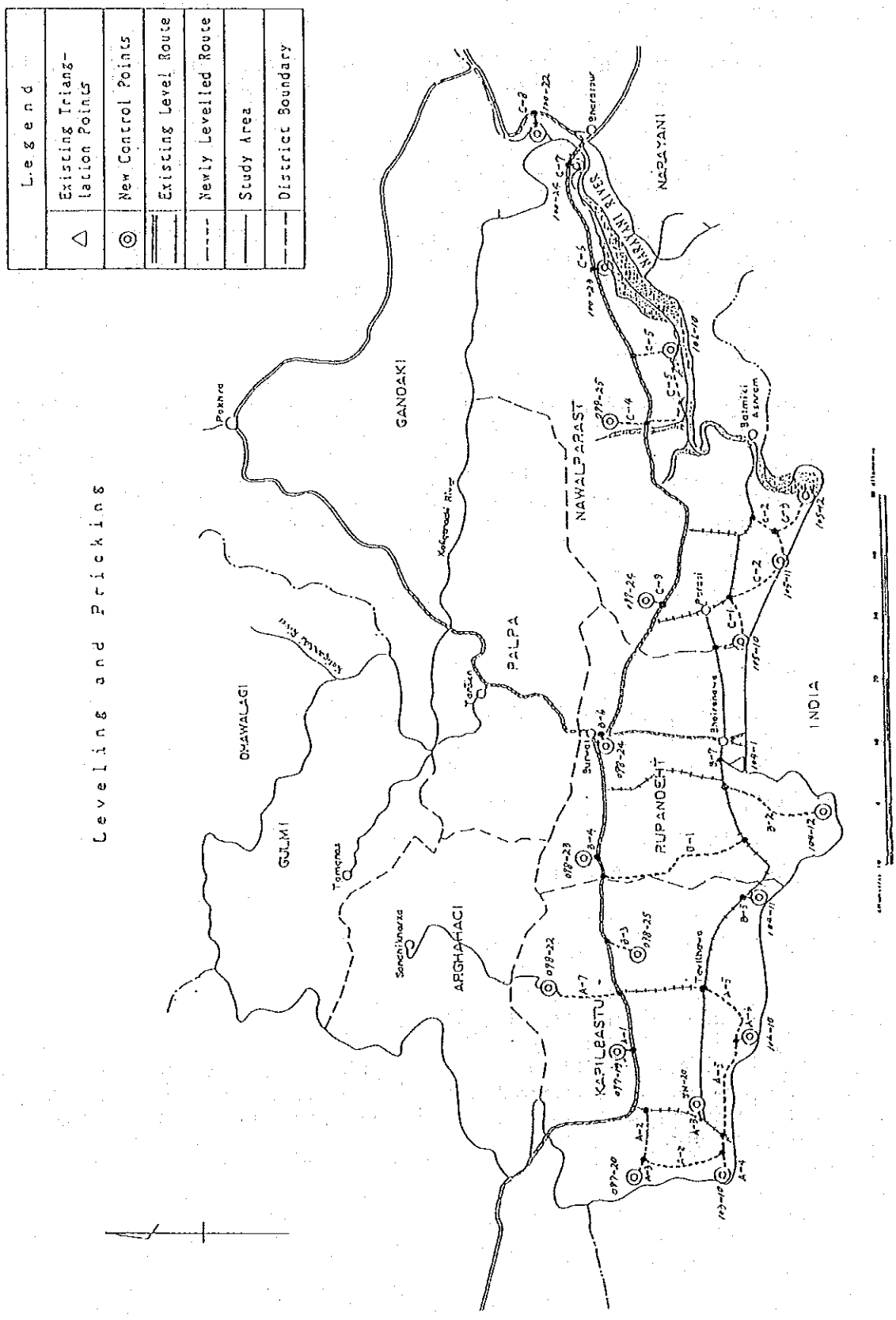


Table-7 Closing Error of Ordinary Leveling

Route Name	Distance (km)	Error of Closure (mm)	Limit of Error (mm)	Remarks
A-1	1.307	5	68	Both Way
A-2	30.689	25	332	Closure
A-3	1.150	1	64	Both Way
A-4	1.348	3	69	"
A-5	36.280	1	361	Closure
A-6	0.550	2	44	Both Way
A-7	9.746	2	187	"
A-8	1.012	6	60	"
B-1	28.265	27	318	Closure
B-2	21.215	3	276	Both Way
B-3	5.735	6	143	"
B-4	0.758	7	52	"
B-5	3.012	19	104	"
B-6	0.901	12	56	"
B-7	0.785	3	53	"
C-1	12.255	51	210	Closure
C-2	21.606	21	278	"
C-3	11.816	17	206	Both Way
C-4	4.928	22	133	"
C-5	26.307	84	307	Closure
C-6	3.150	8	106	Both Way
C-7	1.690	12	78	"
C-8	0.502	1	42	"
C-9	3.214	15	107	"

2-4-2 Pricking of Bench Marks and Spot Heights

The pricking of existing bench marks and newly leveled spot heights were conducted on the twice enlarged aerial photos along the level routes.

The pricked level routes are shown in Fig.-5.

2-5 Observations and Results

The existing 2nd order triangulation point (No. 099-12), planned only to be pricked as a ground control point, was observed by GPS to examine the accuracy of existing survey results in accordance with the request of SD.

For this observation, three newly established points (098-23, 098-24, 099-24) were used as given points.

The two survey results and their comparison are shown in the next Table.

Item	B (Latitude)	L (Longitude)	N	E
① Result from Adjustment of 2nd Order	27°52'19".9917	83°33'3".1214	3,083,793m.609	455,780m.848
② Result from Adjustment of GPS Observation	27°52'19".9898	83°33'3".1158	3,083,793m.549	455,780m.695
① - ②	+0" .0019	+0" .0056	+0m .060	+0m .153

2-6 Field Identification

2-6-1 Outline

Prior to the field identification, the members of the Study Team participated in the identification of typical topographies, for the unification, standardization of the accuracy, and the prevention of variations among the members. In the field identification, twice enlarged aerial photographs were segmented according to the coverage of map sheets. Symbols used in the identification were simplified for the purpose of making the identification less complicated and to increase efficiency.

In accordance with the map symbols and specification, the following investigations were carried out:

(1) Confirmation of the results of estimation conducted in Japan, and investigation of changes over time.

(2) Investigation and confirmation of matters relating to information that were difficult to obtain from the interpretation of aerial photographs.

(3) Investigation of roads, buildings, vegetation, topography, wells, etc.

(4) Investigation and confirmation of the names of major structures that require explanation.

2-6-2 Preparation for Field Work

For the smooth and efficient execution of the field identification works, the Study Team held meetings concerning the duties of the related agencies of both Japan and Nepal.

2-6-3 Identification of Place Names and Political Boundaries

The identification of place names and political boundaries were studied by SD's specialists. This field identification was conducted using twice enlarged aerial photographs and twice enlarged 1/50,000 topographic maps. Results were arranged on twice enlarged aerial photographs according to the map specification. It was confirmed between the experts on both sides that these materials signed by responsible persons were to be provided as information on place names and political boundaries. But since political boundaries could not be shown on aerial photographs, it was finally agreed that they should be drawn on the map that the Study Team would take during supplementary surveys.

Place names were written down on annotation data sheets according to the information provided.

2-6-4 Arrangement of the Results of Field Identification

(1) The results of the field identification work were written down carefully on twice enlarged aerial photographs according to the map symbols and map specification, so that plotting and compilation at later stages could be done smoothly.

(2) Linear features were marked where their shapes changed or at their turning points.

2-6-5 Accuracy Control

The results of the field identification works were checked according to the following, and an accuracy control sheet was made.

- Whether there is any missing part in the identification, and whether the treatment of the results is appropriate;
- Whether the presentation of difficult information is appropriate;
- Whether the edge matching of adjoining aerial photographs is appropriate;
- Whether there is any discrepancy between aerial photographs and other information.

2-7 Aerial Triangulation

2-7-1 Outline

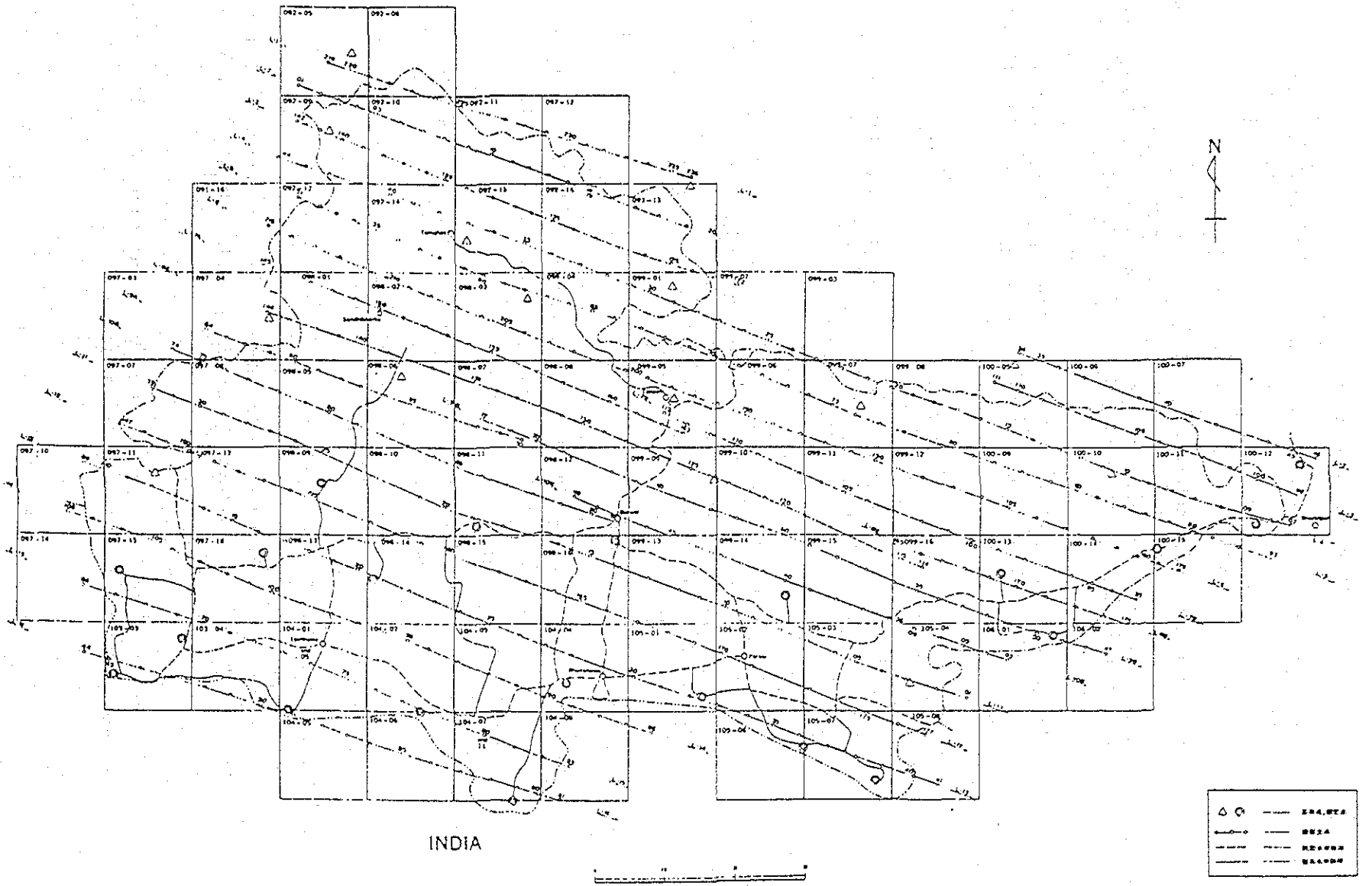
The aerial triangulation was conducted to determine the geodetic coordinates of pass and tie points necessary for stereo plotting on the basis of the results of ground control and leveling points.
Quantities related to the aerial triangulation are as follows:

Photo scale: 1 : 50,000
Number of course: 16 courses
Number of models: 501 models
The aerial triangulation network is shown in Fig. 6.

2-7-2 Main instruments and camera

Pricking device: PUG - II (WILD)
Observation instrument: STECOMETER (ZEISS JENA)
Computer: FACOM M - 360 R (FUJITSU)
Camera: RC - 10 (WILD)
Focus length : 153.79 mm
Lens: AVIOGON
Distortion: Maximum 4 μ

Fig. 6. AERIAL TRIANGULATION



2-7-3 Technical details of aerial triangulation

The technical details of aerial triangulation is described below.

(1) Selection and pricking

As for the pass point selection, 3 points were selected in the common area where 3 aerial photos were overlapped and stereoscopic measurement was possible. As for the tie point, 1 tie point per each model was selected in the area side-lapped by the adjacent course.

The pass points, tie points and other necessary points selected on the contact prints were transferred onto diapositives using a pricking device.

(2) Measurement

The coordinate measurement of fiducial marks at the four corners of the photo, control points, pass points, tie points, etc. was conducted at the measuring unit of 1 μ using a stecometer.

As for the measurements, readings were made twice independently. When the differences of both readings was within 20 μ, the averages were adopted as the measured values. If they exceeded, re-measurement was conducted.

(3) Relative orientation

The limit of residual parallax in the relative orientation was 30μ on the diapositives. If the limit was exceeded, re - measurement was conducted.

The results of residual parallax in the relative orientation of 501 models are as follows:

Maximum: 19.9 μ

(4) Successive orientation

The limit of discrepancies of pass points in the common area with the adjacent model was specified within 0.5 ‰ of the flight altitude as to planimetry and height.

The discrepancies in the successive orientation of 501 models conducted at this time were as follows:

Mean square error		Maximum	
S	H	S	H
2.51m	1.35m	5.06m	5.03m

(Residual of control points)

Number of courses and models	Number of control points		Residual of control points (Planimetry)		Residual of control points (Height)		Remarks
	Planimetry	Height	Mean square error	Maximum	Mean square error	Maximum	JICA SPECS. LIMIT
16 courses 501 models	36 points	234 points	2.74m	5.20m (0.69‰)	1.32m	5.65m (0.75‰)	Planimetry 0.8‰ height 0.8‰

(Discrepancy of tie points)

Planimetry	Height	Remarks
Maximum	Maximum	JICA SPECS. LIMIT Planimetry 0.8 ‰
5.63 m (0.75 ‰)	5.59 m (0.75 ‰)	

In this adjustment computation, the obtained results were more accurate than the limits of the specifications. These excellent results were considered to be attributable to the following:

1) The control points were well distributed.

2) None of the control points were neglected in the adjustment computation, and the results of observation and computation conducted in the field were excellent.

3) The aerial triangulation was made using the program of the independent model method.

2-7-4 Accuracy Control

All results of aerial triangulation were inspected for accuracy, and an accuracy control sheet was made accordingly.

2-8 Plotting

2-8-1 Outline

On the basis of the results of the aerial triangulation and field identification, graphic elements including topographic and planimetric features were measured and plotted, and restitution maps were prepared, using a precision stereo plotter.

2-8-2 Stereo plotter and Paper

A second-order "A" type stereo plotter was used, and relatively inelastic #500 polyester base sheets were used for plotting.

2-8-3 Neat Lines of Topographic Maps

According to Nepal's mapping system, neat lines based on 12.5 km × 12.5 km grids were used.

2-8-4 Plotting

Neat lines, longitude and latitude lines (UTM), pass points and geodetic control points were plotted on restitution maps, using an automatic drawing device.

2-8-5 Work Volume

Plotting will be carried out during the second (1991) and third (1992) years:

2nd Year (1991)	3,500 km^2	(approx. 40%, 32 sheets)
3rd Year (1992)	5,500 km^2	(approx. 60%, 49 sheets)

2-8-6 Orientation

Relative orientation was conducted at six points, and absolute orientation was conducted using the six points obtained by aerial triangulation.

Inspection and corrections were made, when dumed necessary using the geodetic control points in the models.

2-8-7 Accuracy

(1) Allowable Y-parallaxes at the six pass points after relative orientation were 0.02 mm or less on positive film.

(2) Allowable discrepancies between plotted points after absolute orientation and corresponding points in the models were 0.3 mm or less on paper.

(3) In vertical scaling, bench marks and elevation points in the models were used wherever possible so as to enhance the elevation accuracy of topographic maps. The allowable discrepancy in elevation was set at 1/4 of contour intervals.

2-8-8 Detail Plotting

(1) Detail plotting was conducted carefully, in the order of linear features on roads and rivers, buildings, vegetation, and contour lines, to avoid omission.

(2) Plotting for planimetric features and contours was conducted separately, as required.

(3) Intervals of intermediate contours and index contours were set at 10 meters and 50 meters, respectively. Auxiliary contours having an interval of five meters were used for flat terrains.

(4) Positions of elevation points were decided according to the following ground rules:

- Summits of major mountains, larger saddles
- Major junctions of roads
- Major knick points of slope
- Points representing general surfaces near the above points
- Lowest points in definable depressions
- Major valley mouths and junctions of rivers
- Other points needed to define topography

(5) Matching

The edges of map sheets were matched on the basis of neat lines, planimetric features, and contours.

2-8-9 Accuracy Control

All restitution maps and data maps were inspected, and an accuracy control sheet was made accordingly.

2-9 Compilation

2-9-1 Outline

Using restitution maps, results of field identification and collected data, compiled manuscripts and other materials necessary at later stages were prepared according to the map symbols and map specification.

2-9-2 Base Sheet

Base sheets used for compilation manuscripts were relatively inelastic polyester base sheets which were identical with base sheets used for restitution maps.

2-9-3 Plotting

Neat lines, longitude and latitude lines (UTM), and geodetic control points on compilation manuscripts were plotted using an automatic drawing device.

2-9-4 Map Symbols and Map Specification

Map symbols and map specification used were proposed by JICA on the basis of Nepal's map symbols and were finalized in Japan through discussions with Nepal.

2-9-5 Work Volume

Compilation will be carried out during the second (1991) and third (1992) years:

2nd Year (1991)	3,500 km^2	(approx. 40%, 32 sheets)
3rd Year (1992)	5,500 km^2	(approx. 60%, 49 sheets)

2-9-6 Compilation

Compilation was carried out as follows:

(1) The overlay method was adopted, and planes and contours were compiled on separate sheets. Yet another set of sheets were

prepared for annotations. For a greater scribing efficiency at a later stage, road data maps and geodetic control point data maps were prepared separately.

(2) Compilation was carried out carefully to avoid errors or omissions. The places and other necessary information on all uncertainties encountered during compilation were written down on overlays or at other places, so that they can be cleared up during the field supplementary survey in the third year.

(3) The names and numbers of map sheets were decided according to information provided by SD. (Fig. 7)

(4) A compilation manual was prepared in order to ensure the consistency of compilation criteria and expressions used, thereby preventing the deterioration of quality due to variations among individuals.

(5) Usage of colors on compilation manuscripts are as follows:

Black	Double line roads, buildings, power transmission lines, contours (index contours)
Red	Single line roads, paths
Orange	Contours
Blue	Water surfaces
Green	Vegetation boundaries

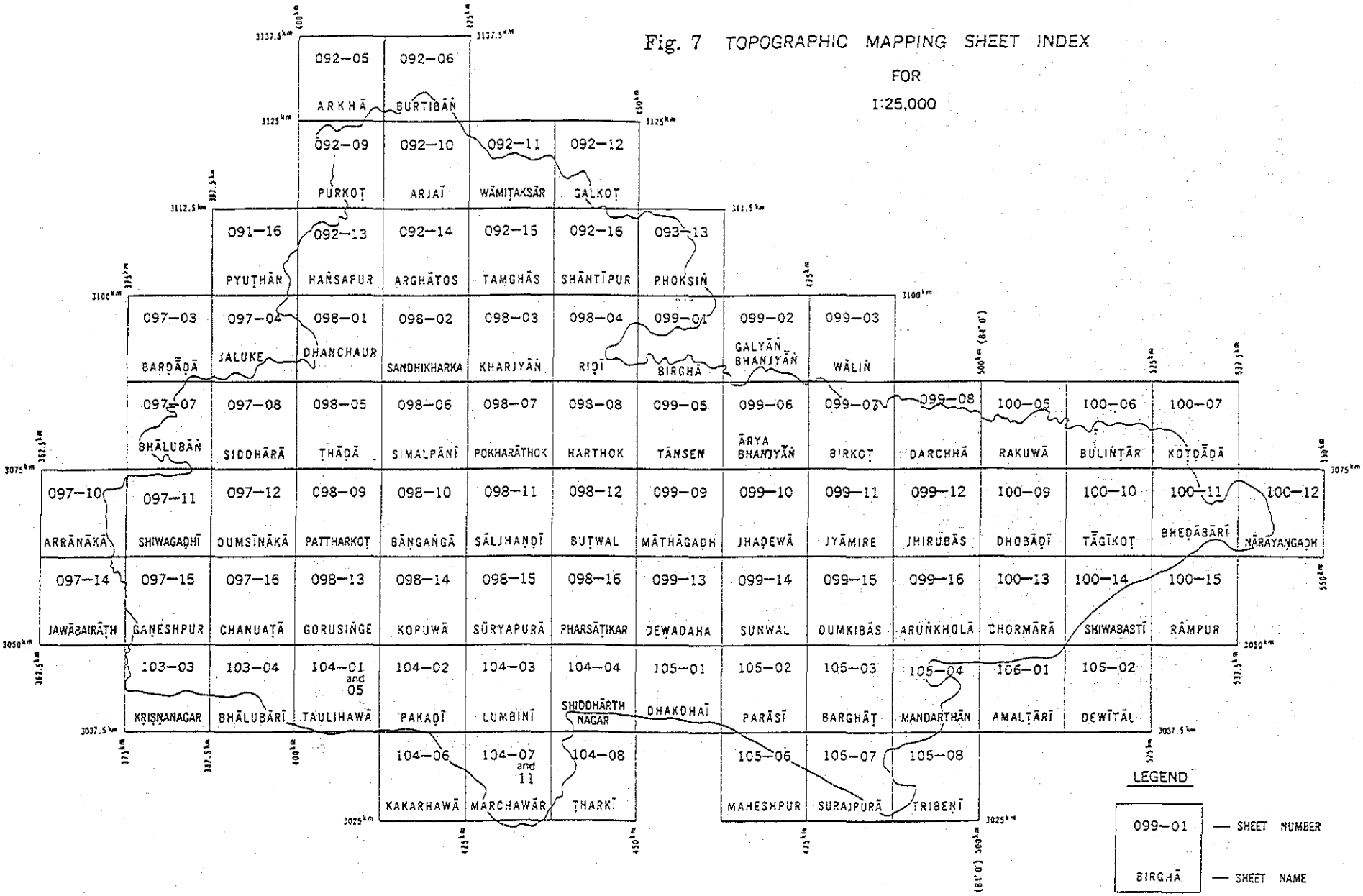
2-9-7 Matching

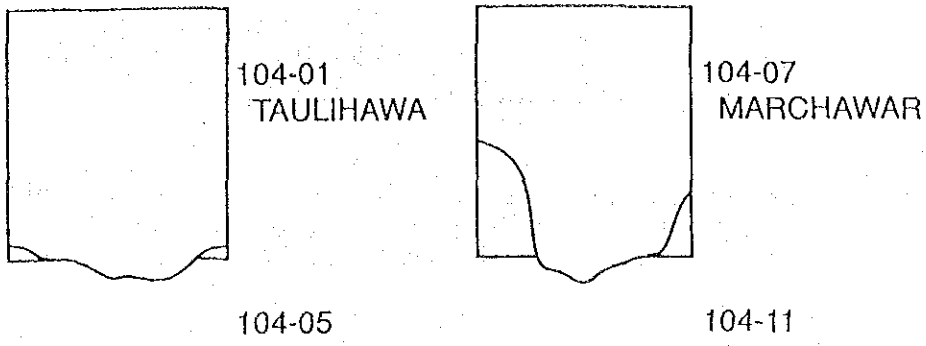
Matching of map sheets was carried out carefully so that linear objects, contours, vegetation boundaries and planimetric features match well.

2-9-8 Extension

Extension techniques were used for the following map sheets.

Fig. 7 TOPOGRAPHIC MAPPING SHEET INDEX FOR 1:25,000





The sheet numbers of map sheets for which extension was performed were written down as follows:

Sheet No. 104-07 and 11

2-9-9 Accuracy Control

After the compilation, a #150 polyester base sheet was laid over all compilation manuscripts to compare them with photographs, to check the relation between contours and elevation points and in compliance with the map symbols and specification. An accuracy control sheet was made accordingly. Uncertainties were identified so that they should be cleared up during the field supplementary survey in the third year.

2-10 Field Completion

2-10-1 Outline

In the field completion, the administrative boundaries, geographical and other names were represented on the compilation manuscripts based on the data provided by SD. Then, the important items shown on the manuscripts were confirmed in the field along with the supplementary or checking survey on the changes occurring after aerial photo-graphy.

2-10-2 Preparatory Work in Japan

(1) The plan for the field completion work was formulated in consideration of the content of the work, the amount of correction of changes after aerial photography, the work period, the schedule of the following work, etc.

(2) A preliminary study was made precisely on the compilation manuscripts, and the uncertain items found in the course of plotting and compilation work and the items to be confirmed in the field were all marked.

(3) The major-changes after aerial photography, for which supplementary survey was considered necessary, were marked.

(4) The matching of adjoining sheets was checked.

(5) Sample maps were prepared for the confirmation of detailed specifications for drafting and printing, color, tone, etc., as reference materials for the technical discussions with SD.

(6) Map sheet

Extension sample sheets were prepared by the Japanese side as a draft sheet.

(7) The plan of operation for field completion was prepared in consideration of the above items.

2-10-3 Field Completion

(1) To attain uniform map representation, the operation manual was prepared for unified field confirmation work.

(2) The survey work was carried out by extending work coverage from the central area of Shiddharth Nagar to other areas.

(3) According to the detailed work plan, the copies of compiled manuscripts were carried into the field, and the plotting work conducted on these manuscripts were checked and confirmed.

(4) As for the major changes occurring after the aerial photography work (roads, afforestation area, etc.), corrections were made using a plain table.

2-10-4 Details of Field Completion

(1) The field completion proceeded according to the sheet assignment of which each party was in charge.

(2) The annotation particularly represented on the sheets, was checked and confirmed by both Japanese and Nepalese sides.

(3) The preliminary study on changes occurring after the aerial photography work was carried out, on the basis of the information on construction work and the like, was provided by SD.

2-11 Drafting

2-11-1 Outline

The drafting of the 1 : 25,000 map was carried out by scribing, based on the compilation manuscripts. The color separation plates were prepared by photo-processing based on the compilation manuscripts and field identification.

2-11-2 Specifications

1) Scale : 1 : 25,000

2) Coverage : 3,500 sq.km, 32 sheets in 1992

5,500 sq.km, 49 sheets in 1993

3) Materials :

Scribe base	(0.12 mm thick) K&E	Yellow base
Mask base	(0.12 mm thick) K&E	Daylight peel coat
Mast base	(0.12 mm thick) KIMOTO	Peel coat
Zip-a-tone	(0.10 mm thick) FUJI FILM	VO 100
Nega films	(0.10 mm thick) FUJI FILM	VO 175
Annotation sheet	(0.08 mm thick) KIMOTO	Diamat

2-11-3 Scribing

(1) For scribing, the symbolized specifications agreed upon were used.

(2) As for image printing on scribe base, images of compilation manuscripts were printed on the scribe bases coated with diago solution by photo-processing.

(3) The separation plates were prepared by scribing for roads, buildings, rivers and contour lines.

(4) Scribing was conducted in the order of black, , blue, red, brown and green sheets so as to avoid any misregistering.

(5) The daylight peel coat bases were used for the mask for complicated representation of vegetation. The peel coat bases were employed for simple features.

2-11-4 Surprints

After scribing, the final composite positives (surprints) were prepared for each sheet, using polyester bases (#500).

These surprints were utilized for every correction.

2-12 Printing

2-12-1 Outline

(1) As for plate making based on the scribed sheets, PS plates were prepared by using vacuum printing frame.

(2) As for 5-color proof prints, PS plate were used for proof printing by using proof printer.

(3) As for color separation combined sheets, scribed sheets were used to prepare positive combined sheet in each color, and then, those positives were reversed to negative combined sheets by photo-processing.

2-12-2 Instruments and Materials for Plate Making

Main instruments:	Vacuum printing frame Automatic processor Offset Printer
Materials:	PS plate 80.0 cm × 103.0 cm, 0.24 thick, 405 sheets Developer 8 bottles (80ℓ)

2-12-3 Plate Making

(1) Plate making on the PS plates was made based on the scribed sheets by using vacuum frame.

(2) Plate making was done using a 4 kw metal halaid lamp.

(3) Exposure for plate making was made at the height of 130 cm with the exposure time of 90 seconds.

(4) For developing, an automatic processor was used.

2-12-4 Proof printing

(1) Proof prints were prepared for each sheet.

These proof prints were used for inspection and for matching the printing colors used. In proof printing, color matching and registering were carefully conducted.

(2) Proof printing was made in the following order:

Black → Red → Blue → Brown → Green

2-12-5 Color Tone of Printing

The color tone of printing was discussed, and based of the JIS color chart, the hue, brightness and chroma were specified.

2-12-6 Printing

Printing was carried out by Japan-made 4-color offset printer. Printing was made in the same order as proof printing.

3. REVIEW

3-1 Aerial Photography

(1) Aerial Photography was not consigned to any agency, but was directly conducted by the study team chartering an aircraft. Because of this, the aerial photography operations went efficiently.

Furthermore, the team was blessed with good weather conditions enabling them to take photographs of good quality in spite of a high altitude of 7,500 m.

(2) As the cabin of the chartered aircraft (Twin Otter) was not airtight because of the camera hole, the entire crew had to wear oxygen masks. However, the oxygen supply was limited.

It is, therefore, advisable to use airtight structured aircrafts, such as rear jet planes, for future aerial photography works conducted on high altitudes.

3-2 Ground Control Point Survey

(1) The net adjustment of the existing 2nd order triangulation points, applied as ground control points inside the study area, was not yet carried out.

Therefore, the computation of the ground control points had to start from the net adjustment of the existing 2nd triangulation points, which was not taken into account in the work schedule.

It is, therefore, advisable to conduct preliminary surveys in detail, for future implementation of this kind of survey.

(2) 3 points of the 1st order triangulation network, applied as given points for the GPS survey, were known to be inaccurate after computing point accuracy using the GPS observation results.

Therefore, newly coordinated survey results on the above 3 points by GPS observations were applied in aerial triangulation.

(3) The northern area were mountainous and had bad roads. Pricking was, therefore, conducted by using a helicopter, a method deemed very effective.

3-3 Field Identification

(1) Due to the absence of a complete set of map symbols and map specification in Nepal, it was necessary to prepare them prior to field identification. Therefore, a map specification was drafted in Japan beforehand, and the contents of the manual was discussed specifically. This paved the way for smooth and efficient discussions, without delaying the field investigation work. In drafting the map specification, the natural and human geographical characteristics of Nepal were considered, and care was used to make the manual applicable to various projects and educational programs.

(2) Since the field identification area was extensive, completion of tasks in a limited period of time depended on the availability of reliable information and the existence of counterparts who have a thorough knowledge of locality. With the whole-hearted cooperation of Nepal by means of sending experienced counterparts for the field identification work, collection of local information and various materials, the field identification could be carried out efficiently.

3-4 Aerial Triangulation

Favorable locations of existing geodetic control points, control points, existing leveling routes and minor-order leveling routes, as well as the accurate results of observation, led to favorable results including residuals at control points and their standard deviations.

3-5 Plotting and Compilation

Planimetric features covered by the map symbols and map specification differed considerably from those used in Japan. There was a need to take some measures to prevent decreases in accuracy due to variations among individuals in applying criteria and filtering data. Therefore, a detailed manual was prepared, and the team members were made to fully understand what was to be done.

3-6 Field Completion

(1) Both sides eagerly conducted the marginal information and legend, printing color, lettering size and style, etc., already finalized during the second year, so as to completely produce the topographic maps. These details were revised, corrected and confirmed by both sides.

(2) The Nepalese counterparts effectively assisted the Japanese surveyors during the field completion works. All the items including newly constructed roads, buildings, factories, afforestation area which have changed after aerial photography, were checked and confirmed to be successful in the whole project area.

3-7 Drafting

Based on the field completion materials, scribing method was applied on the stable polyester base for five (5) color separation. The spelling of the annotation, the boundary line and the letter size, etc., were strictly checked.

3-8 Plate Making and Printing

The PS plate making from the composite negatives was conducted using a 3 kw metal lamp with exposure time of 90 esconds at the height of 130 cm.
At the exposure, attention was paid so as to keep the glass surface clean and to keep perfect vacuum.
In the printing, attention was also paid so as not to make any mistake on the color tone, the heu, brightness and chroma.

APPENDICES

1. MINUTES

(1) Minutes at the initiation of field work (November 1990) ..... (1)

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Appendix 2-1

MINUTES OF DISCUSSIONS

FOR

THE STUDY ON TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN NEPAL

BETWEEN

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

HMG SURVEY DEPARTMENT

ON

NOVEMBER 1, 1990

KATHMANDU

B.N. Shrestha

BUDDHI N. SHRESTHA
Directer General
HMG SURVEY DEPARTMENT
NEPAL

松田博幸

HIROYUKI MATSUDA
Leader of Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY
JAPAN (JICA)

The Japanese Study team of Japan International Cooperation Agency (JICA) headed by Mr. Hiroyuki MATSUDA visited Nepal on 25th Oct. 1990 to carry out the first year work for the Study on Topographic Mapping of Lumbini zone in Nepal.

Prior to the commencement of the first phase survey work, a series of meetings were held from 30th Oct. to 1st Nov. 1990 and following items have been confirmed and agreed by HMG Survey Department (SD) and JICA Study Team.

(1) The Plan of Operation proposed by JICA Study team was discussed and agreed as appendix I

(2) At the meeting, SD strongly requested to the Study team to carry out the GPS observation at the existing triangulation points in the mountainous area for checking the existing geodetic data.

Study team stated that they shall make efforts to observe at least one existing triangulation point if they have surplus time, and also stated that if they find any unacceptable difference between existing geodetic data and GPS observations, it will be informed to SD accordingly.

SD understood the above situation and stated that they shall use this new data for the strengthening of their geodetic net-work.

(3) SD requested to the Study team to include more Nepalese counterpart personnel to study the technical activities in Japan.

Study team stated that they will convey the request of SD to JICA.

The list of attendants of the meetings.

NEPALESE SIDE

(SURVEY DEPARTMENT)

1.	Mr. BUDDHI N. SHRESTHA	DIRECTOR GENERAL
2.	Mr. NARAYAN KRISHNA N. PRADHAN	DEPUTY DIRECTOR GENERAL
3.	Mr. PUNYA P. OLI	PROJECT COORDINATOR
4.	Mr. RAM N. SINGH	CHIEF SURVEY OFFICER
5.	Mr. RAJENDRA P. MARATHA	CHIEF SURVEY OFFICER
6.	Mr. KRISHNA R. ADHIKARY	SENIOR SURVEY OFFICER
7.	Mr. TOYA N. BARAL	SENIOR SURVEY OFFICER

JAPANESE SIDE

(JAPANESE STUDY TEAM)

1.	HIROYUKI MATSUDA	LEADER
2.	TAKEHIKO HIRANO	DEPUTY LEADER
3.	MAMORU MURATA	MAPPING PLANNER
4.	HAYATO TASHIRO	CAMERAMAN
5.	TORAHIKO SUZUKI	NAVIGATOR
6.	SEISHO TSUNODA	PHOTO-PROCESSING

(ADVISORY TEAM)

1.	MITSUO IWASE	GEOGRAPHICAL SURVEY INSTITUTE
2.	KAZUHIDE NAGASAWA	FIRST DEVELOPMENT STUDY DIVISION JICA

APPENDIX I

PLAN OF OPERATION

FOR

TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN NEPAL

OCTOBER, 1990

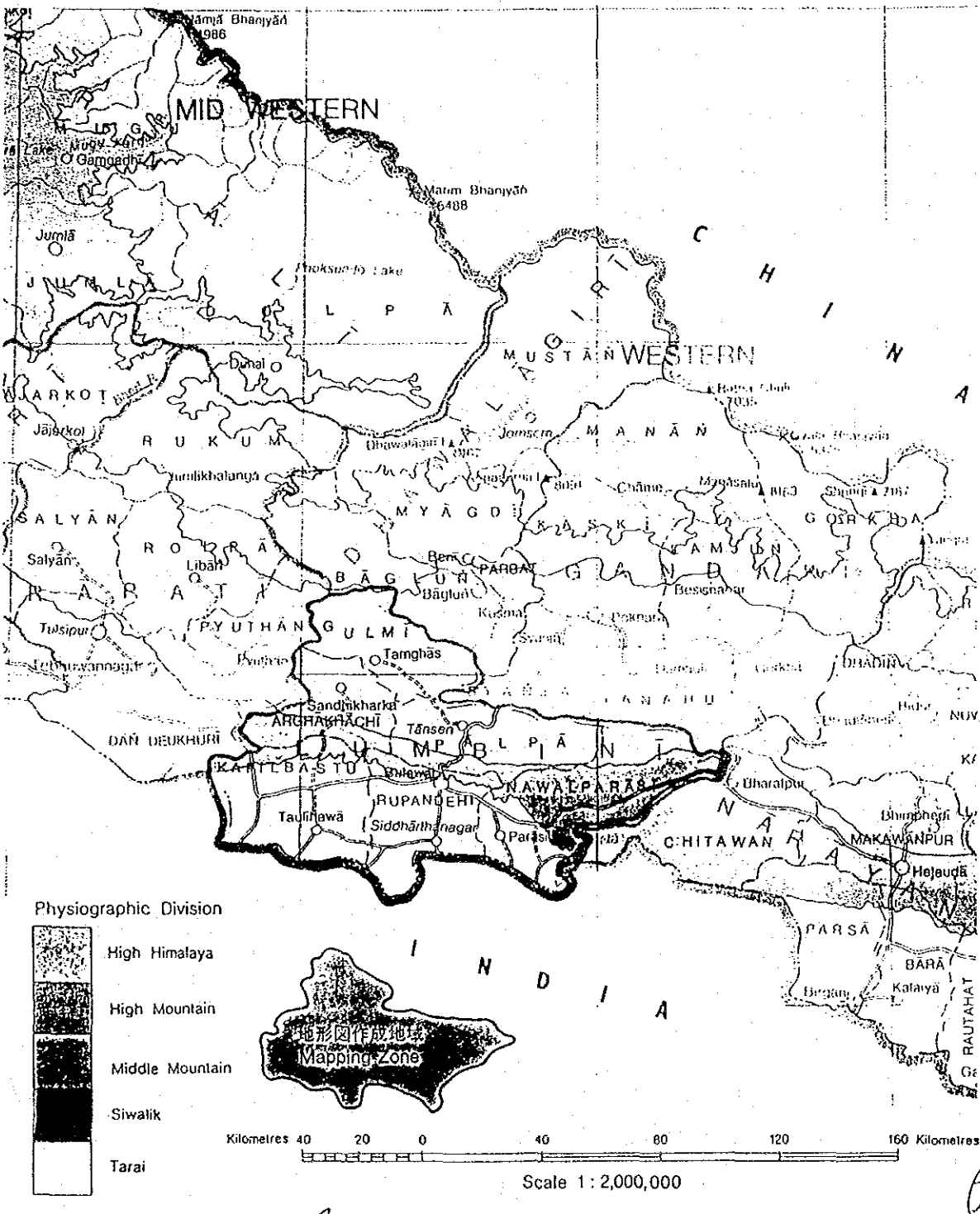
JAPAN INTERNATIONAL COOPERATION AGENCY

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



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1-5 REPORT AND FINAL PRODUCT 4
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ANNEX 1 SCOPE OF WORK

INTRODUCTION

His Majesty's Government of Nepal requested the Technical Cooperation Programme on the Topographic Mapping of Lumbuni Zone (hereinafter referred to as the Study) to the Government of Japan.

In response to the request, Japan International Cooperation Agency (hereinafter referred to as JICA) dispatched the Preliminary Study Team from 31th January to 6th March, 1990.

During that time, field investigation and technical discussions were carried out, and as a result, Scope of Work (S/W) was signed on 28th February, 1990.

This Plan of Operation (P/O) prepared in accordance with S/W describes the outline of the study to be carried out by JICA. The outline consists of the tentative overall plan of 38 months program and the implementation plan for the first year (from October 1990 through March 1991).

The Study shall be carried out according to this P/O and also to the results of discussion between the Study Team composed of International Engineering Consultants Association and Kokusai Kōgyō Co., and Survey Department, Ministry of Land Reform and Management, HMG Nepal (hereinafter referred to as SD).

CHAPTER 1. PLAN OF OPERATION OF THE WHOLE STUDY

1-1 OBJECTIVES OF THE STUDY

The objectives of the study are;

(1) To prepare 1/25,000 topographic maps covering the Lumbini Zone, approximately 9,000 km² (see the cover map),

(2) To trasfer technology to the counterparts of SD through the implementation of the works,

(3) To promote the friendship between Nepal and Japan through the implementation of the Study.

1-2 SCOPE OF THE STUDY

This Study shall cover many technical fields of survey and mapping, including aerial photography, ground control point survey, Pricking, Field idetification 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 shown in TABLE 1.

1-3 OUTLINE OF THE STUDY

(1) Aerial photography

Aerial photography shall be taken at a scale of approximately 1/50,000 with a Twin Otter aircraft chartered from UNDP and a wide angle camera (15 cm focal length, 23 cm X 23 cm photo size). There shall be 16 flight lines and approximately 468 photo sheets (see FIGURE 1).

(2) Ground control survey

The existing 18 triangulation stations and levelling routes (560 km) shall be utilized as the ground control points.

Besides, GPS triangulation (17 points) and Levelling (200 km) shall be newly carried out (see FIGURE 2 and 3).

Computation and adjustment of existing trigrometrial points shall be carried out.

(3) Pricking

The existing 18 triangulation stations and the newly surveyed 17 GPS triangulation stations shall be pricked. All of the bench marks in the existing levelling route shall be pricked, and the spot heights in the new levelling route shall also be pricked at every 2 km.

(4) Field identification

The topographic features, landuse, vegetation and other information necessary for terrain representation shall be identified in the field using the aerial photographs.

Administrative boundaries and geographical names shall also be collected.

(5) Aerial triangulation

Aerial triangulation shall be carried out using the analytical block adjustment method. Approximately, 448 stereo-models shall be applied for the aerial triangulation.

(6) Plotting

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

(7) Compilation

Map compilation shall be executed in accordance with the symbols and specifications as agreed between the Study team and SD.

Sheet size of the compiled topographic maps shall be 12.5 km X 12.5 km on the ground, and the final sheet number shall be 81 sheets (see FIGURE 4).

(8) Field completion

Field completion shall be carried out on items unidentified in the stage of plotting and compilation.

In this stage, SD shall be requested to provide authorized administrative and geographical names as well as the administrative boundaries.

10 proof copies of one sample sheet of map with complete legend shall be submitted to SD before final printing of colour map.

Additionally, subsequent drafting and map-production procedure shall be discussed and agreed between the Study team and SD.

(9) Drafting

Scribing shall be applied on stable polyester bases for five (5) colour separation plates. Annotation shall be done using the photo-typed method.

(10) Map production

Plates shall be made using the combined negatives, and Printing shall be done using the offset method.

Colour applied for printing shall be five (5), and 1,000 final maps shall be produced for each sheet.

1-4 STUDY SCHEDULE

(1) The working period is from October, 1990 to November, 1993.

(2) The working schedule is as shown in FIGURE 5.

(3) The flowchart for the production of topographic map is as shown in FIGURE 6.

1-5 REPORT AND FINAL PRODUCT

A report shall be prepared by Japanese Study team at the end of each fiscal year. A report on the final year shall cover all of the activities in this Study.

The Nepalese counterpart of the Japaneses Study Team shall submit the quaterly reports to SD in the course of the Study.

The final product to be delivered to His Majesty's Government of Nepal are as follows;

(1)	Original negatives and flight records	all sets
(2)	Diapositives	all sets
(3)	Contact prints	all sets
(4)	Photo index maps and aerial photography quality cotrol report	all sets
(5)	Field books and Results of ground control points	all sets
(6)	Pricked and annotated photographs	all sets
(7)	Aerial triangulation results	all sets
(8)	Original manuscripts	1 set each
(9)	Colour separation scribed sheets	1 set each
(10)	Colour separation combined films	1 set each
(11)	1/25,000 topographic maps	1,000 copies each

1-6 UNDERTAKING OF SD

(1) To facilitate the smooth conduct of the Study, SD shall take the necessary arrangement for the Study team as follows, in cooperation with other relevant organizations;

1) To secure permission to take aerial-photographs at the Study area including the national boundary to India,

2) To arrange the aircraft and helicopter for the Study team at their expense,

3) To secure permission for the use of communication facilities, including transcievers,

4) To coordinate the workers and drivers for the Study team at their expense (see TABLE 2),

5) To secure permission for the Study team to take out all necessary data and documents, including the diapositives and other aerial photographs,

6) To install the monument for the new ground control points, of which the materials shall be at the expense of the Study team, if necessary.

7) To carry out observation for magnetic deviation.

(2) SD shall, at its own expense, provide the Study team with the following;

1) Suitable office space and facilities in Kathmandu,

2) Aerial camera, laboratory facilities for aerial photography,

3) Counterpart personnel (see TABLE 2),

4) Credential or identification cards (see TABLE 2),

5) Geodetic data and information necessary for the ground control survey,

6) Information of administrative boundaries and geographical names, at its full responsibility,

7) Available data and information such as roads, public facilities and others.

1-7 UNDERTAKING OF THE STUDY TEAM

Undertaking of the Study team is as follows;

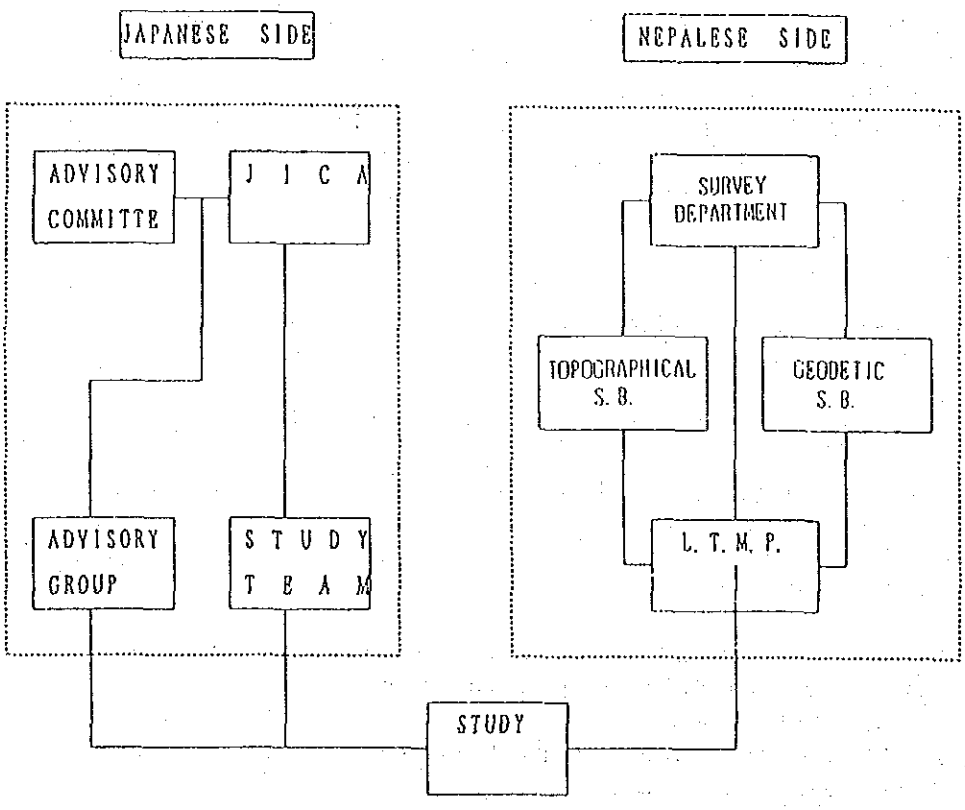
(1) To carry out Aerial photography, Photo-processing ,Ground control survey, Pricking, Field identification and Field completion in Nepal,

(2) To carry out Aerial triangulation, Plotting and compilation, drafting, and Map production in Japan,

(3) To pursue technology transfer to Counterpart personnel during the Study.

1-8 ORGANIZATION

Parties involved in this Study shall be organized as follows:



1-9 ACCURACTY TEST

The accuracy test shall also be carried out in the field by the staff of SD and advisory group.

CHAPTER 2 WORK TO BE CARRIED OUT IN THE FIRST YEAR (PHASE 1)

2-1 VOLUME OF THE WORK

Works in the first year are as follows;

Aerial photography	Scale	approx.	1:50,000
	Flight line		16 lines
	Flight length	approx.	1,724 km
	Area	approx.	9,000 km^2
	Number of photos	approx.	468 sheets
Photo processing	Negatives		1 set
	Diapositives		1 set
	Contact prints		4 sets
	Enlargements		ALL
Ground control survey	GPS triangulation		17 points
	Levelling		200 km
Pricking	Triangulation		35 points
	Levelling		760 km

2-2 WORKING SCHEDULE

The working schedule in the first year is as follows;

Aerial photography and Processing,	from the end of October to the end of December, 1990
Ground control survey and Pricking,	from the middle of January to the end of March, 1991

2-3 WORKING GROUP AND THEIR ASSIGNMENT

TABLE 3 shows the members of the Study Team and their assigment in the first year.

Figure 1
Flight Planning Map

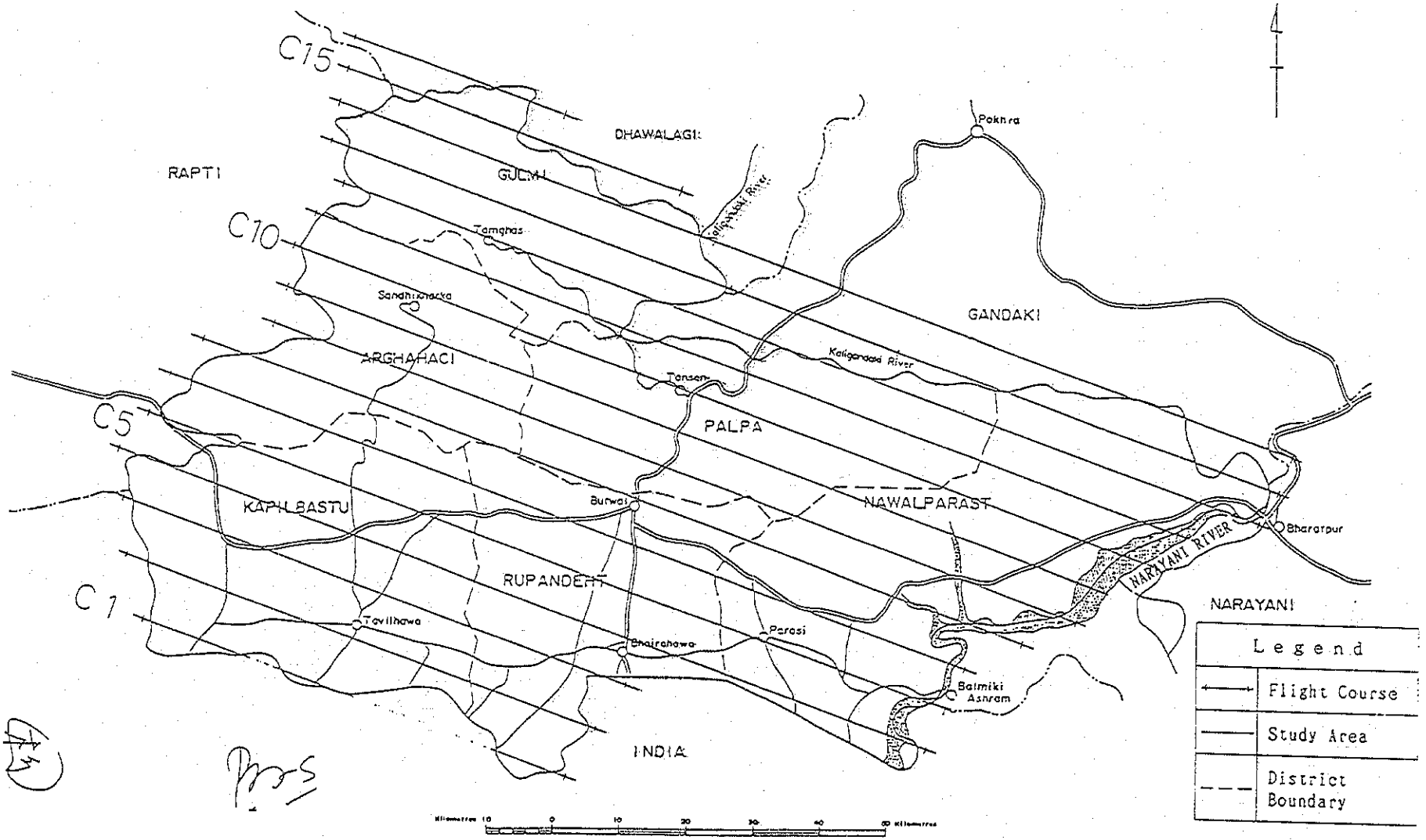


Figure 2
Ground Control Point Survey

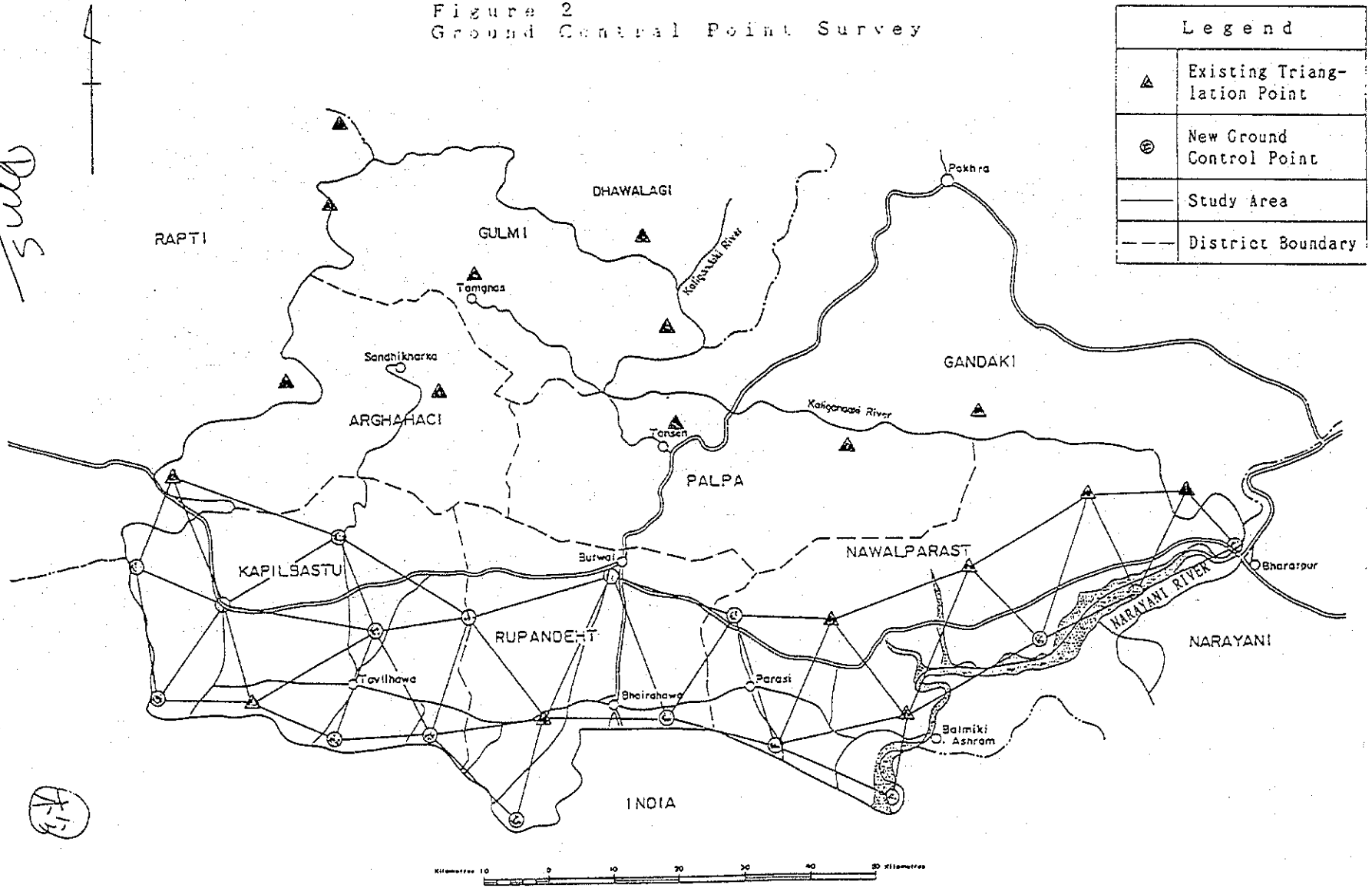


Figure 3
Levelling and Pricking

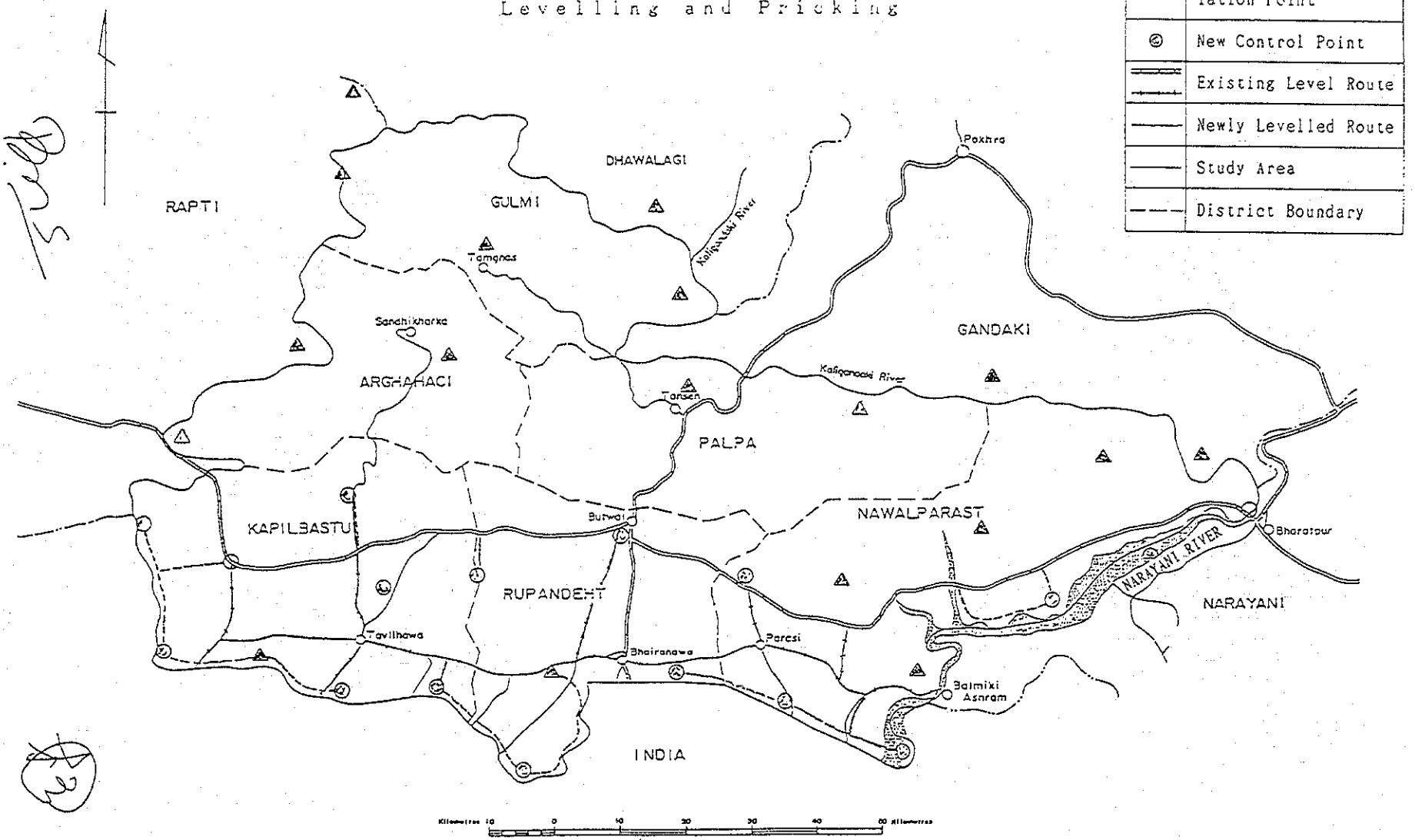


Figure 4
Cartographing

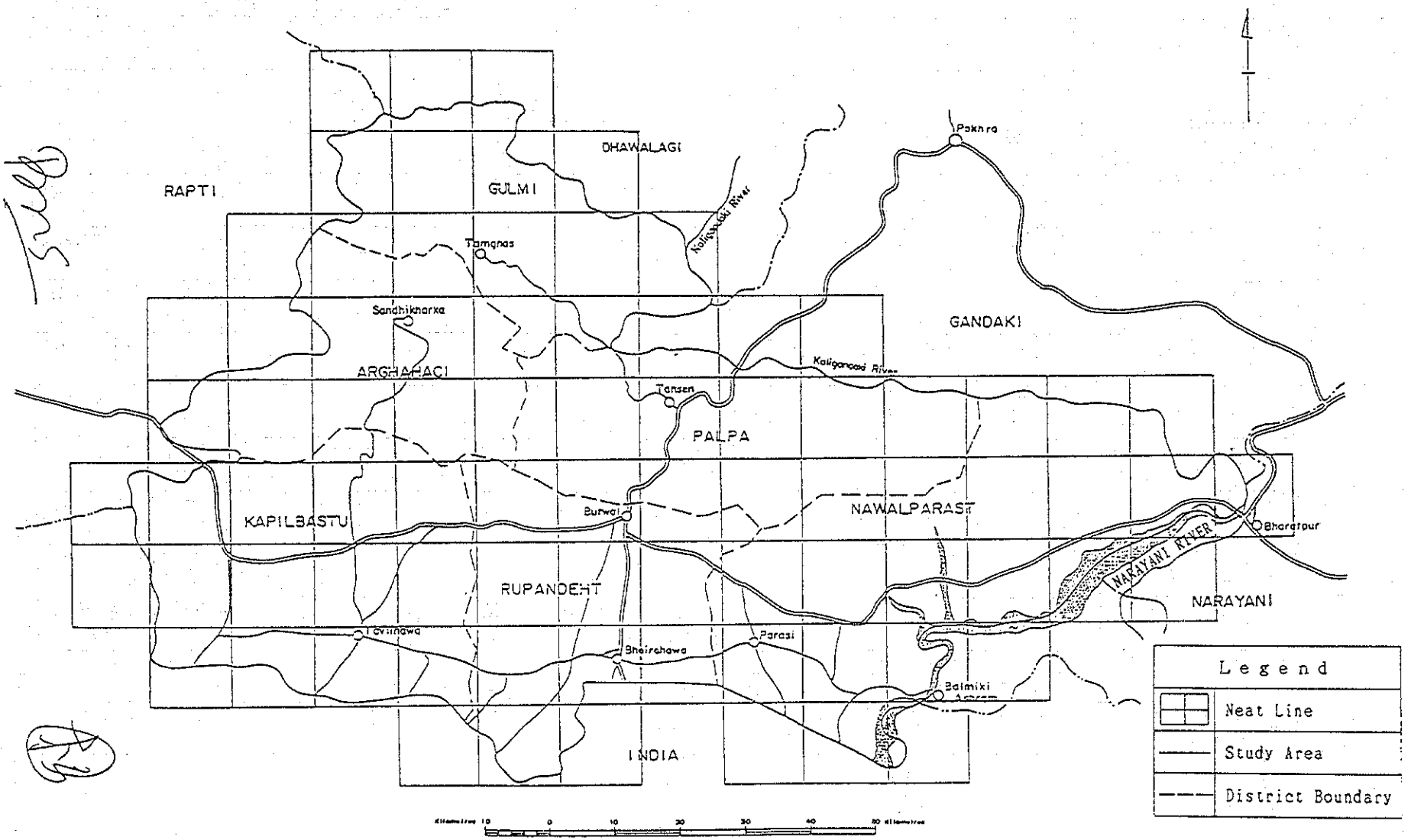


FIGURE 5 TENTATIVE WORKING SCHEDULE

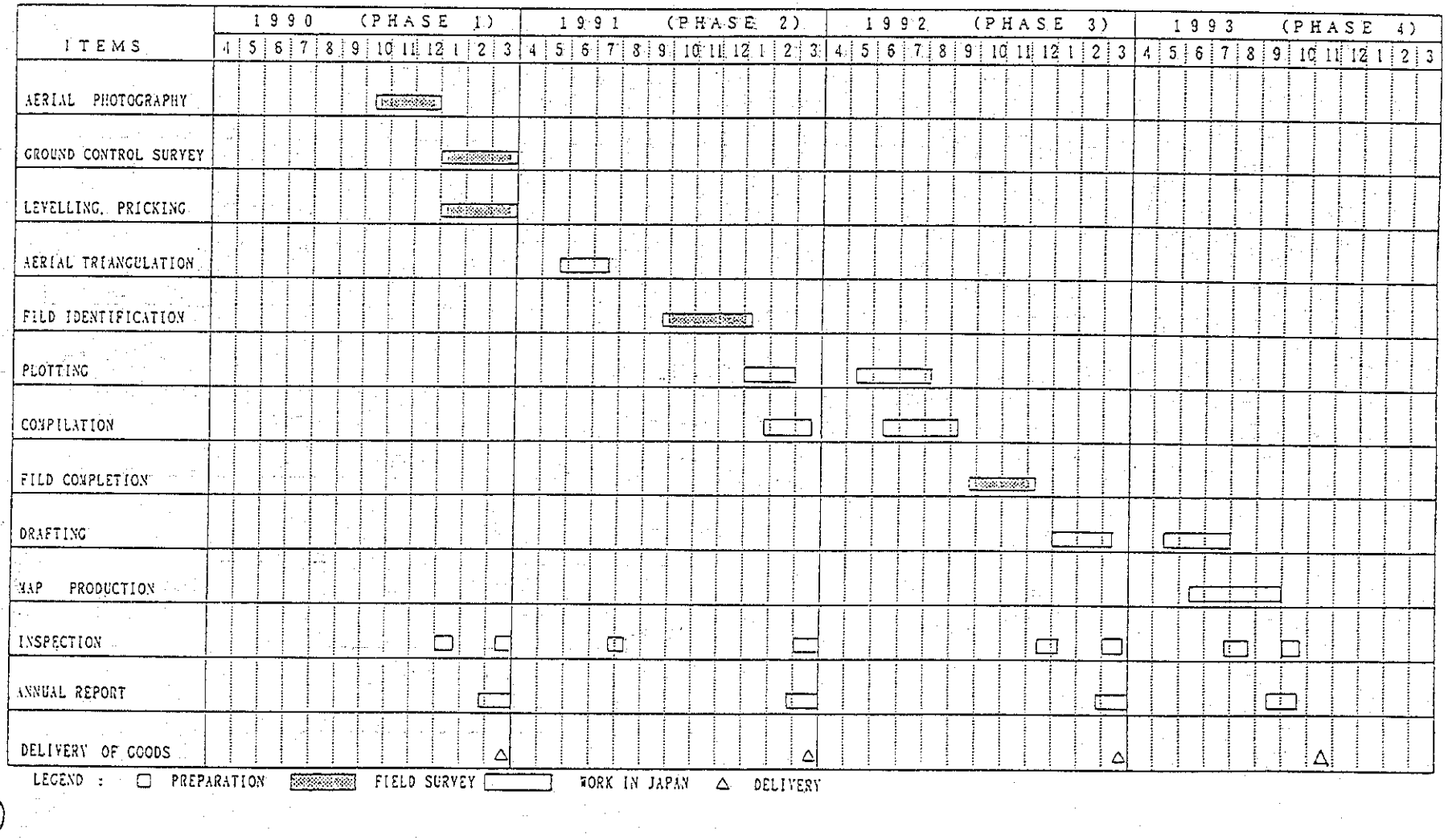
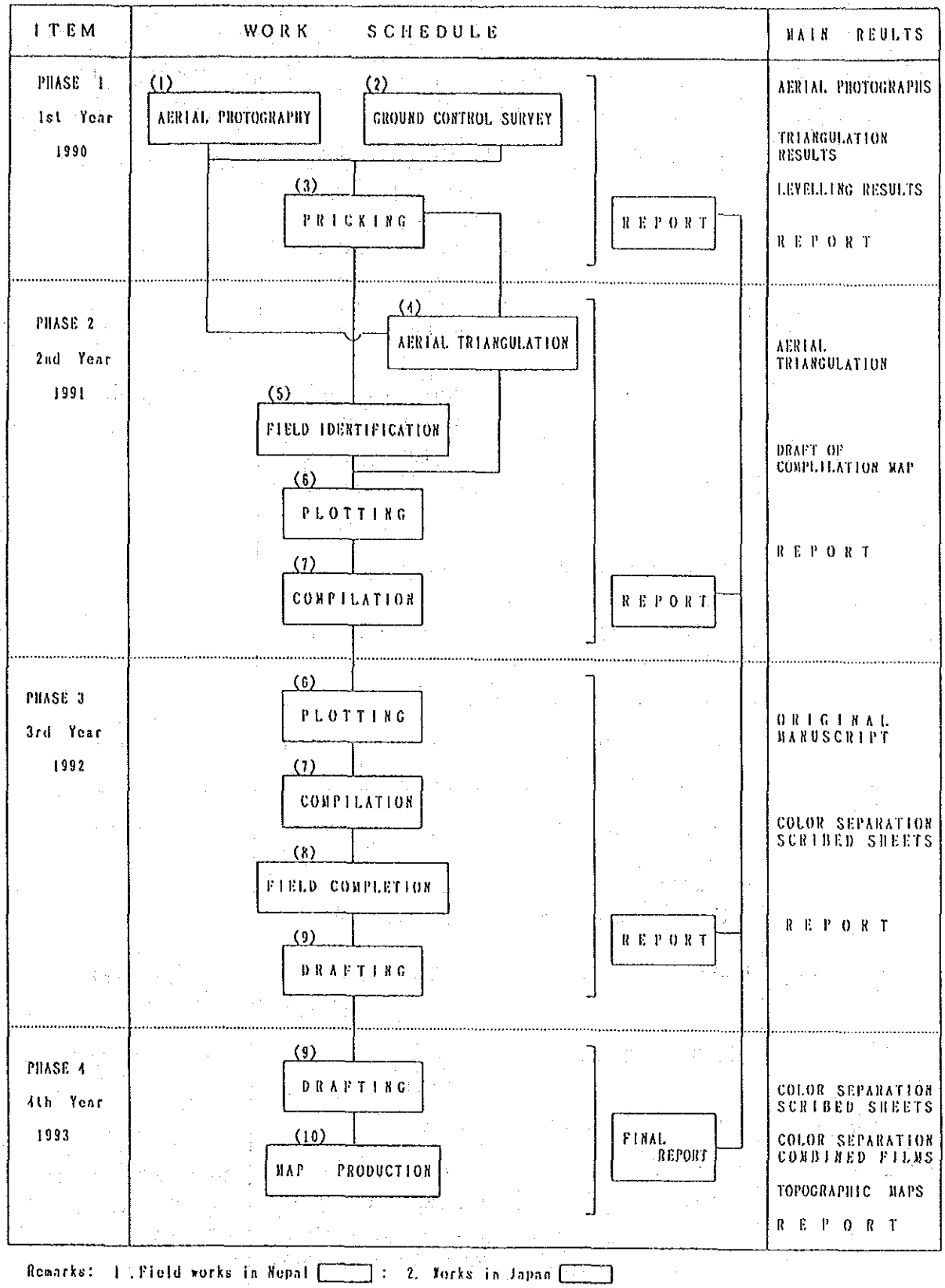


FIGURE 6 FLOWCHART FOR THE PRODUCTION OF TOPOGRAPHIC MAPS



Remarks: 1. Field works in Nepal ☐ : 2. Works in Japan ☐

TABLE 1 TECHNICAL SPECIFICATIONS

ITEMS	CONTENT	APPLICATIONS
FINAL RESULTS	AERIAL PHOTOGRAPH: WIDE ANGLE (15cm) SCALE 1:50,000 APPROX. 9,000 km² Overlap 60 % Sidelap 30 % Crab 10 ° Tip and Tilt 3 °	S/W, INDICATION NOTES
	TOPOGRAPHIC MAP: SCALE 1:25,000 81 SHEETS APPROX. 9,000 km² (Printed Map in English, 5 colors, 1,000s/each)	DITTO
MAP SYMBOLS	1/25,000 MAP SYMBOLS AND ITS APPLICATION RULE BY SD. (Detailed application shall be discussed between the both sides.)	DITTO
APPLICATION RULE	TECHNICAL MANUAL OF OVERSEAS SURVEYING BY JICA	DITTO
SPECIFICATIONS	REFERENCE ELLIPSOID : EVEREST 1830	DITTO
	PROJECTION: MODIFIED UTM (3° zone, Central meridian 84° E Longitude)	
	FORMAT: 12.5 km X 12.5 km (on the ground)	DITTO
	CONTOUR INTERVAL: MAIN 10m SUPPLEMENTARY 5m	DITTO
ACCURACY	MAP ACCURACY: A CLASS (Horizontal : 0.5mm) (Spot height ight : Δh/3) (Contour line : Δh/2)	S/W , TECHNICAL MANUAL OF OVERSEAS SURVEYING BY JICA

TABLE 2 UNDERTAKING TO BE REQUESTED TO SD

ITEMS	PERIOD	CONTENTS
PREPARATION OF I.D. CARD AND SUITABLE OFFICE SPACE	from the end of Oct. to the end of Dec., 1990.	for 7 Japanese
	from the middle of January to the end of March, 1991.	for 19 Japanese
	from the beginning of Oct., to the end of Dec., 1991.	for 13 Japanese
	from the beginning of Oct., to the end of Nov., 1992.	for 11 Japanese
COUTERPART PERSONNEL	from the end of Oct. to the end of Dec., 1990.	3 counterpart for Aerial photography and Processing
	from the middle of January to the end of March, 1991.	7 counterparts for Control point survey and Pricking
	from the beginning of Oct., to the end of Dec., 1991.	8 counterparts for Field identification
	from the beginning of Oct., to the end of Nov., 1992.	6 counterparts for Field completion
DRIVERS AND WORKERS	from the end of Oct. to the end of Dec., 1990.	2 drivers 1 worker
	from the middle of January to the end of March, 1991.	7 drivers 15 workers
	from the beginning of Oct., to the end of Dec., 1991.	5 drivers 8 workers
	from the beginning of Oct., to the end of Nov., 1992.	5 drivers 6 workers

TABLE 3 MEMBER OF STUDY TEAM AND THEIR ASSIGNMENT IN FIRST YEAR (PHASES 1)

NAME	ASSIGNMENT	DUATRATION	CONTENTS
Hiroyuki MATSUDA	LEADER	24. Oct. ~ 3. Dec. 90 6. Mar. ~20. Mar. 91	1. TOTAL MANAGEMENT 2. GENERAL DISCUSSION
Takehiko HIRANO	SUBLEADER	24. Oct. ~26. Dec. 90 10. Jan. ~20. Mar. 91	1. SUB MANAGEMENT 2. GENERAL DISCUSSION 3. ASSISTANCE OF LEADER 4. GENERAL SUPERVISION
Mamoru MURATA	MAPPING PLANNER	24. Oct. ~26. Dec. 90 10. Jan. ~20. Mar. 91	1. FUNDAMENTAL MAP PLANNING 2. GENERAL COORDINATION 3. MAKING REPORT
Tomoharu YOKOTA Kazuhiro ISHIZUKA	CHIEF SURVEYOR	10. Jan. ~20. Mar. 91	1. PLANNING OF IMPLEMENTATION 2. SUPERVISION OF WORKS 3. COORDINATION OF WORKS 4. QUALITY CHEKING
Tadaji KURATA	MECHANICAL ENGINEER	8. Nov. ~26. Dec. 90 10. Jan. ~20. Mar. 91	1. MANAGEMENT OF VEHICLE 2. MAINTENANCE OF VEHICLE
Hayato TASIRO Torahiko SUZUKI Seisho TSUNODA	PHOTOGRAPHER	24. Oct. ~26. Dec. 90	1. PHOTOGRAPHING 2. PHOTO PROCESSING
Masashi SUZUKI Yukio KOIKE Hironao TSUSHIMA Shizuya TAKAYANAGI Masato KIKUCHI Issei NAGUSA Takashi TAKEMOTO	SURVEYOR (GPS)	10. Jan. ~20. Mar. 91	1. G. P. S TRIANGULATION 2. G. P. S ANALYZING 3. PRICKING
Katuyuki KONDO Hisao TANOUE Toshiaki KANEDA Hiroshi ITO Kazunori OBA Tsuyoshi SEINO	SURVEYOR (LEVELLING)	10. Jan. ~20. Mar. 91	1. LEVELLING 2. PRICKING

TABLE 2 UNDERTAKING TO BE REQUESTED TO SD

ITENS	PERIOD	CONTENTS
PREPARATION OF I.D. CARD AND SUITABLE OFFICE SPACE	from the end of Oct. to the end of Dec., 1990.	for 7 Japanese
	from the middle of January to the end of March, 1991.	for 19 Japanese
	from the beginning of Oct., to the end of Dec., 1991.	for 13 Japanese
	from the beginning of Oct., to the end of Nov., 1992.	for 11 Japanese
COUTERPART PERSONNEL	from the end of Oct. to the end of Dec., 1990.	3 counterpart for Aerial photography and Processing
	from the middle of January to the end of March, 1991.	7 counterparts for Control point survey and Pricking
	from the beginning of Oct., to the end of Dec., 1991.	8 counterparts for Field identification
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DRIVERS AND WORKERS	from the end of Oct. to the end of Dec., 1990.	2 drivers 1 worker
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Mamoru MURATA	MAPPING PLANNER	24. Oct. ~26. Dec. 90 10. Jan. ~20. Mar. 91	1. FUNDAMENTAL MAP PLANNING 2. GENERAL COORDINATION 3. MAKING REPORT
Tomoharu YOKOTA Kazuhiro ISHIZUKA	CHIEF SURVEYOR	10. Jan. ~20. Mar. 91	1. PLANNING OF IMPLEMENTATION 2. SUPERVISION OF WORKS 3. COORDINATION OF WORKS 4. QUALITY CHEKING
Tadaji KURATA	MECHANICAL ENGINEER	8. Nov. ~26. Dec. 90 10. Jan. ~20. Mar. 91	1. MANAGEMENT OF VEHICLE 2. MAINTENANCE OF VEHICLE
Hayato TASIRO Torahiko SUZUKI Seishō TSUNODA	PHOTOGRAPHER	24. Oct. ~26. Dec. 90	1. PHOTOGRAPHING 2. PHOTO PROCESSING
Masashi SUZUKI Yukio KOIKE Hironao TSUSHIMA Shizuya TAKAYANAGI Masato KIKUCHI Issei NAGUSA Takashi TAKEMOTO	SURVEYOR (GPS)	10. Jan. ~20. Mar. 91	1. G. P. S TRIANGULATION 2. G. P. S ANALYZING 3. PRICKING
Katuyuki KONDŌ Hisao TANOUE Toshiaki KANEDA Hiroshi ITŌ Kazunori ŌBA Tsuyoshi SEINO	SURVEYOR (LEVELLING)	10. Jan. ~20. Mar. 91	1. LEVELLING 2. PRICKING

APPENDIX 1

SCOPE OF WORK

FOR

TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN

NEPAL

AGREED UPON BETWEEN

SURVEY DEPARTMENT

MINISTRY OF LAND REFORM AND MANAGEMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 28TH, 1990

KATHMANDU

B. N. Shrestha

MR. BUDDHI N. SHRESTHA
DIRECTOR GENERAL
SURVEY DEPARTMENT
MINISTRY OF LAND REFORM
AND MANAGEMENT
HIS MAJESTY'S
GOVERNMENT OF NEPAL(SD)

N. Inoue

MR. NOBORU INOUE
LEADER
THE PRELIMINARY STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY (JICA)

I. INTRODUCTION

In response to the request of His Majesty's Government of Nepal (hereinafter referred to as "HMG/N"), the Government of Japan (hereinafter referred to as "GOJ") has decided to implement the Topographic Mapping of Lumbini Zone in Nepal (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of GOJ, will undertake the Study in close cooperation with the authorities of Nepal.

Survey Department of HMG/N (hereinafter referred to as "SD") shall act as the counterpart body to the Japanese Study Team (hereinafter referred to as "the Team") and also act as the coordinating body with other relevant organizations for the smooth implementation of the Study.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVE OF THE STUDY

The objective of the study is;

(1) To prepare 1/25,000 topographic maps covering the area of approximately 9,000km² (see Appendix I).

III. SCOPE OF THE STUDY

In order to achieve the above mentioned objective, the Study will cover the following items (The technical specifications are as shown in Appendix IV).

1. Aerial Photography
   Aerial Photography shall be taken at the scale of approximately 1/50,000. Setting of air-photo signals shall be done if necessary, prior to commencement of the aerial photography.

2. Ground Control Point Survey
   Existing ground control points shall be utilized, however, GPS, triangulation, traversing and leveling will be carried out, if necessary.

3. Pricking
Pricking on the aerial photographs shall be done in the field, if necessary.

4. Field Identification
The topographic and land use information shall be identified in the field by using the aerial photographs.
Administrative boundaries and geographical names shall be collected.

5. Aerial Triangulation
Aerial Triangulation shall be carried out by analytical block adjustment method.

6. Stereo Plotting and Compilation
Stereo plotting shall be carried out using stereo plotting instrument at the scale of 1/25,000.

Compilation shall be done on the manuscripts.

7. Field Completion
Topographic features, land use, vegetation, etc. which cannot be properly identified on the aerial photographs shall be identified in the field and plotted on the compilation sheets. Administrative boundaries and geographical names shall also be prepared and verified.

8. Drafting and Printing
Based on the compiled sheets, scribing shal be carried out on the stable polyester base for five (5) color separetion plates. Text shall be photo-typed.

Plate making shall be carried out using 1/25,000 combined negatives, and printing shall be carried out by offset method.

N. STUDY SCHEDULE

The whole work will be conducted in accordance with the tentative schedule as shown in Appendix I. In case the aerial photography is not completed within the expected period, both sides shall settle the further programmes of the Study.

The detailed work plan and the schedule of each Japanese fiscal year (from April to March) will be setteled by both sides prior to the commencement of the works.

V. REPORTS AND FINAL RESULTS

A report in English shall be presented to HMG/N by JICA every fiscal year except the final year, and the final report in English shall be presented upon the completion of the Study.

The final results mentioned in Appendix 5 will be submitted to HMG/N by JICA. These materials will belong to HMG/N after having completed the whole work.

All maps produced by the Study shall bear at the lower margin the follwing:

This map was produced under a cooperative undertaking between
His Majesty's Government of Nepal and the Government of Japan.

VI. UNDERTAKING OF HIS MAJESTY'S GOVERNMENT OF NEPAL

1. To facilitate smooth conduct of the Study, HMG/N shall make necessary arrangement;

   1) To secure the safety of the Team,
   2) To permit the members of the Team to enter, leave and sojourn in Nepal for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees,
   3) To exempt the members of the Team from tax, custom duties and other charges on equipment, machinery and other materials brought into Nepal for the implementation of the Study.
   4) To exempt the members of the Team from incom tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study.
   5) To provide the necessary facilities to the Team for the remittances as well as utilization of funds introduced into Nepal from Japan in connection with the implementation of the Study.
   6) To secure permission for entry into private properties for the conduct of the Study.
   7) To secure permission for the Team to take all the necessary data and documents, including the diapositives and other aerial photographs, related to the Study out of Nepal to Japan.
   8) To provide medical services as needed. Its expenses will be chargeable on the members of the Team.

2. HMG/N shall bear claims, if any arises against the members of the Team resulting from, occuring in the course of, or otherwise connected with the discharge of their duties in the implementation for the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

3. To facilitate smooth conduct of the Study, SD shall take necessary arrangements for the Team as follows, in cooperation with other relavent organizations;

   1) To secure permission for the aerial photography and use of airports for the implementation of the Study,
   2) To arrange helicoptor and/or aircraft for the Team on their expenses,
   3) To secure permission for the use of communication facilities including transcivers,
   4) To employ labourers and drivers.

4. SD shall, at its own expense, provide the Team with following in cooperation with other related organizations;

   1) Available data and information related to the Study,
   2) 40-50 man power which includes the technicians, administrator and counterpart personnel,
   3) Suitable office space and facilities in Kathmandu.
   4) Aerial camera, levels, theodolites, laboratory facilities for aerial photography.
   5) Credential or identification cards to the members of the Team,
   6) Information of the necessary administrative boundaries and geographical names on the maps, at its full responsibility.

W. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures, in accordance with the relevant laws and regulations in force in Japan;

1. To dispatch, at its own expense, the Study Team to Nepal, for the field work,

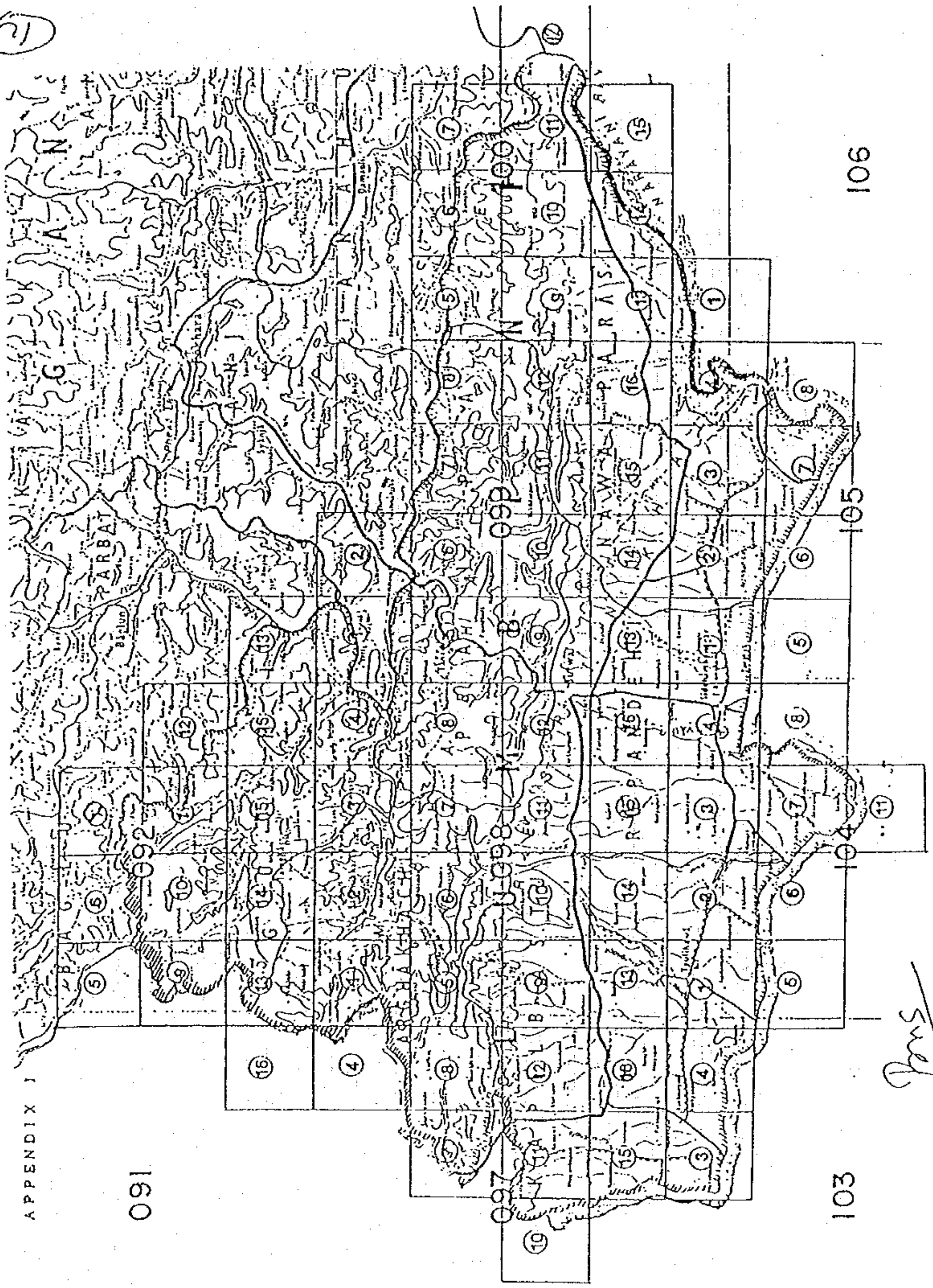
2. To pursue technology transfer for the Nepalese counterpart personnel in the course of the Study,

3. To provide the equipment and machinery for the conduct of the Study, which will remain the property of JICA unless otherwise agreed upon.

Ⅵ. CONSULTATIONS

JICA and SD shall consult with each other in respect of any matter that may arise from or in connection with the Study.

APPENDIX J



APPENDIX I.

TENTATIVE SCHEDULE

ITEM	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 28 29 31 32 33 34 35 36 37 38
AERIAL PHOTOGRAPHY	———
GROUND CONTROL POINT SURVEY	———
PRICKING	—
FIELD IDENTIFICATION	———
AERIAL TRIANGULATION	—
PLOTTING AND COMPILATION	———
FIELD COMPLETION	—
DRAFTING AND PRINTING	———

NOTE : ——— WORK IN NEPAL

——— WORK IN JAPAN

Appendix 8

Final Result

1. Aerial Photography

   (1) Original negatives (roll)

   (2) Diapositives

   (3) Contact paper prints

   (4) Index map

2. Topographic Mapping

   (1) Ground control point survey field books and results

   (2) Pricked and annoted photographs

   (3) Aerial triangulation results

   (4) Original manuscripts

   (5) Color separation combined sheets

   (6) 1/25,000 topographic maps in English (1,000 copies)

Appendix N

Technical Specifications

1. Topographic Mapping:

"A" class mapping specifications in the technical Manual of Overseas Surveying of JICA will be applied with the exception of some subjects and some areas, such as obscure areas on photographs, generalized building area, periphery of road in the suburbs and in rural area, and it will be resolved in consultation with each other.

2. Contour Lines:

10 meters contour intervals in hills and supplementary 5 meters intermediate contour line for flat area.

3. Format:

(12.5km X 12.5km)

4. Number of Colors:

5 colors

5. Projection

Universal Transverse Mercator modified 3° Zone, Central meridian 84° E Longitude.

(12)

MINUTES OF MEETING

ON

THE TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN

NEPAL

BETWEEN

SURVEY DEPARTMENT

MININISTRY OF LAND REFORM AND MANAGEMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

ON

FEBRUARY 28, 1990

KATHMANDU

B.N. Shrestha

MR. BUDDHI N. SHRESTHA
DIRECTOR GENERAL
SURVEY DEPARTMENT
MINISTRY OF LAND REFORM
AND MANAGEMENT
HIS MAJESTY'S
GOVERNMENT OF NEPAL(SD)

N. Inoue

MR. NOBORU INOUE
LEADER
PRELIMINARY STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY(JICA)

The preliminary study team on the topographic mapping of Lumbini zone, organized by JICA and headed by Mr. Noboru Inoue , visited Nepal from February 1, 1990 to March 5, 1990, to carry out the preliminary study for the captioned study.

During their stay in Nepal, the series of meetings were held between the Japanese study team and the Nepalese team, headed by Mr. Buddhi N. Shrestha and composed of officials from the Survey Department of Ministry of Land Reform and Management (SD), and the meetings resulted as follows.

1. The main objectives of the discussions are to set forth the Scope of Work and to exchange views to carry out the study in the most professional manner.

2. The final Scope of Work for the study dated February 28, 1990.

3. In respect with flight permission of the adjacent country for aerial photography over the national boundary, the Nepalese side shall get it at latest two (2) months prior to commencement of the Study.

   In case the flight permission by the adjacent country is not available, the area of approximately 10 km inside along the national boundary shall be basically excluded for the aerial photography, and the existing 1/50,000 aerial photographs shall be utilized to complete the topographic mapping for the whole area of the Lumbini zone.

4. The Nepalese counterpart of the Japanese study team shall submit the quarterly report to SD in the course of the Study.

5. SD shall make an effort to prepare, for the Japanese study team, office space with necessary furniture in the field.

6. SD shall, at its own expense, provide the Japanese study team with reproduction facilities (e.g. photo-copy machine, blue print machine, etc.).

7. Magnetic deviation shall be drawn on the maps based on the data, if provided by SD.

8. SD shall make necessary booking for the mobilization of the UNDP's aircraft, if and when the Japanese side requested.

   All the expenses to be paid to UNDP, for mobilization of the aircraft for the aerial photography, will be borne by the Japanese study team.

9. In case the aerial photographs will be entrusted to the third country's company, the words of "the Japanese Study Team", used in the undertaking of His Majesty's Government of Nepal in the Scope of Work, shall be read as "the Japanese Study Team and the Team of aerial photography".

10. The map symbols shall be basically those of SD.

11. All the data, maps and aerial photographs shall not be published unless otherwise agreed upon by SD.

12. Upon the completion of the whole work of the Study, JICA shall keep two (2) sets of the each sheet of the topographic maps, as a token of the friendly cooperation with SD.

13. The Nepalese side earnestly requested to the Japanese side the followings;

(1) To accept as many Nepalese counterpart personnel as possible to Japan for facilitating technical transfer in the course of the Study.

(2) To provide necessary materials for conducting the Study.

(3) To provide appropriate number of vehicles for smooth implementation of the Study.

(4) To take consideration to transfer of technology, by providing necessary equipments for conducting the Study.

The Japanese team replied that they would convey the above requests to the Japanese authorities concerned.

LIST OF PARTICIPANTS

NEPALESE SIDE

(SURVEY DEPARTMENT)

1.	MR. BUDDHI N. SHRESTHA	DIRECTOR GENERAL
2.	MR. PUNYA PRASAD OLI	ACT. DEPUTY DIRECTOR GENERAL
3.	MR. R. P. MARATHA	CHIEF SURVEY OFFICER
4.	MR. BIJAYA LAL RAJBANSHI	SURVEY OFFICER
5.	MR. K. C. DUTTA	SURVEY OFFICER

JAPANESE SIDE

(JAPANESE STUDY TEAM)

1.	MR. NOBORU INOUE	LEADER
2.	MR. KAZUO INABA	MEMBER
3.	MR. MITSUO IWASE	MEMBER
4.	MR. HIROSHI MURAKAMI	MEMBER
5.	MR. SEIICHI KAKINUMA	MEMBER
6.	MR. CHIYUKI NISHIMURA	MEMBER

(EMBASSY OF JAPAN)

1.	MR. KENZO HIROKI	SECOND SECRETARY

(JICA NEPAL OFFICE)

1.	MR. MASAHITO OHYAMA	ASST. RESIDENT REPRESENTATIVE

MINUTES OF MEETING

ON

THE TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN

NEPAL

BETWEEN

SURVEY DEPARTMENT

MININISTRY OF LAND REFORM AND MANAGEMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

ON

FEBRUARY 8, 1990

KATHMANDU

B. N. Shrestha

MR. BUDDHI N. SHRESTHA
DIRECTOR GENERAL
SURVEY DEPARTMENT
MINISTRY OF LAND REFORM
AND MANAGEMENT
HIS MAJESTY'S
GOVERNMENT OF NEPAL(SD)

Kazuo Inaba

MR. KAZUO INABA
DEPUTY LEADER
PRELIMINARY STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY(JICA)

The preliminary study team on the topographic mapping of Lumbini zone, organized by JICA, visited Nepal from February 1, 1990 to February 10, 1990, to carry out the preliminary study for the captioned study.

During their stay in Nepal, the meetings were held between the Japanese study team and the Survey Department of Ministry of Land Reform and Management (SD) and the meetings resulted as follows.

1. The mutual understanding by both sides mentioned in this document will provide the basic idea to formulate the Scope of Work which will be signed in the beginning of March, 1990 by the leaders of the both sides.

2. The draft of the Scope of Work attached herewith is basically agreed by both sides, and will be finalized in the next meeting.

3. In consideration of budgetary constraint of Japanese side and the alternatives of the scale in Nepal are 1/25,000 or 1/50,000, the aerial photography shall be taken at the scale of approximately 1/50,000.

4. In respect with flight permission of the adjacent country for aerial photography over the national boundary, Nepalese side shall get the flight permission of the adjacent country, at latest two (2) months prior to commencement of the Study.

   In case the flight permission by the adjacent country is not available, the area of approximately 10 km inside along the national boundary shall be basically excluded for the aerial photography, and the existing 1/50,000 aerial photographs shall be utilized for the topographic mapping.

5. The Nepalese counterpart of the team shall submit the quarterly report to SD in the course of the Study.

6. In the item of W.1.6) of the originally drafted Scope of Work, "and restricted areas" was deleted since there is no restricted area in the study area.

7. In the item of W. 1. 7) of the originally drafted Scope of Work, "the original negatives of aerial photographs" was amended to as "the diapositives and other aerial photographs".

8. The Nepalese side stated that the mutual understanding is to be recorded in the Minutes of Meeting, which will be expressed as "All the data, maps and aerial photographs shall not be published unless otherwise agreed upon by SD." The Japanese side will consider this matter and shall reply the result of consideration prior to signing of the Scope of Work.

9. SD shall make an effort to prepare, for the Japanese study team, office space with necessary furniture in the field.

10. SD shall, at its own expense, provide the Japanese study team with reproduction facilities (e.g. photo-copy machine, blue print machine, etc.).

11. Magnetic deviation shall be drawn on the maps based on the data, if provided by SD.

12. SD shall make necessary booking for the mobilization of the UNDP's aircraft, if and when the Japanese side requested.

    All the expenses, to be paid to UNDP, for mobilization of the aircraft for aerial photography will be borne by the Japanese study team.

13. Upon the completion of the whole work of the Study, JICA shall keep two (2) sets of the each sheet of the topographic maps, as a token of the friendly cooperation with SD.

14. In case the aerial photographs will be entrusted to the third country's company, the words of "the Japanese Study Team", used in the undertaking of His Majesty's Government of Nepal in the Scope of Work, shall be read as "the Japanese Study Team and the Team of aerial photography".

15. The Nepalese side strongly requested to the Japanese side the followings;

    (1) To accept as many Nepalese counterpart personnel as possible to Japan for facilitating technical transfer in the course of the Study.

    (2) To provide necessary materials for conducting the Study.

    (3) To provide appropriate number of vehicles for smooth implementation of the Study.

    (4) To take consideration to transfer of technology, by providing necessary equipments for conducting the Study.

    (5) To draw hill shading, which is quite common for small and medium scale of maps in Nepal, for the hilly part of the study area for effective utilization of the maps.

The Japanese team replied that they will convey the above requests to the Japanese authorities concerned.

P. M. Shrestha

LIST OF PARTICIPANTS

NEPALESE SIDE

(SURVEY DEPARTMENT)

1.	MR. BUDDHI N. SHRESTHA	DIRECTOR GENERAL
2.	MR. PUNYA PRASAD OLI	ACT. DEPUTY DIRECTOR GENERAL
3.	Mr. R.P. MARATHA	CHIEF SURVEY OFFICER
4.	Mr. BIJAYA LAL RAJBANSHI	SURVEY OFFICER
5.	Mr. K.C. DUTTA	SURVEY OFFICER

JAPANESE SIDE

(JAPANESE STUDY TEAM)

1.	MR. KAZUO INABA	DEPUTY LEADER
2.	MR. MITSUO IWASE	MEMBER
3.	MR. HIROSHI MURAKAMI	MEMBER
4.	MR. SEIICHI KAKINUMA	MEMBER
5.	MR. CHIYUKI NISHIMURA	MEMBER

(EMBASSY OF JAPAN)

1.	MR. KENZO HIROKI	SECOND SECRETARY

(JICA NEPAL OFFICE)

1.	MR. MASAHITO OOYAMA	ASST. RESIDENT REPRESENTATIVE

B. Shrestha

Appendix 2-2

MINUTES OF DISCUSSIONS

FOR

THE STUDY OF TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN NEPAL

BETWEEN

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

HMG SURVEY DEPARTMENT

ON

MARCH 21, 1991

KATHMANDU

BUDDHI N. SHRESTHA
Director General
HMG SURVEY DEPARTMENT
NEPAL

HIROYUKI MATSUDA
Leader of Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY
(JICA)

At the end of the survey of phase I (1990 F/Y), Joint meetings were held during the period of March 19th to 21st 1991, at the HMG Survey Department (SD) Office. The following items were discussed and agreed by both sides.

1. JICA Study Team expressed its sincere gratitude to SD and related organizations for their close cooperation. Mr. B. N. Shrestha expressed his sincere appreciation and gratitude to the Japanese side for the assistance provided to the Survey Department. Both sides expressed their satisfaction on the successful completion of the assigned works.

2. JICA Study Team submitted the progress report of the first year survey work on Topographical Mapping of Lumbini Zone in Nepal which was accepted and attached as Appendix 1.

3. The following materials were submitted to SD on December 19, 1990.

i)	Original negatives	4 rolls
ii)	Contact paper prints	536 sheets
iii)	Index map	1 sheet

4. JICA Study Team requested SD to prepare the data necessary for field identification as listed in Appendix 2.

5. SD requested to arrange more Nepalese counterpart personnel including high ranking officials' training in Japan.

JICA study team stated to convey the request to concerned JICA officials.

The list of attendants of the meeting.

NEPALESE SIDE

(SURVEY DEPARTMENT)

1. Mr. BUDDHI N. SHRESTHA	DIRECTOR GENERAL
2. Mr. PREM B. PRADHAN	DEPUTY DIRECTOR GENERAL
3. Mr. NARAYAN K. N. PRADHAN	DEPUTY DIRECTOR GENERAL
4. Mr. PUNYA P. OLI	ACT. PROJECT DIRECTOR
5. Mr. RAM N. SINGH	CHIEF SURVEY OFFICER
6. Mr. RAJA RAM CHHATKULI	SENIOR SURVEY OFFICER
7. Mr. GAJENDRA K. KARNA	SURVEY OFFICER

JAPANESE SIDE

(JICA STUDY TEAM)

1. Mr. HIROYUKI MATSUDA	LEADER
2. Mr. TAKEHIKO HIRANO	DEPUTY LEADER
3. Mr. MAMORU MURATA	MAPPING PLANNER
4. Mr. TOMOHARU YOKOTA	CHIEF SURVEYOR
5. Mr. KAZUHIRO ISHIZUKA	CHIEF SURVEYOR

Appendix 2

SD shall provide the following data marked on the map or aerial photographs by the end of December 1991 tentative:

1. Data of road with class and name.
2. Data of transmission line and telephone line and telegraph line.
3. Data of under ground canal.
4. The geographical names.
5. River names.
6. Sample of marginal information and legend. (submitted)
7. Sheet titles (map name) and sheet codes/number. (submitted)
8. Names of colour applied for printing.

SD shall also provide the data of administrative boundaries and names marked on the new maps or enlargement of aerial photographs by July, 1992 tentative.

APPENDIX - I

PROGRESS REPORT
FOR
TOPOGRAPHIC MAPPING
OF
LUMBINI ZONE
IN
NEPAL
(FIRST YEAR FIELD WORK)

Aerial Photography

Ground Control Survey

Leveling

Pricking

MARCH 1991

JICA STUDY TEAM

1. Outline of the First Year Work

1-1 Objectives

Objectives of the study are: (1) To prepare 1/25, 000 topographic maps covering the Lumbini Zone, (2) To transfer technology to the counterparts of SD through the implementation of the works, and (3) To promote the friendship between Nepal and Japan through the implementation of the Study.

The first year work of the study is to carry out the field survey including aerial photography, ground control survey,leveling, pricking, and office work such as arrangement of survey results.

1-2 Period of Survey Work

Field work

(Headquarters)	25 October, 90 - 24 December, 90 16 January, 91 - 23 March, 91
(Aerial Photography)	25 October, 90 - 24 December, 90
(Photo Processing)	25 October, 90 - 24 December, 90
(Ground Control Survey)	16 January, 91 - 23 March, 91
(Leveling and pricking)	16 January, 91 - 14 March, 91

1-3 Formation of the Study Team

Leader	Mr. Hiroyuki MATSUDA	24,Oct. - 03,Nov. 90 10,Mar. - 24,Mar. 91
Deputy Leader	Mr. Takehiko HIRANO	24,Oct. - 25,Dec. 90 15,Jan. - 24,May. 91
Mapping Planner	Mr. Mamoru MURATA	24,Oct. - 25,Dec. 90 15,Jan. - 24,Mar. 91
Chief Surveyor	Mr. Tomoharu YOKOTA	15,Jan. - 24,Mar. 91
Chief Surveyor	Mr. Kazuhiro ISHIZUKA	15,Jan. - 24,Mar. 91
Mechanical Engineer	Mr. Tadaji KURUTA	08,Nov. - 25,Dec. 90
Cameraman	Mr. Hayato TASHIRO	24,Oct. - 25,Dec. 90

Navigater	Mr. Torahiko SUZUKI	24, Oct. - 25, Dec. 90
Photographer	Mr. Seisho TSUNODA	24, Oct. - 25, Dec. 90
Ground Control Survey	Mr. Masashi SUZUKI	15, Jan. - 23, Feb. 91
"	Mr. Yukio KOIKE	15, Jan. - 24, Mar. 91
"	Mr. Hironao TSUSHIMA	15, Jan. - 23, Feb. 91
"	Mr. Shizuya TAKAYANAGI	15, Jan. - 24, Mar. 91
"	Mr. Issei NAGUSA	15, Jan. - 24, Mar. 91
"	Mr. Takashi TAKEMOTO	15, Jan. - 24, Mar. 91
Ground Control Survey Pricking and Leveling		
"	Mr. Katsuyuki KONDO	15, Jan. - 24, Mar. 91
"	Mr. Hideki HIGASHI	15, Jan. - 24, Mar. 91
"	Mr. Tsuyoshi SEINO	15, Jan. - 24, Mar. 91
Leveling and Pricking		
"	Mr. Toshiaki KANADA	15, Jan. - 15, Mar. 91
"	Mr. Hiroshi ITO	15, Jan. - 15, Mar. 91
"	Mr. Kazunori OBA	15, Jan. - 15, Mar. 91

1-4 Amount of the Survey Work (Plan and Results)

Work in the first year are shown in the following Table:

Item		Original Plan	Results
Aerial Photography	Coverage	9,000 SQ/Km	9,000 SQ/Km
	Scale	1: 50,000	1: 50,000
	Courses	16 Lines	16 Lines
	Sheets	468 sheets	536 sheets
Ground Control survey		17 points	20 points
Leveling (ordinary)		200 Km	200 Km
Pricking	Control Points	35 points	36 points
	Leveling	760 Km	760 Km

1-5 Supervision of the Field Work

During the first year field work, the following advisors were sent to Nepal by JICA for technical meeting with SD and supervision of the field work.

Mr. Mitsuo IWASE staff, National Large Scale Mapping division, Topographic Department, Geographical Survey Institue, Ministry o Construction.

24 October, 1990 - 6 November, 1990
19 February, 1991 - 28 February, 1991

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

24 October, 1990 - 6 November, 1990
19 February, 1991 - 28 February, 1991

1-6 Co-operation of Counterparts of SD.

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

2. Field Work

2-1. Aerial Photography

(1) Base for aerail Photograph

Kathmandu Airport was used for the base for the aerial photography. In the flight, the security officers of RNA were accompanied at the time of aerial photography.

(2) Aircraft and Camera

The Team Chartered UNDP/ICAO Air Transport Project aircraft Twin Otter N9 - ABS for all aeril photography.

The team brought the aerial camera Wild RC-10 from Japan. Details of camera are as follows:

Camera Type	: Wild RC-10 NO. 3293
Lens number	: UAG 11 3135, F = 153.79 mm
Magazine number	: No. 3387, 3388

(3) Photographic work

Test flights were made on November 7, 1990 and full-scale aerial photography was commenced from November 8, 1990.

(4) Materials of Aerial Film

The Team use Kodak films for aerial photography and details are as follows:

Film Type	: Kodak DX 2405
Emulsion number	: No. 716-21

2-2 Photo Processing

(1) Development

The Team used SD'S laboratory and instrument at Baneshwor
The instruments and materials were as follows:

Developer	: Fuji
Paper	: Fuji
Film development	: Zeiss FE - 120
Contact printer	: Zeiss KG - 30

(2) Printing and inspection

After printing and inspection of the aerial photos, reflight was made, in case of necessity.
Items to be inspected were as follows:

1) Overlap and side lap
2) Cloud, cloud shadow, uneven development
3) Deviation of flight cource
4) Halation
5) Smoke of field fire

(3) Amount of work

Film roll	4 rolls
Flight Lines	16 lines
Photographs	536 photos
2 - times enlargement	1 set
4 - times enlargement	1 set

Number of photographs per strip is shown in Table - 1.

2 - 3 Ground Control Survey

(1) Control point survey by GPS

In planning stage, 17 new points were selected on 1: 50,000 topographic map. In the implementing stage, however, 3 more points were added, considering the topographic features on the project area, and total 20 points were newly established and observed.

Therefore, new control points were connected with 6 existing points on the first order network by the SD.

Besides, 1 existing second order point applied only for for pricking was observed for examing the existing survey result, according to the request of the SD.

The observation network including above point is shown in Fig. 2.

(2) GPS observation

GPS observation were carried out by the using differential positioning system, and those observations were carried out simutaneously at 3 points. Time zone of observation were selected when GPS receiver can receive more than 4 sattelites.

(3) Rough computaiton

1) Closing error by WGS - 84

Computation method was carried out by the traversing of circuit at GPS observation area.

Closing Error was obtained the following rough results.

Total distance	ΣS =	Approx. 430 Km
Closing Error	ΔX =	- 0.482 m
	ΔY =	+ 0.156 m
	ΔZ =	+ 0.403 m
	ΔS =	0.647 m

2) Closing error of existing points

For the accuracy confirmation of existing first order triangulation points, computation were carried out by the transformation from coordinates(λ, ϕ, H of WGS-84). Computation for closing error was carried out by fixing of the JN.C (098-1), and it result is shown in table-2 and Fig 3;

Table - 2 Closing error

Point No	X (m)	Y (m)	Error (m)	Remarks
JN.A 097-1	- 0.180	- 0.366	0.408	
JN.B 103-1	-	-	-	change to new point
JN.C 098-1	0.000	0.000	0.000	
JN.D 104-1	- 0.077	+ 0.267	0.278	
JN.E 099-3	± 0.000	+ 0.033	0.033	
JN.F 105-1	- 0.279	- 0.483	0.558	
JN.G 100-1	- 0.075	+ 0.051	0.091	

(4) Adjustment and computation

The Study Team carried out adjustment and computation of existing 2nd order triangulation points in Lumnibi Zone.

(5) Main equipments

Trimble 4000 SL	3 pcs
Toshiba J 3100 SGT	1 pc
WILD T 2	1 pc
YHP 3808 A	1 pc
Topcon GUPY GTS-10	1 pc

2-4 Leveling

(1) Ordinary leveling

Ordinary leveling was carried out covering about 200 km at the flat part of Project area. Observation was carried out at the error of closure less than 60 mm s with the following results as per table 3.

Ordinary leveling routes are shown in Fig 4.

(2) Main equipments

Nikon AE 6 pcs

(3) Indirect leveling

Indirect leveling (EDM distance and vertical angle) was carried out along the side of Tansen-Tamghas Road and Gorusinge-Thada Road.
The second order Triangulation Points JN.0 (No.099-19) was also connected.

2-5 Pricking of Existing Triangulation Points.

Pricking of 36 points of existing triangulation and newly established GPS points was carried out on the 4-times enlargements of aerial photos, and point description cards were also prepared on the newly estabalished 20 GPS points. Preparation of the description cards was made according to the from shown in the Fig 5.

(2) Pricking of bench marks and spot heights

Pricking of existing bench marks and spot heights was conducted on the 2-times enlargements of aerial photos along the leveling Routes.

Routes of pricked leveling are shown in Fig 4.

TABLE - 1 NUMBER OF AERIAL PHOTOGRAPHS PER STRIP

LINE NO.	COUNTER NO.	ROLL NO.	PHOTO NO.	NUMBER
1	219 ~ 237	9011	1 ~ 19	19
2	01~20, 33~46	9012	1~20, 33~46	34
3	97~113, 122~142	9011	1~17, 26~46	38
4	02 ~ 44	9011	1 ~ 43	43
5	51 ~ 94	9011	1 ~ 44	44
6	178 ~ 215	9011	1 ~ 38	38
7A	145 ~ 163	9011	1 ~ 19	19
7B	92 ~ 113	9012	1 ~ 22	22
8A	114 ~ 145	9012	1 ~ 32	32
8B	165 ~ 174	9011	1 ~ 10	10
9A	50 ~ 63	9013	1 ~ 14	14
9B	48 ~ 72	9012	1 ~ 25	25
10A	74 ~ 91	9012	1 ~ 18	18
10B	34 ~ 49	9013	1 ~ 16	16
10C	02 ~ 07	9010	1 ~ 6	6
11	01 ~ 32	9013	1 ~ 32	32
12	147 ~ 177	9012	1 ~ 31	31
13	09 ~ 42	9010	1 ~ 34	34
14	85 ~ 109	9013	1 ~ 25	25
15	66 ~ 83	9013	1 ~ 18	18
16	44 ~ 61	9010	1 ~ 18	18
TOTAL		4		536

Closing Error of Ordinary leveling

TABLE - 3

NUMBER OF ROUTE	DISTANCE (KM)	ERROR OF CLOSURE (MM)	LIMIT OF ERROR (MM)	REMARKS
A - 1	1.307	-		BOTH WAY
A - 2	30.69	18	332	CLOSURE
A - 3	1.150	-		BOTH WAY
A - 4	1.340	-		BOTH WAY
A - 5	36.280	1	361	CLOSURE
A - 6	0.050	-		BOTH WAY
A - 7	9.740	-		BOTH WAY
A - 8	1.012	-		BOTH WAY
B - 1	28.265	32	318	CLOSURE
B - 2	21.215	-		BOTH WAY
B - 3	5.735	-		BOTH WAY
B - 4	0.758	-		BOTH WAY
B - 5	3.012	-		BOTH WAY
B - 6	0.901	-		BOTH WAY
B - 7	0.785	-		BOTH WAY
C - 1	12.255	51	210	CLOSURE
C - 2	21.606	21	278	CLOSURE
C - 3	11.816	-		BOTH WAY
C - 4	4.298	-		BOTH WAY
C - 5	26.310	84	307	CLOSURE
C - 6	3.150	-		BOTH WAY
C - 7	1.690	-		BOTH WAY
C - 8	0.251	-		BOTH WAY
C - 9	3.214	-		BOTH WAY

Fig.1
Photo index map

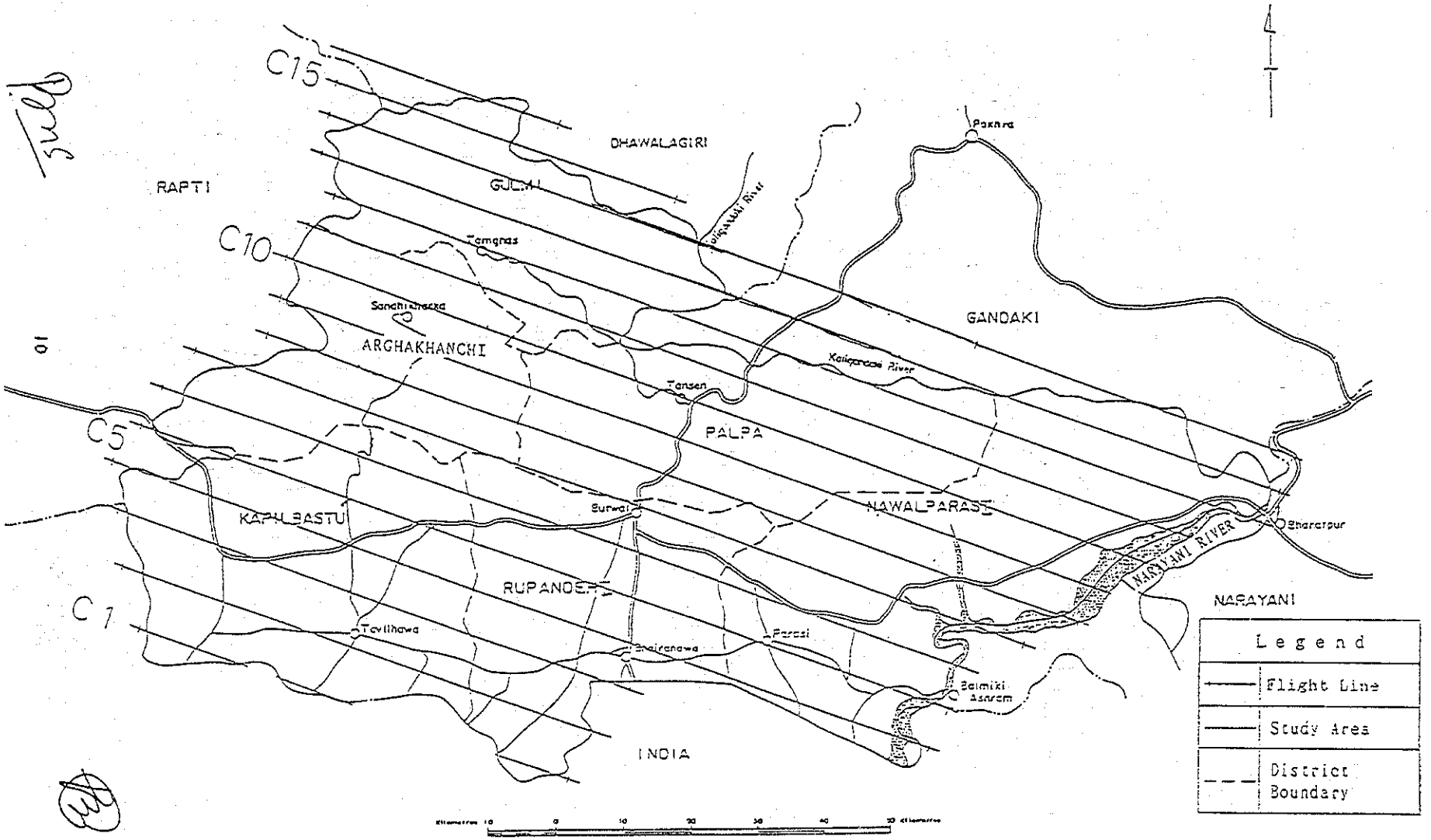


Fig.2.Ground Control Survey

Legend		Qty
△	1st Order Triangulation Points	6
▽	2nd Order Triangulation Points	10
○	New Ground Control Points (GPS)	20

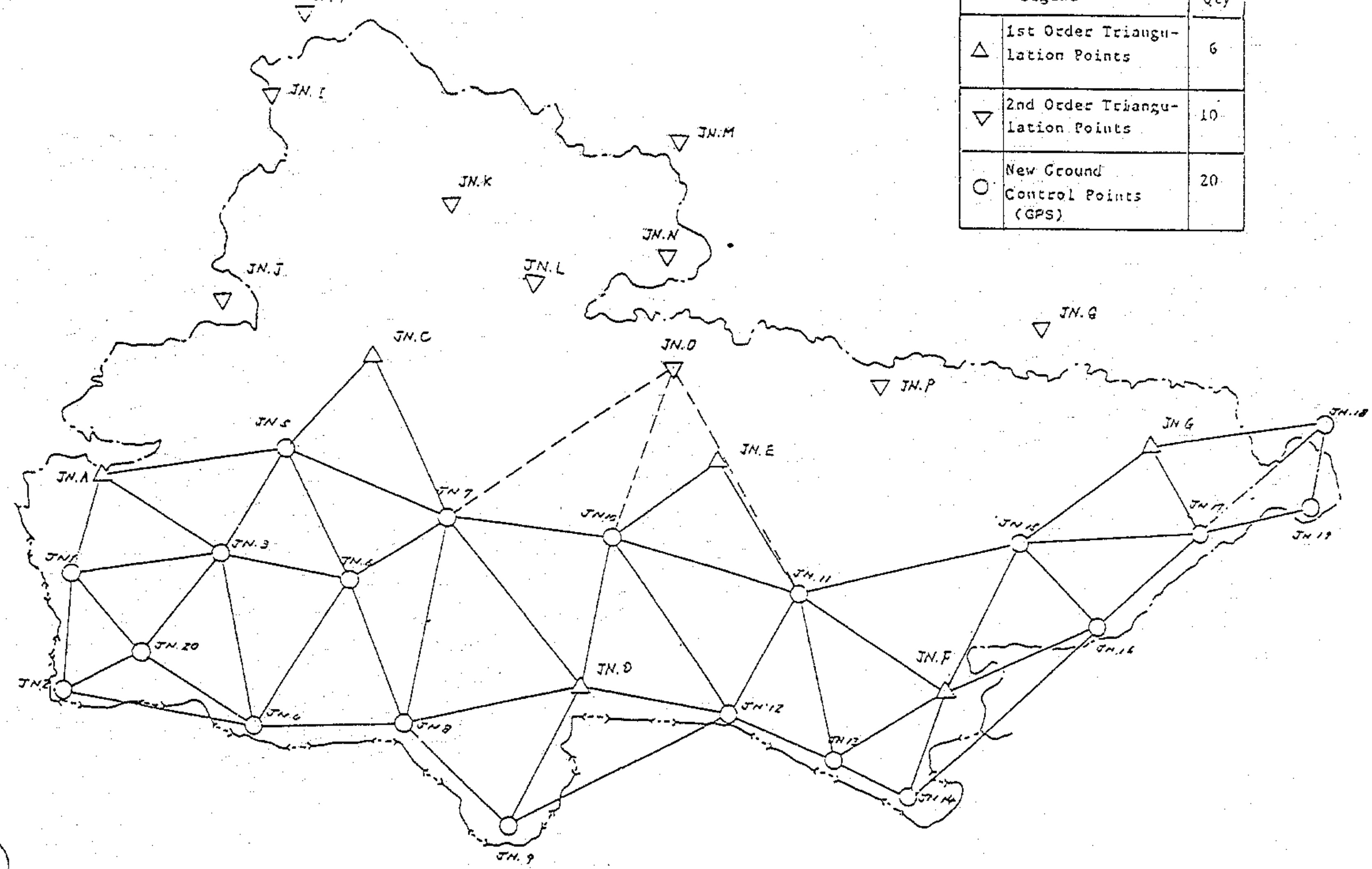
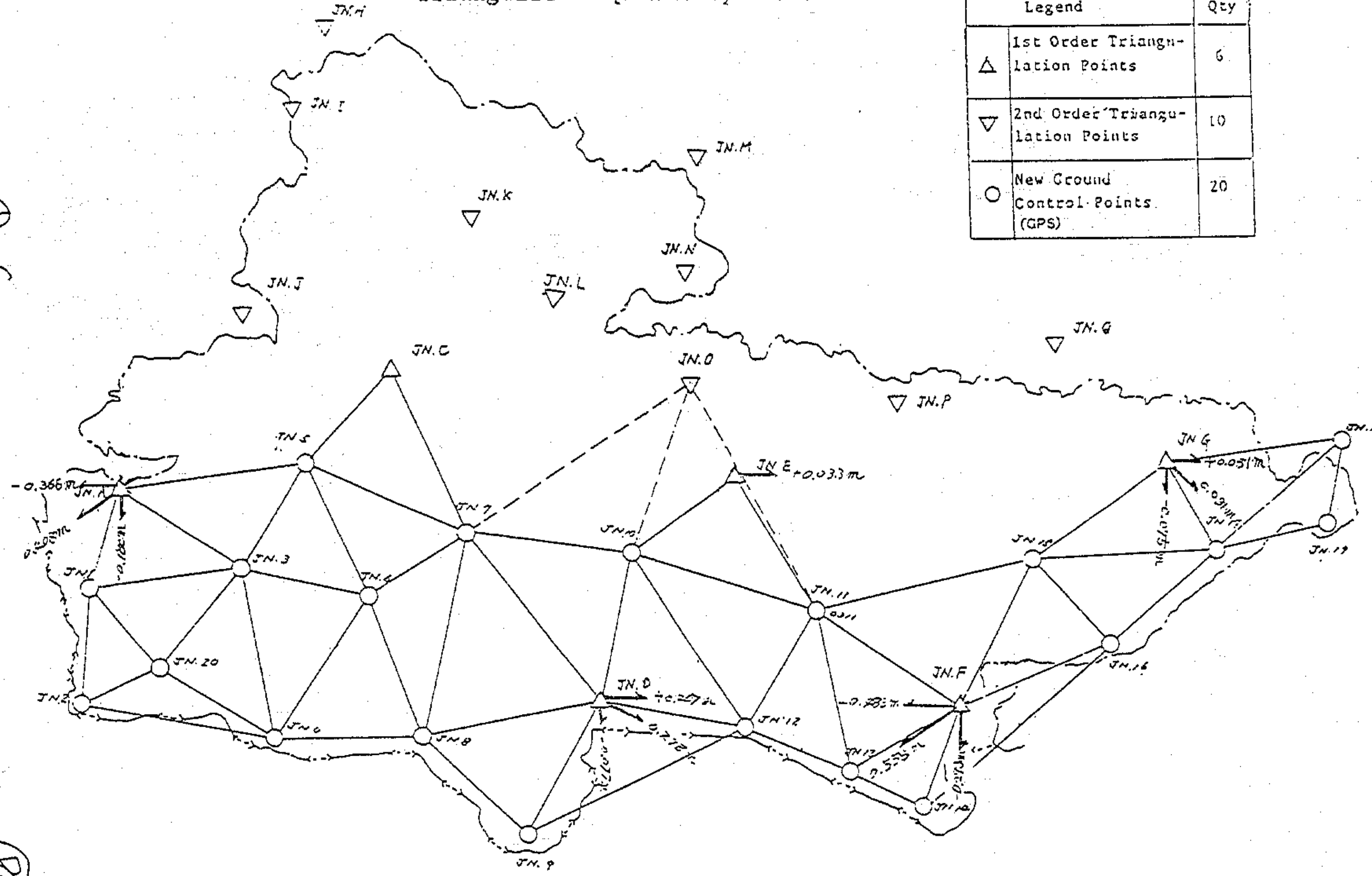
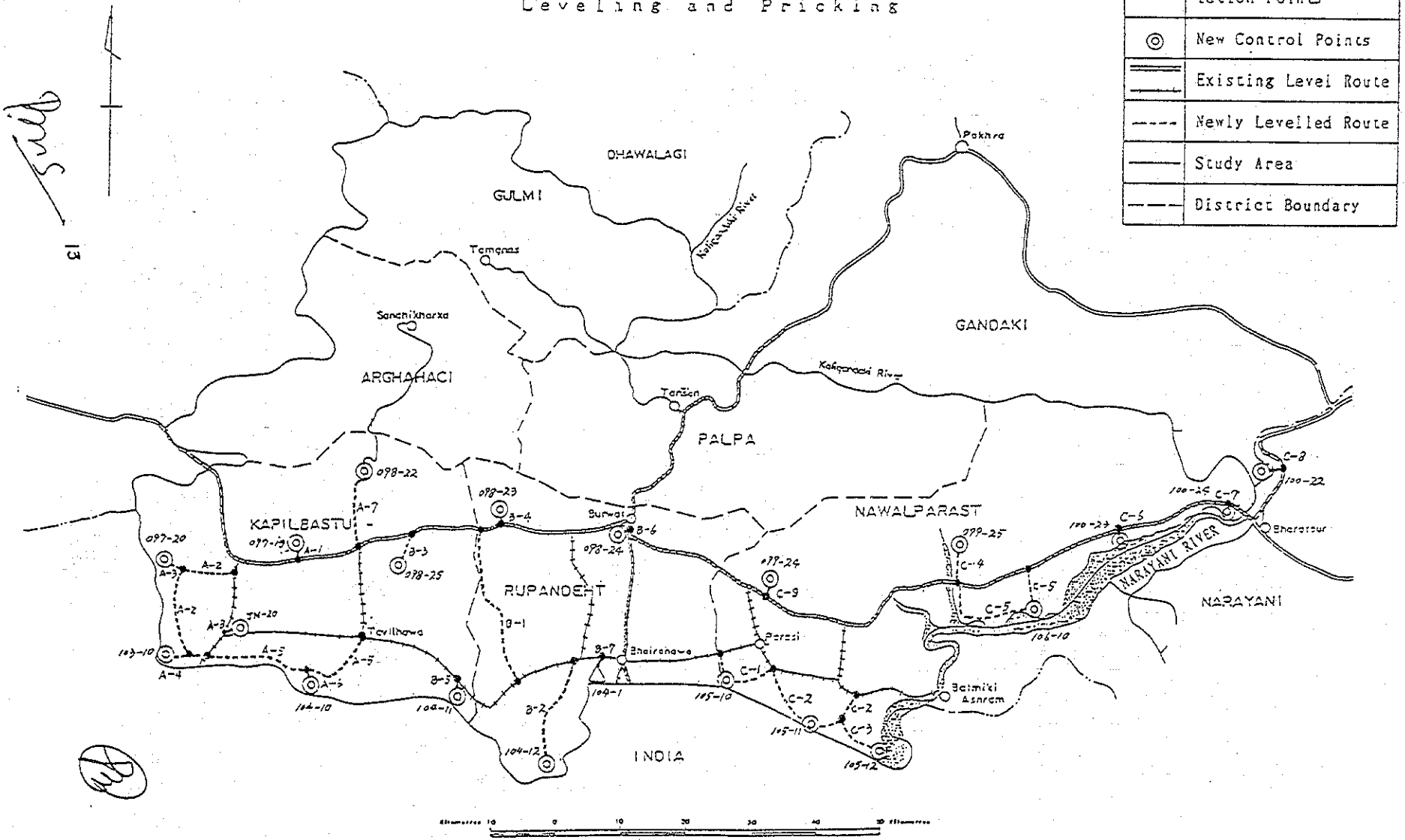


Fig.3. Shifting of First order Triangulation points by WGS-84



	Legend	Qty
△	1st Order Triangu-lation Points	6
▽	2nd Order Triangu-lation Points	10
○	New Ground Control Points (GPS)	20

Fig. 4
Leveling and Pricking



Appendix 3

Computation Result of 2nd Order Triangulation Points 1

St. No	Latitude (B) Longitude (L)	North (N) East(E)	Elevation	Remark
	d m s	m	m	
091 - 10	28 11 22.1927 82 56 12.2473	3,119,323.947 396,620.678	2,228.970	Elevation is result from S.D.
091 - 11	28 5 4.3111 82 53 40.5938	3,107,729.377 391,379.106	1,663.440	"
091 - 13	28 2 16.0012 82 48 41.0456	3,102,625.683 383,151.512	1,479.463	"
091 - 14	28 6 43.5298 82 40 26.2859	3,111,000.171 369,729.178	2,079.860	"
091 -16	28 11 18.9094 82 47 43.0038	3,119,352.744 381,731.993	2,441.311	"
091 -18	28 16 36.6933 82 53 26.4968	3,129,045.197 391,189.179	2,655.328	"
092 - 10	28 11 29.7791 83 2 21.8442	3,119,473.361 405,701.650	2,389.932	"
092 - 11	28 7 22.7847 83 8 22.3588	3,111,797.117 415,478.859	1,691.143	"
092 - 12	28 5 11.5031 83 1 2.8585	3,107,847.177 403,453.547	2,014.725	"
092 - 13	28 3 44.0051 83 16 11.4182	3,104,979.565 428,237.460	2,327.203	"
092 - 14	28 1 46.3376 83 8 41.3628	3,101,437.822 416,924.666	1,917.356	"
092 - 15	28 17 41.4249 83 4 58.4187	3,130,879.711 410,058.050	3,039.156	"
092 - 16	28 19 25.0972 83 14 13.6865	3,133,965.618 425,205.398	3,127.297	"
092 - 17	28 12 53.3297 83 10 48.7121	3,121,943.568 419,541.087	2,222.903	"

Computation Result of 2nd Order Triangulation Points 2

St. No	Latitude (B) Longitude(L)	North (N) East (E)	Elevation	Remark
	d m s	m	m	Elevation is result from S.D.
092 - 18	28 9 34.5424 83 21 10.2244	3,115,722.525 436,452.754	2,446.930	
092 - 19	28 10 23.1938 83 27 0.4943	3,117,172.848 446,013.722	2,759.642	"
092 - 20	28 3 18.4907 83 28 59.4502	3,104,086.936 449,202.446	2,570.383	"
092 - 22	28 19 54.7200 83 20 6.3261	3,134,820.621 434,814.655	3,455.379	"
092 - 23	28 19 48.1905 83 26 40.3875	3,134,565.406 445,545.147	3,042.690	"
093 - 14	28 18 2.3534 83 32 14.4039	3,131,269.484 454,628.960	2,673.976	"
093 - 16	28 13 21.3393 83 36 55.6985	3,122,593.384 462,264.044	2,129.228	"
093 - 17	28 13 47.2198 83 47 50.6686	3,123,346.680 480,119.872	2,508.800	"
093 - 18	28 8 6.6159 83 34 7.6184	3,112,922.125 457,647.720	2,206.238	"
093 - 19	28 6 30.8748 83 39 25.4390	3,109,947.785 466,310.296	2,264.024	"
093 - 21	28 9 38.2376 83 56 1.7045	3,115,668.655 493,500.361	1,533.800	"
093 - 22	28 3 39.4710 83 51 3.6927	3,104,633.856 485,358.392	1,720.340	"
094 - 14	28 4 38.8333 84 25 27.0404	3,106,524.542 541,683.215	1,103.979	"
094 - 15	28 12 46.6563 84 5 18.6982	3,121,469.166 508,688.434	1,418.840	"

Computation Result of 2nd Order Triangulation Points 3

St. No	Latitudfe (B) Longitude (L)	North (N) East (E)	Elevation	Remark
	d m s	m	m	Elevation is result from S.D.
094 - 16	28 6 24.8460 84 20 46.0230	3,109,763.086 534,003.018	1,648.195	
094 - 17	28 4 7.5703 84 1 6.7782	3,105,489.863 501,822.963	1,278.730	"
094 - 18	28 2 16.2125 84 20 23.2037	3,102,108.979 533,401.650		
094 - 19	28 11 54.6259 84 14 57.6369	3,119,889.794 524,474.945	1,514.660	Elevation is result from S.D.
095 - 27	28 10 21.2097 84 30 39.6354	3,117,095.106 550,171.850	1,831.898	"
097 - 10	28 0 20.1375 82 52 17.9333	3,099,003.030 389,041.663	1,710.864	"
097 - 11	27 58 27.0970 82 44 52.8660	3,095,642.113 376,847.595	1,809.286	"
097 - 12	27 57 27.7222 82 58 9.8458	3,093,611.056 398,610.229	1,645.466	"
097 - 13	27 52 11.9497 82 54 9.3369	3,083,948.832 391,950.086	989.990	"
097 - 14	27 50 11.1190 82 47 51.0840	3,080,326.705 381,567.642	664.293	"
097 - 15	27 47 38.9713 82 53 40.8344	3,075,553.662 391,094.807	1,078.920	"
097 - 16	27 47 34.7184 82 58 10.0420	3,075,358.715 398,462.082	1,281.590	"
097 - 17	28 0 7.7000 82 43 19.2296	3,098,765.316 374,321.270	1,745.852	"
098 - 10	27 54 21.3913 83 5 8.1903	3,087,784.987 410,000.305	2,057.181	"

Computation Result of 2nd Order Triangulation Points 4

St. No	Latitude (B) Longitude(L)	North (N) East (E)	Elevation	Remark
	d m s	m	m	Elevation
098 - 11	27 58 49.8469	3,095,888.091	1,198.609	is result from
	83 20 13.2474	434,790.558		S.D.
098 - 12	27 57 26.5395	3,093,254.361	1,275.563	"
	83 29 1.8003	449,220.785		
098 - 13	27 51 5.2090	3,081,601.010	1,945.400	"
	83 18 43.6071	432,261.006		
098 - 14	27 54 12.6693	3,087,335.886	1,687.507	"
	83 22 41.1802	438,788.993		
098 - 15	27 47 58.3616	3,075,896.348	1,098.742	"
	83 13 59.3791	424,450.087		
098 - 16	27 49 51.0631	3,079,256,339	1,893.357	"
	83 26 12.7319	444,536.095		
098 - 17	27 45 49.8319	3,071,873.670	1,128.893	"
	83 21 3.4688	436,035.568		
098 - 18	27 44 5.1953	3,068,612.659	1,060.643	"
	83 26 3.9860	444,247.832		
098 - 19	27 59 46.0430	3,097,573.000	1,652.903	"
	83 25 36.4019	443,627.894		
098 - 20	27 48 47.2185	3,077,441.696	1,397.996	"
	83 10 5.6323	418.063.074		
098 - 21	27 49 50.1787	3,079,470.236	1,493.247	"
	83 2 30.8830	405,633.968		
099 - 10	28 0 8.0500	3,098,197.782	2,076.520	"
	83 33 17.4483	456,225.110		
099 - 11	27 57 20.2682	3,092,975.734	1,595.920	"
	83 46 5.6330	477,198.941		
099 - 12	27 52 19.9917	3,083,793.609	1,491.850	"
	83 33 3.1214	455,780.848		

St. No	Latitude (B) Longitude(L)	North (N) East (E)	Elevation	Remark
	d m s	m	m	Elevation is result from S.D.
099 - 13	27 51 56.5354 83 41 8.3098	3,083,030.366 469,048.248	1,775.630	
099 - 14	27 50 51.5645 83 49 37.7619	3,081,003.096 482,978,990	1,307.038	"
099 - 15	27 45 27.7605 83 45 34.7742	3,071,048.768 476,312.665	1,778.610	"
099 - 16	27 40 21.4553 83 40 32.8199	3,061,640.843 468,021.194	1,029.800	"
099 - 17	27 38 27.0104 83 45 4.7471	3,058,101,412 475,464.484	1,180.810	"
099 - 18	27 45 14.0420 83 51 16.0998	3,070,611.912 485,656.672	1,420.697	"
099 - 19	27 34 46.6296 83 54 8.6268	3,051,298.203 490,364.843	299.720	"
099 - 20	27 59 41.8612 83 57 55.8742	3,097,312.404 496,609.203	1,527.025	"
099 - 21	28 0 50.7586 83 39 56.8081	3,099,477.409 467,137.601	1,819.510	"
099 - 22	27 55 25.8574 83 54 50.0153	3,089,435.893 491,526.464	1,461.420	"
099 - 23	27 41 19.9345 83 58 43.4479	3,063,398.741 497,902.916	972.480	"
100 - 10	27 54 30.7847 84 2 33.6967	3,087,738.683 504,201.941	951.710	"
100 - 11	27 46 14.3909 84 0 34.2857	3,072,460.765 500,938.529	1,796.850	"
100 - 12	27 56 6.0890 84 9 56.8052	3,090,682.165 516,312.203	1,241.652	"

Computation Result of 2nd Order Triangulation Points 6

St. No	Latitude (B) Longitude(L)	North (N) East (E)	Elevation	Remark
	d m s	m	m	
100 - 13	27 51 47.4952 84 18 2.0294	3,082,748.730 529,594.201	1,222.566	Elevation is result from S.D.
100 - 14	27 50 13.5923 84 5 56.6957	3,079,826.394 509,758.170	881.790	"
100 - 20	27 52 47.5496 84 29 51.4111	3,084,660.200 548,988.967		
100 - 21	27 56 33.0314 84 23 2.0118	3,091,559.608 537,771.421		
100 - 16	27 48 41.9156 84 21 50.2570	3,077,054.110 535,853.361	1,630.608	Elevation is result from S.D.
100 - 17	27 43 33.0327 84 16 23.6371	3,067,521.112 525,291.091	829.927	"
100 - 18	27 41 50.6984 84 4 59.1157	3,064,348.107 508,193.401	645.440	"
100 - 19	27 48 3.9609 84 27 40.1293	3,075,918.149 545,431.621	940.521	"
101 - 15	28 0 12.9304 84 38 12.4496	3,098,431.537 562,619.551	1,521.530	"
101 - 18	27 55 15.8564 84 36 7.8099	3,089,270.932 559,259.934	1,712.760	"
101 - 25	28 0 39.4617 84 31 11.5701	3,099,193.625 551,119.313		

MINUTES OF DISCUSSION

FOR

THE STUDY OF TOPOGRAPHIC MAPPING OF LUMBINI ZONE

IN NEPAL

BETWEEN

HMG SURVEY DEPARTMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

SEPTEMBER 20, 1991

KATHMANDU

B.N. Shrestha

BUDDHI N. SHRESTHA
Director General
HMG SURVEY DEPARTMENT
NEPAL

松田博幸

HIROYUKI MATSUDA
Leader of Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY
JAPAN (JICA)

The Japanese Study Team of the Japan International Cooperation Agency (JICA), headed by Mr.Hiroyuki MATSUDA, visited Nepal on the 12th, Sept. 1991 to carry out the second year work for the Study on Topographic Mapping of Lumbini Zone in Nepal.

Prior to the commencement of the second phase survey works, a series of meetings were held from the 13th to the 20th Sept. 1991 and agreed upon by the HMG Survey Deparment (SD) and JICA Study Team.

(1)
The Plan fo Operation proposed by JICA Study Team was discussed and agreed as Appendix 1.

(2)
The Study Team submitted to the SD the Map Specification and Symbols for 1:25,000 scale, Topographic Map Sheets Index, List of Sheet Number, Sheet Name and others.
It was agreeded that both sides shall discuss and agree the Map Specification and Symbols and other by Nov. 25th, 1991.

The list of attendants at the meeting

NEPALESE SIDE

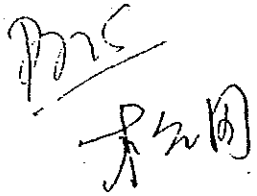
(SURVEY DEPARTMENT)

1. Mr. BUDDHI N.SHRESTHA	DIRECTOR GENERAL
2. Mr. RAM N.SINGH	DEPUTY DIRECTOR GENERAL
3. Mr. PUNYA P.OLI	PROJECT DIRECTOR
4. Mr. RAJA RAM CHHATKULI	SENIOR SURVEY OFFICER

JAPANESE SIDE

(JAPANESE STUDY TEAM)

1. Mr. HIROYUKI MATSUDA	LEADER
2. Mr. TAKEHIKO HIRANO	DEPUTY LEADER
3. Mr. MAMORU MURATA	MAPPING PLANNER
4. Mr. TOMOHARU YOKOTA	CHIEF SURVEYOR



Appendix 1

PLAN OF OPERATION

FOR

THE STUDY OF TOPOGRAPHIC MAPPING OF LUMBINI ZONE IN NEPAL

(SECOND YEAR WORKS)

September, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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Figure 2 Tentative Working Schedule
Figure 3 Flowchart for the Producton of Topographic Maps

Table List of Members and Assignments

Plan of Operation
for
The Study of Topographic Mapping of Lumbini Zone in Nepal

1. Background

Topographic Mapping of Lumbini Zone was set forth upon in the agreement on Technical Cooperation between the HM Government of Nepal and the Government of Japan signed on February 28, 1990, for 38 months.
The second year works consist of aerial triangulation, field identification, stereo plotting and compilation. The aerial triangulation was already carried out in Japan.

2. Outline of the second year works

The following works shall be completed during the second year

(1) Aerial triangulation	501 models,	in Japan
(2) Field identification	9,000 sq.km,	in Nepal
(3) Stereo Plotting	3,500 sq.km,	in Japan
(4) Compilation	3,500 sq.km,	in Japan
(5) Disucussion of map symbols etc.		in Nepal

All of the above works shall be carried out by the end of March 1992.

3. Works to be carried out during the second year (Phase 2)

3-1 Volume of works in the second year

(1) Aerial triangulation 501 models
Aerial triangulation was carried out in July by analytical block adjustment method, in Japan.

(2) Field identification 9,000 sq.km
The topographic features, land use, vegetation and other information necessary for terrain representation shall be identified in the field using aerial photographs. Administrative boundaries and geographical names, etc., shall also be collected.

(3) Stereo plotting 3,500 sq.km
Stereo plotting shall be carried out at a scale of 1/25.000 with stereo plotters in Japan. The UTM (3 degree zone) shall be applied for the projection. Height control points shall be used as check points in a model.

(4) Compilation 3,500 sq.km
Map compilation shall be executed in accordance with