

ANNEX - 1 0

ENVIRONMENTAL STUDIES

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

FINAL REPORT

Supporting Report

Annex-10 : Environmental Studies

TABLE OF CONTENTS

		<u>Page</u>
1.	INITIAL ENVIRONMENTAL EXAMINATIONS FOR THE DISASTER PREVENTION	
1.1	Objective of the Study.....	A10-1
1.2	Definition of Words Used in the Report	A10-2
1.3	Study Area.....	A10-2
1.3.1	Sub-divisions of the Study Area	A10-2
1.3.2	General Characteristics of the Study Area.....	A10-3
1.4	Project Activities.....	A10-3
1.4.1	Infrastructural Disaster Prevention Plan (IDPP) for Mahadevbesi Bridge	A10-3
1.4.2	Infrastructural Disaster Prevention Plan (IDPP) for Kulekhani Reservoir	A10-4
1.4.3	Community Disaster Prevention Plan (CDPP)	A10-4
1.5	Present Environmental Conditions	A10-6
1.5.1	Physico-chemical Environment.....	A10-6
1.5.2	Biological Environment	A10-10
1.5.3	Social Environment	A10-13
1.6	Expected Impacts to the Environment.....	A10-14
1.6.1	Physico-chemical Environment.....	A10-14
1.6.2	Biological Environment	A10-18
1.6.3	Social Environment	A10-20
1.7	Expected Environmental Management Programme.....	A10-22
1.7.1	Site of IDPP for Mahadevbesi bridge.....	A10-22
1.7.2	Area of IDPP for Kulekhani Reservoir.....	A10-22
1.7.3	Community Development and Disaster Prevention Plan	A10-22
1.8	Expected Environmental Monitoring Programme.....	A10-23
1.8.1	Community Organization.....	A10-23
1.8.2	Reintroduction of Fishes	A10-23
1.8.3	Turbidity of Water in Kulekhani Reservoir	A10-23
1.9	References.....	A10-23
1.9.1	Existing Government Reports Related to the Project	A10-23
1.9.2	Maps.....	A10-24
1.9.3	Publications.....	A10-24

	<u>Page</u>
2. ENVIRONMENTAL IMPACT ASSESSMENT	
2.1 Introduction	A10-49
2.1.1 Background of the Project	A10-49
2.1.2 Proposed Disaster Prevention Plan	A10-49
2.1.3 Scope of Works for Environmental Impact Analysis	A10-50
2.1.4 Methodology of Environmental Impact Analysis.....	A10-51
2.2 Environmental Impact Assessment for the Community	A10-52
Disaster Prevention Plan for Phedigaon/Phatbazar	
2.2.1 Present Environmental Conditions.....	A10-52
2.2.2 Environmental Impact Assessment.....	A10-66
2.2.3 Environmental Management Programme.....	A10-70
2.2.4 Environmental Monitoring Programme.....	A10-71
2.3 Environmental Impact Assessment for the Community.....	A10-72
Disaster Prevention Plan for Namtar VDC	
2.3.1 Present Environmental Conditions.....	A10-72
2.3.2 Environmental Impact Assessment.....	A10-82
2.3.3 Environmental Management Programme.....	A10-84
2.3.4 Environmental Monitoring Programme.....	A10-85
2.4 Environmental Impact Assessment for the Community Disaster.....	A10-86
Prevention Plan for Chisapani of Agra VDC	
2.4.1 Present Environmental Conditions.....	A10-86
2.4.2 Environmental Impact Assessment.....	A10-94
2.4.3 Environmental Management Programme.....	A10-96
2.4.4 Environmental Monitoring Programme.....	A10-97
2.5 Environmental Impact Assessment for the Infrastructural	A10-98
Disaster Prevention Plan for Mahadev Besi Bridge	
2.5.1 Present Environmental Conditions.....	A10-98
2.5.2 Environmental Impact Assessment.....	A10-105
2.5.3 Environmental Management Programme.....	A10-107
2.5.4 Environmental Monitoring Programme.....	A10-107
2.6 Environmental Impact Assessment for the Infrastructure Disaster... A10-108	
Prevention Plan for Kulekhani Watershed Area	
2.6.1 Present Environmental Conditions.....	A10-108
2.6.2 Environmental Impact Analysis	A10-119
2.6.3 Environmental Management Programme.....	A10-122
2.6.4 Environmental Monitoring Programme.....	A10-122

Page

LIST OF TABLES

Table 1.1	Socio-economic Profile in Lower Agra Khola Area	A10-25
Table 1.2	Socio-economic Profile in Upper Kulekhani Khola Area	A10-26
Table 1.3	Socio-economic Profile in Upper Agra Khola Area	A10-27
Table 1.4	Socio-economic Profile in Upper Manhari Khola Area	A10-28
Table 1.5	Socio-economic Profile in Kulekhani Dakshinkali Area	A10-29
Table 2.1	Result of Water Quality Test	A10-123
Table 2.2	Average Rainfall Patterns Recorded by Daman Weather Station	A10-124
Table 2.3	List of Wildlife and Bird Species Found in Palung VDC, Agra VDC and Mahadev Besi Bridge	A10-125
Table 2.4	List of Plant Species Found in Palung VDC and Agra VDC	A10-127
Table 2.5	Demographic Characteristics in Palung VDC	A10-128
Table 2.6	Land Holding in Palung VDC	A10-129
Table 2.7	General Cropping Patterns in Palung VDC	A10-130
Table 2.8	Agroforestry Trees Accepted in Palung VDC	A10-131
Table 2.9	Religious Establishment in Palung VDC	A10-132
Table 2.10	Result of Environmental Impact Analyses for Phedigaon/Phatbazar CDPP	A10-133
Table 2.11	Wildlife and Bird Species Found in Namtar	A10-135
Table 2.12	Species of Vegetation in Namtar	A10-136
Table 2.13	Demographic Characteristic of Namtar VDC	A10-138
Table 2.14	Cropping Patterns in Namtar	A10-139
Table 2.15	Agro-forestry Species Acceptable in Namtar	A10-141
Table 2.16	Use of Forest Product in Namtar	A10-141
Table 2.17	Result of Environmental Impact Analysis for Namtar CDPP	A10-142
Table 2.18	Demographic Characteristic of Agra VDC	A10-144
Table 2.19	Land Use Patterns of Agra VDC	A10-145
Table 2.20	Annual Use of Forest Product in Agra VDC	A10-145
Table 2.21	Cropping Patterns in Agra VDC	A10-146
Table 2.22	Result of Environmental Impact Analysis for Chisapani CDPP	A10-147
Table 2.23	Slope Gradient of the Kulekhani Watershed Area	A10-149
Table 2.24	Rainfall Pattern in Kulekhani Reservoir at Markhu Weather Station	A10-150
Table 2.25	List of Fish Species in Kulekhani Reservoir	A10-151
Table 2.26	Demographic Characteristics in the Kulekhani Watershed Area	A10-152
Table 2.27	Land Area by Type in Kulekhani Watershed Area (unit: ha)	A10-153
Table 2.28	General Cropping Patterns in the Kulekhani Watershed Area	A10-154
Table 2.29	Use of Forest Production in the Kulekhani Watershed Area	A10-155
Table 2.30	Rainfall Patterns in Dhunibesi, Dhading District	A10-156
Table 2.31	Demographic Characteristics in the Mahadev Besi Bridge Area	A10-157
Table 2.32	Result of Environmental Impact Analysis for Mahadev Besi Bridge IDPP	A10-159

Page

LIST OF FIGURES

Fig. 1.1	Location Map of the Study Area.....	A10-30
Fig. 1.2	Study Area for the Road Linking Kulekhani Reservoir to Pharpin.....	A10-31
Fig. 1.3	Study Area - Phedigaon/Phatbazar.....	A10-32
Fig. 1.4	Study Area - Chisapani.....	A10-33
Fig. 1.5	Study Area- Namtar/Tilar	A10-34
Fig. 1.6	Proposed Structures for Mahadev Besi Bridge.....	A10-35
Fig. 1.7	Proposed Alignment of the Road Linking from Kulekhani Reservoir to Pharpin.....	A10-36
Fig. 1.8	Priority Plan for Phedigaon/Phatbazar CDPP	A10-37
Fig. 1.9	Priority Plan for Chisapani CDPP	A10-38
Fig. 1.10	Priority Plan for Namtar CDPP	A10-39
Fig. 1.11	Land Use in Agra Khola and Upper Kulekhani Khola (Makwanpur and Dhading District)	A10-40
Fig. 1.12	Land Use in Upper Manhari Khola (Makwanpur District).....	A10-41
Fig. 1.13	Land Use in the Area between Kulekhani and Dakshinkall	A10-42
Fig. 1.14	Location Map of Proposed Check Dam Site in and around Reservoir.....	A10-43
Fig. 2.1	Location Map of the Study Area.....	A10-160
Fig. 2.2	Study Area - Phedigaon/Phatbazar.....	A10-161
Fig. 2.3	Study Area - Chisapani.....	A10-162
Fig. 2.4	Study Area- Namtar/Tilar	A10-163
Fig. 2.5	Proposed Structures for Mahadev Besi Bridge.....	A10-164
Fig. 2.6	Priority Plan for Phedigaon/Phatbazar CDPP	A10-165
Fig. 2.7	Priority Plan for Chisapani CDPP	A10-166
Fig. 2.8	Priority Plan for Namtar CDPP	A10-167
Fig. 2.9	Land Use Patterns in Palung VDC.....	A10-168
Fig. 2.10	Detailed Land Use in Phedigaon/Phatbazar	A10-169
Fig. 2.11	Land Use Patterns in Namtar VDC	A10-170
Fig. 2.12	Detailed Land Use in Namtar	A10-171
Fig. 2.13	Land Use Patterns in Agra VDC	A10-172
Fig. 2.14	Detailed Land Use in Chisapani.....	A10-173
Fig. 2.15	Land Use Map with Ward Boundary and Settlement Pattern of Markhu VDC	A10-174
Fig. 2.16	Location Map of Proposed Check Dam site in and around Reservoir.....	A10-175

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

FINAL REPORT

Supporting Report

Annex-10: Environmental Studies

**1 INITIAL ENVIRONMENTAL EXAMINATION FOR THE
DISASTER PREVENTION**

1.1 Objective of the Study

The Study on the "Disaster Prevention Plan for Severely Affected Area by 1993 Disaster in the Central Development Region of Nepal" is a project initiated by the Department of Soil Conservation, the Ministry of Forest and Soil Conservation, His Majesty's Government of Nepal, in order to rehabilitate and redevelop the areas severely damaged by the 1993 Disaster as well as to conduct a plan to prevent these areas from being impaired by further flood and land slide events.

divided into three broadly categorized plan and that the Study is conducted to seek feasibility of the components of Project as follows:

(1) Infrastructural Disaster Prevention Plan (IDPP) for Mahadevbesi Bridge

Mahadevbesi Bridge was under reconstruction at the time of initial environmental examination as it was damaged by the 1993 Flood. The bridge is on the Prithivi Highway, the country's most important roadway and that it is necessary to protect from the debris flow and flood events, a set of structural measures are planned to conduct.

(2) Infrastructural Disaster Prevention Plan (IDPP) for Kulekhani Reservoir

a. Community Disaster Prevention Plan

The construction works of a series of check dams and gabion structures for river training works in Phedigaon, the upper most area of Kulekhani Watershed Area, are considered as indirect measures to prevent debris from excessively accumulating into the reservoir.

b. Excavation of Sand Accumulated in Kulekhani Reservoir

Major purpose of the plan is to make use of the materials accumulated in the Kulekhani Reservoir as construction aggregate. Background of the plan is that the sand for construction in Kathmandu is in high demand while excavation of sand on the river banks of Bagmati River and its tributaries has been totally banned in July 1996. In view of this, the sand accumulated behind the check

dam should be excavated and transported to Kathmandu.

Within the framework of the Project, a provision of machinery for excavation of sand in Kulekhani Reservoir is also suggested as a part of plan.

- c. Upgrading of the Road Linking Kulekhani Reservoir to Pharpin
Transportation of the sand excavated in Kulekhani Reservoir can become expensive if transported to Kathmandu via Tribhuvan Highway. Thus, in order to make the price of sand competitive, transportation of it to Kathmandu via the road linking Kulekhani Reservoir from Pharpin has been suggested to upgrade. At present, there is a single track vehicular path completed to 10 km section from Pharpin. The rest of 11 km is to be completed by the end of 1997. This road is further expanded to double track paved road for transportation of sand from Kulekhani Reservoir.

(3) Community Disaster Prevention Plan (CDPP)

In order to develop means to prevent disasters induced by torrential rain, disaster prevention plan linked to social and economic development components has been suggested. Community participation is encouraged in the plan. The target areas have been selected from the areas most affected by the torrential rain that triggered the disaster occurred in July 1993. They are Phedigaon and Phatbazar in Palung VDC, Chisapani in Agra VDC and Namtar in Namtar VDC in Makawanpur District.

1.2 Definition of Words Used in the Report

Within this report, the following terminology is adapted to use:

The "Study" refers to the study on the "Disaster Prevention Plan for Severely Affected Area by 1993 Disaster in the Central Development Region of Nepal";

The "Project" refers to a set of project components intended to implement by the Department of Soil Conservation, the Ministry of Forest and Soil Conservation upon completion of the Study.

The "EIA Study" refers to a set of study conducted for environmental impact assessment that is a requirement for relatively large scale development project within the laws and regulations of His Majesty's Government of Nepal.

The "Study Area" refers to a set of areas subject to EIA study based on ecological entity.

1.3 Study Area

1.3.1 Sub-divisions of the Study Area

The Project area is shown in the Figure 1.1. The area subject to study is generally confined in Makawanpur District. However, for the Infrastructural Disaster Prevention Plan (IDPP) for Mahadevbesi Bridge, the area is confined to Dhading District. For the Infrastructural Disaster Prevention Plan (IDPP) for Kulekhani Reservoir, a portion of Kathmandu District is involved. The following watershed areas are noted as major areas of the Project:

(1) Infrastructural Disaster Prevention Plan (IDPP) for Mahadevbesi Bridge;

Lower Agra Khola area that consists of a part of Agra VDC in Makawanpur District and a part of Bhumestan VDC in Dhading District as is shown in the Figure 1.1.

(2) Infrastructural Disaster Prevention Plan (IDPP) for Kulekhani Reservoir;

Upper Bagmati River and Lower Kulekhani River area that consist Chhaimale VDC, Dakshinkali VDC and Talku Dudechaur VDC in Kathmandu District and Markhu VDC, Chilang VDC, Fakei VDC, kulekhani VDC and Sisneri VDC in Makawanpur District is shown in the Figure 1.2.

(3) Community Disaster Prevention Plan (CDPP);

- a. Phedigaon/Phatbazar - Upper Palung Khola - A part of Palung VDC as per Figure 1.3.
- b. Chisapani -Upper Agra Khola - A part of Agra VDC as per Figure 1.4.
- c. Namtar/Tilar -Upper Manhari Khola -A part of Namtar VDC as per Figure 1.5.

1.3.2 General Characteristics of the Study Area

Table 1.1 to 1.4 shows outline of the socio-economic profile of Districts and VDCs in which the Project takes place. General characteristics of the Study Area are:

- a. Ethnic composition consists of mainly Tamang, Brahmin/Chhetri and Danuwar/Sunwar;
- b. There is essentially no seasonal migration of male population for cash income;
- c. Occupation is predominantly "agriculture-on-the-mountain-slope" i.e. maintenance of forest is essential;
- d. Altitude of the Study Area is in the range of 850 m to 2,500 m; and
- e. There is no significant ecological area nor wildlife within the Study Area.

1.4 Project Activities

1.4.1 Infrastructural Disaster Prevention Plan (IDPP) for Mahadevbesi Bridge

In order to protect Mahadevbesi Bridge on the Prithivi Highway in Mahadevbesi VDC, Dhading District, a series of slope protection and river training works in the upstream area of the confluence of Agra Khola to Mahesh Khola is necessary to conduct.

Figure 1.6 shows structural components of the Plan that should take place in the Lower Agra Khola near Mahadevbesi Bridge. Detailed components of the Plan is as follows:

- a. A series of spur dikes, average length of 10 m, in order to reduce the velocity of water in the river are planned to construct in the upstream area of the Mahadevbesi Bridge;

- b. Consolidation dam to check debris of the river is planned to construct across Agra Khola, approximately 500 m upstream of Mahadevbesi Bridge;
- c. Ground sill that holds up large size boulders but allows gravel going through is planned to construct across Agra Khola approximately 1,000 m upstream of Mahadevbesi Bridge.
- d. Subject of further study, an introduction of warning system is considered. This is a measure to close down traffic on the Prithivi Highway upon excessive rainfall. The measure could also be applied to the local residents living in the areas likely to be affected by landslide, flood, and debris flow; and
- e. Subject to further study, zoning regulation is considered to introduce. Hazard map prepared to produce under the framework of the Study should become the basis of zoning regulation. This is to indicate hazard areas that allow no construction of any houses, or conducting any economic activities. Law enforcement is necessary to implement the suggested zoning regulation.

1.4.2 Infrastructural Disaster Prevention Plan (IDPP) for Kulekhani Reservoir

Direct measures that should contribute to reduce sedimentation in Kulekhani Reservoir is to excavate the floor of reservoir and obtain sand for construction works in Kathmandu. For the purpose of the plan, a provision of sand excavation machinery is considered within the framework of the Project.

Improvement of the road linking from Kulekhani Reservoir to Pharpin, Bagmati VDC in Kathmandu District is also a part of plan as is shown in the Figure 1.7.

Lower portions of the road, the one starting from the road on the left bank of Kulekhani Reservoir and the other branching out from the road leading to Pharpin, are already motorable although paving is yet to be conducted. These portions of the road are also subject to expansion for the trucks transporting sand.

There are a series of measures planned to conduct in Phedigaon and Phatbazar, the upper most area of Kulekhani Watershed Area. These measures are the major parts of community development programme for Phedigaon and Phatbazar and they are considered as indirect measures to prevent the reservoir from further sedimentation as per described in the next section.

The Figure 1.14 shows a series of measures recommended to conduct separate from the Project but conducted for their studies within the framework of the Study. These are the measures considered effective to maintain the water level of reservoir so as the normal operation of the electricity generation of the Kulekhani hydro-power station is maintained.

1.4.3 Community Disaster Prevention Plan (CDPP)

(1) Phedigaon and Phatbazar

In relation to the Infrastructural Disaster Prevention Plan (IDPP) for Kulekhani Reservoir, the following is planned to conduct in Phedigaon and Phatbazar, Palung VDC in Makawanpur District as is shown in the Figure 1.8. The Plan is conducted as community development programme based on the concept of the participation of the local residents:

- a. Bio-engineering measures by planting trees and shrubs on the dike slopes in order to stabilize the dike structure;
- b. Agro-forestry programme by planting trees and shrubs on the slopes where terraced farming areas suffer from soil erosion;
- c. Construction of motorable road on the dikes;
- d. Reclamation of farming areas along Phedi Khola; and
- e. Introduction of warning and evacuation system is considered. This measure is integrated as a major portion of community organization to involve the local residents living in the areas likely to be affected by landslide, flood, and debris flow upon excessive rainfall.

(2) Chisapani

As is shown in the Figure 1.9, the following is considered to conduct in Chisapani, Agra VDC in Makawanpur District.

- a. A series of slope stabilization works made of gabion type structure across gullies in the area below the village and bio-engineering works to cover the gabion structures;
- b. River bank and mountain slope protection works as bio-engineering measures of the gullies running through the village;
- c. A series of small scale irrigation and water supply works in order to enhance agricultural activities as well as to a more equal supply of water for the villagers;
- d. Planting forest species as well as shrub for ground cover for mountain slope protection as well as to prevent soil erosion on the farming areas; and
- e. Introduction of warning system is considered. This measure is planned to integrate as a major portion of community organization involving the local residents living in the areas likely to be affected by landslide, flood, and debris flow upon excessive rainfall.

(3) Namtar and Tilar

As is shown in the Figure 1.10, the following is considered to conduct in Namtar and Tilar area, Namtar VDC in Makawanpur District.

- a. A masonry check dam across Syalse Khola draining into Manhari Khola is planned to construct;
- b. A multipurpose check dam that includes mini-hydro power generator of 20 kWh and a ford on the Manhari Khola are planned to construct;
- c. Slope stabilization and protection works along the rural road leading to Namtar and Tilar from Tribhuvan Highway is planned to conduct;
- d. Reinstatement of village irrigation system is planned to conduct; and

- e. Community organization with emphasis on the evacuation system is planned to conduct that involves local residents living in the areas likely to be affected by landslide, flood, and debris flow upon excessive rainfall.

1.5 Present Environmental Conditions

1.5.1 Physico-chemical Environment

(1) Site of IDPP for Mahadevbesi Bridge

a. Topographical Features

The altitude of the area where the slope protection work for the Mahadevbesi Bridge is approximately 600 m above sea level (asl). To the south of the site is the area geographically classified as Mahabharat Mountain Range of 2,400 m asl and to the north is the Sub-Himalayan Mountain Range of above 2,000 m asl. The site is in the area geographically classified as "Mid-Valley" region.

Slope gradient of the mountain side around the site of IDPP is approximately 25-30% whereas the slope gradient of the road that runs generally from east to west is approximately 10-12%.

b. Water in the River

The water of Agra Khola during the dry season forms very small streams running on the relatively wide river bed. During the rainy season, however, the river water activates scouring action in the river as massive amount of water cause to tumble boulders and gravel down the slope. The velocity of river water running on the side of mountain is relatively fast. Thus, visible morphological change of the river takes place during the rainy season. In places, bare mountain slopes slides down during the rain season depending on the amount of rain. With intense rainfall, it causes massive debris flow for further scouring action on the side of the mountain slopes washing portions of terraced farming areas.

c. Geological Conditions

Large boulders and gravel dominate in the sandy clay loam, loamy sand and sandy soil of the area. Boulders are particularly noticeable in the river bed. Geological conditions in this area generally do not encourage people to create farming area. However, because of less porous soil characteristic in this area is relatively fertile comparing to other areas in Nepal. Thus the soil in the area has attracted agricultural activities during the past decades among Nepalese whose tradition to create terraced farming area does not dissuade them from so doing.

(2) Area of IDPP for Kulekhani Reservoir

a. Topographical Features

The altitude of the area where a series of river training works is intended to implement ranges from 1,500 to 2,000 m asl. Geographical classification of the project area in Nepal is termed as Mahabharat Mountain Range and its average height is approximately 2,400 m asl.

Slope gradient of the mountain side in the area around Kulekhani Reservoir and Upper Bagmati River is approximately 25-30%, or more in the further up-slope area. Thus the velocity of river water running on the side of mountain is relatively fast.

Construction work of the road linking to Pharpin from Kulekhani Reservoir has been undertaken for the first 10 km in 1996. The remaining 11 km should be completed by the end of 1997. Present plan of the road is a single track vehicular path.

b. Water in the River

The river water during the dry season forms very small streams. During the rainy season, however, the river water makes scouring action active as massive amount of water tumbles boulders and gravel down the stream. Thus, visible morphological change of the river takes place during the rainy season.

c. Geological Conditions

Large boulders and gravel dominate in the sandy clay loam, loamy sand and sandy soil of the area. Thus geological conditions generally do not encourage people to create farming area. However, because of less porous soil characteristic in this area is relatively fertile comparing to other parts of Nepal. It has therefore attracted agricultural activities during the past decades in the area around Kulekhani Reservoir and Upper Bagmati River.

Material accumulated in the Kulekhani Reservoir has been identified as sand suitable for construction aggregate. It is this reason that the sand is excavated and hauled to Kathmandu for sale. To do so, construction of new road linking to Pharpin from Kulekhani Reservoir.

(3) Areas for Community Disaster Prevention Plan

a. Topographical Features

i. Phedigaon and Phatbazar

The altitude of the upper most area of Kulekhani Khola, or Phedi Khola as is termed by the local residents, where Phedigaon and Phatbazar are located, is between 1,800 to 2,540m asl. Gradient of the slope at the head of the river is more than 40% while it is in the range of 15-25% in the area around Phedigaon and Phatbazar. The gradient of the river levels out toward the area near the confluence of Phedi Khola and Garti Khola.

Slope of the hills to the north of Phedigaon and Phatbazar is generally steeper than the slope to the south. The slope to the south is more fragile and there is a sign of a large block sliding from the slope to Phedi Khola area.

Terraced farming areas dominate the landscape of the mountain slopes in Phedigaon and Phatbazar. Changes of mountain slope for the present terraced farming area have taken place during the past centuries and it has become almost a part of natural landscape.

ii. Chisapani

There are a number of small streams formed within the Ward No.4 of Agra VDC. They stay as stream even during the dry season although the amount of flow is smaller. It is this water that the people in Chisapani make use of for drinking water and irrigation for vegetable farms.

During the rain season, these rivers cause boulders and gravel tumbling down, scouring the bottom and the side of the rivers. Thus morphological changes of the river are visible during and after the rain season. These changes have been causing to disrupt transportation of agricultural commodities as well as transportation of daily necessities for the villagers in places.

Terraced farming areas dominate the landscape of the mountain slopes in the area. The change of mountain slope has taken place during the past centuries and it has become almost a part of natural landscape.

iii. Namtar and Tilar

Namtar and Tilar is located in the upper Manhari Khola area. Its altitude is approximately 850m asl. The slope gradient where Namtar and Tilar is located, which is on the right bank of Manhari Khola, is in the range of 25-40%.

Terraced farming areas are located in the thick forest areas. The change of mountain slope has taken place during the past centuries. However, it would take further centuries if the terraced farming areas become integrated into the natural landscape.

b. Morphology of the Rivers

i. Phedigaon and Phatbazar

There are a number of small streams formed within Palung VDC during the dry season. No streams are formed upstream of Phedi Khola during the dry season while there is relatively abundant water flowing in Garti Khola during the dry season. During the rain season, these rivers cause boulders and gravel tumbling down, scouring the bottom and the side of the rivers. Thus morphological changes of the river are visible during and after the rain season. These changes have been causing to disrupt transportation of agricultural commodities as well as transportation of daily necessities for the villagers in places.

ii. Chisapani

Chisapani is located in the upper most area of Chalti Khola, a tributary to Agra Khola draining to Mahesh Khola. It is located in the area whose altitude is around 1,800 m to 2,540m. Gradient of the slope at the head of the river is more than 40%. Rock and soil conditions of the slopes at the top of river are easy breakable. Thus a number of houses built on the slopes above which land slide is induced by heavy rainfall are in danger throughout the year.

Terraced farming areas are formed in the area above fragile slopes. Morphological changes of the slopes, induced by a combination of heavy rainfall and subsequent land slides in the area have been causing disruption to transport agricultural commodities usually shipped out to Phedigaon or Palung village, other daily necessities transported from Phedigaon to Chisapani.

There are a large number of cracks on the surface of ground in the area to the east of Chisapani. This is a sign of land slide and that the villagers do not cultivate in the area nor live in the area below the slope.

iii. Namtar and Tilar

Confluence of Syalse Khola and Khade Khola to Manhari Khola is almost at the same place on the left bank of Manhari Khola across Namtar Village. Streams of these rivers are with relatively abundant amount of water during the dry season. Because of the gradient of 25-40%, these rivers wash down boulders and gravel during the rain season.

Slope gradient of Manhari Khola is also 25-40 %. Quantity of water in the river is relatively abundant throughout the year. Thus morphological change of the river is visible, particularly during the flood events and that the riverbed is scoured nearly 1 m deep during normal rainy season while more materials are supplied during the rainy season with excessive amount of rain.

c. Geological Conditions

i. Phedigaon and Phatbazar

Large boulders and gravel dominate in the sandy clay loam, loamy sand and sandy soil of the area. Thus geological conditions generally do not encourage people to create farming area. However, because of less porous soil characteristic in this area is relatively fertile comparing to other parts of Nepal. It has therefore attracted agricultural activities during the past decades in the area.

ii. Chisapani

Large boulders and gravel dominate in the sandy clay loam, loamy sand and sandy soil of the area. Thus geological conditions generally do not encourage people to create farming area. However, because of less porous soil characteristic in this area is relatively fertile comparing to other parts of Nepal. It has therefore attracted agricultural activities during the past decades in the area.

iii. Namtar and Tilar

Large boulders and gravel dominate in the sandy clay loam, loamy sand and sandy soil of the area. Thus geological conditions generally do not encourage people to create farming area. However, because of less porous soil characteristic in this area is relatively fertile comparing to other parts of Nepal. It has therefore attracted agricultural activities during the past decades in the area.

1.5.2 Biological Environment

(1) Site of IDPP for Mahadevbesi Bridge

a. Fauna

No observation of significant ground dwelling wildlife has been reported in the area. There are a number of bird species observed. However, no significant bird species subject to protection or endangered to extinction are known to exist in the area.

Fish species are present in the streams. They are rapid stream type of fishes. However, their size is relatively small and that there is no commercial value for the local residents nor the value for home consumption.

b. Flora

As the Figure 1.11 shows, the watershed area of the Lower Agra Khola has been heavily developed for agriculture. A few patches of forest are left in the upper most slopes of the river. Most of them are classified as mixed deciduous trees and 75% of them are hard wood. In places, pine tree forest mixed with deciduous trees are found. A large patch of Rhododendron forest is found on the slope of the right bank of Agra Khola, below the western slope of Chisapani, at about 1,500-1,800m asl.

Because of relatively large concentration of population in the area, trees have been cut down for various purposes since the occupation of the local residents. Thus present trees are immature secondary forest with various crown densities of 10-40%. In the area to the top of mountain slopes, crown density of the forest goes up to 70%. In general, the extent of forest in the watershed area of Agra Khola is on the decline.

(2) Area of IDPP for Kulekhani Reservoir

a. Fauna

Distribution of wildlife in the area is very limited. No observation of significant ground dwelling wildlife subject to protection or endangered to extinction has been reported in the area. Ground marks of wildlife are hardly observed. However, there is a high possibility of jackal and deer are present in the forest areas especially in the area near Kulekhani Reservoir.

There are a number of bird species observed. However, no significant bird species are known to exist in the area.

There is a large community of still water fish species distributed in the Kulekhani Reservoir. Fishery Department of the Ministry of Agriculture has been active to enhance fish population in the reservoir.

No stream water fish species for local consumption is present in the area between Kulekhani Reservoir and Pharpin area.

b. Flora

As the Figure 1.13 shows, the general land use patterns of the area between Kulekhani Reservoir and Dakshinkali VDC in Kathmandu District.

The area on the left bank of Kulekhani Reservoir is covered with relatively thick forest because of the steep slope provided less accessibility for agricultural activities. Most of these forest areas are classified as mixed coniferous forest and dominating species is pine trees. However, the area in the east of the route of road has been heavily developed for agriculture while there are a few patches of forest left in the upper most slopes of the area.

Because of relatively large concentration of human population in the area, trees have been cut down for various purposes since the occupation of the local residents. Thus present trees are immature secondary forest with various crown densities of 10-40%. In places, limited patches of forest with the crown density of 40-70% are found, especially the area on the left bank of reservoir. The extent of natural vegetation in the area is on the decline because of grazing and agricultural activities.

(3) Areas for Community Disaster Prevention Plan

a. Fauna

i. Phedigaon and Phatbazar

Distribution of wildlife in the area is very limited. No observation of significant ground dwelling wildlife subject to protection or endangered to extinction has been reported in the area except for a couple of musk deer in the forest above 2,200m asl.

There are a number of bird species observed. However, no significant bird species are known to exist in the area.

Stream water type of fishes are not present in the streams around Phedigaon and Phatbazar.

ii. Chisapani

Distribution of wildlife in the area is very limited. No observation of significant ground dwelling wildlife subject to protection or endangered to extinction has been reported in the area except for a couple of musk deer in the forest area above 2,200 m.

There are a number of bird species observed. However, no significant bird species are known to exist in the area. No fishes are present in most part of the river.

iii. Namtar and Tilar

There is a possibility of some significant ground dwelling wildlife found in the area. Historically, local residents go out for hunting musk deer and other wildlife species.

There are a number of bird species observed. However, no significant bird species are known to exist in the area.

Stream water fishes are present in most part of the river. However, sizes of them are very small in the upstream area near Namtar and Tilar although

they are caught for home consumption. On the other hand, there are relatively large size of fishes caught for sale in the downstream of Manhari Khola outside of study area.

The area that large size of fishes area caught is limited to the deep and still water area near the confluence to Rapti River. There is a possibility of fishes spawn in the upstream area and grow larger in the downstream area depending on the species. Thus distribution of fish species is subject to further study.

a. Flora

i. Phedigaon and Phatbazar

As the Figure 1.11 shows, the upper most watershed area of Kulekhani Khola, which consists of Palung Khola in the upstream area and that it branches out to Phedi Khola and Gharti Khola, has been heavily developed for agriculture. However, there are a few patches of forest left in the upper most slope of the area. The area to the west of Phedigaon is classified as mixed deciduous trees, predominantly oak trees, and a mixture of pine trees. The forested area to the east of Phedigaon indicates similar feature of vegetation. Crown density of the forested patches around Phedigaon and Phatbazar is about 40-70%.

ii. Chisapani

As the Figure 1.11 shows, there are a few patches of forest in the areas above and below Chisapani, which has been developed on the steep hillside. These forested areas are classified as deciduous forest mixed with coniferous trees. Dominant species is oak mixed with very old Rhododendron. Because of the moisture in the air relatively high throughout the year, development of moss on the branches of the trees in the forest is noted.

There are separate patches of forest in the area below Chisapani. It is a mature forest of Rhododendron mixed with deciduous trees.

Crown density of the forest above Chisapani is between 40-70% while that of below Chisapani is 10-40%. Rhododendron forest should maintain crown density of 40-70% or more in places.

iii. Namtar and Tilar

The Figure 1.12 Land Use in Agra Khola and Upper Kulekhani Khola shows the general land use patters of Namtar and Tilar.

Because of relatively small concentration of population along the river, trees have been cut down in the areas limited to the main stream of the river during the past years. Thus forest in the upstream areas of Namtar and Tilar is relatively mature.

The mountain ranges to the north and the south of Manhari Khola are covered with deciduous forest while there are a few patches of denuded forest near Namtar and Tilar along the river. There is a large size of mature

forest of pine trees on the right bank of the river and this is continued to the upper most area of the watershed area. Their crown density is estimated as high as 70-90 % in most areas.

Most of the immature forest areas located near the top of the mountain range are classified as mixed deciduous forest. Their crown density is approximately 40-70%. Majority of the trees in the immature forest located in the lower altitude are of tropical hardwood type.

1.5.3 Social Environment

(1) Site of IDPP for Mahadevbesi bridge

Table 1.1 shows an outline of the socio-economic profile of the area related to the protection of Mahadevbesi Bridge on the Prithivi Highway.

Most of the area of Lower Agra Khola belongs to Mahadevbesi VDC of Dhading District. Occupation of the population in the Lower Agra Khola is predominantly agriculture conducted on the hill slopes. On the other hand, there is a large area of grazing land distributed within the Lower Agra Khola Area.

There is a recent development of deploying local residents as well as those from outside the Study Area for making construction material in the lower part of Agra Khola. Deployed local residents earn wage according to the amount of construction materials they produce a day. Large boulders at the exit of Agra Khola are manually split to desired sizes of construction aggregate. In places, gravel on the river flow is excavated and sifted for different sizes of construction aggregate.

Table 1.1 shows socio-economic profile of Lower Agra Khola area. Detailed profile of the socio-economic conditions of the area directly affected by the Project is subject to further study.

(2) Area of IDPP for Kulekhani Reservoir

Table 1.2 shows an outline of the socio-economic profile of the area related to the prevention of sedimentation to the Kulekhani Reservoir. Occupation of the population in the area between Kulekhani Reservoir and Pharpin is predominantly agriculture. Standard of life in the area is relatively high. This is mainly due to the fact that the distance to Kathmandu, the largest commercial center in the country, is relatively short.

Detailed profile of the socio-economic conditions of the area directly affected by the Project is subject to further study.

(3) Areas for Community Disaster Prevention Plan

a. Phedigaon and Phatbazar

Table 1.2 shows an outline of the socio-economic profile of Phedigaon and Phatbazar.

Occupation of the population in Phedigaon is predominantly agriculture. There is a demand of porter for transporting agricultural commodities as well as daily necessities consumed in Chisapani. Thus relatively large population of

Phedigaon works as porter.

Detailed profile of the socio-economic conditions of the area directly affected by the Project is subject to further study.

b. Chisapani

Table 1.3 shows an outline of the socio-economic profile of Chisapani.

Occupation of the population in Chisapani is predominantly agriculture. Some of the population in Chisapani work as porter but it is not significant as major occupation in the area.

Detailed profile of the socio-economic conditions of the area directly affected by the Project is subject to further study.

c. Namtar and Tilar

Table 1.4 shows an outline of the socio-economic profile of Namtar and Tilar.

Occupation of the population in Namtar and Tilar is predominantly agriculture. Some of the village population work as blacksmith simultaneously operating grain mill. Fishing is one of the major activities in Namtar and Tilar. The fishing technique has been brought in the area by the tribe living in Terai i.e. there are some ethnic minority that has migrated to Namtar and Tilar area who has brought with them fishing technique.

1.6 Expected Impacts to the Environment

1.6.1 Physico-chemical Environment

(1) Site of IDPP for Mahadevbesi Bridge

a. Morphological Change of Agra River

Morphology of Agra Khola is expected to change to a some extent as a series of structural measures are taken. General slope gradient of the river upstream of the ground sills would be greatly reduced. In effect, the speed of the natural changes on the morphology of Agra Khola will have to be greatly reduced. With the measures, natural course of the river and its scouring action to the floor and the bank of the river at the section of 1 km from the confluence of Agra Khola to Mahesh Khola to upstream area is reduced. Supply of boulders and gravel to Mahesh Khola is also reduced to some extent.

Depending on the quantity of gravel deposited, effect of ground sill that allows gravel going through would attract local residents as gravel should become ready to excavate and sold to construction material buyers. Thus further morphological changes induced by economic activity of the local residents should occur.

Gabion spur dike with bio-engineering measures to increase vegetation on the side of the river should also change natural course of change on the river morphology. However, it is considered as a measure to protect river banks from further erosion. If left as it is now, the road as well as residential areas should

endanger as the river bank erode away i.e. the degree of the changes on the morphology of the river is compensated by the degree of contributions made to the local community's use of the area.

b. Changes in Water Quality and Flow Rate of Agra River

Changes in the quality of water in the river should occur to some extent as still water area increases in the upstream side on ground sill and that it should induce algal growth to some extent. Changes on the flow rate of the river should occur to some extent. However, changes induced by ground sill on the changes of water quality and flow rate is insignificant.

c. Geological Changes

There is no geological change expected to take place as a result of project implementation in the area around Mahadevbesi Bridge.

(2) Area of IDPP for Kulekhani Reservoir

a. Morphological Change on the Mountain Slope

Since paving works of the road leading to Pharpin from Kathmandu is being undertaken, the section subject to study within the framework of the Study for environmental impact assessment is the road between Pharpin in Sheshnarayan VDC, Kethmandu District and Kulekhani Reservoir in Markhu VDC, Makawanpur District. This route of road passes through Sundol and Sanimal in Kathmandu District, and Phakelchaur, Rakaskholagau and Purandi in Makawanpur District.

The following is considered as major impact on the physico-chemical environment with the construction works of the road:

i. Dislodging and Disposal of Materials;

There are a number of places that land slide is likely to occur along the route of road. There are some sections that are not only delicate for road construction works but also there are danger of the risks of land slide. However the road constructions are conducted with precautions, there are very high possibilities to cause accidental dislodgment of fragmented rocks and other materials to the areas below the construction works take place. In places, there are some residential and agricultural areas in the sections below the road construction works take place.

Blasting of rock materials at the section on the steep hillside is necessary. Alternatively, hydro-mechanically operated rock breakers should be used. Either the blasting method or rock breaker method, rock breaking operation should cause fragmented rocks and other materials accidentally rolling down the steep slope of the area and should lodge in the river. In places the materials should lodge in the farming areas. They should cause some negative impact to the river environment and the local social environment respectively. The same should occur during the normal hauling operation.

The excavated materials obtained from the normal excavation operation

should be disposed in the near-by designated areas. The amount expected to dispose to the spoil bank will be relatively small. In places, excavated material should be used for embankment fill and use the area as part of the road. This is a way to minimize the area of spoil bank as well as the disturbance to the mountain slope in the area.

ii. Expansion of Road in the Forest Area;

A section of the road from Kulekhani Reservoir leading to Purandi is wide enough for driving with truck or four-wheel drive vehicle. Expansion of the section of road requires disposal of excavated materials. Some land acquisition of the forest area is necessary.

iii. Operation and Maintenance Works

While the mountain slopes are stable at the moment, road construction works should disturb the stability to some extent. It would mean to cause further small and medium scale slope erosion especially in the areas where streams are created during the rainy seasons. Thus maintenance works on the eroded portions of the road should be conducted by the central government, or a joint effort of the local government and the central government with a large contribution of the local communities concerned with the use of the road.

b. Changes in the Water Quality and Flow Rate of the Streams

No significant changes on the quality and quantity of water in the rivers in the area between Kulekhani Reservoir and Pharpin should take place.

c. Geological Changes

There is no geological change expected to take place as a result of project implementation in the area along the route of the road.

(3) Areas for Community Disaster Prevention Plan

a. Phedigaon and Phatbazar

i. Morphological Change of the Rivers around Phedigaon and Phatbazar

Permanent change on the morphology of Phedi Khola should take place as a result of the river training works and other project components fixing the natural course of the main stream as well as other streams branching out of Phedi Khola. However, overall changes taking place in the river morphology is to safeguard the residential areas as well as their agricultural land.

ii. Water Quality and Flow Rate in the Streams and Rivers

Flow rate of the river should change to some extent. Quality of the water in the river will not change where as the flow rate of the streams around Phedigaon and Phatbazar should take place.

iii. Geological Changes

There is no geological change expected to take place as a result of project implementation in the area around Phedigaon and Phatbazar.

b. Chisapani

i. Morphological Change of the Rivers in Chisapani

Slopes above the presently eroded by gullies are stabilized with bio-technical slope stabilization measures. Gabion structures and a concrete check dam should stop debris from tumbling down on the slope. These measures cause to change natural process of river morphology to some extent. On the other hand, with these measures, possibility of the occurrence of land slide near the village should be greatly reduced i.e. the degree of the changes to the natural environment is compensated by the degree of contributions made to the local society.

ii. Changes in Water Quality and Flow Rate of the Streams in Chisapani

Installation of water supply tank for distribution of drinking water and irrigation water should change natural course of waterway. This is a measure to make better use of limited water sources in Chisapani for improving the standard of life as well as to improve agricultural activities.

iii. Geological Changes

There is no geological change expected to take place as a result of project implementation in Chisapani.

c. Namtar and Tilar

i. Morphological Change of the Rivers in Namtar and Tilar

There are a number of project components causing morphological change of the rivers in Namtar and Tilar as follows:

- A check dam to Syalse Khola;
- A consolidation dam on Manhari Khola;
- A multipurpose consolidation dam on Manhari Khola;
- A multipurpose check dam on Manhari Khola; and
- Reclamation in the river and bank protection works on Manhari Khola.

These structures should change the gradient of the stream toward upstream of these rivers. Thus scouring action of the river is greatly reduced while the process of sedimentation toward the upstream of these structures increase. On the other hand, sedimentation in the downstream of these rivers would be greatly reduced.

ii. Morphological Change of the Mountain Side

The rural road leading from Chunya on the Tribhuvan Highway to Namtar and Tilar is subject to rehabilitation as the hillside is frequently damaged during rainy season. Introduction of bio-engineering road improvement

work stops natural process of dislodging loose materials on the slope. The bio-engineering measures should function to maintain social environment of Namtar and Tilar.

iii. Changes in the Water Quality and Flow Rate of the Rivers

A number of measures taking place in Manhari Khola and Syalse Khola should change water quantity at the point of impoundment. With the impoundment of water, flow rate of river water should also change. It does not cause major inconvenience to the life of the people in Namtar and Tilar nor their economic activities. However, there is a possibility of causing impact to fish species in Manhari Khola to some extent.

iii. Geological Changes

There is no geological change expected to take place as a result of project implementation in Namtar and Tilar.

1.6.2 Biological Environment

(1) Site of IDPP for Mahadevbesi Bridge

a. Fauna

Impact to the existing biological environment could be very small since the site is in the middle of hill slope agricultural area and that the continuity of the forest in Agra Khola, and the local wildlife has been greatly reduced since the occupation of the local residents.

Fish species appears to be extinct in the Agra Khola Basin.

b. Flora

There is no major impact on the vegetation around Mahadevbesi Bridge.

(2) Area of IDPP for Kulekhani Reservoir

a. Fauna

Impact to the existing biological environment could be very small since the site is in the middle of hill slope agricultural area and that the continuity of the forest in Palung Khola, and the local wildlife has been greatly reduced since the occupation of the local residents.

There are a number of fish species in the river.

As excavation of sand as construction aggregate in the Kulekhani Reservoir is intended to conduct, turbidity of water in the reservoir should increase. Depending on the scale of operation, it should affect fish species in the reservoir. Thus turbidity of the water in the river is subject to monitoring and if it was proved to be affecting quality and quantity of fish culture in the reservoir, some sort of preventive measures should be implemented.

Ecological importance of the reservoir is relatively lower than its importance as commercial and domestic values of the fish species in the reservoir. Thus any further study should be made on the basis of commercial importance.

b. Flora

Major impact on the remaining forest patches should occur in places as new road construction takes place.

(3) Community Disaster Prevention Plan

a. Fauna

i. Phedigaon and Phatbazar

Impact to the existing biological environment could be very small since the site is in the middle of hill slope agricultural area and that the continuity of the forest and the distribution of local wildlife in the Phedi Khola basin have been greatly reduced since the occupation of the local residents.

There are a number of fish species in the river. The species, ecological importance and commercial and domestic values are subject to further study. In addition, construction of a check dam across Palung Khola upstream of Palung Bridge has been planned by NEA. Effect on fish species induced by the combination of NEA's work and a series of measures under the frame work of the Study should cause to increase still water type of fish in the area upstream of the river.

ii Chisapani

Impact to the existing biological environment could be very small since the site is in the middle of very steep hill slope dominated by terraced agricultural area. Continuity of the forest and the distribution of local wildlife in the area have already been greatly reduced since the occupation of the local residents.

iii. Namtar and Tilar

Continuity of the forest on both sides of Manhari Khola has been maintained to date. Wildlife, including bird species, should be widely but probably thinly distributed in the Manhari Khola basin. They must be temporarily disturbed by the noise and dust emanated from the construction works.

Introduction of bio-gas plant and micro-hydropower station should greatly reduce the rate of cutting trees for fuel in the basin. There should not be any permanent nor cumulative nature of impacts on the biological environment in Manhari Khola basin.

b. Flora

i. Phedigaon and Phatbazar

Afforestation programme, mainly in the form of community forestry and

agro-forestry programme for individual farmers, should enhance to increase crown cover of Phedigaon and Phatbazar as a whole. No introduction of exotic variety is intended to plan.

ii. Chisapani

Afforestation programme, mainly in the form of community forestry and agro-forestry programme for individual farmers, should enhance crown cover of the area as a whole. No introduction of exotic variety is intended to plan.

iii. Namtar and Tilar

There is no community forestry programme intended to conduct within the framework of the Project. However, agricultural programme should make emphasis on the agro-forestry programme that should increase crown cover of the area to some extent.

1.6.3 Social Environment

(1) Site of IDPP for Mahadevbesi bridge

Protection of Mahadevbesi Bridge would eliminate the great risk on the disruption of transportation system that is linked to the national level of economy. Economic conditions of the local communities should also be protected as the bridge is protected.

Negative impact induced by the structural measures of constructing check dam and ground sill would be to realign existing foot path, which are used during the dry season.

Direct benefits to the local communities induced by the construction of access road to the construction site of check dam and ground sill should be small since the length of the road from Mahadevbesi Bridge is relatively short.

Job opportunities generated by the construction works should cause positive impact to the local economy on the condition that the local residents are deployed for the construction works.

(2) Area of IDPP for Kulekhani Reservoir

a. Land Acquisition

The present road from Pharpin is not paved nor wide enough for the trucks transporting sand. At present, the first 10 km section from Pharpin in Pharpin VDC, Kathmandu District, is expected to complete by the end of the dry season in 1996/97. The remaining 11 km section should be completed by the end of the dry season in 1997/98. Thus improvement of the road should be conducted for the entire length of 21 km.

With the works for expanding the width of the road, acquisition of land areas is involved. Approximately 6.3 ha (extra 3m for expansion of the road x 21,000m) of area is subject to land acquisition and 35 % of the area, or 2.3 ha, is forest area owned by the Government of Nepal.

Acquisition of a part or entire residential areas of about 28 houses should also be involved in the plan. Thus compensation for these houses should be made.

b. Local Demand of Road Construction and Their Willingness to Participate

Desire to build a motorable road going through the area is very high and most of the local residents are willing to participate the road construction works as unskilled or skilled labour at nominal rate of wage or even at free of charge i.e. land acquisition in the area should not pose any severe socio-economic problem.

Willingness of the local community to construct the road linking Pharpin and Kulekhani Reservoir is noticeable. Local residents are willing to participate the road construction work as unskilled labour at free of charge. It should probably the way to exchange local labour for the environmental degradation and the land acquisition of agricultural land and residential areas for the new road.

c. Changes of the Land Use Patterns

As a result of road construction in the area, land use patterns of the area between Pharpin and Kulekhani Reservoir should be greatly changed upon completion of the road construction works. The changes should be made toward the more income generating agricultural activities i.e. more vegetables grown in the area than the varieties of agricultural commodities for home consumption.

(3) Areas of Community Disaster Prevention Plan

a. Phedigaon and Phatbazar

Construction of all weather surface road on the dike planned to construct along Phedi Khola would enable to speeding up and more quantity of the flow of commodities throughout the year. On the other hand, these conveniences of moving commodities should further accelerate the rate of developing the hill slope agricultural activities without leveling terraces. This should help to increase the rate of cutting trees for fuel, rate of expanding grazing areas or correcting fodder leaves for raising domestic animals.

Land use patterns in Phedigaon and Phatbazar should change to a great extent. With an implementation of community forestry programme, including tree and shrub planting in the agricultural area and the river training area would demonstrate that the awareness on the importance of environmental management with tree planting should increase to a very large extent.

b. Chisapani

Measures planned to implement in Chisapani village is to protect terraced agricultural area. No significant negative impact should be induced by the measures to the local community.

Land use patterns in Chisapani should change to a great extent. With an implementation of community forestry programme, including tree and shrub planting in the agricultural area and the river training area would demonstrate that the awareness on the importance of environmental management with tree planting should increase to a very large extent.

c. Namtar and Tilar

Most of the measures planned to implement in Namtar and Tilar should function to enhance local economy.

Land use patterns in Namtar and Tilar should change to a great extent. With an implementation of community forestry programme, including tree and shrub planting in the agricultural area and the river training area would demonstrate that the awareness on the importance of environmental management with tree planting should increase to a very large extent.

1.7 Expected Environmental Management Programme

1.7.1 Site of IDPP for Mahadevbesi bridge

- (1) Regulations on the controlled excavation of river floor materials in Agra Khola should be imposed.
- (2) Introduction of early warning system should function as a means to manage social environment of the local communities.
- (3) Ground sill, revetment works and gabion spur dikes intended to conduct in the area are considered, as a whole, to function as environmental management programme by themselves.

1.7.2 Area of IDPP for Kulekhani Reservoir

- (1) Regulations on the controlled excavation of materials in the Kulekhani Reservoir should be imposed.
- (2) Acquisition of land is involved in the plan as road construction takes place. Any improvement of the land should be compensated.
- (3) Relocation of the local residents whose properties are subject to compensation should be made. Depending on the preference of local people, monetary compensation or land-to-land compensation should be considered.
- (4) Operation of the sand excavation works should be accompanied with the monitoring programme on the water quality. If excessive, silt protection should be installed so as to disturb nor fish population in the reservoir.

1.7.3 Community Development and Disaster Prevention Plan

(1) Phedigaon and Phatbazar

Introducing community forestry, river training works, tree and shrub planting works for slope protection as well as to increase fodder and fruit-bearing trees, and the maintenance work on the slope of newly created dike should all function as environmental management measures for the local communities.

(2) Chisapani

Introducing community forestry, river training works, bio-engineering measures, water supply system, tree and shrub planting works for mountain slope protection as well as to increase fodder and fruit-bearing trees should function as environmental management measures.

(3) Namtar and Tilar

Fish species caught in the river should be reproduced by means of fish culture method. These fishes have to be released to the area up-stream of the multi-purpose check dam so as to redistribute fish species in the upstream area of Namtar and Tilar.

1.8 Expected Environmental Monitoring Programme

1.8.1 Community Organization

Introduction of early warning system and zoning regulations on hazardous areas that law enforcement for it is an important part should function as integrated part of the environmental monitoring programme. Other detailed programme for environmental monitoring is subject to further study.

1.8.2 Reintroduction of Fishes

Fish population and distribution in Manhari River has not been closely studied yet. Since there is a possibility of impounding water in the upstream area of Namtar and Tilar, migratory course for fishes in the river could be separated by the dam. Thus further monitoring on the catches of fish in the upstream and downstream of the multi-purpose check dam in the river should be conducted while redistribution of fishes to the river is conducted as a part of environmental management programme.

1.8.3 Turbidity of Water in Kulekhani Reservoir

As excavation of sand in the Kulekhani Reservoir is intended to conduct, turbidity of water in the reservoir should increase. Depending on the scale of operation, it should affect fish species in the reservoir. Thus turbidity of the water in the river is subject to monitoring.

1.9 References

1.9.1 Existing Government Reports Related to the Project

- a. A Report on and Photo Documentation of the Phedigaon Flood Relief Programme and the Primary School Development, Integrated Development Consultants, 1995.
- b. The Bagmati Watershed Project, Integrated Development Consultants, 1995.
- c. An Appraisal of Kulekhani Integrated Watershed Management Project, Integrated Development Consultants, 1995.

1.9.2 Maps

- a. Topographical map, scale - 1:25,000, HMG Survey Department, Kathmandu, Sheet No. 2785 06C, 2785 05D, 2785 06A, 2785 05B.
- b. Land Use Map, scale-1:50,000, HMG Survey Department, Kathmandu, 1984.

1.9.3 Publications

- a. Land Resource Mapping Project Land System Report, Land System Maps, 1:125,000 Scale, Survey Department, Ministry of land Reform, HMG of Nepal.
- b. Woman in Nepal - Some Statistical Facts, Central Bureau of Statistics, Nepal, 1995.
- c. Statistical Year Book of Nepal, Central Bureau of Statistics, Nepal, 1995.

Table 1.1 Socio-economic Profile in Lower Agra Khola Area

(1) District Profile: Dhading		d. Infrastructure Development		No.
Area (km ²)	1,926	School		24
No. of H/Hold	51,273	Dispensary		0
Average Size of H/H	5.4	Connecting Point to Motorable Road		3
Population	278,068	Post Office		3
Density of Population(persons/km ²)	144.4	Police Post		3
		Irrigation System		2
		Agri/Veterinary Sub-center		0
		Electricity Outlet		19
(2) Profile of Lower Agra Khola Area				
a. Population		No.		
i. Tasarpu VDC	4,321			
No. of H/Hold	688	e. Water Supply		No.
Average Size of H/H	6.3	Village Tap		73
		Spring Water		109
		Piping Without Tap		4
ii. Thakre VDC	6,842	River Water		156
No. of H/Hold	1,249			
Average Size of H/H	5.5	f. Sanitation		%
		Latrine		2
iii. Bhumesthan VDC	7,521	No Latrine		98
No. of H/Hold	1,401			
Average Size of H/H	5.7	g. Occupation		%
		Agriculture		93.2
b. Ethnic Composition	%	Business		4.6
Tamang	20	Govt. Services		0.2
Magar	2	Labour/Wage Works		2.0
Danuwari/Sunwar	0			
Gurung	1	h. Land Use		%
Brahmin/Chhetri	75	Mature Forest		0
Newar	1	Immature Forest		0
Dhami/Kami & Others	1	Grazing Land		29
		Rice Field (Level)		26
c. Literacy	%	Upland Crop Area		25
Primary	14.9	Shrub		20
Lower Secondary	3.0			
Higher Secondary	0.4			
Higher Education	0.1			
Reading and Writing	10.2			
Average Literacy	27.3			

Note) Population Data based on 1991 Census
n.a. - Data Not Available.

Table 1.2 Socio-economic Profile in Upper Kulekhani Khola Area

(1) District Profile: Makawanpur			
Area (km ²)	2,426	e. Water Supply	No.
No. of H/Hold	60,500	Village Tap	27
Average Size of H/H	5.2	Spring Water	20
Population	314,599	Piping Without Tap	0
Density of Population(persons/km ²)	129.7	River Water	0
(2) Profile of Palung VDC			
a. Demography	No.	f. Sanitation	%
Population in Palung VDC	6,454	Latrine	1
No. of H/Hold	977	No Latrine	99
Average Size of H/H	6.6		
b. Ethnic Composition	%	g. Occupation	%
Tamang	42.0	Agriculture	86.8
Magar	4.3	Business	7.1
Danuwari/Sunwar	0	Govt. Services	0.2
Gurung	0.5	Labour/Wage Works	6.0
Brahmin/Chhetri	32.5		
Newar	14.6		
Dhami/Kami & Others	6.0		
c. Literacy	%	h. Land Use	%
Primary	18.5	Mature Forest	0.9
Lower Secondary	6.5	Immature Forest	42.1
Higher Secondary	1.0	Rice Field (Level)	20.5
Higher Education	0.4	Upland Crop Area	36.5
Reading and Writing	12.9	Shrub	0
Average Literacy	41.5	Grazing Land	0
d. Infrastructure Development	No.		
School	28		
Dispensary	1		
Connecting Point to Motorable Road	13		
Post Office	4		
Police Post	n.a.		
Irrigation System	n.a.		
Agri/Veterinary Sub-center	0		
Electricity Outlet	32		

Note) Population Data based on 1991 Census
n.a. - Data Not Available.

Table 1.3 Socio-economic Profile in Upper Agra Khola Area

(1) District Profile: Makwanpur			
Area (km ²)	2,426	e. Water Supply	No.
No. of H/Hold	60,500	Village Tap	5
Average Size of H/H	5.2	Spring Water	0
Population	314,599	Piping Without Tap	0
Density of Population (persons/km ²)	129.7	River Water	0
(2) Profile of Agra VDC			
a. Demography			
Population	6,839	f. Sanitation	%
No. of H/Hold	1,252	Latrine	1
Average Size of H/H	5.5	No Latrine	99
b. Ethnic Composition			
	No.	g. Occupation	%
Tamang	60.0	Agriculture	96.6
Magar	2.4	Business	1.40
Danuwar/Sunwar	0	Govt. Services	0.03
Gurung	1.6	Labour/Wage Works	1.97
Brahmin/Chhetri	26.6		
Newar	0		
Dhami/Kami & Others	9.4		
c. Literacy			
	%	h. Land Use	
Primary	11.9	Mature Forest	0
Lower Secondary	2.0	Immature Forest	33
Higher Secondary	0.4	Grazing Land	8
Higher Education	0.1	Shrub land	15
Reading and Writing	7.2	Rice Field (Level)	15
Average Literacy	21.7 %	Upland Crop Land	29
d. Infrastructure Development			
	No.		
School	8		
Dispensary	0		
Connecting Point to Motorable Road	0		
Post Office	1		
Police Post	0		
Irrigation System	0		
Agri/Veterinary Sub-center	0		
Electricity Outlet	0		

Note) Population Data based on 1991 Census
n.a. - Data Not Available.

Table 1.4 Socio-economic Profile in Upper Manhari Khola Area

(1) District Profile: Makwanpur			
Area (km ²)	2,426	e. Water Supply	No.
No. of H/Hold	60,500	Village Tap	6
Average Size of H/H	5.2	Spring Water	0
Population	314,599	Piping Without Tap	0
Density of Population(persons/km ²)	129.7	River Water	0
(2) Profile of Namtar VDC			
a. Demography	No.	f. Sanitation	%
Population	7,999	Latrine	1
No. of H/Hold	1,331	No Latrine	99
Average Size of H/H	6.0		
b. Ethnic Composition	%	g. Occupation	%
Tamang	30	Agriculture	81
Magar	5	Business	5
Danuwari/Sunwar	55	Govt. Services	12
Gurung	2	Labour/Wage Works	2
Brahmin/Chhetri	5		
Newar	1		
Dhami/Kami & Others	2		
c. Literacy	%	h. Land Use	%
Primary	10.2	Mature Forest	24
Lower Secondary	6.8	Immature Forest	47
Higher Secondary	3.7	Grazing Land	0
Higher Education	0.4	Shrub	12
Reading and Writing	9.4	Rice Field (Level)	14
Average Literacy	30.5	Upland Crop Area	3
d. Infrastructure Development	No.		
School	14		
Dispensary	0		
Connecting Point to Motorable Road	1		
Post Office	0		
Police Post	0		
Irrigation System	1		
Agri/Veterinary Sub-center	0		
Electricity Outlet	0		

Note) Population Data based on 1991 Census
n.a. - Data Not Available.

Table 1.5 Socio-economic Profile in Kulekhani Dakshinkali Area

(1) District Profile: Makawanpur		b. Ethnic Composition		%
Area (km ²)	2,426	Tamang		20
No. of H/Hold	60,500	Magar		2
Average Size of H/H	5.2	Danuwari/Sunwar		0
Population	314,599	Gurung		1
Density of Population(persons/km ²)	129.7	Brahmin/Chhetri		75
		Newar		1
		Dhami/Kami & Others		1
(2) District Profile: Kathmandu		c. Literacy		%
Area (km ²)		Primary		14.9
No. of H/Hold	81,139	Lower Secondary		3.0
Average Size of H/H	5.2	Higher Secondary		0.4
Population	421,258	Higher Education		0.1
Density of Population(persons/km ²)		Reading and Writing		10.2
		Average Literacy		27.3
(2) Profile of Lower Agra Khola Area		d. Infrastructure Development		No.
a. Population	No.	School		8
i. Markhu VDC	3,137	Dispensary		0
No. of H/Hold	581	Connecting Point to Motorable Road		1
Average Size of H/H	5.4	Post Office		1
ii. Chitlang VDC	6,442	Police Post		1
No. of H/Hold	1,136	Irrigation System		0
Average Size of H/H	5.7	Agri/Veterinary Sub-center		0
iii. Fackel VDC	4,446	Electricity Outlet		5
No. of H/Hold	772			
Average Size of H/H	5.8			
iv. Kulekhani VDC	2972	e. Water Supply		%
No. of H/Hold	535	Village Tap		28
Average Size of H/H	5.6	Spring Water		30
		Piping Without Tap		1
		River Water		41
v. Sisneri VDC	3562	f. Sanitation		%
No. of H/Hold	612	Latrine		2
Average Size of H/H	5.8	No Latrine		98
vi. Chhaimale VDC	3675	g. Occupation		%
No. of H/Hold	668	Agriculture		93.2
Average Size of H/H	5.5	Business		4.6
		Govt. Services		0.2
		Labour/Wage Works		2.0
vii. Dakshinkali VDC	3478	h. Land Use		%
No. of H/Hold	613	Mature Forest		0
Average Size of H/H	5.7	Immature Forest		12
		Grazing Land		29
viii. Talku Dudechaur VDC	2601	Rice Field (Level)		18
No. of H/Hold	465	Upland Crop Area		21
Average Size of H/H	5.6	Shrub		20

Note) Population Data based on 1991 Census.

Village taps are shown in percentage instead of number.

n.a. - Data Not Available

Concerned VDC: Marku, Chitlang, Fackel, Kulekhani and Sisneri VDC in Makawanpur District and Chhaimale, Dakshinkali, and Talku Dudechaur VDC in Kathmandu District

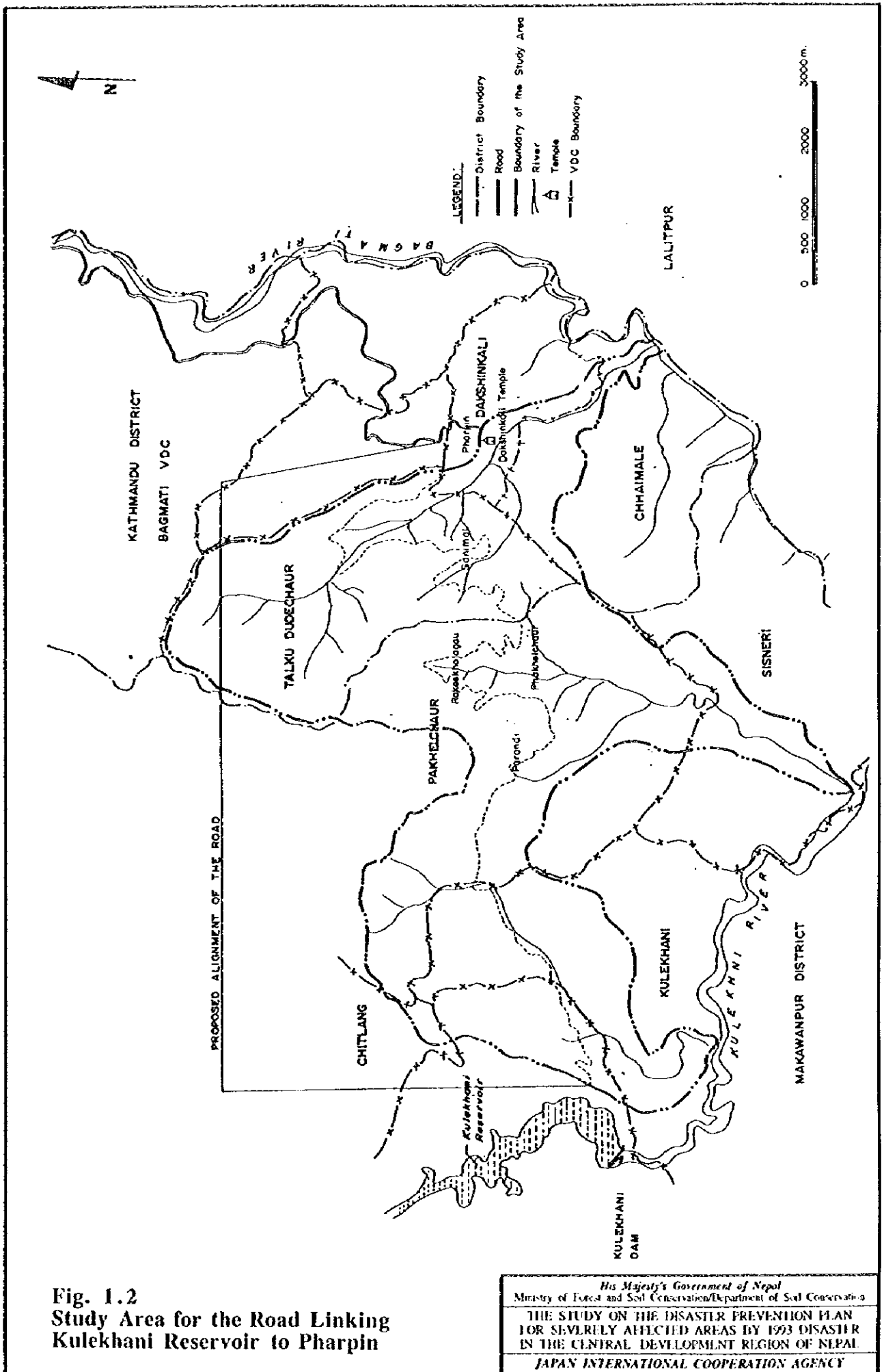
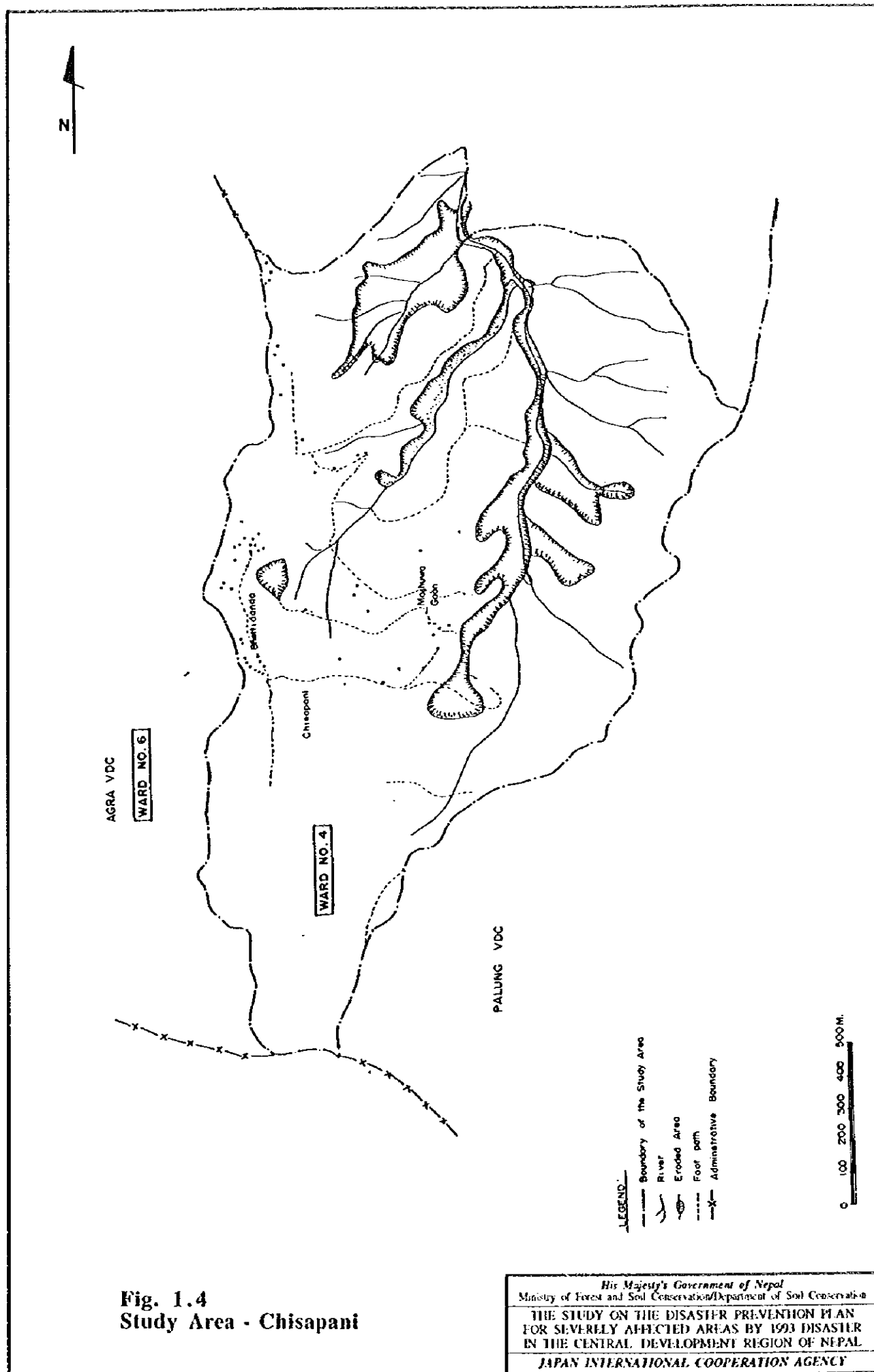


Fig. 1.2
Study Area for the Road Linking
Kulekhani Reservoir to Pharpin

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



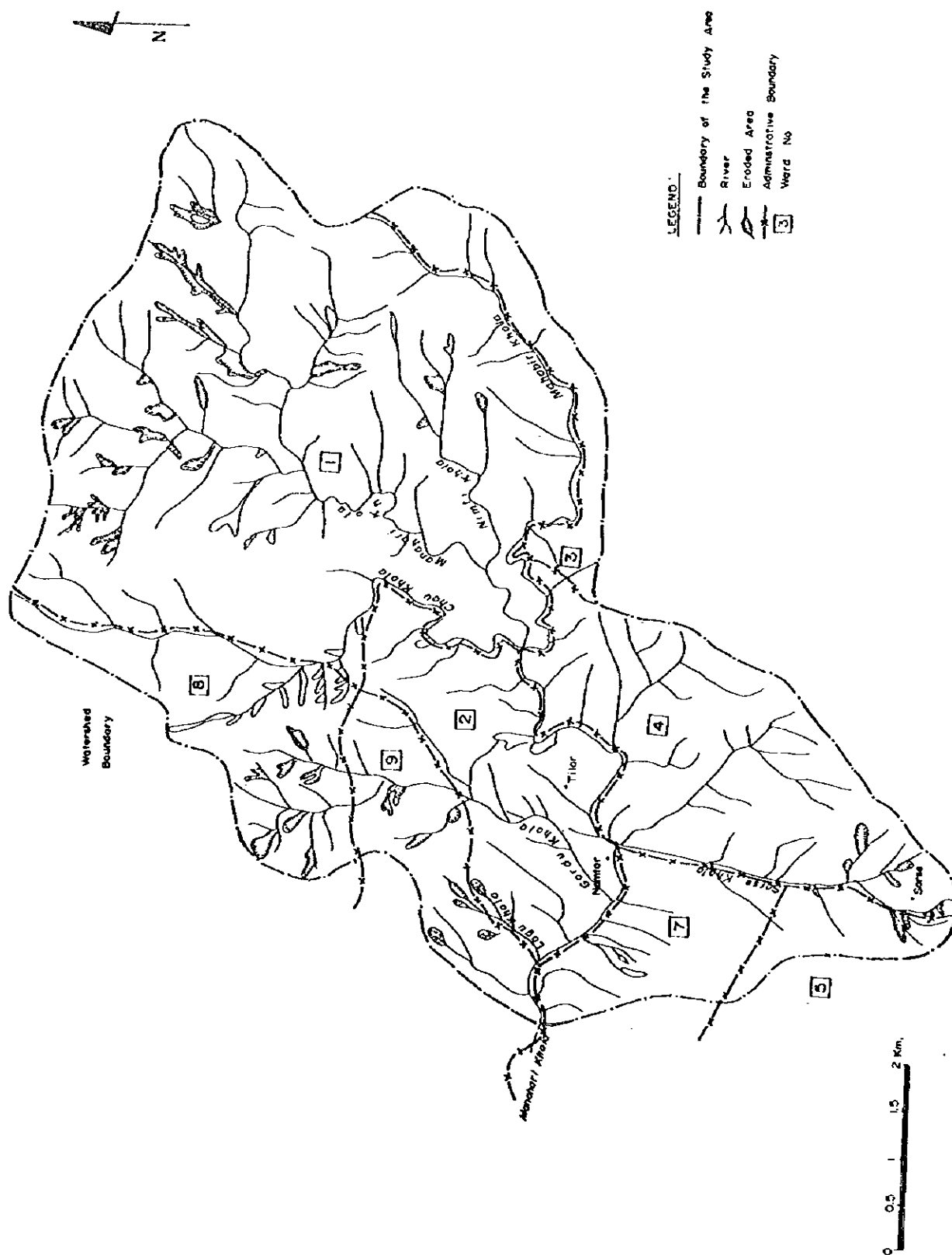


Fig. 1.5
Study Area- Namtar/Tilar

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

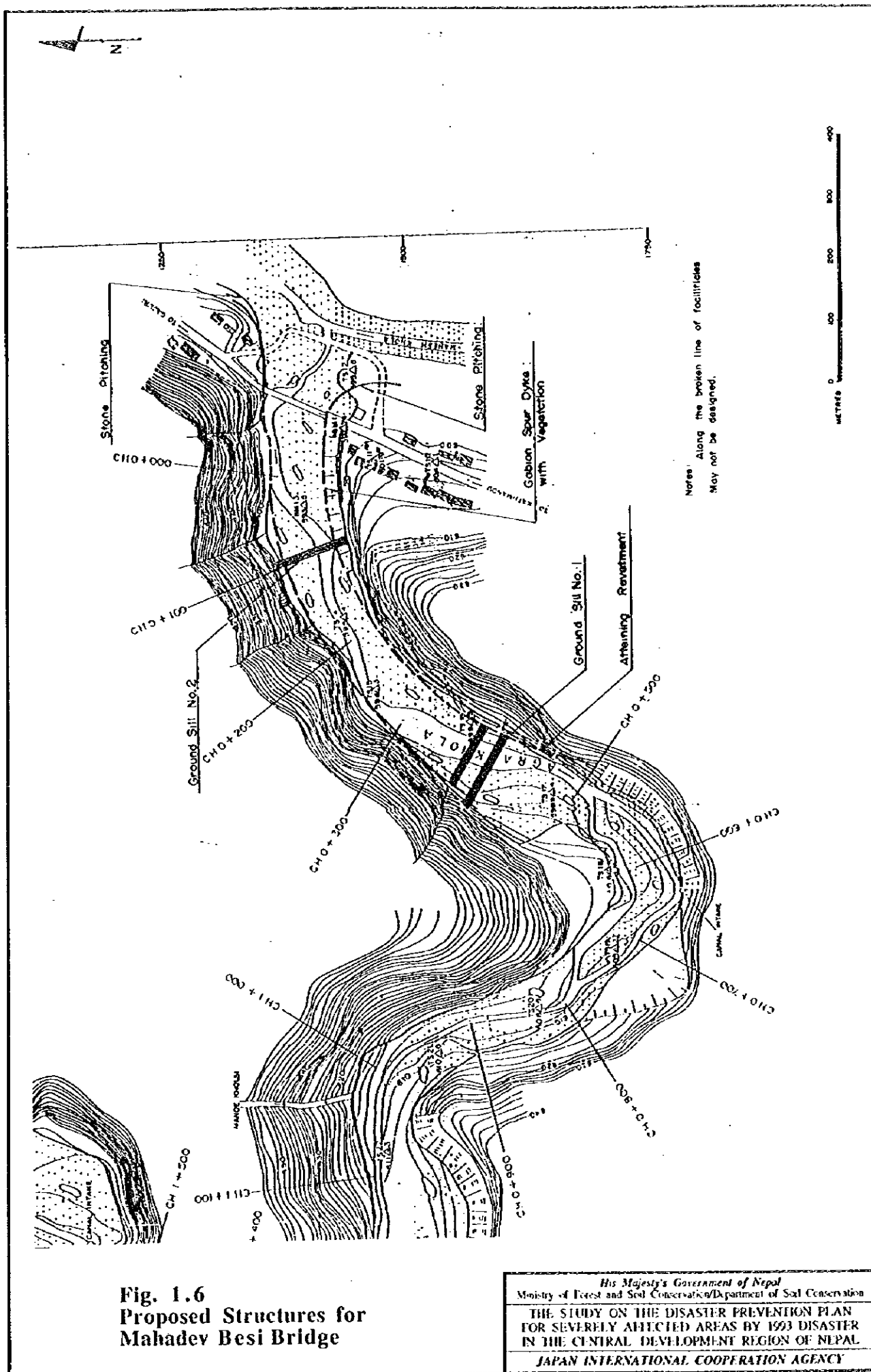


Fig. 1.6
Proposed Structures for
Mahadev Besi Bridge

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

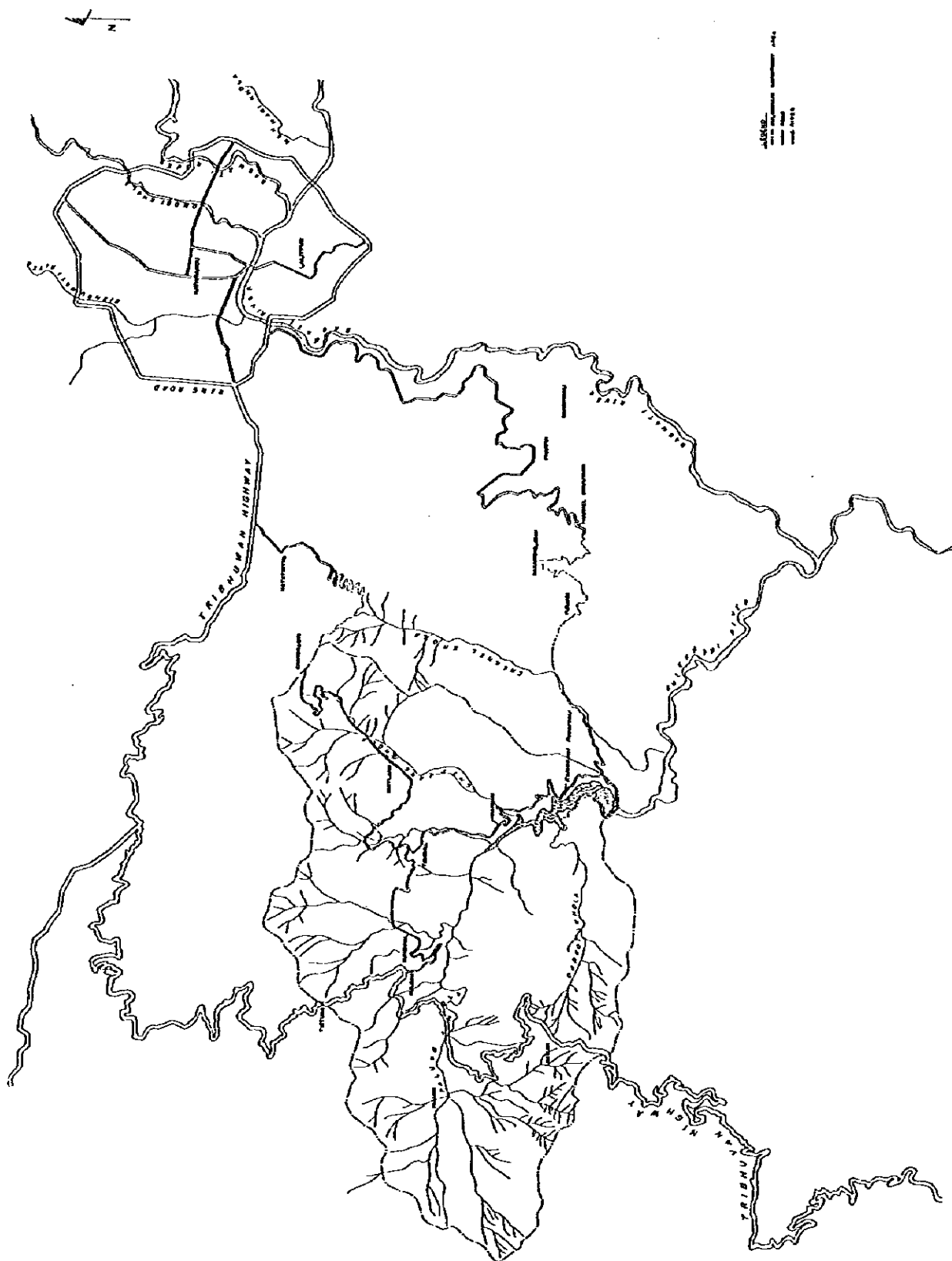


Fig. 1.7
Proposed Alignment of the Road
Linking from Kulekhani
Reservoir to Pharpin

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

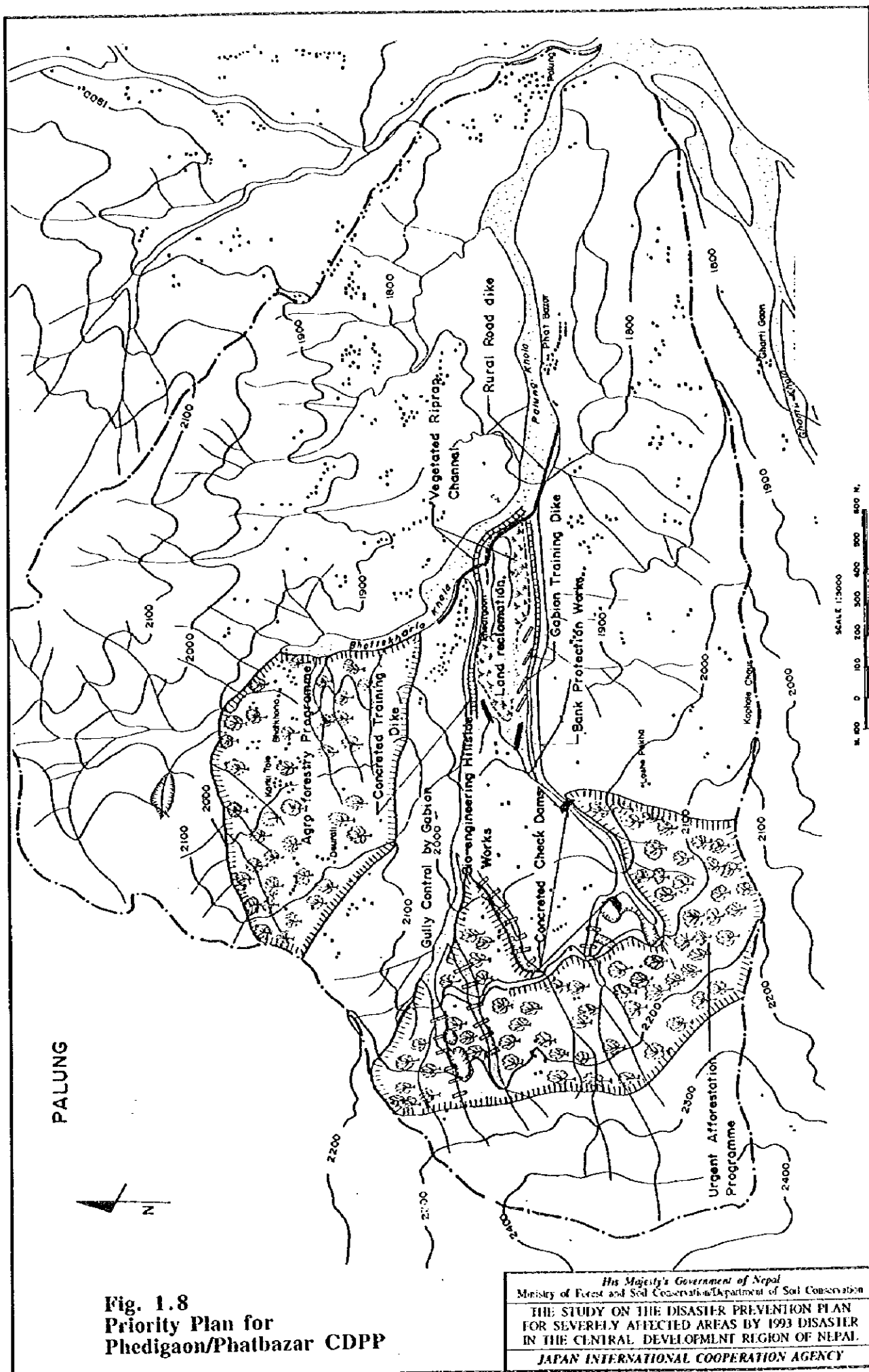
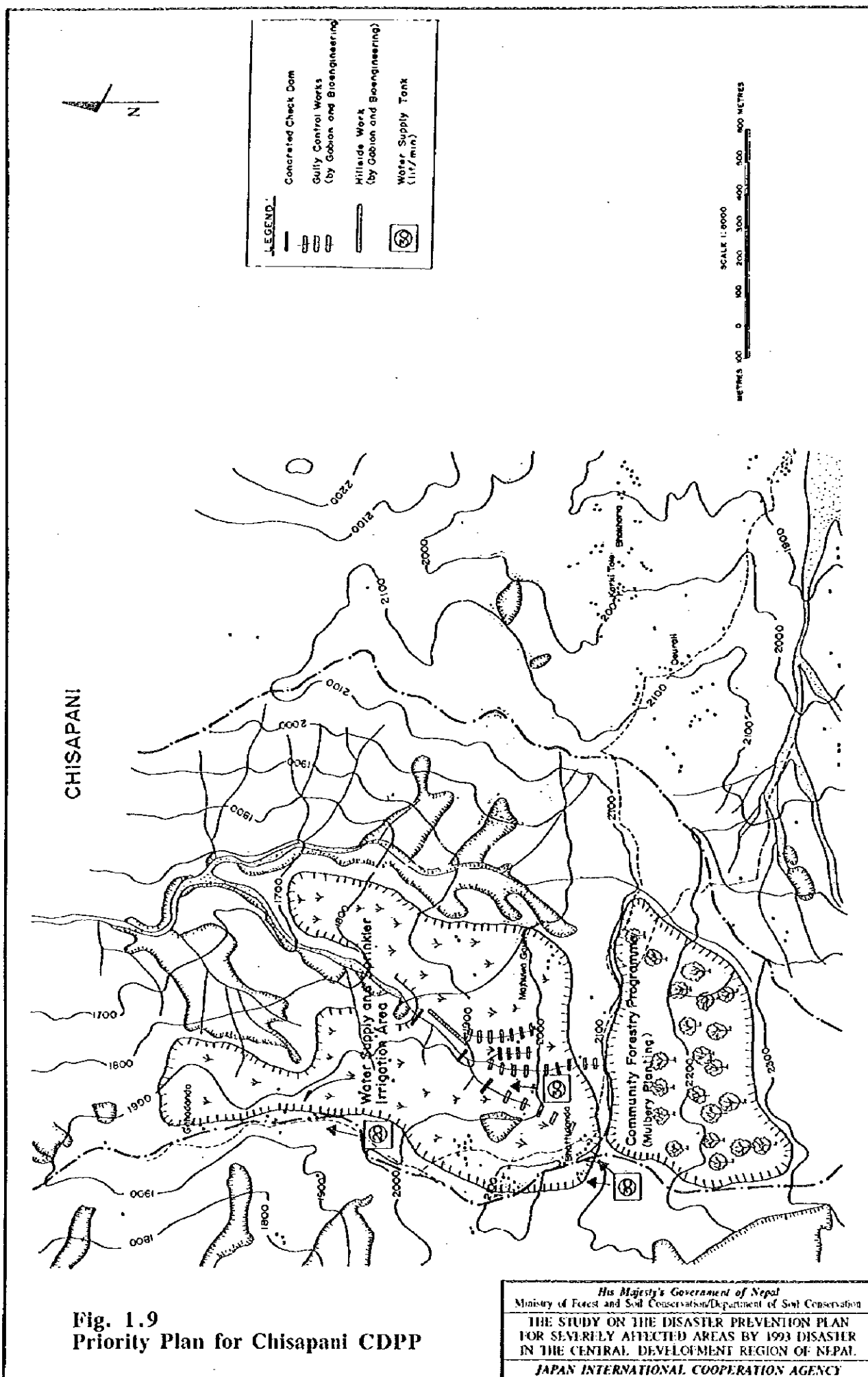


Fig. 1.8
Priority Plan for
Phedigaon/Phatbazar CDDP



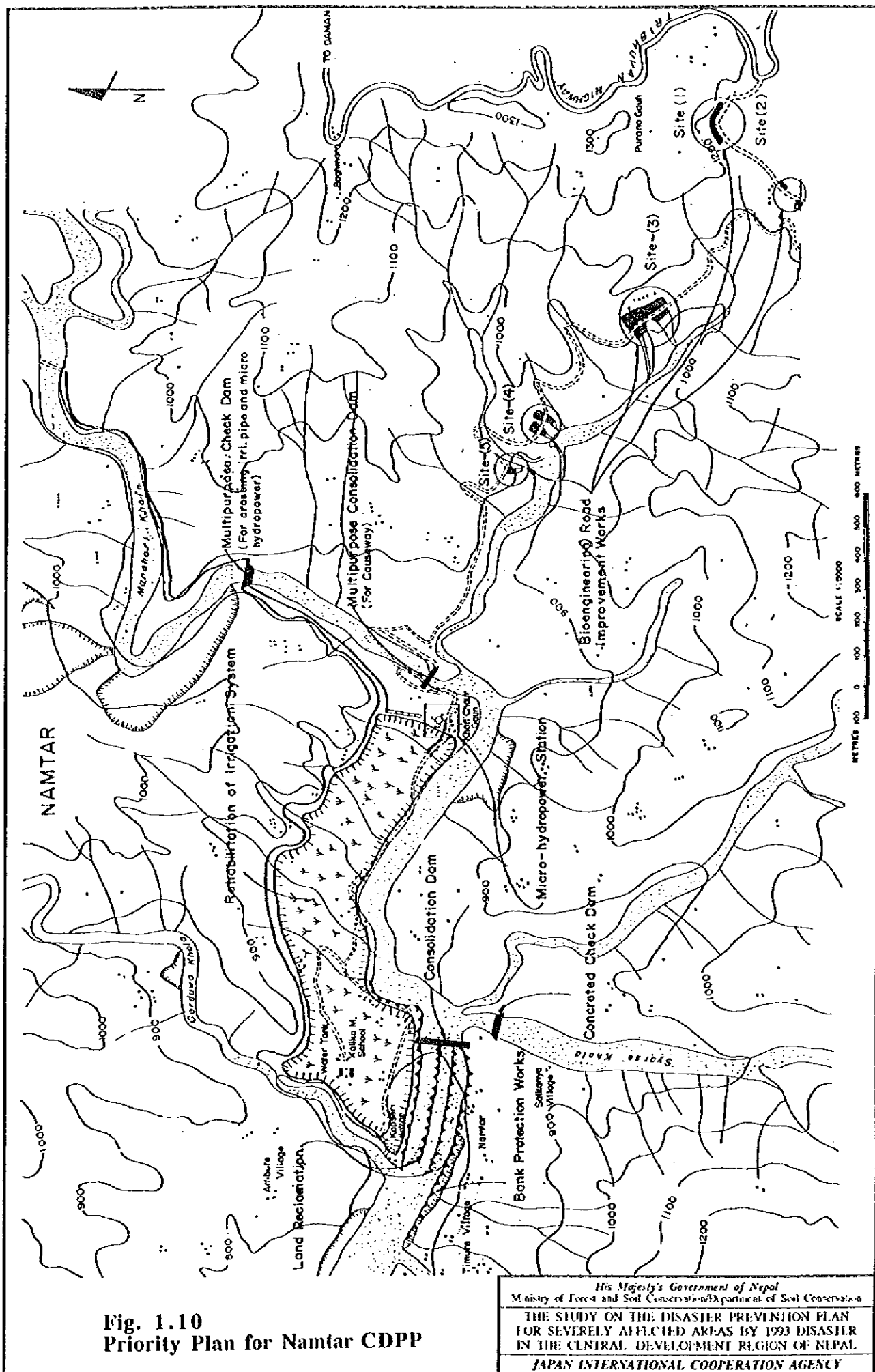


Fig. 1.10
Priority Plan for Namtar CDPP

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 1973 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL**
JAPAN INTERNATIONAL COOPERATION AGENCY

LAND-USE LEGEND

TERAI CULTIVATION

Wet Lands W
Upper Wetlands W
Dry Lands D
Mixed Lands X

HILLSLOPE CULTIVATION

Level Terraces T
Steep Terraces C
Intense 75% - 100% cultivated 3
Medium 50% - 75% cultivated 2
Light 25% - 50% cultivated 1
Abandoned A

VALLEY CULTIVATION

Valley Floors, including Tors, Footslopes and/or Alluvial Fans which are too small to map V
Tors, Alluvial Fans and/or Lower Footslopes F

GRAZING LANDS

Sub-Tropical Zone <1000 m 1
Warm Temperate Zone 1000 m - 2000 m 2
Temperate Zone 2000 m - 2600 m 3
Cool Temperate Zone 2600 m - 3000 m 4
Sub-Alpine Zone 3000 m - 4000 m 5
Alpine Zone >4000 m 6

NON AGRICULTURAL LANDS

Perpetual Snow and Ice I
Rocks A
Scree/Gravel/Boulders B
Lakes L
Urban U

DOMINANT CROPPING PATTERNS

MONSOON SEASON	WINTER/DRY SEASON
Rice	Fallow
Rice	Oilseed
Rice	Pulses
Rice	Cereal
Wheat-Rice	Fallow
Maize-Rice	Winter crop
Maize or Millet	Fallow
Maize	Mustard
Maize	Cereal
Maize	Pulses
Maize	Portulac
Maize + Pome	Winter crop
Cereal + Fallow	Fallow
Portulac	Fallow-Fallow
	Fallow
	Misc
	Super Cane
	Other

Land use boundaries: Double monsoon crop in brackets (i.e.) Fallow winter crop in square brackets (i.e.)

TYPE LEGEND SAMPLE

Level Terraces Rice-Rice-Fallow Rice-Polyed Pulses
50-75% Cultivated Rice-Cereal
Land-use Boundary

FORESTRY LEGEND

COVER TYPE

C - Coniferous - 75% or more of tree species are coniferous
H - Hardwood - 75% or more of tree species are hardwoods
M - All other combinations of tree species
S - Shrub/shrub vegetation which may include hardwood regeneration

SPECIES TYPE

Tropical Types

Sol - Shoreal forest
KS - Kailash forest and Dandak forest
Py - Pinus roxburghii (Chir Pine)
TMH - Tropical mixed hardwoods

Temperate and Alpine Types

DMB - Deciduous mixed broad leaved
Q - Quercus (Oak) all species
Bu - Betula (Birch)
A - Abies, spruce and other
P - Pinus wallichiana (Blue Pine)
Td - Tsuga dumosa (Hemlock)

Species of forest which may form a minor or infrequent component within a major type will be shown by subscripts in lower case. Species abbreviation is shown by the subscripts d.

c - Centers present in hardwood mix
ce - Cedrus deodora (Cedar)
cl - Cupressus torulosa (Cypress)
d - Degraded, caused by heavy logging of trees for fodder and/or fuel
pw - Pinus wallichiana (Blue Pine)
lg - Larix griffithiana (Larch)
pw - Pinus wallichiana (Blue Pine)
sp - Pinus sp. (Pinus)
td - Tsuga dumosa (Hemlock)

Major species are noted. When feasible more than one species or species group is given, if possible in order of predominance, e.g. APw for an Apes stand with Pinus wallichiana

CONDITION TYPES

R - Rock or rock outcrop with scattered trees
S - Safe and size - arrow indicates downwind direction
Br - Burn - area of burn leaving little or no residual stand
Pl - Plantation
PF - Protection Forest - forests with management problems due to site fragility

CROWN DENSITY

Expressed as a percentage of the area covered by tree crowns
1. <40% (non-forest type)
2. 40-60%
3. 60-70%
4. >70%

MATURITY CLASS

M - Mature to overmature - trees have reached at least estimated rotation age or saw timber size
I - Immature or small timber size material
R - Rejuvenation - new regeneration to pole size

TYPE LEGEND SAMPLE

M A Bu Id AM
Mixed wood Fir Birch (Hemlock) >70% Mature
Forest Boundary

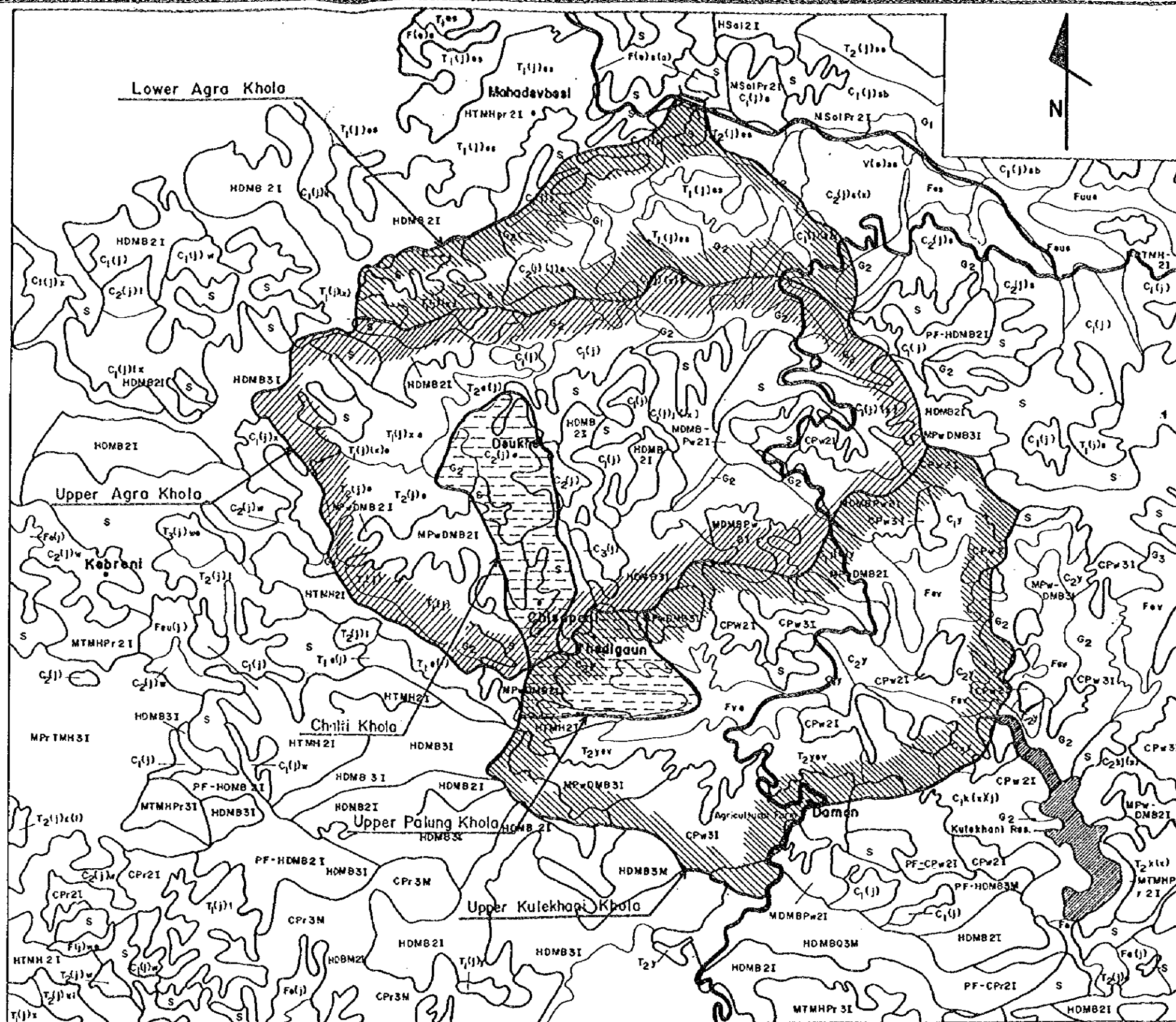


Fig. 1.11
Land Use in Agra Khola and Upper Kulekhani Khola
(Makwanpur and Dhading District)

Source: Land Utilization Map, Central Development Region, Nepal,

1:50,000, H.M.G. Survey Department, 1984

M. 1000 500 0 1 2 3 4 5 Km.

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 1973 DISASTER
IN THE CENTRAL DEVELOPMENT REGION OF NEPAL
JAPAN INTERNATIONAL COOPERATION AGENCY

LAND-USE LEGEND

TERAI CULTIVATION

Wet Lands : W
Upper Wetlands : W
Dry Lands : D
Mixed Lands : M

HILLSLOPE CULTIVATION

Level Terraces : T
Sloping Terraces : C
Intense : 75% - 100% cultivated : 3
Medium : 50% - 75% cultivated : 2
Light : 25% - 50% cultivated : 1
Abandoned : A

VALLEY CULTIVATION

Valley Floors, including Tars, Footslopes and/or Alluvial Fans which are too small to map : V
Tars, Alluvial Fans and/or Lower Footslopes : F

GRAZING LANDS

Sub-Tropical Zone : 1000m - 2000m : 1
Warm Temperate Zone : 2000m - 2600m : 2
Cool Temperate Zone : 2600m - 3000m : 3
Sub-Alpine Zone : 3000m - 4000m : 4
Alpine Zone : 4000m - 5000m : 5

NON AGRICULTURAL LANDS

Perennial Snow and Ice : I
Rock : R
Sand/Gravel/Boulders : B
Lakes : L
Urban : U

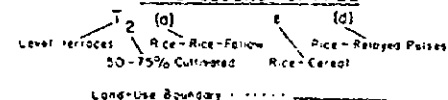
DOMINANT CROPPING PATTERNS

MONSOON SEASON	WINTER/DRY SEASON
Rice	Follow
Rice	Oilseed
Rice	Pulses
Rice	Cereal
Maize-Rice	Follow
Maize-Rice	Winter crop
Maize-Millet	Follow
Maize	Mustard
Maize	Cereal
Maize	Pulses
Maize	Potato
Maize + Potato	Winter crop
Cereal	Follow
Cereal-Follow	Follow-Follow
Potato	Follow

Mixed
Sugar Cane
Other

Land use underlined : Double monsoon area in brackets : () Relayed water area in square brackets : []

TYPE LEGEND SAMPLE



FORESTRY LEGEND

COVER TYPE

C - Coniferous - 75% or more of tree species are coniferous
M - Hardwood - 75% or more of tree species are hardwoods
U - All other combinations of tree species
S - Shrubland vegetation which may include hardwood regeneration

SPECIES TYPE

Tropical Types

Sol - Shore robust
KS - Khasi, Khasi and Dandara sassa
Pr - Pines, roxburghii (Chir Pine)
TMH - Tropical mixed hardwoods

Temperate and Alpine Types

DNB - Deciduous mixed broad leaved
D - Oak (Oak) all species
Bu - Betula (Birch)
A - Abies spectabilis and Abies pinnatifida
Pw - Pines, wallichiana (Blue Pine)
Ts - Tsuga dumosa (Himalayan)

Species of interest which may form a minor or infrequent component within a major type will be shown by subscripts in lower case. Species abbreviation. Severe degradation is shown by the subscript d.

c - Cedrus present in hardwood mix
ce - Cedrus deodora (Cedar)
ci - Cedrus toruosa (Cypress)
d - Degraded, caused by heavy logging of trees for fodder and/or fuel
ju - Juniperus wallichiana (Juniper)
lg - Larix griffithiana (Larch)
pw - Pines, wallichiana (Blue Pine)
so - Pinus smithiana (Banquet)
ts - Tsuga dumosa (Himalayan)

Major species are noted when feasible more than one species or species group is given, if possible in order of predominance, e.g. 2Pw for an Abies stand with Pines wallichiana.

CONDITION TYPES

P - Rock or rock outcrop with scattered trees
Br - Bare area and/or - or low indicates down-slope direction
Pl - Planted
PF - Protection Forest - forests with management problems due to site fragility

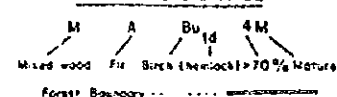
CROWN DENSITY

Expressed as a percentage of the area covered by tree crown
1 - <10% (Non-forest type)
2 - 10-40%
3 - 40-70%
4 - >70%

MATURITY CLASS

M - Mature to pre-mature - trees have reached or nearly reached maximum size
I - Immature or small - timber size material
R - Reproduction - new regeneration to some size

TYPE LEGEND SAMPLE



Source : Land Utilization Map, Central Development Region, Nepal,
1:50,000, H.M.G. Survey Department, 1984

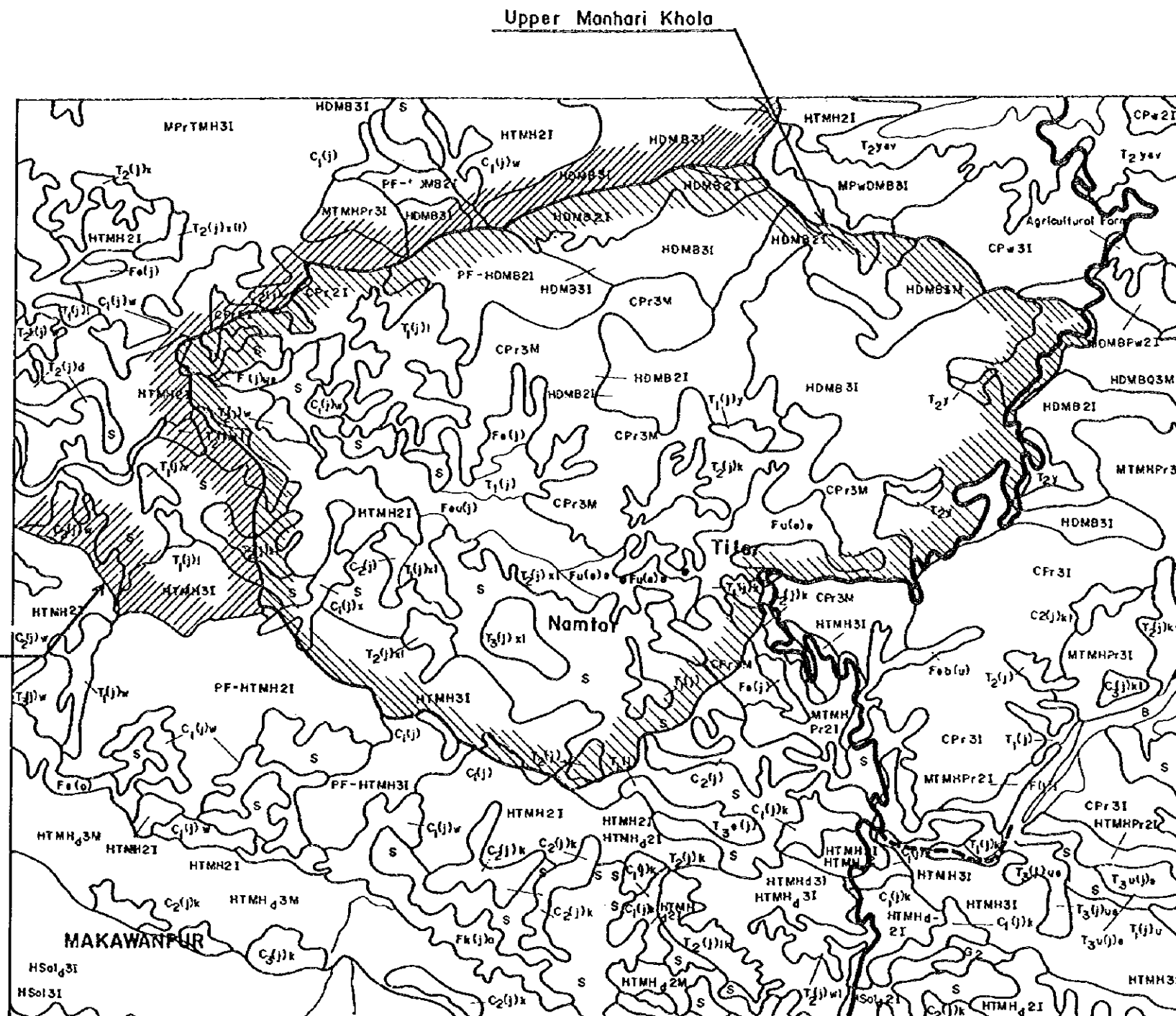
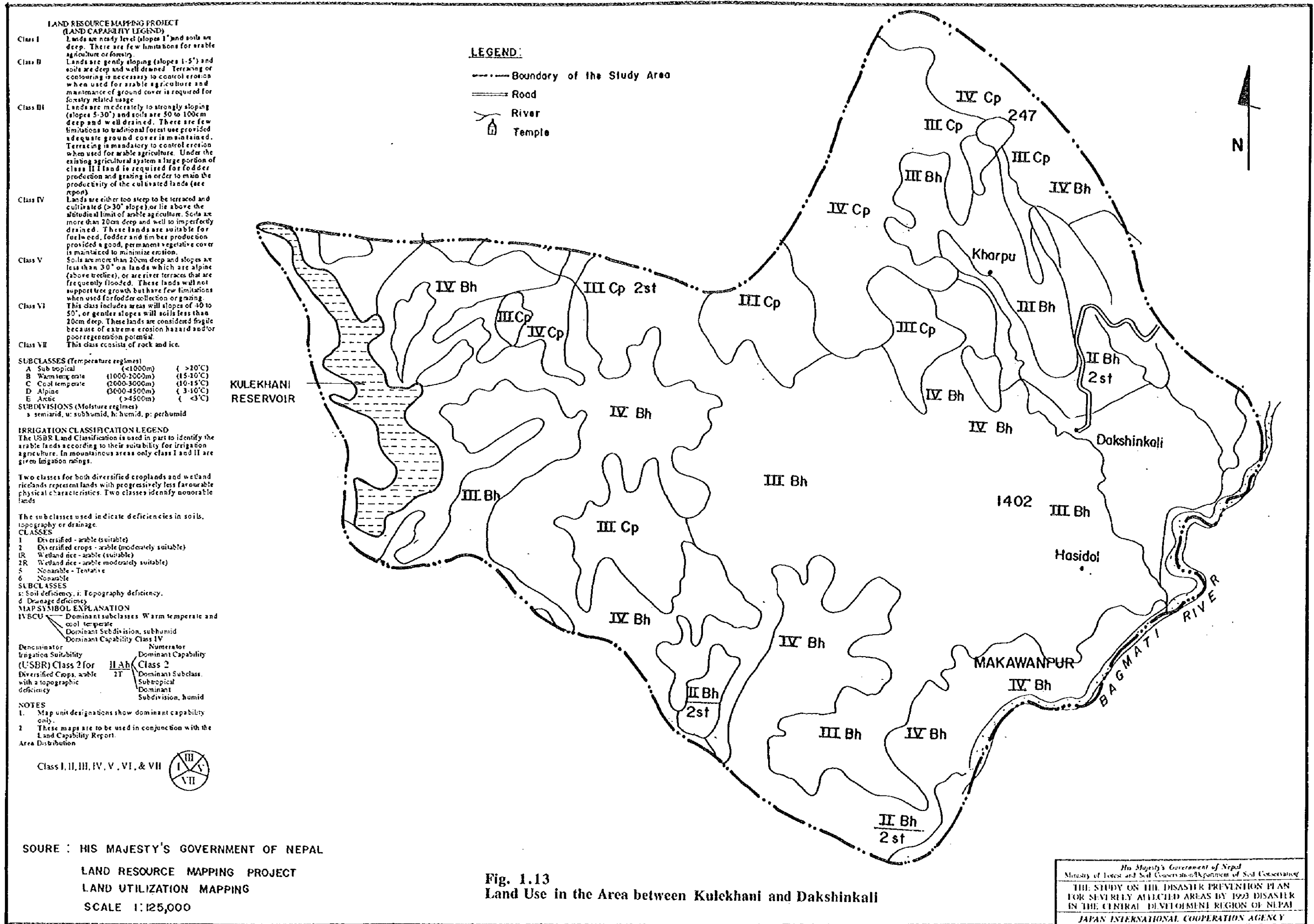


Fig. 1.12
Land Use in Upper Manhari Khola
(Makwanpur District)

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



KULEKHANI RESERVOIR

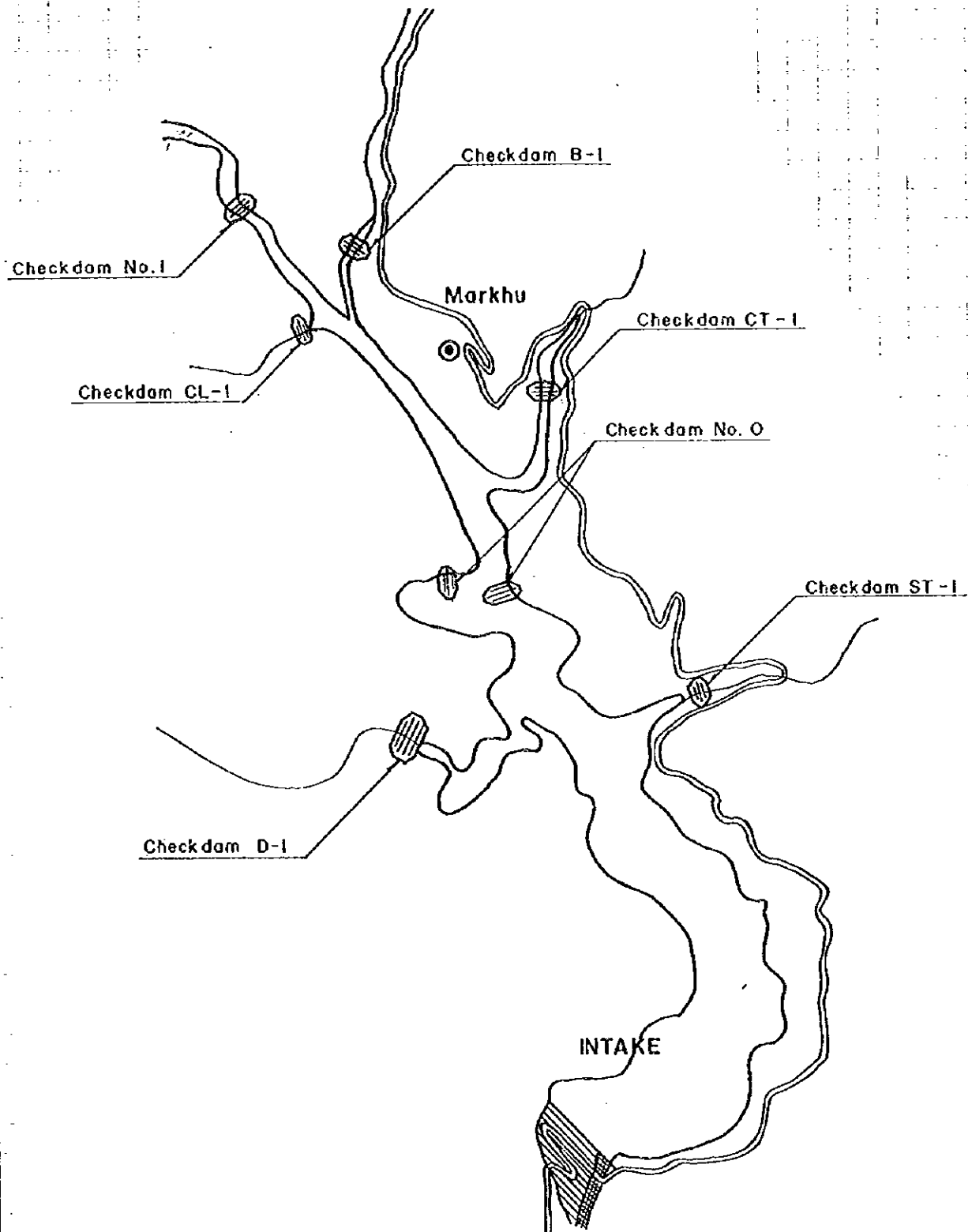


Fig. 1.14
Location Map of Proposed Check Dam Site
in and around Reservoir

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 1.1 Phedigaon: Land potential for community forestry



Photo 1.2 Phedigaon: Gully formed by Dhungakate Khola, stone quarry at the top



Photo 1.3 *Alnus nepalensis* saplings growing at Dhungakate riverside, stone accumulated by 1993 landslide



Photo 1.4 Phatbazar: Agricultural land under reclamation covered due to landslide, after 3 years

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 1.5 Degraded land in Chisapani village of Agra VDC

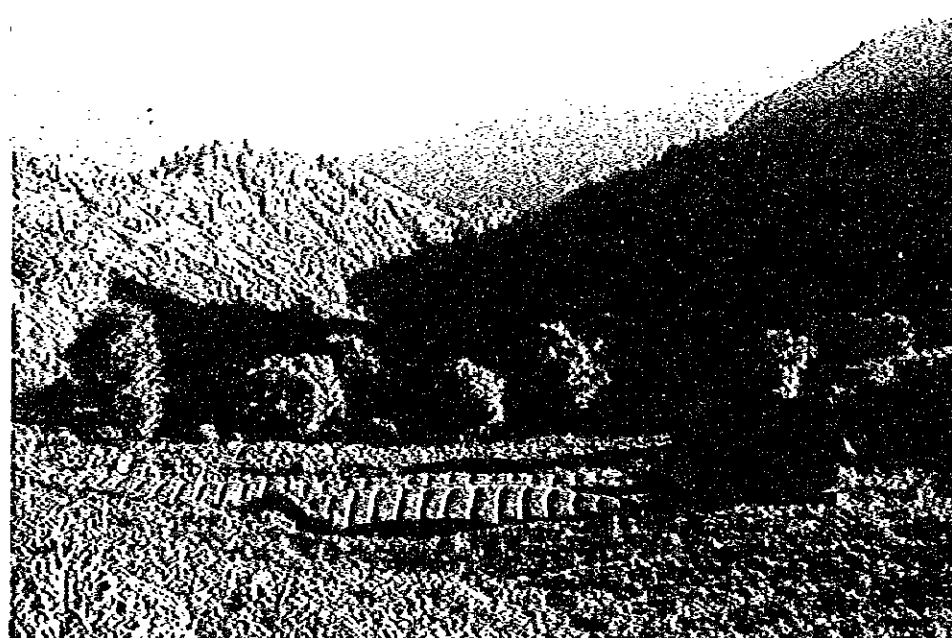


Photo 1.6 Agro-forestry practice in Chisapani village, Agra VDC

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



Photo 1.7 Syarse Khola accumulated debris to Manahari Khola in front



Photo 1.8 Women in rice transplantation mood in Namatar village, Namatar VDC

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

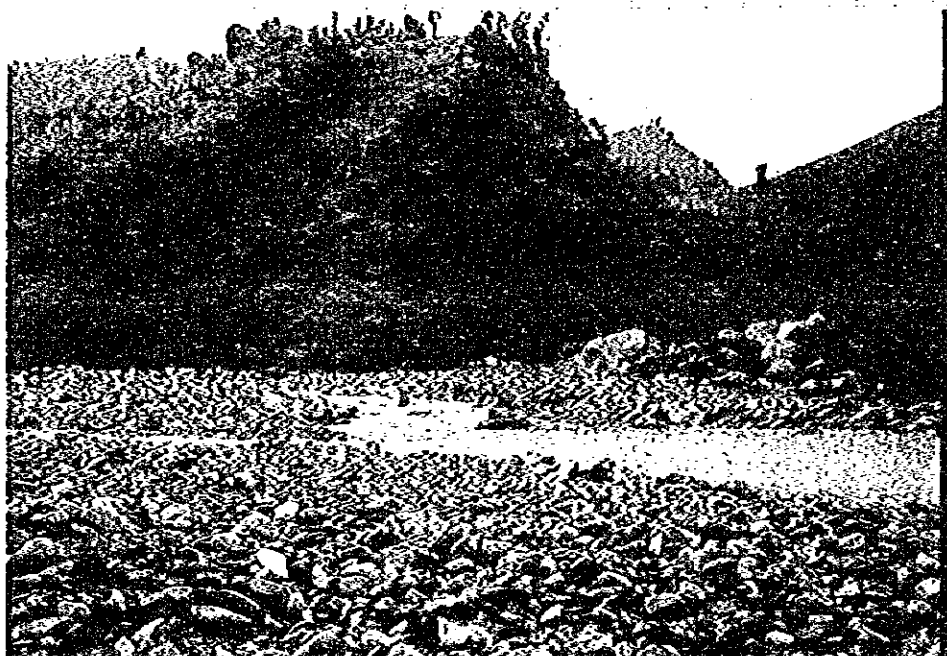


Photo 1.9 Confluence of Agra and Liti Khola, the color of Liti Khola changes into red when it rains in the uphill with soil erosion



Photo 1.10 Victims of environmental disaster people from Sangramtar compelled to shift from fishing to some crushing work

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