

JAPAN INTERNATIONAL COOPERATION AGENCY
DEPARTMENT OF SOIL CONSERVATION
MINISTRY OF FOREST AND SOIL CONSERVATION
HIS MAJESTY'S GOVERNMENT OF NEPAL



**THE STUDY ON THE DISASTER PREVENTION PLAN
FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL**

**FINAL REPORT
VOLUME II
MAIN REPORT**

JICA LIBRARY



J 1133851 (4)

MARCH 1997

NIPPON KOEI CO., LTD., TOKYO, JAPAN
INA CORPORATION, TOKYO, JAPAN

S S S

J R

97-035

JAPAN INTERNATIONAL COOPERATION AGENCY
DEPARTMENT OF SOIL CONSERVATION
MINISTRY OF FOREST AND SOIL CONSERVATION
HIS MAJESTY'S GOVERNMENT OF NEPAL

**THE STUDY ON THE DISASTER PREVENTION PLAN
FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL**

FINAL REPORT
VOLUME II
MAIN REPORT

MARCH 1997

NIPPON KOEI CO., LTD., TOKYO, JAPAN
INA CORPORATION, TOKYO, JAPAN

**The Study
on The Disaster Prevention Plan
for Severely Affected Areas by 1993 Disaster
in The Central Development Region of Nepal**

Composition of Reports

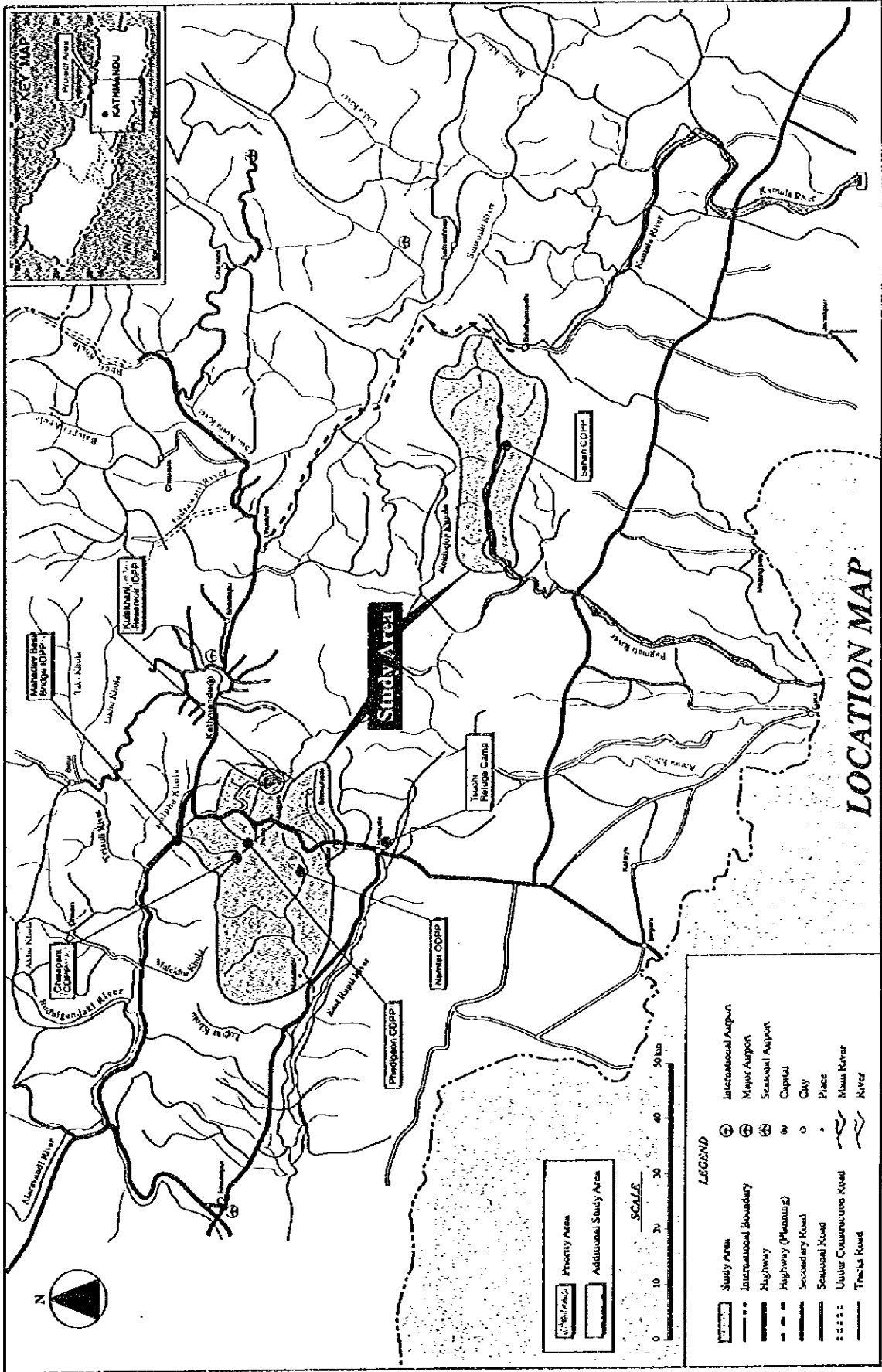
- Volume I : Executive Summary**
- Volume II : Main Report**
- Volume III : Supporting Report - I**
Annex-1 : Disaster Analysis
Annex-2 : Disaster Prevention Plan
Annex-3 : Hydrology
- Volume IV : Supporting Report - II**
Annex-4 : Preliminary Design for Disaster Prevention Measures
Annex-5 : Community Disaster Evacuation System
- Volume V : Supporting Report - III**
Annex-6 : Participatory Community Development Plan
Annex-7 : Agriculture
- Volume VI : Supporting Report - IV**
Annex-8 : Community Forestry
Annex-9 : Preliminary Design for Community Infrastructures
Annex-10 : Environmental Studies
- Volume VII : Data Book - I**
1. Questionnaires and answers for Households Sampling
2. Minutes for Discussion with People
3. Report on Geological Investigation of Kulekhani Reservoir
4. Collected Meteo-hydrological Data
5. Material for Seminar
6. Manual for Mulberry Tree Plantation (Nepalese Version)
- Volume VIII : Data Book-II**
1. Topographic Maps Produced by the Study

Exchange Rate

The exchange rates used in this Study are:

NRs.55.75 = US\$1.00 = ¥109.1
as of June, 1996





LOCATION MAP

LEGEND

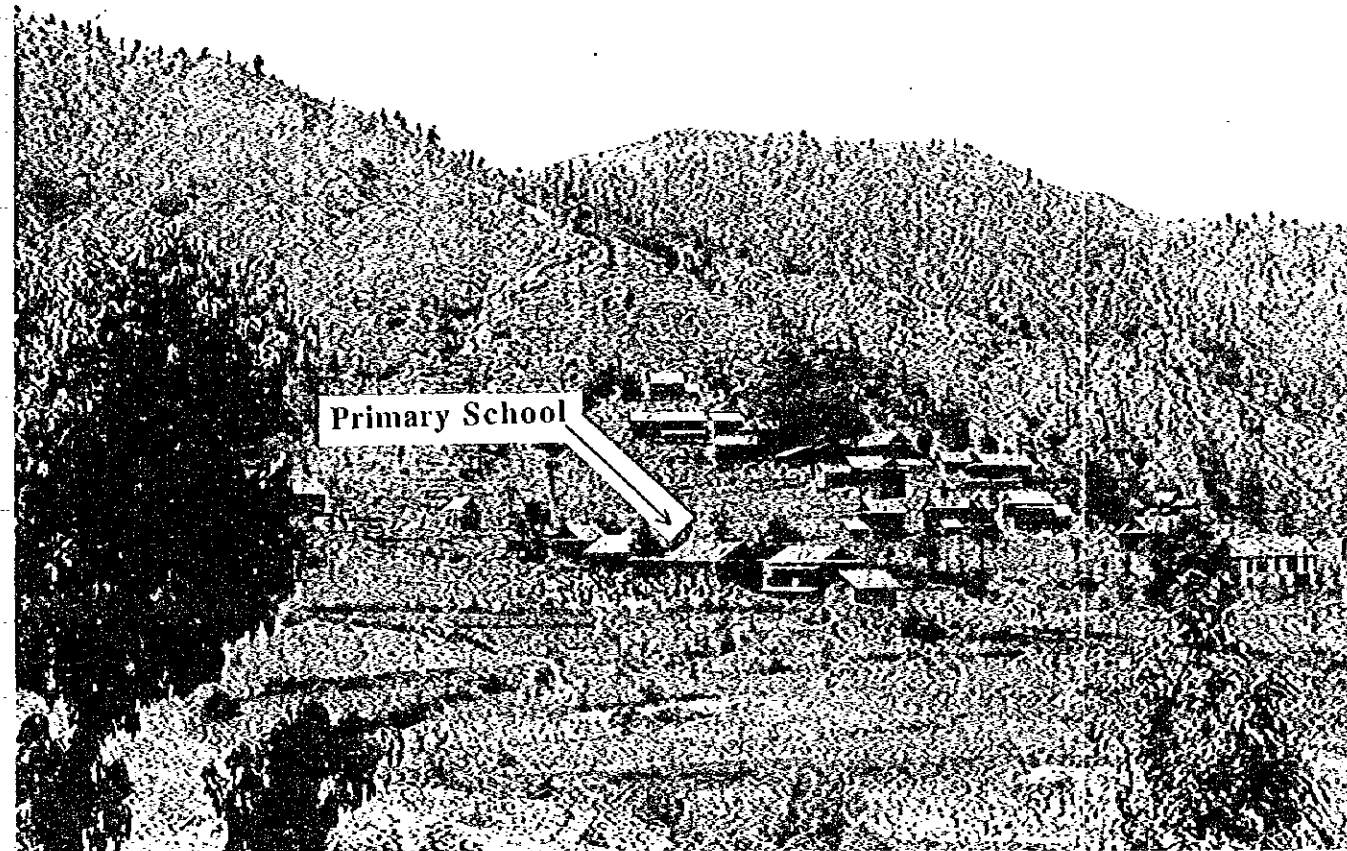
	Study Area		International Airport
	International Boundary		Major Airport
	Highway		Seasonal Airport
	Highway (Planning)		Capital
	Secondary Road		City
	Seasonal Road		Place
	Under Construction Road		Major River
	Track Road		Minor River

SCALE

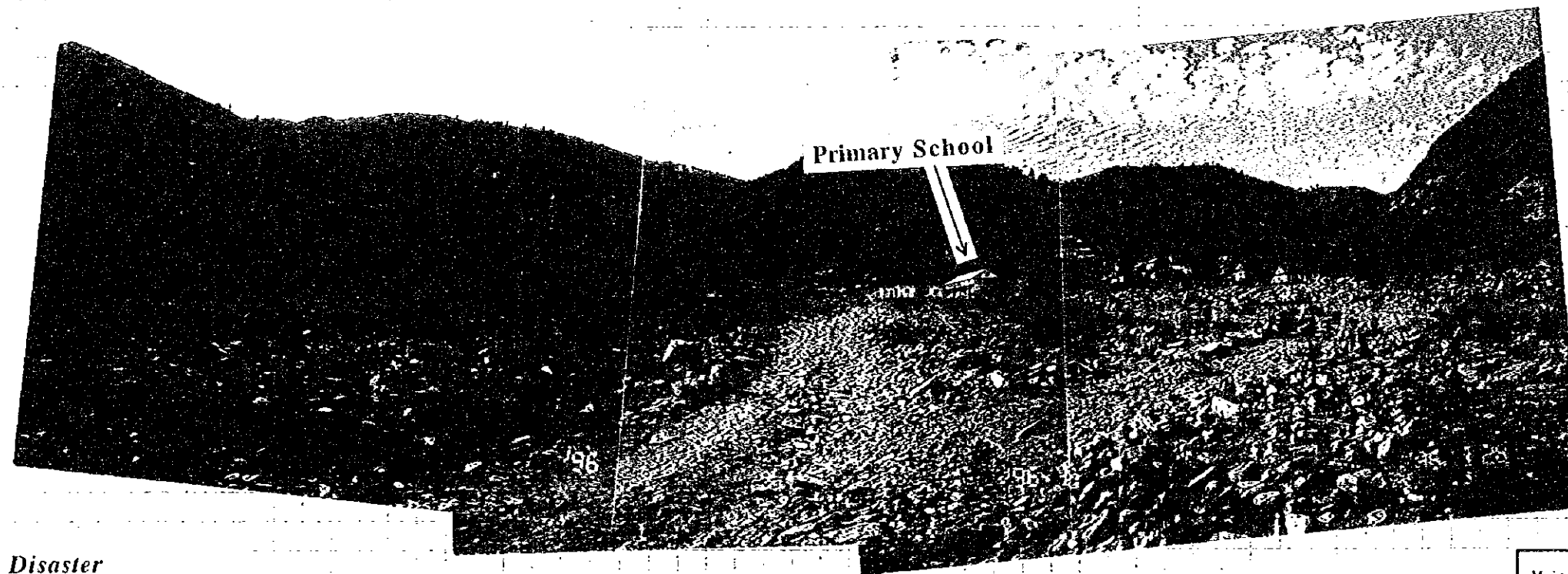
0 10 20 30 40 50 km

KEY MAP

KATHMANDU



*Before the Disaster
(Taken by a villager in 1991)*



*After the 1993 Disaster
(Taken by the Study Team in 1996)*

Photo 1
Contrast of Phedigaon Community before and after the 1993 Disaster

His Majesty's Government of Nepal
 Ministry of Forest and Soil Conservation/Department of Soil Conservation
 THE STUDY ON THE DISASTER PREVENTION PLAN
 FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
 IN THE CENTRAL DEVELOPMENT REGION OF NEPAL
 JAPAN INTERNATIONAL COOPERATION AGENCY



An Overview of Namtar Bazar before the 1993 Disaster (Date is unknown)



An Overview of Namtar Bazar after the 1993 Disaster (Sep. 1996)

Photo 2
Contrast of Namtar Community
before and after the 1993 Disaster

His Majesty's Government of Nepal
Ministry of Forest and Soil Conservation/Department of Soil Conservation
THE STUDY ON THE DISASTER PREVENTION PLAN
FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL
JAPAN INTERNATIONAL COOPERATION AGENCY

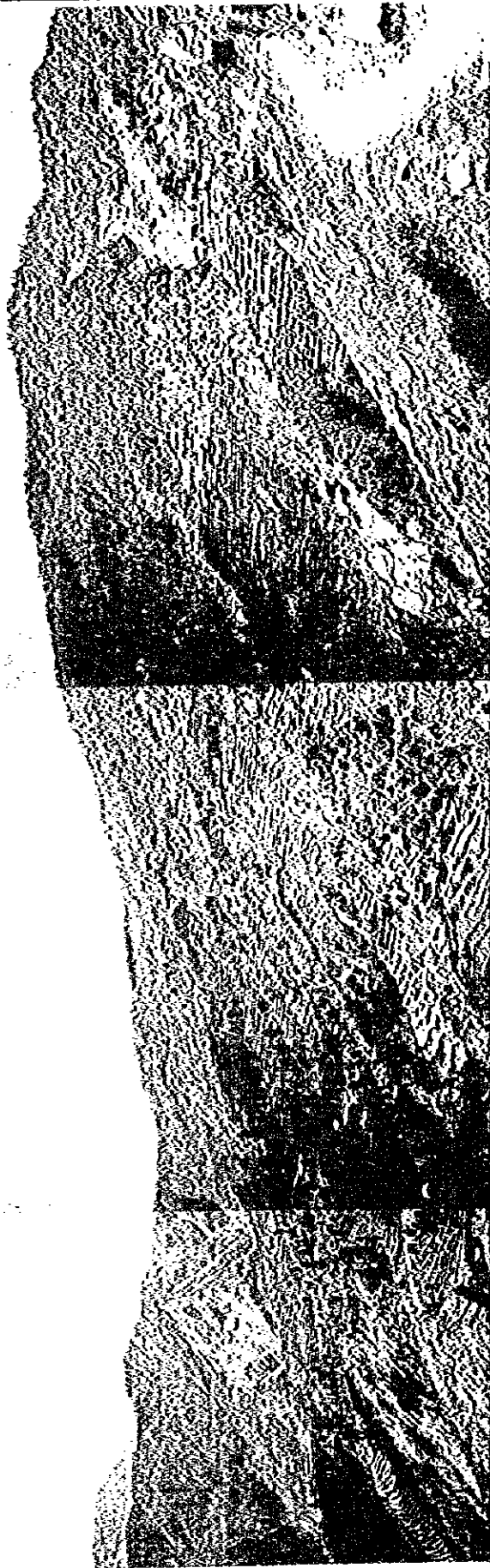
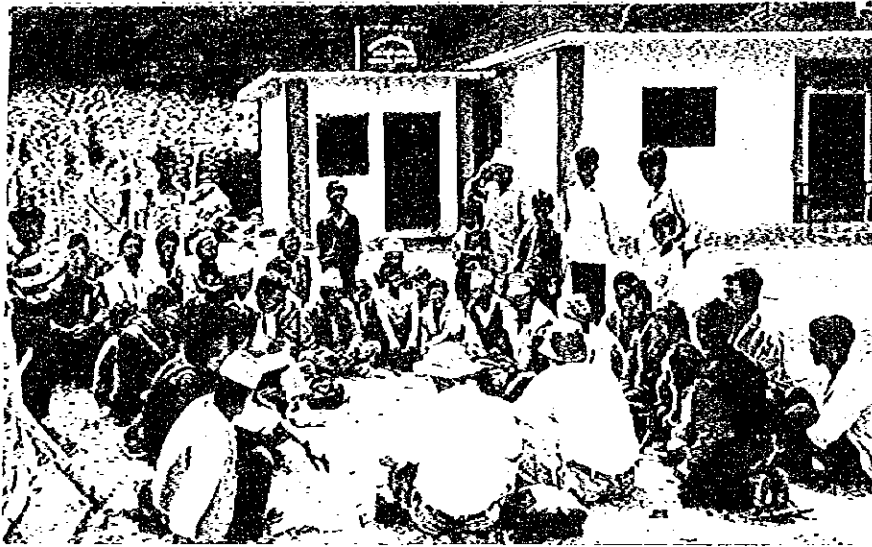


Photo 3
General View of Chisapani

His Majesty's Government of Nepal
Ministry of Forest and Soil Conservation/Department of Soil Conservation

THE STUDY ON THE DISASTER PREVENTION PLAN
FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL.

JAPAN INTERNATIONAL COOPERATION AGENCY



in Phedigaon



in Namtar



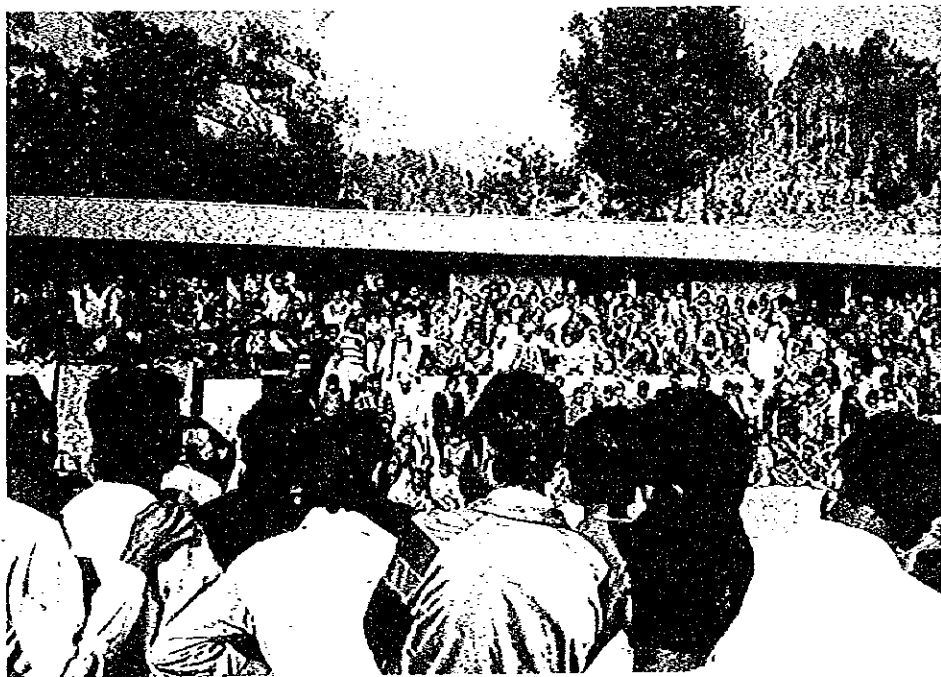
in Chisapani

Photo 4
Discussions on the Study Team's Plan

His Majesty's Government of Nepal
Ministry of Forest and Soil Conservation/Department of Soil Conservation
**THE STUDY ON THE DISASTER PREVENTION PLAN
FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL**
JAPAN INTERNATIONAL COOPERATION AGENCY



at Phedigaon (16 January, 1997)



at Namtar (17 January, 1997)

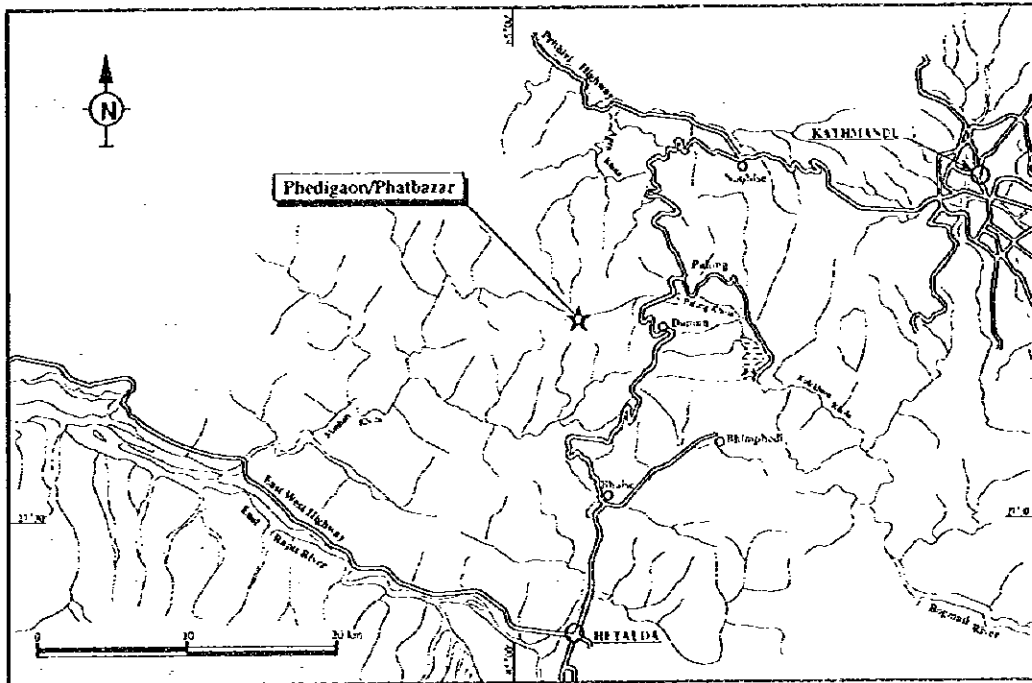
Photo 5
Seminar of Transfer Technology at Project Site

His Majesty's Government of Nepal
Ministry of Forest and Soil Conservation/Department of Soil Conservation
THE STUDY ON THE DISASTER PREVENTION PLAN
FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL
JAPAN INTERNATIONAL COOPERATION AGENCY

Listen to the Villagers' Voice

The disaster of July 1993 was unprecedentedly disastrous and brought about a massive destruction over the people's daily lives. Heavy rainstorm continued from July 19 to 20, 1993. In the night of July 19, a heavy debris flow suddenly occurred along Dhungakate Khola and Ghatte Khola in Palung VDC, and swallowed the centre of the Phedigaon village. The debris flow deprived 58 people of their lives instantly.

Before discussing the disaster prevention plans, let's listen to the voice of villagers who have lost their parents and three children in Phedigaon.....



(Location Map)

Shankar Basnet (32 years old) and
Uma Basnet (29 years old), living in
Ward No. 9 (Phedigaon), Palung VDC in Makwanpur District (*1)

Tribhuvan Highway, the oldest highway in Nepal, connects Kathmandu with Hetauda lying across the Mahabharat range. Within two-and-a-half-hour driving by car from Naubise which is the entrance gate to Kathmandu Valley, we can see a green basin with a gentle slope. This place, the Palung village in Makwanpur District, had become a big production spot for fresh vegetables such as cauliflower, cabbage, radish, and so on. Previously, UN organisations such as the FAO and the UNCDF, encouraged the village people to produce vegetables. Since then, so many cargoes loaded with fresh vegetable were collected and transported to Kathmandu and Pokhara every day. The farmland was covered with green colour throughout the year, and the traditional houses made of piled-up natural stones and slate roofs gave a clear impression of wealth.

The house of Mr. Shankar Basnet was located in Phedigaon in the Palung village. "Phedigaon" means a foot of a mountain in Nepali language, and his house was located on the southern side of Dadheyang⁽⁴²⁾ Khola where the whole area of Palung Valley could be seen. The soil of this area was very fertile. A villager said:

"We were able to produce even 5 kg of cauliflower from a single bunch."

However, the 1993 disaster has changed such a fertile land into a barren land, with the merciless debris produced from Dadheyang Khola and Dhungakate Khola⁽⁴³⁾.

While Shankar cultivated his own 0.85 ha of vegetable field and 0.12 ha of paddy field, he worked for the vegetable collection centre. In addition to his house for living, he also had a barn where he raised many livestock. His five children always helped their parents and worked hard in the field. His family had a peaceful time those days. His wife, Uma, said:

"One day before the flood, my mother-in-law said: 'When I was young, a fortune teller told me that my family would meet a misfortune before I became sixty years old'. She might recall this story because her sixtieth birthday will come in the next Margu (January/February). But nobody worried about her story because we were all doing fine. I think the misfortune she mentioned must be that disaster."

The debris flow attacked the village on July 19, 1993. That day, Shankar was working at the vegetable collecting centre as usual. A heavy rain started around three o'clock and did not stop in the evening, so he gave up to return to his home. During that period, landslides started to occur on the hills surrounding the Palung basin due to the heavy downpour and sediments flowed down to the village. The house of Shankar, located in the middle of a hill, was crushed and swallowed by the debris around ten o'clock in the night.

In his house, his parents, wife, and five children were shivering holding each other, gazing the heavy rainfall through the window of the room on the second floor. All of a sudden, the debris flow attacked the family and the house was crushed. At that moment, a big beam fell down on the head of the parents, then it hit Uma hard in the back. The parents tumbled down on Uma's knees, and died on the spot. As soon as Uma decided to get out of the house with her children to the barn nearby, all of them were pushed away together with the house. The bodies of died parents, five children, and herself were all washed away by the debris, and in the end, Uma's body was buried with only her head above the surface. She could hardly breathe under the soil pressure, and she had blood in her eyes. She lost her sight and became unconscious after a while.

The following morning she was rescued by her neighbours, but she hovered between life and death for the next two days.

In the evening of the second day from the disaster, the flow of water was tamed and Shankar was able to come back home. He had looked at his house from a height where he had taken refuge and thought that all his family members must have died. Shankar and Uma couldn't talk to each other. His parents and three children, as well as his house and barn, were all lost. His wife was in critical condition. His two children were alive, but injured. He couldn't even cry or shout over this accident which happened during his absence, he was just stupefied.

On the same day, Uma recovered consciousness and was informed that the first daughter, five years old, and the fourth son, three years old, were alive. The two children were washed away for about ten meters, then they were helped out by a neighbour. They stayed in the house of an elder sister of that neighbour for ten days and received a treatment.

"Even my first son, aged thirteen years, died. I wonder why such little children could be alive. I thought all my family members must have died."

Thanks to the efforts of the villagers, Shankar's parents and three children were found later under the debris. His first son was washed away for three kilometres down to the Palung village. Both his house and barn were washed away, his farmland was buried, and the irrigation system was destroyed. This flood killed fifty eight people in total in Phedigaon.

Uma, injured and weakened, was carried to Kathmandu on the third day together with other thirteen villagers by an army's helicopter. She was hospitalised for nine days. Her doctor diagnosed that she had no fracture in bones, but had received a pressure to her internal organs. The right side of Uma's back is still swollen up with an acute pain when she bends forward.

While her wife was in hospital, Shankar as the head of the family had to cremate his five family members. He carried five remains to the crematorium near Dadheyang Khola which robbed their lives, placed the driftwood carried by the flood, and laid them down on it. After Shankar set fire with a torch to the parents' bodies, he rushed out of the crematorium and prostrated himself to the ground and cried loudly.

"It was too sad to stay beside the bodies of my families. I even had to set fire to my children's bodies. It was the most painful day I have ever had in my life."

When he recalls the funeral, his eyes are moist with tears even now.

Fourteen families in Phedigaon, suffered most by the disaster, have been given one katha of land (3.3 are) per family in Hetauda, the capital of Makwanpur District, by the assistance from the German Football Team. However, it is required to have 400,000 to 500,000 rupees for building a house there. This big amount cannot be prepared by the victims. Even if they have sufficient financial resources to build a house, it will be very difficult to find a job over there for them who have not lived in a city and have low educational backgrounds. Even if they move there, they would be ripped off from their community tie. Among the fourteen families who have received the land, it is said that no one has built a house in Hetauda and the given land is still left vacant.

In 1994, the German Football Team has started the assistance for removing the rocks and sand. Shankar applied to the German Football Team for this assistance, but he was rejected because he had already received the land in Hetauda.

"If I had had a right to choose either the removal of rocks or the land in Hetauda, I would have chosen the removal of rocks for sure."

He regrets. It is prohibited to sell the land in Hetauda now, but once this condition expires, he plans to sell the land and with that money, he will remove the rocks in his farmland.

Two years have passed since the flood. Shankar constructed a small cottage in the middle of a hill and his family is living there, being afraid of another debris flow. Last year, he borrowed 50,000 rupees at a high interest rate and began to build a house at the same place where his house had existed. The interest amount is five rupees for 100 rupees per month, which means that the interest rate is 60 percent per year.

“Was there any other way to choose? I had no money to buy a safe land. I cannot find a job in Hetauda. I could only build a house on my own land, after all.”

The construction of his house is almost completed except for the roof, and it is now ready to live in. But he cannot decide to return to his house, because he is so afraid of another debris flow. His five-year-old son always shouts: “I am going to be washed away,” whenever the rain starts. It has been two years since the disaster, but their harsh memory has not been wiped out yet even by now.

-
- Notes: *1) Source: JICA, interviewed by Yumi Sato, translated by the Study Team
*2) Dadheyang Khola: A local name of Ghatte Khola. “Dadheyang” means a sound of boulders rolling down.
*3) Dhungakate Khola: “Dhungakate” means a tree cutting for wooden boat fabrication.

The Study
on
The Disaster Prevention Plan
for
Severely Affected Areas by the 1993 Disaster
in
The Central Development Region of Nepal

FINAL REPORT

Main Report

TABLE OF CONTENTS

Location Map
Photos
Listen to the villager's voice

	<u>Page</u>
1. INTRODUCTION	
1.1 Background of The Study	1-1
1.2 Objectives	1-1
1.3 Study Area.....	1-2
1.4 Study Organisation.....	1-2
1.5 Flow of the Study	1-3
2. BASIC CONCEPT OF THE STUDY	
2.1 Background of Disasters in Nepal	2-1
2.2 Approaches to Disaster Prevention in Nepal	2-4
2.2.1 Status of Disaster Prevention Programme in the Eighth Plan	2-4
2.2.2 National Action Plan in Disaster Management	2-5
2.3 Basic Concept of JICA Disaster Prevention Study	2-6
2.3.1 Basic Concept	2-6
2.3.2 Overall Plan and Priority Plan	2-8
2.4 Basic Approaches to the Plan Formulation	2-9
2.5 Disaster Prevention Approach	2-10
2.5.1 Formulation of Disaster Prevention Plan	2-10
2.5.2 Planning Range and Scale.....	2-13
2.6 Community Development Approach	2-13
2.6.1 Basic Concept of Community Development and People's Participation.....	2-13
2.6.2 People's Participation and Co-operation with NGOs	2-16
2.6.3 CDPP Plan Formulation.....	2-18
2.6.4 Basic Strategy for Implementation	2-20

	<u>Page</u>
3. COMMUNITY DISASTER PREVENTION PLAN FOR PHEDIGAON / PHATBAZAR	
3.1 Background of Community	3-1
3.1.1 Topography and Geology	3-1
3.1.2 Landuse Condition	3-1
3.1.3 Socio-economy	3-2
3.2 Description of The Disaster	3-3
3.2.1 Disaster Damage to the Community	3-3
3.2.2 Mechanism of 1993 Disaster	3-3
3.3 Needs of Disaster Prevention and Community Development	3-4
3.3.1 Current Major Issues in The Community	3-4
3.3.2 Hazard Assessment of The Community.....	3-5
3.4 Overall Disaster Prevention and Community Development Plan.....	3-6
3.4.1 Disaster Prevention Aspects	3-6
3.4.2 Community Development Aspects.....	3-7
3.5 Priority Plan.....	3-9
3.5.1 Structural Disaster Prevention Measures.....	3-9
3.5.2 Non-Structural Disaster Prevention Measures.....	3-11
3.5.3 Community Organisation Set-up.....	3-12
3.5.4 Agriculture Development	3-17
3.5.5 Forestry Administration.....	3-20
3.5.6 Community Infrastructures	3-26
4. COMMUNITY DISASTER PREVENTION PLAN FOR NAMTAR/TILAR	
4.1 Background of Community	4-1
4.1.1 Topography and Geology	4-1
4.1.2 Landuse	4-1
4.1.3 Socio-economy	4-2
4.2 Description of The Disaster	4-3
4.2.1 Disaster Damages to the Community	4-3
4.2.2 Mechanism of the 1993 Disaster	4-3
4.3 Needs of Disaster Prevention and Community Development	4-5
4.3.1 Current Major Issues in The Community	4-5
4.3.2 Hazard Condition at Namtar/Tiral Community.....	4-6
4.4 Overall Plan	4-7
4.4.1 Disaster Prevention Aspects	4-7
4.4.2 Community Development Aspects.....	4-9
4.5 Priority Plan.....	4-11
4.5.1 Structural Disaster Prevention Measures.....	4-11
4.5.2 Community Organisation Set-up.....	4-14
4.5.3 Agriculture Development	4-14
4.5.4 Forestry Administration.....	4-17
4.5.5 Community Infrastructures	4-18
4.5.6 Income Generation Measures and Women in Development .	4-22
5. COMMUNITY DISASTER PREVENTION PLAN FOR CHISAPANI	
5.1 Background of Community	5-1
5.1.1 Topography and Geology	5-1

	<u>Page</u>
5.1.2 Land use Condition	5-1
5.1.3 Socio-economy	5-2
5.2 Description of the Disaster	5-4
5.2.1 Assessment of Damage due to the 1993 Disaster	5-4
5.2.2 Mechanism of Disaster	5-5
5.3 Needs of Disaster Prevention and Community Development	5-6
5.3.1 Current Major Issues in the Community	5-6
5.3.2 Hazardous Condition in the Community	5-7
5.4 Overall Plan	5-8
5.4.1 Disaster Prevention Aspects	5-8
5.4.2 Community Development Aspects	5-10
5.5 Priority Plan	5-12
5.5.1 Structural Disaster Prevention Measures	5-12
5.5.2 Non-Structural Disaster Prevention Measures	5-14
5.5.3 Community Organisation Set-up	5-14
5.5.4 Agriculture Development	5-15
5.5.5 Forestry Administration	5-17
5.5.6 Community Infrastructures	5-19
5.5.7 Income Generation Measures	5-22
6. INFRASTRUCTURE DISASTER PREVENTION PLAN FOR MAHADEVESI BRIDGE	
6.1 General	6-1
6.2 Basin Topography and Geology	6-1
6.3 Assessment of Damage due to the 1993 Disaster	6-2
6.4 River Channel Condition	6-3
6.5 Mechanism of the 1993 Disaster and Disaster Potential in Future	6-5
6.6 Overall Plan	6-6
6.6.1 Objectives	6-6
6.6.2 Technical Framework	6-7
6.6.3 Overall Plan Formulation	6-8
6.7 Priority Plan	6-11
6.7.1 Criteria for Selection of Priority Schemes	6-11
6.7.2 Selected Priority Schemes	6-12
7. INFRASTRUCTURE DISASTER PREVENTION PLAN FOR KULEKHANI RESERVOIR	
7.1 General	7-1
7.2 The Basin Characteristics	7-2
7.2.1 Topography	7-2
7.2.2 Geology	7-2
7.2.3 Land use	7-3
7.3 Assessment of Damage due to the 1993 Disaster	7-4
7.4 Sedimentation Trend in the Kulekhani Reservoir	7-4
7.5 Approaches to Overall Plan Formulation	7-5
7.5.1 Current Major Issues	7-5
7.5.2 Problem Analysis	7-6
7.5.3 Objectives Analysis	7-7
7.5.4 Approaches to the Overall Disaster Prevention Plan	7-7
7.6 Priority Plan for the Kulekhani Reservoir	7-9

	<u>Page</u>
8 ENVIRONMENTAL IMPACT ASSESSMENT	
8.1 Phedigaon/Phatbazar CDPP.....	8-1
8.1.1 Physico-chemical Environment	8-1
8.1.2 Biological Environment	8-2
8.1.3 Socio-economic Environment	8-2
8.2 Namtar/Tiral CDPP.....	8-4
8.2.1 Physico-chemical Environment	8-4
8.2.2 Biological Environment	8-4
8.2.3 Socio-cultural Environment.....	8-5
8.3 Chisapani CDPP.....	8-5
8.3.1 Physico-chemical Environment	8-6
8.3.2 Biological Environment	8-6
8.3.3 Socio-cultural Environment.....	8-7
8.4 IDPP for the Mahadevbesi Bridge.....	8-7
8.4.1 Physico-chemical Environment	8-7
8.4.2 Biological Environment	8-8
8.4.3 Social Environment	8-8
8.5 IDPP for the Kulekhani Watershed Area	8-9
8.5.1 Physico-chemical Environment	8-9
8.5.2 Biological Environment	8-10
8.5.3 Socio-cultural Environment.....	8-10
9 PROJECT COST ESTIMATE	
9.1 Basic Conditions of Cost Estimate	9-1
9.1.1 International Competitive Bidding (ICB)	9-1
9.1.2 Local Competitive Bidding (LCB).....	9-2
9.1.3 People's Participatory Program (PPP)	9-3
9.2 Unit Price Assessment	9-4
9.2.1 Material Price and Labour Cost	9-5
9.2.2 Equipment Cost.....	9-5
9.3 Unit Price Estimate	9-6
9.3.1 Unit Prices on the ICB Basis.....	9-6
9.3.2 Unit Prices on the LCB Basis	9-6
9.3.3 Unit Prices on the PPP Basis.....	9-6
9.4 Breakdown of the Project Cost	9-6
9.4.1 Direct Construction Cost.....	9-6
9.4.2 Indirect Cost.....	9-7
9.5 Cost Estimate for Priority Projects	9-7
10 PROJECT EVALUATION	
10.1 Economic Evaluation.....	10-1
10.1.1 General.....	10-1
10.1.2 Basic Assumptions	10-1
10.1.3 Shadow Prices	10-2
10.1.4 Economic Costs.....	10-3
10.1.5 Economic Benefits.....	10-4
10.1.6 EIRR, NPV and B/C	10-9
10.1.7 Results of Economic Evaluation	10-10
10.2 Impact Analysis.....	10-12
10.2.1 General.....	10-12

	<u>Page</u>
10.2.2 Intangible Benefits.....	10-12
10.3 Overall Project Evaluation.....	10-19
11. IMPLEMENTATION PLAN	
11.1 Implementation Plan for Community Disaster Prevention Plans.....	11-1
11.1.1 Strategy of Project Implementation for CDPPs.....	11-1
11.1.2 Institutional Arrangement in Central Government.....	11-2
11.1.3 Formation of User's Group and Committees.....	11-4
11.1.4 Roles of Governments, Donors and People.....	11-5
11.1.5 Implementation of Basic Disaster Prevention Sub-programs	11-6
11.1.6 Implementation of Participatory Disaster Prevention Sub-programs.....	11-7
11.1.7 Implementation of Community Development Sub-programs	11-9
11.2 Implementation Plan for Infrastructure Disaster Prevention Plans.....	11-11
11.2.1 Mahadevbesi Bridge IDPP.....	11-11
11.2.2 Kulekhani Reservoir IDPP.....	11-11
 APPENDIX A	
STUDY AREA AND SELECTION OF PRIORITY AREAS	
 APPENDIX B	
COMMUNITY DISASTER PREVENTION PLAN FOR SAHAN (Semi-detailed Study)	

LIST OF TABLES

	<u>Page</u>
Table 2.6.1	Loss of Lives by Disasters (1984-1993)..... 2-22
Table 2.6.2	Transition of Development Priorities 2-23
Table 3.1.1	Demographic Information in Phedigaon..... 3-28
Table 3.1.2	Demographic Information in Phatbazar..... 3-29
Table 3.2.1	Casualties and Their Caste by the 1993 Disaster 3-30
Table 3.4.1(1)	Main Features of Proposed Structures on Dhungakate Khola .. 3-31
Table 3.4.1(2)	Main Features of Proposed Structures on Ghatte Khola 3-31
Table 3.4.1(3)	Main Features of Proposed Structures on Bhottekhoria Khola. 3-32
Table 3.4.1(4)	Main Features of Proposed Structures on Alluvial Fan..... 3-32
Table 3.4.1(5)	Main Features of Proposed Structures between Phedigaon and Palung bazar 3-33
Table 3.5.1	Cost of Production and Net Profit from Potato and Cauliflower 3-34
Table 3.5.2	Monthly (Average) Wholesale Price of Some Fruits and Vegetable of Kalimati Market of Kathmandu, Year 2051 (1994/95)..... 3-35
Table 3.5.3	Available Plants 3-36
Table 3.5.4	Fodder Trees..... 3-37
Table 3.5.5	Grasses..... 3-37
Table 3.5.6	Estimated Per Ropani Production of Pear and Lemon..... 3-38
Table 3.5.7	Export of Medicinal Herbs (1974/75-1994/95)..... 3-38
Table 3.5.8	Some Medicinal Herbs and their Cost of Production and Net Profit 3-39
Table 4.1.1	Demographic Information in Namtar 4-27
Table 4.5.1	Cost of Production and Net Profit of some Main Crops 4-28
Table 4.5.2	Main Features of Site-wise Problems and Proposed Improvement Works on the Rural Road Improvement in Namtar Area..... 4-29
Table 4.5.3	Summary of Proposed Major Construction Works on the Rural Road Improvement in Namtar Area..... 4-30
Table 5.1.1	Demographic Information in Chisapani 5-23
Table 5.5.1	Cost of Production and Net Profit from Potato and Cauliflower Production in Chisapani..... 5-24
Table 5.5.2	Potential Water Supply for Network Development in Chisapani Area 5-25
Table 5.5.3	Summary of Quantity for Rural Water Supply Network System in Chisapani Area..... 5-26
Table 7.4.1	Record of sediment Investigation in Kulekhani Reservoir 7-11
Table 8.1.1	Result of Environment Impact Analysis for Phedigaon/Phatbazar CDDP 8-12
Table 8.2.1	Result of Environmental Impact Analysis for Namtar/Tilar CDDP..... 8-13
Table 8.3.1	Result of Environmental Impact Analysis for Chisapani CDDP..... 8-14
Table 8.4.1	Result of Environmental Impact Analysis for Mahadevbesi Bridge IDPP 8-15
Table 8.5.1	Result of Environmental Impact Analysis for IDPP in the Kulekhani Watershed Area..... 8-16
Table 9.2.1	Price Investigation 9-8
Table 9.2.2	Unit Price for Major Construction Equipment under ICB Basis 9-9
Table 9.3.1	List of Unit Prices for Major Work Items for Disaster Prevention Works..... 9-10

	<u>Page</u>
Table 9.3.2	List of Unit Price for Major Work Items for Community Infrastructures 9-11
Table 9.5.1	Project Cost for Phedigaon/Phatbazar CDPP..... 9-12
Table 9.5.2	Project Cost for Namtar/Tilar CDPP..... 9-13
Table 9.5.3	Project Cost for Chisapani CDPP..... 9-14
Table 9.5.4	Project Cost for Mahadevbesi Bridge CDPP 9-15
Table 9.5.5	Project Cost for Kulekhani Reservoir IDPP 9-16
Table 10.1.1	Economic Costs in Phedigaon/Phatbazar..... 10-20
Table 10.1.2	Economic Costs in Namtar/Tilar 10-21
Table 10.1.3	Economic Costs in Chisapani..... 10-22
Table 10.1.4	Economic Costs in Mahadevbesi Bridge 10-23
Table 10.1.5	Economic Costs in Kulekhani Reservoir..... 10-24
Table 10.1.6	Economic Cash Flow in Phedigaon/Phatbazar 10-25
Table 10.1.7	Economic Cash Flow in Namtar/Tilar..... 10-26
Table 10.1.8	Economic Cash Flow in Chisapani 10-27
Table 10.1.9	Economic Cash Flow in Mahadevbesi Bridge..... 10-28
Table 10.1.10	Economic Cash Flow in Kulekhani Reservoir..... 10-29
Table 10.1.11	Capacity Value and Energy Value Calculation..... 10-30
Table 10.2.1	Intangible Benefits in Phedigaon/Phatbazar..... 10-31
Table 10.2.2	Intangible Benefits in Namtar/Tilar 10-32
Table 10.2.3	Intangible Benefits in Chisapani..... 10-33
Table 11.1.1	Roles of HMG, Donor, and Users Group 11-12
Table 11.1.2	Funding Arrangement for Basic Sabo Project on CDPPs..... 11-13
Table 11.1.3	List of Participatory Disaster Prevention Sub-program..... 11-14
Table 11.1.4	Funding Arrangement for Participatory Disaster Prevention Sub Project on CDPPs 11-15
Table 11.1.5	List of Community Development Sub-program 11-16

LIST OF FIGURES

Fig. 1.5.1	Flowchart of the Study 1-5
Fig. 2.1.1	Backgrounds of Disasters in Nepal 2-24
Fig. 2.2.1	National Action Plan on Disaster Mitigation in Nepal 2-25
Fig. 2.3.1	Basic Approach for JICA Disaster Prevention Study..... 2-26
Fig. 2.6.1	Major Components of the CDPP..... 2-27
Fig. 3.1.1	Topographic Map of Phedigaon/Phatbazar Area 3-40
Fig. 3.1.2	Profiles of Phedigaon Torrents..... 3-41
Fig. 3.1.3	Land Use Map..... 3-42
Fig. 3.2.1	Location of Damaged Houses due to the 1993 Disaster 3-43
Fig. 3.2.2	Disaster Map of the Phedigaon/Phatbazar Area..... 3-44
Fig. 3.3.1	Hazard Map of Phedigaon/Phatbazar Area 3-45
Fig. 3.4.1	Overall Disaster Prevention Plan for Phedigaon/Phatbazar 3-46
Fig. 3.4.2	Alternative Disaster Prevention Plan (Provision of Debris Retarding Basin at Alluvium Fan Area) 3-47
Fig. 3.4.3	Proposed Disaster Prevention Plan for Alluvium Fan Area (Combination with the Upstream Prevention Measures and the Downstream Channel Work) 3-48
Fig. 3.4.4	Overall Community Development Plan for Phedigaon/Phatbazar..... 3-49
Fig. 3.5.1	Priority Plan for Phedigaon..... 3-50

	<u>Page</u>
Fig. 3.5.2	Check Dam Dh-1 in Phedigaon/Phatbazar CDPP 3-51
Fig. 3.5.3	Channel Works for Dhungakate Khola in Phedigaon/Phatbazar CDPP..... 3-52
Fig. 3.5.4	The River Structures Related to Channel Works for Dhungakate Khola 3-53
Fig. 3.5.5	Channel Works for Ghatte Khola in Phedigaon/Phatbazar CDPP..... 3-54
Fig. 3.5.6.	The River Structures Related to Channel Works for Ghatte Khola 3-55
Fig. 3.5.7	Community Disaster Evacuation System for Phedigaon/Chisapani 3-56
Fig. 3.5.8	Organisational Structure of Community..... 3-57
Fig. 3.5.9	Community Organisers..... 3-58
Fig. 3.5.10	Proposed Sites of Community Forestry 3-59
Fig. 3.5.11	Flow of Starting Up Community Forestry Programme 3-60
Fig. 4.1.1	River Profile of Manhari Khola 4-31
Fig. 4.1.2	Geological Map of Manhari Catchment Area 4-32
Fig. 4.1.3	Land Use Map for Namtar 4-33
Fig. 4.2.1	Disaster Map of Namtar Area..... 4-34
Fig. 4.2.2	Schematic Cross Section of Namtar 4-35
Fig. 4.2.3	Landform Changing Map before and after 1993 Disaster..... 4-36
Fig. 4.2.4	Detailed River Conditions at Upstream Part of Manhari Khola. 4-37
Fig. 4.2.5	Detailed River Profile of Manhari Khola near Namtar..... 4-38
Fig. 4.2.6	Sketch of Bank Scouring in Manhari Khola..... 4-39
Fig. 4.2.7	Sketch of Landslide and Collapsed Area in Gorduwa Khola ... 4-40
Fig. 4.3.1	Hazard Map of Namtar/Tilar..... 4-41
Fig. 4.4.1	Disaster Prevention Plan for Namtar..... 4-42
Fig. 4.4.2	Overall Plan for Community Infrastructure Development in Namtar..... 4-43
Fig. 4.5.1	Priority Plan for Namtar..... 4-44
Fig. 4.5.2	Longitudinal Profile of Manhari Khola at the Upstream Check Dam Sites 4-45
Fig. 4.5.3	Designed Longitudinal Profile at Namtar Community..... 4-46
Fig. 4.5.4	Check Dam Na-1 in Namtar/Tilar CDPP..... 4-47
Fig. 4.5.5	Check Dam Na-2/Tilar CDPP 4-48
Fig. 4.5.6.	Check Dam Na-3/Tilar CDPP 4-49
Fig. 4.5.7	Check Dam Na-4/Tilar CDPP 4-50
Fig. 4.5.8	Channel Works for Manhari Khola in Namtar/Tilar CDPP..... 4-51
Fig. 4.5.9	General Layout for Rural Road in Namtar..... 4-52
Fig. 4.5.10	Rehabilitation Plan for Namtar Irrigation Project in Namtar/Tilar Area 4-53
Fig. 4.5.11	Schematic Diagram for Suspension Aqueduct..... 4-54
Fig. 4.5.12	Schematic Diagram for Recovery of Canal at Landslide Section 4-55
Fig. 5.1.1	Outline of Topography and Geological Structure 5-27
Fig. 5.1.2	Land Use Pattern by Aero-Photo Investigation..... 5-28
Fig. 5.2.1	Disaster Map of Chisapani Area..... 5-29
Fig. 5.2.2	Longitudinal Profiles of Chisapani Area 5-30
Fig. 5.3.1	Hazard Map of Chisapani Area..... 5-31
Fig. 5.4.1	Disaster Prevention Plan for Chisapani..... 5-32
Fig. 5.4.2	Arrangement of Structure in Chisapani Khola and Dharapani Khola 5-33
Fig. 5.4.3	Longitudinal Profile of Chisapani Khola (Downstream) 5-34

	<u>Page</u>
Fig. 5.4.4	Longitudinal Profile of Chisapani Khola (Upstream side)..... 5-35
Fig. 5.4.5	Longitudinal Profile of Dharapani Khola..... 5-36
Fig. 5.4.6	Schematic Idea on Series of Gabion Check Dam and Bank Protection Works..... 5-37
Fig. 5.4.7	Overall Plan Community Development in Chisapani 5-38
Fig. 5.5.1	Priority Plan for Chisapani..... 5-39
Fig. 5.5.2	Check Dam Ch-1 in Chisapani CDPP 5-40
Fig. 5.5.3	Typical Design for Hillside Works..... 5-41
Fig. 5.5.4	Proposed Water Supply Network System in Chisapani..... 5-42
Fig. 5.5.5	Sketch Drawing for Rural Water Supply Network Development in Chisapani Area 5-43
Fig. 6.2.1	Topographical and Geological Map of the Agra Khola Basin .. 6-13
Fig. 6.4.1	River Channel Condition Map..... 6-14
Fig. 6.4.2	Longitudinal Profiles of the Agra Khola, Mel Khola and the Chalti Khola 6-15
Fig. 6.6.1	Longitudinal Channel Profile on Upstream of Mahadevbesi Bridge 6-16
Fig. 6.7.1	Proposed Structure to Channel Stabilisation at Mahadevbesi Bridge 6-17
Fig. 6.7.2	Groundsill No.1 in Mahadevbesi IDPP 6-18
Fig. 6.7.3	Groundsill No.2 in Mahadevbesi IDPP 6-19
Fig. 7.1.1	Location Map of Kulekhani Hydropower Project..... 7-12
Fig. 7.2.1	Slope Map of the Kulekhani Watershed..... 7-13
Fig. 7.2.2	Geological Map of Kulekhani Watershed 7-14
Fig. 7.2.3	Updated Land Use Map 7-15
Fig. 7.3.1	Result of Sediment Yield Analysis for Kulekhani Watershed .. 7-16
Fig. 7.3.2	Location Map of Slope Failure in Kulekhani Watershed 7-17
Fig. 7.3.3	Trend of Sediment Deposition in Kulekhani Reservoir (At the lowest point of Reservoir)..... 7-18
Fig. 7.4.1	Location Map for Echo-Sounding Line in Kulekhani Reservoir 7-19
Fig. 7.5.1	Problem Tree for the IDPP for Kulekhani Watershed 7-20
Fig. 7.5.2	Objectives Analysis for the IDPP for Kulekhani Watershed.... 7-21
Fig. 7.5.3	Alternatives Analysis for the IDPP for Kulekhani Watershed .. 7-22
Fig. 7.6.1	Plan of Alternative Route of sand Transportation Route from Kulekhani to Kathmandu..... 7-23
Fig. 11.1.1	Implementation Strategy for the CDPP..... 11-17
Fig. 11.1.2	Institutional Arrangement 11-18
Fig. 11.1.3	Organisational Structure of Community..... 11-19
Fig. 11.1.4	Implementation Schedule for Basic Sabo Project on CDPPs ... 11-20
Fig. 11.1.5	Implementation Schedule for Participatory Disaster Prevention Sub-project on CDPPs 11-21

LIST OF PHOTOGRAPHS

Photo 3.4.1	Landslide at the Upper Stream of the Dhungakate Khola and the Gatte Khola 3-61
Photo 3.4.2	Focus Group Discussion of Males in Phedigaon..... 3-62
Photo 3.4.3	Focus Group Discussion of Females in Phedigaon..... 3-62
Photo 3.4.4	Focus Group Discussion of Males in Phatbazar..... 3-63

	<u>Page</u>
Photo 3.4.5	Focus Group Discussion of Females in Phatbazar..... 3-63
Photo 4.4.1	Focus Group Discussion of Males in Namtar (1) 4-56
Photo 4.4.2	Focus Group Discussion of Males in Namtar (2) 4-56
Photo 4.4.3	Focus Group Discussion of Females in Namtar (1) 4-57
Photo 4.4.4	Focus Group Discussion of Females in Namtar (2) 4-57
Photo 4.4.5	The Lecture by the Study Team at the Kalika Secondary School in Namtar..... 4-58
Photo 5.4.1	Focus Group Discussion of Males in Chisapani 5-44
Photo 5.4.2	Focus Group Discussion of Females in Chisapani..... 5-44
Photo 6.1	Mahadevbesi Bridge (1)..... 6-20
Photo 6.2	Mahadevbesi Bridge (2)..... 6-21

CHAPTER 1

INTRODUCTION

1. Introduction

2. Methodology

The Study
on
The Disaster Prevention Plan
for
Severely Affected Areas by the 1993 Disaster
in
The Central Development Region of Nepal

FINAL REPORT

MAIN REPORT

1. INTRODUCTION

1.1 Background of The Study

From July 19 to 21, 1993, an unprecedented disaster caused by floods, landslides, and debris flows occurred and severely damaged the Central Development Region of Nepal, killing about 1,500 people and destroying the national infrastructures such as Kulekhani Dam and its hydropower stations, Tribhuvan and Prithivi Highways, and so on.

The damage to the communities was also quite serious. About 500,000 persons suffered from the damage to rural infrastructures such as buried farmland and disconnected rural roads. Many people have lost their houses and farmland, and families. Although three years have passed since the disaster, they are still suffering from the damage due to the loss of farmland and job opportunities. Moreover, such damaged communities are still dangerous by subject to future disasters since unstable debris remaining along river courses and hill slopes may easily collapse and flow down to the communities, triggered by even a small storm. Even they stay in the high hazardous areas and some people wish to resettle somewhere, they are forced to stay there due to financial constraints.

Urgent remedial measures to the damaged infrastructures have been carried out and major infrastructures such as Kulekhani Hydropower Stations and Tribhuvan and Prithivi Highways have been rehabilitated and are currently under operation. However, there are still many remedial measures to be done in order to mitigate the damage caused by similar natural phenomena in the future.

Under such present conditions in the severely affected areas by the storm of July 1993, the HMG/N requested the Government of Japan for technical assistance for "the Study on the Disaster Prevention Plan for Severely Affected Areas by 1993 Disaster in the Central Development Region of Nepal" in October 1994.

Considering that many people are still in difficulties in their living and recognising that disaster prevention is essential for the national and rural socio-economic development, the Government of Japan has decided to co-operate with the HMG/N to carry out the Study.

1.2 Objectives

The objectives of the Study are:

- (1) To investigate 15 areas and to select 5 areas severely affected by the disaster of July 1993 to form disaster prevention plans in the upper basins of Bagmati, East Rapti, and Trisuli Rivers. The following matters should be taken into consideration:
 - a) Disaster prevention plans of the community should aim not only to rehabilitate rural infrastructures, but also to encourage people's participation to disaster prevention activities and to stimulate rural economic activities. Improvement of the women's situation shall also be considered. This is called Community Disaster Prevention Plans ("CDPP") in the Study.
 - b) Disaster prevention plans for major infrastructures such as the Kulekhani Hydropower Stations and Tribhuvan and Prithivi Highways shall not contain massive structures to prevent huge disasters, but appropriate technologies in Nepal aiming at the maximum economic viability with the concept of disaster management and mitigation shall be considered. This is called Infrastructure Disaster Prevention Plans ("IDPP") in the Study.
- (2) To transfer relevant planning and designing technologies to the Nepalese counterpart in the course of the Study.

1.3 Study Area

The Study Area, shown in the location map, covers the following five river basins in the Central Development Region of Nepal:

- a) Kulekhani River in the Bagmati River system,
- b) Upper part of the East Rapti River basin (upstream of the Bhainse village),
- c) Manahari River basin in the East Rapti River system,
- d) Upper part of the Agra River basin in the Trisuli River system, and
- e) Marin River basin in the Bagmati River basin.

Five priority areas were selected by the Steering Committee in February 1996 for feasibility studies and one additional area for further study as shown below:

Priority areas

- 1) Phedigaon/Phatbazar CDPP in Makwanpur District,
- 2) Namtar/Tilar CDPP in Makwanpur District,
- 3) Chisapani CDPP in Makwanpur District,
- 4) Mahadev Besi Bridge IDPP in Dhardin District, and
- 5) Kulekhani Watershed IDPP in Makwanpur District.

The details of selection of priority areas are described in Appendix-A of the Main Report.

1.4 Study Organisation

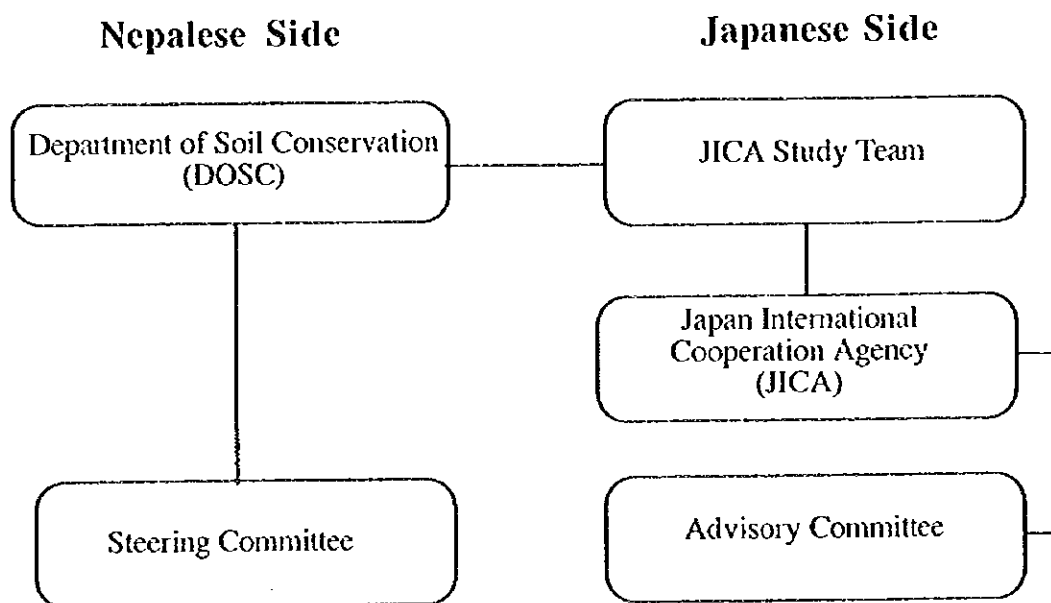
The Department of Soil Conservation (DOSC) acts as an executing agency for the Study and also as a co-ordination agency with other relevant organisations of the HMG/Nepal,

such as local Village Development Committee (VDC), the Department of Road (DOR), the Nepal Electricity Authority (NEA) and the National Planning Committee (NPC).

The Study Team conducted the Study in close co-operation with the relevant government agencies of Nepal, foreign agencies, and NGO groups.

A Steering Committee has been organised by the members of government agencies of HMG/N. The JICA has organised an Advisory Committee by consisting of the officials of the Japanese Government. Both committees gave advice and technical support to the Study Team.

The organisational frame of the Study is shown below:



Organisational Frame of the Study

1.5 Flow of the Study

The flow chart of the Study is shown in Figure 1.5.1. The Study is carried out from the middle of January 1996 to the middle of March 1997, in two phases: the first phase from the middle of January to the end of July 1996, and the second phase from September 1996 to the middle of March 1997. The Study is outlined below.

FIRST PHASE : Overall Basic Study and Selection of Priority Areas (Jan.-Jul. 1996)

- A: Preparatory Works,
- B: Data Collection and Selection of Priority Areas,
- C: Data Analysis and Clarification of the Problems in the Study Area,
- D: Seminar on Initial Output of the Study and Discussion.

**SECOND PHASE: Feasibility Study for Disaster Prevention Plans for Priority Areas
(Sep. 1996-Mar. 1997)**

- E: Detailed Field Investigation for Priority Areas,**
- F: Feasibility Study and Preparation of Implementation Program,**
- G: Seminar for Transfer of Technology based on the Draft Final Report,**
- H: Preparation of the Final Report.**

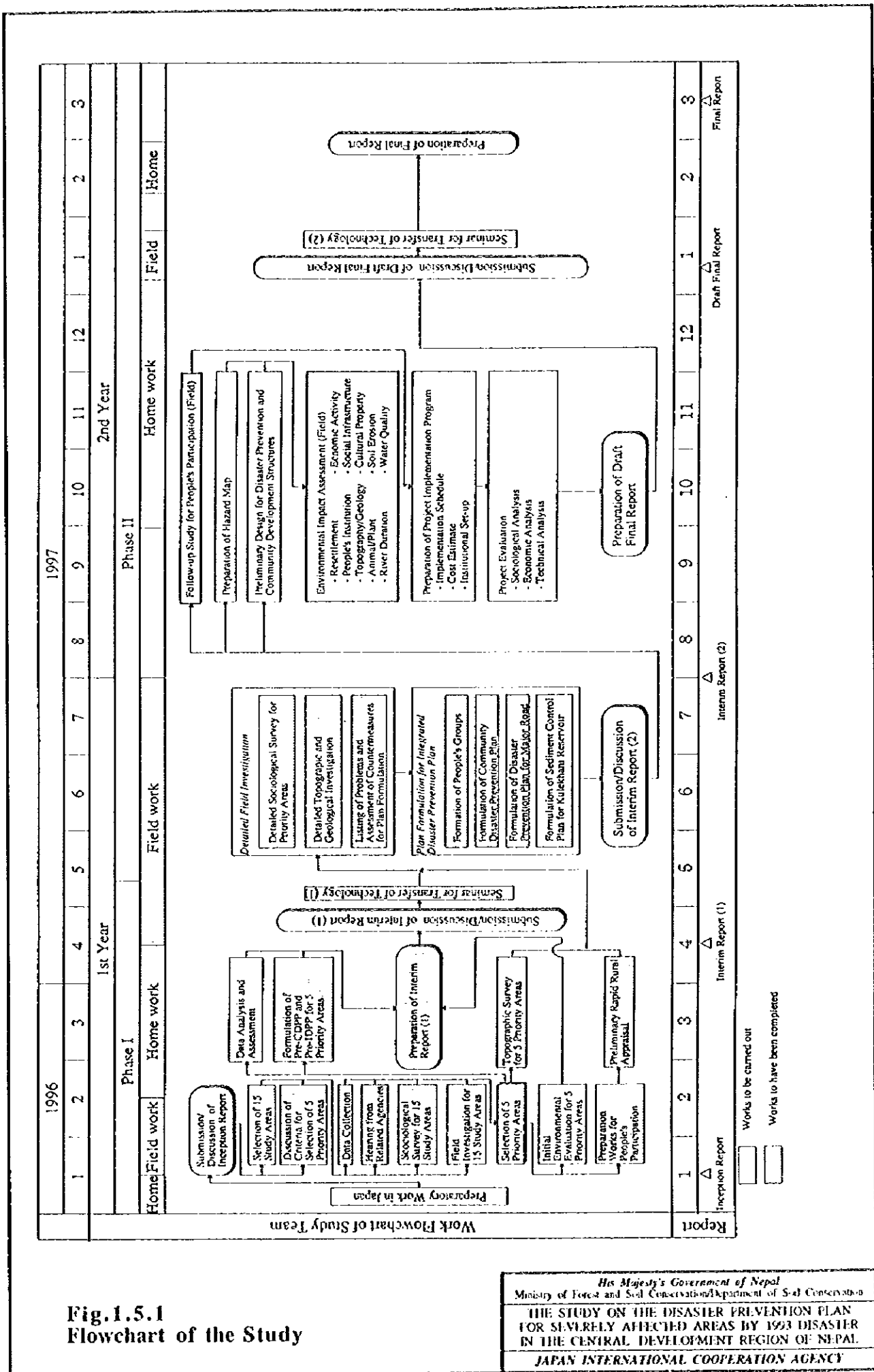


Fig.1.5.1
Flowchart of the Study

His Majesty's Government of Nepal
Ministry of Forest and Soil Conservation/Department of Soil Conservation
THE STUDY ON THE DISASTER PREVENTION PLAN FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER IN THE CENTRAL DEVELOPMENT REGION OF NEPAL.
JAPAN INTERNATIONAL COOPERATION AGENCY