CHAPTER 4

COMMUNITY DISASTER PREVENTION PLAN FOR NAMTAR/TILAR

4. COMMUNITY DISASTER PREVENTION PLAN FOR NAMTAR/TILAR

4.1 Background of Community

4.1.1 Topography and Geology

The Manhari River originates from the Mahabharat Range, flows through Namtar, and joins the Rapti River in the Terai plain after incising the mountains. The Namtar/Tilar area is located on the river terrace at an elevation of about 860 m, about 10 km downstream of the headwaters of the Manhari Khola.

Figure 4.1.1 shows the longitudinal profile of the Manhari river. As shown in the profile, a clear knick point at which the river gradient changes suddenly is found about 4 km upstream of the Namtar community. The average river gradient in the upstream part is from 1/6.5 to 1/5, and in the downstream part is 1/59.

The geological formation of the study area consists of Nuwakot Complex (Upper Paleozoic) and Bhimphedi Group as shown in Figure 4.1.2. The watershed upstream of Namtar is composed of granites, amphiboles, marbles, quartzites, limestones, schists, conglomerates, sandstones, and siltstones. The rocks generally dip towards the north-east with an angle ranging between 50 and 80 degrees. In addition to MBT and MT, there are also many transverse faults.

The granite is deeply weathered and gives rock fragments which contain sands, gravels, cobbles, and boulders. In contrast to other rock types, the persistency of joints in granite is very good.

A thick sequence of quartzites (Dunga Quartzite Member) is observed at the confluence of the Dunga Khola and the Manhari Khola.

Bhimphedi Group contains relatively high-grade meta-sedimentary rocks. Bhimphedi Group begins (in the ascending order) with Raduwa Formation which is composed of coarse crystalline, garnetiferous biotite-muscovite schists with quartzite intercalations.

The coarse crystalline, thick-bedded marbles constitute the rocks of Bhainsedobhan Marble.

Kalitar Formation consists of dark green-grey biotite and biotite-muscovite schists and micaceous quartzites. The schists from the lower part of the formation contain granites. A high alternation of schist and pale-green quartzite is observed in Pandrang Quartzite Member. From the villages of Namtar/Tilar to Kalikatar, Manhari Khola flows frequently through Pandrang Quartzite Member. Many rockslides observed on the banks of the Manhari Khola are on schists and quartzites of Kalitar Formation.

4.1.2 Landuse

Figure 4.1.3 shows the land use map of the Namtar community. The houses and cultivated fields are scattered around the river terraces and the toes of the slopes and ridges.

Paddy is planted mostly on the lowest terrace; corn, potatoes and cauliflower on the lower terrace; maize on the highland; and ginger and garlic on the middle where cultivated fields

exist. Fruit plantation is observed in a wide range over the Khade Khola basin.

No particular distribution pattern of the houses is observed, but most houses are located on the wide terraces and the gentle slopes. Some houses are located on the margin of the terraces and directly under the terrace scarps.

Several water mills and cultivated land are found on the present river channel which was filled up by the sediment deposits brought by the 1993 disaster. Now there are five water mills and the farmers are trying to plant maize and paddy over the flood plain made by the 1993 disaster.

4.1.3 Socio-economy

Namtar and Tilar are in Namtar VDC, Makwanpur District. It takes one and a half hours from Hetauda by car if the access road, about 6.5 km between Chuniya on Tribhuvan Highway and the Namtar village, is motorable (it is usually not motorable during the monsoon season). The elevation of Namtar is around 800 to 900 m above the sea level, which makes Namtar special: Namtar can provide agricultural goods for Hetauda and other areas in the Terai in a timely manner.

The population of Namtar VDC in 1994 was about 8,000, according to the Central Bureau of Statistics, while Ward No. 2, which includes the Namtar village and the Tilar village, has about 820 according to the interview of a Namtar VDC secretary and a member of Ward No. 2 conducted by the Study Team (Namtar VDC does not have census data right now). The community of Namtar that the Study Team focused may consist of mainly Ward No. 2 and some parts of Wards No. 4 and No. 7. Therefore, the total population of the community may be a little bigger than 820.

Regarding caste groups in Ward No. 2 in Namtar VDC, 47 % of the total population is classified as Brahmin and Chhetri, 42 % as Tamang, 9.5 % as Damai, and 1.5 % as Kami (refer to Table 4.1.1).

The people in Namtar have a strong community with good intention. Their minds are set on community development, and in the discussions no one gave a selfish opinion or tried to divert the discussion to fulfil his self interest. It seems that there are many people who are well educated and have generous minds. One of the reasons for the Namtar people to have such a mature community may be that they are so close in distance to Hetauda: Frequent contacts with Hetauda make the Namtar people well informed of and influenced by updated information , technology, civilisation, and so forth.

The Namtar people say that since a suspension bridge, a secondary school, a sub health post, and a VDC office have been constructed or under construction after the 1993 disaster, the inclination to migration has gradually disappeared. They look like having a hope and a strong will for development and being ready for participation in development activities.

It is observed in Namtar that there are several successful foreign aid activities. A typical example is the suspension bridge built by using a donation from Japanese private individuals. Another good example is the secondary school reconstruction with the help from multiple donors such as Swiss Disaster Relief Fund, Japanese privates, UNICEF, and some other organisations. (For more information on the school, the result of SLC is satisfactory and the school won several times awards in cultural and song competitions.) A typical example of people's participatory projects is the construction of several wooden

bridges that were constructed 100 % the people. Many previous small wooden bridges were washed away by the 1993 disaster.

4.2 Description of the Disaster

4.2.1 Disaster Damages to the Community

Although there are many landslides observed along the Manhari Khola, Syarse Khola, Gorduwa Khola, Khade Khola, and other small torrents, only a few places are defined as the hazardous areas except for the area along the Manhari Khola.

The flood of July 1993 devastated the lower terraces on both river banks and a lot of farmland and houses were washed out. Three years have passed by now and some residents have been back to their original places by constructing huts on the riverbed. There are several water mills constructed after the disaster near the confluence of the Syarse Khola and Manhari Khola. Land reclamation is seen in some places along the river but most part of the lost land by the 1993 disaster is left as it is.

In the 1993 disaster, a commercial centre of Namtar, located along the right bank of the Manahari Khola was washed away, similarly other portions of the banks of the Manahari Khola were scoured and washed away as well. Nevertheless, fortunately no one died in the 1993 disaster. The number of fully damaged houses is 71, the washed-away land area is roughly estimated by the Study Team to be more than 25 ha.

According to the village history, floods occurred every ten years or so, but the flood of July 1993 brought about the biggest damage that the Namtar people have never experienced before. Quite a larger number of houses (71 houses) were washed away by the 1993 disaster, which implies that there are many landless people there. Some are living with their relatives, some have built new houses in their land which was not washed away, and some have migrated to somewhere like Hetauda. Those landless people have difficulties to make their living. Since there are not many job opportunities in Namtar, they are basically willing to go out of Namtar to look for a better life, but they know that a life outside Namtar is not easy without having enough money initially.

As the high hazardous areas along the Manhari Khola have not been so far reutilized by the villagers, those areas can be regarded as non-dangerous areas. The width of the Manhari Khola was widened up to about 200 m by the disaster while it was between 30 to 50 m before the disaster. The stretch of about 150 m wide of residential land and/or farmland on both sides of the river is currently classified as "river", which is without doubt classified as the high hazardous area. Such a high hazardous area extends over 6 km along the Manhari Khola from the confluence of the Syarse Khola and Manhari Khola to the lower reaches.

4.2.2 Mechanism of the 1993 Disaster

Figure 4.2.1 shows the disaster map of Namtar after the 1993 flood. The map indicates that the banks washed out by the turbulence flow which was affected by the debris from the torrents are found in the entire section along the main stream, particularly in the downstream section of 6 km long from the confluence with the Syarse Khola. The river channel was much widened due to the bank erosions for about 30 m to 200 m along the main stream, and the sediments spread over the whole section. The same phenomenon is observed along the Syarse Khola and Khade Khola.

Figure 4.2.2 describes the landform characteristics around the Namtar village. The figure indicates that there were four stages of river terraces along the Manhari Khola on the right bank. The lowest terrace was completely washed away by the turbulent river flow. The same phenomenon was observed in a 6 km long section downstream of the confluence of the Manhari Khola and Syarse Khola. As the river banks are not strong enough against the turbulence flow during the flood, the villagers fear that bank erosion or terrace removal will be repeated by another flood.

The major disaster phenomena at Namtar are the following:

1) Right bank washing out in the Namtar community,

2) Bank scouring on the Manhari Khola

3) Landslide and collapse on the Gorduwa Khola

(1) Right bank washing out in the Namtar community

Before the 1993 disaster, the Namtar bazaar was located on the lower river terrace on the right bank. The Tilar village was located on the upper river terrace on the right bank. The channel of the Manhari Khola was narrow and close to the left bank as shown in Figure 4.2.3.

During the 1993 disaster, the villages of Namtar/Tilar were severely damaged. The river channel was filled up with the sediments transported from the main stream and the discharge spread over the flood plain. Then, the river flow from the main stream was blocked by the debris brought by the Syarse Khola and Gorduwa Khola. The debris brought by Syarse Khola and Gorduwa Khola formed the temporary debris cones at the confluence. Consequently, the main course of the Manhari Khola shifted towards the opposite bank, and the debris cone was washed away and the lower terraces were destroyed. Various turbulences occurred and changed the river course which accelerated the land scouring. Houses, farmland, the VDC office, and other public facilities were all washed away. A suspension bridge was also destroyed by the same event.

Prior to the bank erosion activities in the community, it is observed that severe erosion occurred in the upstream area of the mainstream. As shown in Figure 4.2.4, the gully networks are well developed in the granite area, and all the tributaries are severely eroded by the rainstorm of the 1993 disaster. It must yield a tremendous amount of sediments which are transported downstream.

As shown in Figure 4.1.1, a knick point exists at about 1 km upstream of the Namtar community, and the river gradient has remarkably changed at the knick point. The river width has been remarkably widened from the knick point to the downstream part and the river became winding from the point. The sediment deposition will be concentrated from the knick point to the downstream section, particularly in Namtar. Based on the sediment transportation mechanism, the disaster potential at Namtar seems to be quite high. In fact, many villagers reported that remarkable river bed aggradation was observed with several meters before the bank was washed out. This river phenomenon must be one of the key factors of the disasters.

Figure 4.2.5 shows the detailed river profile near Namtar. The profile indicates that the river gradient becomes gentle at every bending portion, particularly, at the confluence with the Syarse Khola. From the viewpoint of river morphology the sediment material are accumulated at such portions. The Namtar community located just downstream of the

confluence with the Syarse Khola would have high possibility of sediment accumulation, debris flow from Syarse, and the flood course fluctuates.

(2) Bank scouring on the Manhari Khola

In addition to the flood-prone area in the lowest river terrace, the edge of the second terrace from the river will be critically dangerous due to further bank erosion by turbulence flows. Some specific locations, particularly at the undercut slope and a river bend, will be attacked by another flood. Figure 4.2.6 shows the general mechanism of scouring on the undercut slope along the Manhari Khola.

On the edge of the second terrace from the riverbed on the opposite side around the confluence of the Syarse Khola and Gorduwa Khola, bank erosion will occur during a flood by turbulence flow, and therefore the area will be defined as hazardous. Particularly, the area with some existing houses near the right bank of the suspension bridge in Namtar will be classified as hazardous area.

(3) Landslide and collapse on the Gorduwa Khola

At the western edge of Ward No. 2, a high potential of big landslide is recognised along the left bank where the irrigation canal runs through the middle portion. The mechanism of hazard is shown in Figure 4.2.7.

4.3 Needs of Disaster Prevention and Community Development

4.3.1 Current Major Issues in The Community

Through the survey and frequent site visits, the Study Team has been noticing many problems in the communities from major ones to minor ones. Among those problems, several major problems that should be paid attention to in the Study, are described in the following. Please note that the order of presentation of each problem does not necessarily represent the degree of importance.

Basically Namtar is already in a good position for development as no serious problems are found. The people are better off in many respects compared to the national average.

(1) No motorable road to Tribhuvan Highway during the monsoon season

The biggest problem in Namtar is the road to Tribhuvan Highway, which is not motorable during the monsoon season. The community of Namtar is unified, efficient, and ready for any participatory community development projects, but the only obstacle that hampers development is the road. The road is usually not motorable from July to December every year, that is a six-month blockade. During this period, the people have to walk along the trail for one and a half hours up to Tribhuvan Highway.

(2) Destruction of irrigation canals

The 1993 disaster destroyed many parts of the irrigation canals. The largest canal among the destroyed ones had been constructed by the ILO about a decade ago by which 50 ha of farmland around the central portion of Ward No. 2 were irrigated. The farmers said that their income had dropped down to 40 % of what they used to earn before the 1993 disaster.

(3) Bridges

In addition to the impracticability of the road during the monsoon season, many simple wooden bridges are often washed away. The Manahari Khola is lying through the centre of the Namtar community, dividing Ward No. 2 in which Namtar exists from Wards No. 7 and No. 4. The increased volume of flow in the Manahari Khola in the monsoon season disturbs the people's interaction inside the community and with the outside world. When water flow is big in the Manahari Khola, the suspension bridge funded by Japanese individuals is the only means to link the people with each other.

(4) Lost land

Tremendous portions of the Manahari Khola river banks were scoured and eroded by the 1993 disaster. Those lands do not exist any more as they form parts of the river bed, and there is no chance to get them back as they used to be. If all the river course along the Manahari Khola in Namtar is fixed by river training works, those lost lands may be reclaimed for agriculture, but it is not possible to live there.

(5) Contaminated water

Namtar has no problem of finding appropriate water sources, but the people in Namtar often connect the pipelines with contaminated water sources. Besides, the existing water pipelines are not systematically arranged, so there is a huge loss in using the limited amount of pipelines.

4.3.2 Hazard Condition in Namtar / Tiral Community

Based on the condition of the 1993 disaster, hazardous areas were examined and a hazard map has been prepared for the local disaster prevention activities. The procedures mentioned in Section 1.4 in this report have been taken for hazard mapping.

The hazard map of the Namtar community is shown in Figure 4.3.1. The following disaster phenomena are considered in preparing the hazard map of Namtar.

	Type of Disaster	Description
I	Estimated hazard area of landslide	Each zone for landslide is classified into three hazard levels A, B and C. The high hazardous areas defined as levels "A" are mainly located along the Manhari Khola.
II	Estimated hazard area of failure	Each zone of failure is shown in the hazard map. There is no hazard degree classification, and all the locations are identified as the low hazard areas. The hazard areas of failure are mainly located on the terrace along the river.
III	Debris flow	Identified hazardous gullies of debris flow are shown in the map. There is no hazard degree classification for debris flow, and all the areas are defined as highly hazardous. The identified hazardous gullies are located on the left bank of the Syarse Khola and Manhari Khola
IV	River bank erosion	Each zone of bank erosion is classified into three hazard levels A, B and C. The high hazardous areas defined as level "A" are mainly located along the Manhari Khola near the community, and on the left bank of the Syarse Khola.
V	Safety zone	The zones in this category is relatively safer than in other areas. The safety zones are mainly located on the river terrace at the higher portion along the river
VI	Dangerous houses	The houses located in the high and medium hazard areas of category I or hazard areas of category B are identified as dangerous.

4.4 Overall Plan

4.4.1 Disaster Prevention Aspects

The overall disaster prevention plan for Namtar / Tiral is shown in Figure 4.4.1, which is formulated taking into account the hazard potential of the area as well as the following disaster phenomena:

The most serious damage caused by the 1993s disaster in Namtar was the washing out of the bazaar on the terrace by the flood. Photo 2 at the beginning of the report shows the condition before and after the 1993 disaster, in which all the bazaar along the Manhari Khola were washed out. There were also debris flow in the tributaries, new landslide in Manahari, new landslide in Khola, and the enlargement of gully erosion. Due to such damage of the 1993s disaster, the condition of the Manhari Khola, especially in the section near the Namtar area, has greatly changed.

The phenomena of river change are as follows:

1) The river bed in the main stream of the Manhari Khola, has dramatically risen up due to the debris flow from the upstream areas.

2) Debris flow occurred in the tributaries, Syarse Khola, Khade Khola, and Gorduwa Khola.

3) The main stream of 40~50 m wide expanded to 200 m in a section of about 6 km long from the confluence with the Syarse Khola.

4) Slope failure and landslide occurred on the outer river bank due to the meander of the river and erosion by flooding.

5) The river width upstream of Namtar was enlarged by gully erosion.

There were two kinds of factors leading to the 1993 disaster. One is river bed aggradation due to the over-abundant debris flow from the upstream areas.

As mentioned in Annex-1, Namtar is located just downstream of a knick point on the Manhari Khola, at which the river gradient suddenly changes from steep to gentle. In such area, sediment materials are easily deposited so that the sediment transportation capability of the river is decreased. Reflecting the topographic characteristics in the Namtar stretch, the river width becomes much wider, and a remarkably meandering river course is formed near the Namtar stretch. Such conditions cause remarkable riverbed aggradation and widen the river course at the stretch, resulting in much more serious damage than in other portions along the Manhari Khola.

Another factor is the bank erosion phenomenon due to the debris flow from the tributaries. The flood on the main stream was pushed away and changed the flow direction to the opposite site from the tributaries by forming an alluvial cone of debris at the outfall of the tributaries.

Considering the above disaster characteristics, the anticipated pattern of disaster in Namtar and the magnitude of damage occurred in 1993 are shown below:

Pattern of Anticipated Disaster and Damage

Area	Disaster Pattern	Damage in 1993
Upstream section of the Manhari main stream and tributaries	• Tremendous amount of sediment yield by landslide, failure, gully erosion and bank erosion.	• Almost no human damage since there is less residential areas. • Severe devastation of forest land and gullies.
Stretch along the Namtar community	• Washing away of cultivated lands and houses caused by riverbed aggradation, bank erosion, flood meandering and debris flow of the tributaries.	• A major part of the community is completely washed out (71 houses were washed away) • Rich cultivation areas along the main stream are severely eroded or buried by the sediment.

Prior to the formulation of a comprehensive disaster prevention plan for the basin, it is necessary to consider the reality of the project implementation. In the case of Namtar, the upstream basin is seriously devastated and that is the cause of the damage to the community, and it should consider the watershed management approach for the upstream basins should be considered from the long-term viewpoints.

On the other hand, the upstream area has so far less residents and the countermeasures must be quite expensive, imposing heavy financial load for a long time. In addition, the effects will take quite a long time to be apparent in the Namtar community.

Taking into account the urgency of the countermeasures, cost effectiveness of the upstream countermeasures, as well as the difficulty of the participatory disaster prevention measures in the upstream areas, the Disaster Prevention Plan is focused on the Namtar stretch, at which the direct causes of the damage are treated and proposed.

Accordingly, the main objectives of the disaster prevention plan for Namtar are defined as follows:

1) To mitigate sediment transportation and riverbed aggradation in the Namtar stretch,

2) To prevent the debris flow in the tributaries from attacking the main stream,

3) To restore the cultivated land along the main stream (to restore the natural river courses), and

4) To control the major sources of disaster damage such as landslide, big failures, and so on.

The proposed overall plan is formulated accordingly as shown in Figure 4.4.1.

4.4.2 Community Development Aspects

The overall community development plan is formulated taking into account the villagers needs and the development potential from the rural economic viewpoints. Figure 4.4.2 shows the general layout of overall community development plan of Namtar / Tiral.

The plan is basically formulated based on the results of the discussion with local people as well as the development views by the specialists.

The Study Team visited Namtar from April 30 to May 3, 1996, discussed the development priorities in Namtar, and the results of the discussions are described in this section. As explained in Chapter 4, various types of survey had been conducted prior to this period. The procedure to determine the ranks of development priorities in Namtar is also the same as that adopted for Phedigaon and Phatbazar. That is, women's group discussion, men's group discussion, and key informant interviews were carried out before the final overall discussion in which the development priorities were finalised with heterogeneous participants. Photos 4.4.1 to 4.4.4 show those group discussions.

One thing that should be noticed is that the Namtar people are so wise that they tried to discuss only the things that they could not deal with by themselves. That is, they have a clear idea on what they can do and what they cannot do themselves. They think that the things they cannot do themselves are the ones they should ask the JICA to do.

Development priorities for Namtar and Tilar are:

No. 1: Road Development
No. 2: Rehabilitation of Irrigation Canals
No. 3: Installation of Electricity

No. 4: Protection of Syarse Khola
No. 5: Reforestation

All the villagers in Namtar have acknowledged with confidence and faith that the road development by which vehicles can run all the year round was the most important thing to do right away for the development of Namtar. They think that with a year-round motorable road they can do anything they want for themselves after all. They also think that without such a road there is no use of whatever development projects that take place in the village. The road development was unanimously selected as the highest priority by all the villagers.

Their agricultural production has dramatically dropped due to the destruction of canals by the 1993 disaster. They understand that benefits of rehabilitation will mainly go to landholders but they think that there will be indirect effects sufficiently on landless people, poor farmers, and the village as a whole. The ILO constructed a canal about a decade ago by which 50 ha of land in Namtar were irrigated, but it was destroyed by the 1993 disaster. There are other small irrigation canals around Namtar most of which need to be rehabilitated. A farmer complained that his annual income has dropped down to 40 % of that he once earned with irrigation.

The Namtar people are basically fine without electricity, but if electricity is available, they know that their living conditions will be improved and that most importantly industrialisation will be realised. Like in many rural areas in Nepal, they are eager to have employment opportunities in their village. Without those opportunities, they have to go out of their village to find jobs in a large city such as Hetauda and Kathmandu. Most of them are farmers who have no particular skills except for agriculture. If a small industry is founded inside the village, they can find jobs, accumulate some skills, and earn some cash income without taking any risk to go out of the village. For this, they understand that electricity should be available, to begin with.

They have a strong fear of another debris flow in the future. In their understanding, the Syarse Khola is the major cause of the damage to their village in July 1993. They think that the debris carried by the Syarse Khola hampered the flow of the Manahari Khola. Due to debris deposition at the confluence of the two rivers, the flood in the Manahari Khola shifted toward the centre of the Namtar village with the water level being increased. Because of these phenomena, the river bank where the central function of Namtar was located right behind, was fiercely scoured and washed away. They think that by providing good protection works along the Syarse Khola their village will be secured.

They have realised that some reforestation measure is to take place. The Nepal Timber Corporation, authorised by the HMG/N under the Corporation Act, is cutting trees for timber in the forests around Namtar. In addition, a private company is extracting resin from pine trees around Namtar by paying some royalty to the HMG/N. Both activities gradually damage the forests and the Namtar people consider they should be stopped.

Table 2.6.2 shows the transition of development priorities in Namtar from February to May 1996. Even in Namtar where the people are so unified as one community, the household sampling survey that was conducted at the very beginning of the Study indicates that the people asked for drinking water supply as their first development priority. A motorable road to Chuniya has been given higher priority from the beginning. At the end of a series of discussions, the people in Namtar have understood what are important for development of Namtar. The Study Team gave a lecture to Class 10 students in a school in May, in which disaster management and development priority were discussed (see Photo 4.4.5). Quite surprisingly, the Class 10 students gave the same

order of development priorities as that given by the adults. This implies that the concept of development of Namtar community has been understood and prevailed all over the community.

4.5 Priority Plan

Figure 4.5.1 shows the selected priority plan of the CDPP for Namtar / Tiral. For the respective selected schemes, the proposed modes of implementation are indicated. The detailed description of the selected priority schemes is given below:

4.5.1 Structural Disaster Prevention Measures

Under the overall disaster prevention plan shown in Figure 4.1.1, a feasibility study is made for the most important and urgently necessary schemes with top priority. To select the top priority schemes, comparative studies are made of the sociological urgency, engineering priority aspects as well as the economic effect of the structures to be provided.

(1) Criteria for Selection of Priority Schemes

In the case of the Namtar disaster prevention plan, the following three criteria are considered for priority assessment:

a) Importance of the objective area of the countermeasures,

b) Effect of the countermeasures,

c) Urgency of countermeasures.

(a) Importance of the objective area of the countermeasures

There are mainly three different objectives to protect against disasters by the countermeasures, which are human lives, social infrastructures and cultivation land, and unused land. It is no doubt that saving human lives is essentially important for disaster prevention works. Accordingly, the number of affected houses must be a major factor to determine the importance of the objective area. The density of houses and bazaar in the objective area should be assessed in the priority assessment. The next importance is the social infrastructures and cultivation land, which substantsially affect the people's activities. The number of rural infrastructures and area of cultivation land in the objective area shall be considered to determine the importance of the objective area. Then the area of unused land such as forest, pasture area shall be considered as the important asset to protect following to the houses / bazaar, rural infrastructures and cultivation land, because this affects indirectly or in the long term the human livings in such aspects as water regulation, sources for firewood, breeding of livestock, and so on.

Considering the above, the priorities are assessed based on the quality and quantity of various assets in the objective area as follows:

Priority a : Area of high density population and buildings
Priority b: Area of cultivation land and high density of rural infrastructure,
Priority c: Area of forest and pasture land, and others.

Effect of the countermeasures

(b) Magnitude of natural hazard of the objective disaster phenomena

Every countermeasure has direct objectives such as to detain sedimentation, to prevent debris flow, to prevent bank erosion and so on. The second criteria for selection of priority schemes are defined on the basis of the estimated magnitude of natural hazard of the objective disaster phenomena in the area of countermeasures. Accordingly, the following priorities are defined:

Priority a : The structure shall be effective against the disaster phenomena which is large scale of natural hazard.

Priority b: The structure shall be effective against the disaster phenomena which is not so large scale of natural hazaard.

(c) Urgency of the countermeasures

Urgency of the countermeasures is defined as the third criteria for priority assessment. The assessment is made based on the output of hazard assessment described in Annex-1. The hazard level in the objective area of the respective structure is assessed and the following priorities are defined:

Priority a : The objective area is within a high or medium hazard area,

Priority b: The objective area is within a low hazard area or out of a hazard zone.

(2) Results of Priority Assessment

Based on the criteria defined above, priority assessment is carried out by the Study Team. The results are summarised below:

Results of Priority Assessment

Structure	Location	Importance of Objective Area	Magnitude of Disaster Potential	Urgency of the Counter-measures	Overall Evaluation
Check dam Na-1	Manhari	a	a	a	A
Check dam Na-2	Manhari	a	a	a	A
Check dam Na-3	Syarse	a	a	a	A
Groundsill Na-4	Manhari	a	a	a	A
Check dam Na-5	Khade	a	b	b	B
Check dam Na-6	Gorduwa	b	b	a	B
Check dam Na-7	Gorduwa	b	b	b	B
Groundsill Na-8	Manhari	b	b	a	B
Channel work Na-9	Manhari	a	a	a	A
Other protection works		b	a	b	B

Notes: a: Relatively high A: First priority district
b: Medium B: Second priority district

In the overall evaluation, those countermeasures which are judged as "a" in all the three aspects are defined as A, and the others B.

In the objective areas, all the structures which are expected to mitigate the disaster damage in the Namtar stretch on the right bank are defined as high priority structures because the population density of the area is high and many important rural infrastructures such as school, health post, VDC office, irrigation facilities, rural road, suspension bridge are located in the area. The area downstream of the confluence of the Gorduwa Khola along the main stream as well as the area along the tributaries is defined as priority "b" area. The left bank of the main stream in the upper area is also defined as priority "b" area since cultivation land is mainly located along the left bank.

With regard to the magnitude of disaster potential, the huge potential is observed in the areas upstream of the Manhari Khola and Syarse Khola considering the sediment yield and debris flow in these areas. Accordingly, the countermeasures in the areas upstream of the Manhari Khola and Syarse Khola are given priority "a". The countermeasures at other tributaries such as the Khade and Gorduwa Khola are given priority "b".

As to the urgency of the countermeasures, the risk of disaster in the objective areas is assessed based on the hazard map. Since the area along the main stream is defined as high hazardous area, most of the countermeasures to be taken in this area are defined as high priority ones.

(3) Priority Stuctures

Based on the above priority assessment, the priority schemes under the Namtar Disaster Prevention Plan are formulated. The locations of priority structures are shown in Figure 4.5.1, and listed below:

ID No.	Type of Structure	Material	Quantity	Function
Na-1	Check dam	Concrete	1	To detain and control the sediment transportation to the downstream area. To support the unstable slope on the upstream right bank.
Na-2	Check dam	Concrete	1	To detain the unstable sediment material on the upstream riverbed, To stabilise the upstream riverbed.
Na-3	Check dam on Syarse Khola	Concrete	1	To mitigate the debris flow attacking the main stream, To protect the left bank of the Syarse Khola.
Na-4	Groundsill	Concrete	1	To stabilise the river channel of the Manhari main stream, To prevent scouring of the toe portion of Check dam Na-3.
Na-9	Channel works	Gabion with vegetation	1	To control the river course, To protect the river bank, To reclaim farmland on both sides of the river.

Based on the results of priority assessment, preliminary design was carried out. The designed longitudinal river profile of Manhari Khola is as shown in Figures 4.5.2 and 4.5.3. The structural designs of the check dams Na-1, Na-2 and Na-3 and groundsill Na-4 are shown in Figures 4.5.4 to 4.5.7, and that of channel work, is shown in Figure 4.5.8.

4.5.2 Community Organisation Set-up

Please note that detailed descriptions are often omitted due to the fact that there is a considerable degree of redundancy between the CDPP for Phedigaon/Phatbazar and the one here. The same is true for Chisapani as well.

(1) Formation of Users' Groups

This project should come first prior to any community development project. Even though Namtar has already had a good community, it must have a well organised community to accommodate development projects. Namtar is no exception.

After forming users' groups, a users' committee should also be formed. Then other committees will be formed accordingly when a development project comes to Namtar.

(2) Disaster Management Training

It is good for the Namtar people to know how to manage disasters. With relatively small investment, they can save their lives and become stronger against disasters.

(3) Training of Community Organisers

This project can be implemented with small expense, along with other study areas. The community organisers will surely boost the development of Namtar. The education level in Namtar is high, it is expected that human resources are abundant and very capable people will be appointed as community organisers. With a little stimulation from outside, Namtar will start flourishing.

(4) Construction Works with People's Participation

There are many construction works planned in Namtar. Especially, road improvement works should be done by the people. According to the plan on road improvement, there is no permanent structures in the plan, all works are scheduled to be done by the people with mainly gabions and bio-engineering works. Every time the road is destroyed, the people need to repair the road by themselves. To do so, this project should be carried out and the people get to know the technologies.

4.5.3 Agricultural Development

(1) Concentration on Profitable Varieties in Large Quantity

According to the records in Namtar VDC, the total agricultural land in the VDC is about 13,254 ropani (663 ha) of which 3,604 ropani (180 ha) are khet land and 9,650 ropani (483 ha) are pakho land. The major portion of the paddy land is rainfed. In ward No. 2 there are 594 ropani (30 ha) of khet land and 848 ropani (42 ha) of pakho land. In this ward the major portion of khet land is rainfed. As explained before, farmers cultivate many varieties but in small quantity of cash crops which makes it difficult to introduce important changes in the marketing .

The following cash crops are proposed to be cultivated intensively.

(a) Garlic Production

Garlic, which is less perishable, is getting popular among the farmers in Namtar. The monthly average price of dry garlic in Kalimati Wholesale Market was NRs. 54.73 in January/February and was lowest at NRs. 20.19 in May/June (refer to Table 3.5.2). Garlic is planted in November/December in khet land and is harvested in March/April. It can be dried in the sun light and can be sold when the price rises in the market. As explained earlier it will generate remarkable net income per ropani of land.

(b) Ginger Production

Among different crops, ginger provides the highest net income to farmers. It is cultivated in pakho land and it takes about one year from plantation to harvest. The highest price is in April/May (NRs. 29.16/kg) in the Kalimati Whole-sale Market (refer to Table 3.5.2). It is comparatively more labour intensive and may generate more farm employment.

Ginger is one of the important exportable crops of Nepal and is mostly exported to India either fresh or dried. The Eighth Five Year Plan has emphasised ginger production putting it under the species development programme, and agricultural inputs, agricultural credit and technical support will be provided by the concerned agencies.

(c) Cauliflower Production

Cauliflower production is also profitable in Namtar. Although per ropani yield of cauliflower is comparatively high, regular supply of chemical fertilisers and other nutrients may contribute to increase in its yield.

(d) Potato

Potato cultivation which is generally practised in Namtar, is more profitable than other cereal crops (refer to Table 4.5.1). Potato is grown in khet land and pakho land.

(e) Mushroom Production

Mushroom is in high demand in the urban areas of Nepal. In 1990/91 the production of mushroom was only 56 tons and it has been targeted to increase to the level of 300 tons during the Eighth Five-Year Plan period. The production of different varieties of mushrooms will contribute to the enhancement of income of small farmers. The price of fresh mushroom such as Agaricus bisporous (gobre chyau) in the market is very high in November to February (NRs. 130 per kg) and low in March to May ((NRs. 70 per kg (NARC, 1994)). The cost and net profit of production of 200 kg of Agaricus bisporus is estimated at about NRs. 6,700 and NRs. 7,300 respectively (NARC, 1994).

(2) Promotion of Horticulture and Installation of a Small Scale Processing Plant

Planting fruit trees in pakho land is in increasing trend in the area. According to the farmers in Bhadaure Ward No.4 (Near Khade Khola), about 100 households are growing fruit trees and in July/August last year about 300 metric tons of pear were exported mainly to Hetauda. The farmers are convinced to increase commercial production of fruits.

As mentioned before, lime and lemon are also produced in big volumes. Due to difficulties in marketing, a large portion of perishable fruit are wasted.

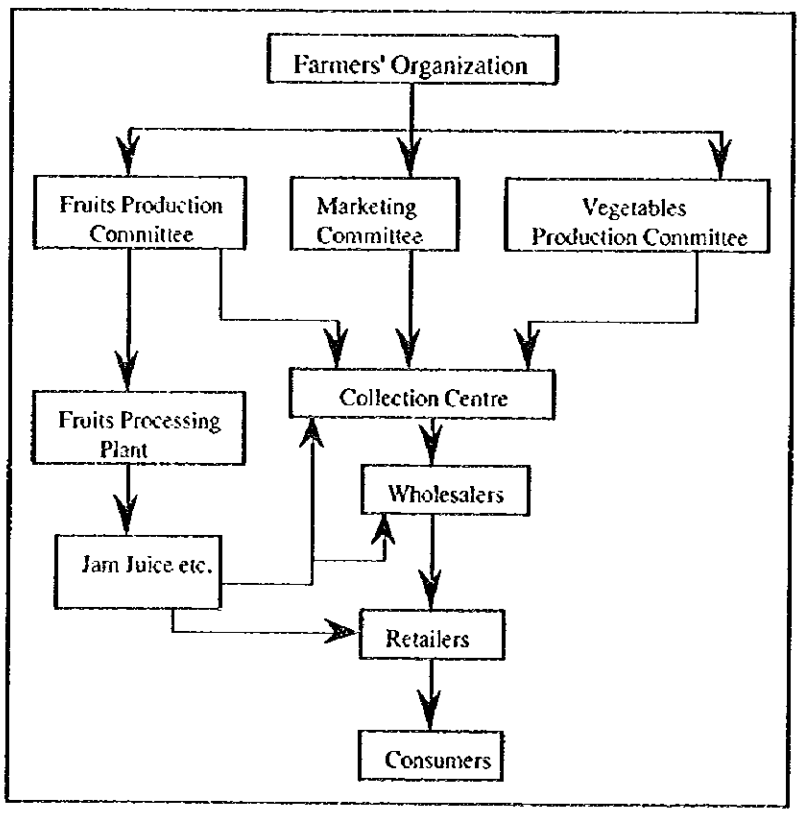
To encourage the farmers in expanding fruit production, a small scale processing plant in which jam and juice are produced may be suitable. A lime and lemon juice extracting plant seems necessary so that farmers may be encouraged to plant more fruit trees which generate more income and contribute to soil conservation.

(3) Formation of Farmers' Organisation

As described earlier, individual farmers in the Namtar area deal with small volumes and it is very difficult for them to export it outside the area. Here, three committees are proposed, a vegetable production committee, fruit production committee, and a marketing committee.

The vegetable production committee will estimate the total inputs such as chemical fertiliser, seeds, pesticide, etc. for the next crops and will inform them to the marketing committee. The marketing committee will inform them to the related organisations and will manage the procurement of the same.

The main activities of the marketing committee is to collect the vegetables and fruits from individual farmers, manage trucks and export them to the cities. All member farmers of the organisation are supposed to use the collection centre managed by the marketing committee. A simple hut near VDC office can be used as a collection centre. A nominal amount, about NRs. 0.10 may be charged as handling cost. This amount will be used for the maintenance of the collection centre



Farmers' Organisation

4.5.4 Forestry Administration

(1) Agroforestry Programme

(a) Promotion of Fodder Trees Plantation

Because of the disaster of 1993 and human encroachment to the forest, a high degree of forest degradation is observed around the area. This has led the farmers to become more dependent on private resources for meeting their basic requirement for fodder, fuel wood, and other tree products. Therefore plantation of more fodder trees at farm level without grossly affecting crop production is required.

The Eighth Five-Year Plan (1992-1997) has emphasised the tree plantation along field boundaries and terrace ridges. Fodder tree saplings required for livestock development programme will be supplied in co-operation and co-ordination with the forestry management programme (the Eighth Plan).

According to the farmers in Namtar, they are interested in planting fodder trees but they cannot get the desired amount of saplings because there is no nursery near Namtar VDC. The forest nursery development and plant distribution programme which has been proposed, will play a significant role for the development of agroforestry in the area. For the promotion of fodder trees plantation, locally available and suitable plant species should be identified and less branchy and crown density tree species should be chosen for the plantation on agricultural land.

Depending upon the altitude and farmers' interests and requirements, the following fodder tree species are recommended for Namtar.

Khanyu (Ficus semicordata)
Kabro (Ficus lacor)
Dudhilo (Ficus nemoralis)
Nimaro (Ficus roxburghii)
Gogan (Saurauia napalensis) and
Kimbu (Silkworm mulberry)

By planting mulberry trees and rearing silkworms, the farmers can generate more income than cultivating traditional cereal crops (refer to the sector report, Appendix 7: Agriculture). Silkworm mulberry can be used as good fodder as well.

(b) Promotion of Improved Grass Plantation

To reduce the pressure on the existing forest, improved grass species such as Napier (Pennisetum purpureum), Amriso (Thysanolaena maxima) and Vetivar should be introduced.

(c) Promotion of Horticulture

As described before, planting fruit trees in pakho (upland) is in an increasing trend in Namtar. Although farmers know that fruit trees cause some loss in crop production, they plant fruit trees because the benefits from fruit are more

valuable than loss in cereal crop production. The long lag time for returns is the barrier for small farmers who might want to start fruit production. And without a clear and well-defined market, there is no advantage in promoting fruit production that cannot be otherwise consumed locally. Depending upon climatic conditions and altitudes, the following varieties of fruit species can be recommended.

Pear, Lemon, Lime, Litchi, Orange (in Timure area)

To encourage the farmers to increase fruit production, a small-scale processing plant in which jam and juice are produced may be suitable. Such a plant may encourage the farmers to plant more fruit trees on their private land which generate more income and contribute to soil conservation.

4.5.5 Community Infrastructures

(1) Installation of Telephone System

There is a good possibility for the VHF to be installed in Namtar. According to a staff in the local NTC in Hetauda, it would be technically feasible to install the VHF in Namtar. Moreover, since there is no telephone system around there, the Namtar people have to go to Hetauda to make a phone call. This inconvenient situation may induce the NTC to decide to install the VHF system.

In fact, with guidance by the Study Team, the chairman of Namtar VDC has written a request letter to Makwanpur DDC, and Makwanpur DDC has sent a letter to the local NTC office in Hetauda. (It takes one and a half hours by car to Hetauda.) The local NTC has also sent a letter to the headquarters of the NTC in Kathmandu. As of July 1, 1996, that letter has not been received by the headquarters of the NTC yet.

(2) Rural Road Improvement in Namtar/ Tilar Area

Major improvement works and further development of all-season motorable roads are proposed in Namtar/ Tilar Area for the following objectives:

i) To assist further economic development of the community and the surrounding areas through agricultural development in co-operation with the road improvement, i.e., to generate income through safe and efficient transportation of agricultural products to outer markets in cities.

ii) To enhance the reduction of vulnerability among the communities and the areas against water-induced hazards through participation of villagers in the road construction works.

iii) To achieve sustainable economic development as well as operation and maintenance of infrastructure through above activities in the future.

Moreover, the activity may enhance the electrification of the villages, possibly from Chuniya.

(a) Site condition

A general layout of the investigated rural road is given in Figure 4.5.9. In order to improve and maintain this 6-km long rural road, vegetative measures and/or bio-engineering will be applied along the remarkable landslide areas. Frequent transportation blockages occur in these areas due to slope failure or earth/rock fall, despite the fact that this road is so called the life-line route for the Namtar village. The application of vegetative measures or bio-engineering will be meaningful in terms of low construction cost as well as people's participation in community development and its maintenance activities. It can be also pointed out that one of the main causes of slope failures is lack of side-ditch, which can be installed by people's participation under proper instruction of local engineers. Since slope failure occurs so frequently in the Study Area, it is important to store some materials and equipment such as gabion wire, stones, boulders, cement, etc. This stock will further help and enhance the villagers for periodical maintenance and repair of road by themselves.

The locations of currently identified five hazardous sites as shown in Figure 4.5.9 and Table 4.5.2 summarise the site-wise problems, geological/ topographical conditions, and proposed countermeasures against each hazardous location.

(b) Countermeasures

The designs and quantities of major construction works for the improvement of this 6-km long rural road are proposed as summarised in Table 4.5.3. The five hazardous locations will be provided with gabion structures, such as check dams and prop walls, on either side of the road (ms: mountain side; vs: valley side) for slope stabilisation. A side-ditch with be provided along the mountain side of the road at the foot of slopes. Some other drainage facilities will be provided at the sites where insufficient drainage is one of the main causes of slope failures. It is also proposed to install dry rubble masonry side-ditches as much as over 6-km along the road, and other drainage facilities at every 200 meters in the whole area. Vegetative measures also play an important role at each site, and it is expected to be achieved at the people's initiative under instructions of soil, forest and/ or agricultural engineers. Finally, gabion nets / wires, a small amount of cement as well as RCC pipes should be provided to the community as spare parts for further sustainable maintenance activities by the villagers.

It is also notable that the construction of a causeway proposed at the crossing point of the Manahari Khola, as a mechanical measures of disaster prevention, will finally connect the branched access road from Chuniya to Namtar/ Tilar Area

(3) Rehabilitation of the Namtar Irrigation Project

Rehabilitation of the Namtar Irrigation scheme, which is one of the largest schemes used to feed 50 ha, and was one of the most severely damaged systems, has been proposed to accomplish the following objectives:

i) To retrieve the past agricultural activities and to develop agricultural productivity in the community

ii) To reduce the vulnerability of the community through raising the living standards by the agricultural development as well as other infrastructure development.

The rehabilitation works will be conducted by combining two irrigation schemes on both sides of the Manahari Khola: the Namtar Scheme (right bank; 50 ha) and the Dungeon Scheme (left bank; 40 ha). It has been proposed that the water to be introduced to the Dungeon scheme from the Manahari left bank intake, will be conveyed over the Manahari Khola using a huge crossing structure.

(a) Current Status of Irrigation Activities

Several FMIS schemes are now under recovery since the 1993 disaster, nonetheless they are still confronted with several problems. There exists a total farmland area of about 65 ha in Namtar Ward No. 2., of which only 15 ha have been irrigated with water from the Manahari Khola (Namtar Lower Scheme) and Gorduwa Khola (Gorduwa scheme), since the destruction of the largest scheme, the Namtar Upper Scheme (referred to as "Namtar Scheme" herein after). The Namtar scheme, which used to feed 50 ha, was constructed by the ILO during 1982 - 1984. However, during the 1993 disaster, the riverbed nose by over 20 m due to debris flow, which destroyed its intake as well as the head-reach section, along the right bank of the Manahari Khola. Moreover, some parts of the upper reach was completely buried by a sequence of landslides, which is difficult to be re-excavated and recovered.

On the other hand, the Dungeon scheme, which irrigates about 40 ha in Ward No. 4, is one of a few well functioning systems, which have been maintained by farmers for about 30 years. Its source is located in the Dhed Khola, near confluence with the Manahari Khola, and a canal which runs along the left bank of the Manahari. Therefore, the villagers in the Study Area (Ward No. 2) have come up with a rehabilitation plan; that is to construct a new intake for the Dungeon Scheme on the left bank of the Manahari Khola, and convey the yielded water through the Dungeon Scheme, then transport it to Namtar through a crossing structure over the Manahari Khola, such as a suspension type aqueduct. People have already identified a site for this new intake. Regarding the request from the villagers to Makwanpur DDC, the District Irrigation Office (DIO) has formulated a rehabilitation project for a total area of 90 ha, by combining the said two schemes, after conducting a feasibility study in June 1996. Then this project has been approved by the National Government in July 1996 and the detailed survey as well as the design is now undertaken by the DIO, although the budget for the year 1996/ 97 is rather small. According to the national criteria, the budget ceiling for a irrigation rehabilitation project in hilly areas is NRs. 30,000 per ha, that is NRs. 2,700,000 in total. (cf. NRs. 60,000 per ha for a new project).

In the command area, a number of crossing structures and earthen canals are left either damaged or destroyed, thus disconnecting the system. Culverts, aqueducts as well as gabion protections and retaining walls also were either destroyed or covered by debris.

(b) Technical Findings by the Study Team

The locations of proposed structures are shown in Figure 4.5.10. Schematic diagrams of the suspended aqueduct and an example drawing for landslide recovery works are shown in Figures 4.5.11 and 4.5.12, respectively.

The findings by the Study Team regarding this rehabilitation project are as follows:

a) The proposed site for the new intake will be able to yield enough capacity and suitable for construction.

b) According to the geological survey and soundings, it is less feasible both technically and economically to reconstruct the original head reach section along the landslide part on the right bank of the Manahari.

c) Improvement of the Gorduwa scheme alone can cover less than 1/3 of the command area of the Namtar scheme, due to its lower elevation relative to the Namtar scheme.

d) Therefore, it seems to be the best alternative to make use of the Dungeon scheme and to construct a crossing structure to convey water to Namtar/Tilar.

e) In the case of d), some enlargement works, i.e., increasing and reshaping of the canal section, in the Dungeon scheme will be required to accommodate an additional discharge

f) Along the Dungeon and the Namtar schemes, appropriate sites are available for the construction of abutments for the suspended aqueduct.

g) The DIO has been conducting detailed survey, design and cost estimate for project preparation since June 1996, hoping that the construction will start in December 1996.

h) Construction cost for the suspended aqueduct, with a span of about 70 to 80 m, is estimated to be from NRs. 2 to 3 million, based on the cost for another existing suspension bridge in Namtar.

i) Since there are not only a number of crossing structures to be reconstructed in the scheme, but also protection works and a new intake structure, the total construction cost is estimated to be over NRs. 4.5 to 5 million, which exceeds the budget ceiling of NRs. 2.7 million.

j) The project has been approved by the HMG/N, and a budget of NRs. 2.0 million has been allocated for the fiscal year 1996/97 for the beginning of construction works. Every year, some budget will be allocated until it is completed, however, it may take 4 to 5 years to complete, and the villagers should cover 7% of the project cost until its completion.

k) If a check dam a cross the Manahari Khola is realised, an alternative to the suspended aqueduct is a siphon, which will be combined into the crest of the check dam.

Through rehabilitation of this scheme, stable farming activities including cultivation of paddy as well as winter cash crops, such as ginger and garlic will be assured. It is also possible to supplementally irrigate the lower part of farmland using the excess water from a micro-hydropower scheme through villagers'efforts, after its construction.

4.5.6 Income Generation Measures and Women in Development

(1) Eri Silkworm Rearing In Namtar/Tilar

It can be said that sericulture is one of effective ways to develop developing countries. For example, Japan was once a massive producer of raw silk and its fabrics around 70 years ago and she had achieved industrialisation through silk industry. Even today, sericulture is considered to be a quite effective development strategy to be taken in developing countries because of the following reasons:

1) sericulture calls for labour-intensive production method,
2) no large initial investment is required,
3) women can be effective labour forces, which will lead to women's liberty and empowerment,
4) no high technology is required,
5) production activities are environmental friendly,
6) silkworm rearing leads to textile-based industrialisation,
7) low transportation cost makes it possible for the people in remote areas to engage themselves in silk business,
8) rural people have opportunities to receive cash income,
9) afforestation prevails,
10) the by-products, pupae, can be used as feed for livestock and fishery, so on and so forth.

Based on the climatic condition, Eri silkworm is proposed to be the most promising silkworm to be reared in Namtar/Tilar. There are several kinds of silkworms in the world. Among them, so-called silkworm is categorised into Bombycidae and it has been the most popular kind of silkworm that has been through a long history of improvement of breed. On the other hand, Eri silkworm is categorised into Saturniidae, which is so-called wild silkworms. Eri silkworms eat the leaves of castor as well as tree of heaven, Chinese tallow tree, and cassava.

In Namtar/Tilar, the field survey by the Study Team shows that there had been silkworm rearing activities before the 1993 disaster. Though it is not clear why the Namtar people have given up silkworm business at this moment, it can be concluded that Namtar/Tilar has a strong background in sericulture and that they may be able to succeed in this field.

The following gives the explanation of the implementation procedure. With describing the procedure, important issues are also discussed at each step of the procedure. the procedure is divided into two phases. The first phase is regarded as a training period. The most activities in the first phase will take place by the school in Namtar which will provides lectures on Eri silkworm rearing, a test lab, rearing instruments, and so on. After enough technology and experience are accumulated in Namtar, the second phase will be started. The second phase is to disseminate the Eri silkworm production to the people in and around Namtar. The people who are interested in the Eri silkworm rearing can participate in this project and receive technical and financial support from outsiders. When everything goes well, the Eri silkworm rearing will be the major income sources and employment opportunities in Namtar/Tilar as well as Namtar VDC in the end.

Implementation Procedure

First Phase

1) Promoter

First of all, someone who is Nepali and can take a leadership to promote and carry out this Eri silkworm rearing project should be identified. He/she will be also a mediator among the local people, donors and buyers.

Without him/her, the local people will be easily discouraged to participate in this project, or when they face technical and/or social problems they will simply decide to throw this project away.

2) Establishment of Eri silk programme in school

In the very initial stage of the project, the school must be the centre of starting up any activities. Thus technical training and experiments will be provided and done in the school first before inviting the villagers to participate in the project.

Technical training can be provided as one of school curricula in the vocation training courses. The lectures will be delivered mostly by the promoter appointed and sometimes by school science teachers and sericulture experts. Of course the school science teachers should be well trained beforehand. The sericulture experts can be brought from a sericulture technical centre in Nepal.

In the school, production experiments will be done. A test laboratory with necessary instruments and eqiupment will be constructed around the school nearby.

The promoter will manage to provide those things mentioned above for the school and assist to run the project in the school.

The main reason that all activities in the first phase will be conducted in the school is to establish a firm foundation of technologies and experiences for the future Eri silkworm rearing. Without such a foundation, it is likely to face difficulties in dealing with the Eri silkworm rearing and its business. Once they fail, they will easily give up Eri silkworm rearing and get back to their original life style. It should be reminded that silkworm rearing still belongs to agriculture and that it should go slowly and steadily unlike other industries. In the first phase, there will be some core people who are well trained and motivated in Eri silkworm rearing and they will take a leading role for diffusing this business around Namtar.

3) Formation of small women's group

The promoter visits the site and identify those women who are willing to do Eri silkworm rearing in the school. In order to do so, he/she must many times discuss with the local people and explain about Eri silkworm rearing as well as about sericulture. Those women are to be selected mainly from ninth and tenth graders in the beginning. Based on the performance of those students, the project can be expanded and other girl students in different grades can be invited.

After finding those women in the school, he/she divides them into small groups, consisting of 5 to 6 members. Each group will independently work and try to do Eri silkworm rearing along the school programme. Grouping is necessary because silkworm rearing requires a lot of labour forces for multiple activities such as feeding worms several time a day, cleaning, and so on.

The reasons for choosing only women are that the viewpoint of the women in development (WID) is strongly emphasised in this project and that women usually have a proper characteristic to the type of works in the rearing - patience.

4) Operation of school programme

After completing the works described in the above three items, training and experiments will begin in the school under the initiative of the promoter with a strong support from the school teachers.

The programme will continue with trail and error until the promoter has a confidence in establishing comprehensive Eri silkworm business in Namtar. It will take a half year or whole one year for the promoter to figure out whether there is enough foundation in Eri silkworm rearing in the school.

Second Phase

1) Management

A local people in the village should be assigned as a site manager of the project who, unlike the promoter, stay at the site and support and manage the project. He/she may be the chairperson of the sericulture users committee, if it exists. The promoter may usually live in Kathmandu and he/she cannot keep watching the project all the time. Thus the manager is the person who can keep watching and manage the project when the promoter is not available.

2) Dissemination of Eri silkworm rearing

After a successful rearing becomes possible and enough technologies and experiences are accumulated in the school, the second phase will start to be implemented to disseminate Eri silkworm rearing business in and around Namtar. Any villager who are willing to participate in this business will be welcome and given all necessary supports for him/her to start up the business by his/her families.

Those people who have been trained in the school will be the core persons to disseminate the business because the promoter has a limited capability in doing this by himself alone.

The villagers interested in the business may be grouped as done in the school in the first phase if the promoter thinks it should be necessary.

3) Provisions of eggs and instruments

The eggs and the materials to do silkworm rearing are to be provided by the promoter with financial support from a donor. The eggs can be provided through The Bhandara Sericulture Office in Bhandara, Makwanpur District or

other areas. Almost all materials are procured domestically since there is no high-tech equipment required. The villagers have no cash to obtain those things by themselves. Thus some external assistance is to be provided through the promoter.

4) Seed grant

Even everything is provided for free, the people are not certain whether they can make money or fail. If this tendency is observed by the promoter, it may be better to give some seed grant to them so that they feel no fear to a failure. Since there will be some costs incurred for the initial period until they produce and sell cocoons, there should be a security for the people to embark on unknown business.

The promoter will decide how much is appropriate for seed grant and he/she must keep a careful eye on how the people use the money after he/she gives it to them, otherwise they may spend the money for another purpose, not for the Eri silk business.

Another way to encourage the people to do the Eri silk business is to promise them to buy all cocoons they make at a fix rate. With this promise, they can visualise how much money hey can make and feel secured. There may be some difficulty to determine a proper fixed rate, so it needs further investigation to do so. The degree of the guarantee to buy everything at a fixed rate will be weakened gradually as the production continues. That is, at the second time of the production, although all cocoons are bought, the prices to buy them will vary in accordance with qualities of the cocoons. This will be an incentive for the people to produce the cocoons with much higher quality. And on and on, the guarantee becomes weaker and weaker, then the production and the prices will reach to the international standards.

5) Continuous support

While they are engaged in Eri silkworm rearing, continuous support from the promoter to them, technically and mentally, is definitely necessary. Until the business gets on the right track, the promoter must frequently visit the site and give all kinds of support he/she can give.

6) Duplication of the project to other areas

If the project is successful, it can be duplicated to other areas in Nepal. As long as the project generates positive profits, all the people who get to know the project will be willing to do the same business in their areas. As understood by many people, there are few chances to succeed in the industrialisation that has been adopted by many developing countries as the best strategy for development. Sericulture is one of promising industries to be adopted in Nepal which is, unlike other usual industries, environmental friendly and gives great contribution to WID.

This project is up to producing cocoons of Eri silkworm. But sericulture goes on further. From cocoons, spinning factories can be established in Nepal to produce silk yarns. Then weaving and textile industries can be founded in the future. The world silk market has a tremendous capacity to absorb increasing production. In 1994, the total production of raw silk in the world was 115,000 ton, while those of cotton wool were 16.3 million

ton and 1.8 million ton, respectively. If synthetic fibres are included, the share of silk in the world was only 0.2 %. This fact implies, considering the high quality of silk, that the world silk market can accommodate a further increase in production.

Table 4.1.1 Demographic Informaiton in Namtar

No.	Kind of Information			
1	Household and Population in Ward No. 2	Household (Nos.) 136	Population (person) 816	Average Family (person) 6.00
2	Poplulation and Household by Caste Group	Household (Nos.)	Population (Nos.)	Share (%)
1	Brahmin/Chettri	64	384	47%
2	Tamang	57	342	42%
3	Damai	13	78	10%
4	Kami	2	12	1%
3	Damages by 1993 Disaster			
1	Human damage	Dead persons 0	Injured persons 1	
2	House damage	Fully 71	Partially 0	

Source: The various field survey by the Study Team, 1996

Table 4.5.1 Cost of Production and Net Profit of some Main Crops.

Rops	Yield Kg/ropani	Value (Rs)	Cost Per ropani (Variable and Fixed Cost Rs)	Marketing Cost (Rs)	Total Cost (Rs)	Net Profit (Rs)
(1) Paddy	200	900	1,246	200	1,446	-546
(2) Maize	200	1,060	1,318	200	1,260	-458
(3) Wheat	100	600	928	100	1,028	-428
(4) Potato	600	3,600	2,160	600	2,760	840
(5) Cauliflower	1,200	10,800	1,525	1,200	2,725	8,075
(6) Ginger	1,000	14,000	3,478	1,000	4,478	9,522
(7) Garlic	750	13,500	3,364	750	4,114	9,386

Source : The Hearing Survey by the Study Team, 1996

Table 4.5.2 Main Features of Site-wise Problems and Proposed Improvement Works on the Rural Road Improvement in Namtar Area

Site No.	Problems and Symptoms	Geological / Topographical Conditions	Mechanical Measures	Vegetative Measures	Expected Effects	Material	Remarks
Site - 1	Slope Collapsed on ms	- Located on a Devastated ravine	Gabion checkdam, Side-ditch	Line-sodding with locally dominant grasses over surface of embankment, possibly with Straw-mat / Jute-net	Stabilisation of slopes; Check further collapse	Gabion, Wet masonry, Vegetated Riprap.	- Vegetation should be done by villagers' participation;
			Drop-chute channels with Vegetated riprap		Effective drainage of rain water	Vegetation (Rooted-cuttings of grasses and shrubs),	- Rooted cuttings of grass should be planted in rainy season for a better growth
	Slope Collapsed on vs		Gabion prop wall		Stabilisation of slopes	Straw-mat, Jute-net	- Backfill with soil firmly; - Confirm bearing strength of the earth
Site - 2 - a	Road shoulder failure on vs due to slope failure	- Saddle portion of hill slopes;	Gabion prop wall	(Natural vegetation)	Retain required road-width	Gabion	
Site - 2 - b	Hill slope Collapsed on ms	- Insufficient drainage of rain water	Gabion prop wall, Side-ditch	Natural vegetation enhanced by backfill soil (behind) and soil dressing (over) on gabion wall	Stabilisation of slopes on ms	Gabion, Dry rubble masonry	- Installation of proper drainage facilities along and across the road will be effective
			Surface drainage, Drainage pipe culvert, Drop-chute		Effective drainage of rain water	Stone-Pitching, Drainage pipe culvert,	
Site - 3	Tendency of mass soil movement over a long downward slope on vs	- Situated above the layer of a past large-scale landslide; - Appearance of weathered rock in the middle of slope on vs;	Gabion prop wall piled on levelling cement mortar and wet masonry layers	Vegetated gabion	Stabilisation of slopes on vs	Gabion, Cement mortar, Dry rubble masonry, Vegetation	- Prop wall can be based on the weathered rock by placement of a thin layer of levelling cement mortar and small volume of wet masonry in between
	Development of gully/ rill erosion over natural vegetation on ms	- Irregular slopes	Removal of unstable surface soil, grading of irregular slopes in advance; Gabion prop wall, Side-ditch	Plantation of rooted cuttings of grasses along contour lines	Secure the safety of road by Check further gully/ rill erosion; Rapid drainage of rain water		
Site - 4	Tendency of mass soil movement over a long downward slope on vs	- Situated above the layer of a past large-scale landslide; - High water contents;	Surface drainage, Side-ditch, Drainage pipe culvert, Drop-chutes	Plantation of grass and shrubs over naked slopes	Highly focused on an effective drainage of rain water	Stone-Pitching, Wet masonry, Drainage pipe culvert	- Drainage of rain water is very important
		- High undulation of slopes due to repeated landslide	Gabion checkdam, Gabion prop wall,	Vegetated gabions	Control washouts of soil particles	Gabion, Vegetation	- Remove unstable surface soil, and grade or trim irregular slopes in advance
Site - 5	Subsidence and destruction of road subgrade caused by Clumsy drainage of rain water	- Cavity development due to pipe clogging and careless embankment	Removal of embankment, Surface drainage, Side-ditch, Drainage pipe culvert, Drop-chute	Vegetated drop-chute	Rapid and effective drainage of existing excess water	Gabion, Wet masonry, Stone-Pitching, Drainage pipe culvert,	- Road-shoulder should be protected by gabions drain culvert across the road
			Gabion checkdam, Gabion prop wall,	Vegetated gabions	Road shoulder protection	Vegetated Riprap	

Source: Field Survey by the Study Team in May - June, 1996

Note: vs = Valley side; ms = Mountain side

Table 4.5.3 Summary of Proposed Major Construction Works on the Rural Road Improvement in Namtar Area

S.N	Major Construction Works	Material	Design of Major Construction Work Items: Count (nos.)	Dimension B (m)	Dimension L (m)	Unit Quantity	Unit	Quantity	Remarks
1.	**Site - 1**								
	Gabion checkdam (Upper)	Gabion box	2 rows	-	35.00	2.50 m3 / m	m3	88	Vegetation
	Gabion prop wall (ms)	Gabion box	2 rows	-	20.00	2.50 m3 / m	m3	50	should
	Gabion prop wall (vs)	Gabion box	2 rows	-	15.00	2.50 m3 / m	m3	38	be done by
	Side-ditch (Type-A)	Wet masonry	1 nos.	-	20.00	0.31 m3 / m	m3	6	villagers'
	Drop-Chute	Vegetated Riprap	1 nos.	2.00	5.00	10.00 m2/ nos.	m2	10	participation
	Vegetation	Rooted Cuttings	As per required						
2.	**Site - 2**								
	Site - 2-a								
	Gabion prop wall (vs)	Gabion box	3 rows	-	15.00	4.50 m3 / m	m3	68	
	Site - 2-b								
	Gabion prop wall (ms)	Gabion box	2 rows	-	20.00	2.50 m3 / m	-	50	Installation of
	Side-ditch (Type-B)	Rubble stone	1 nos.	-	20.00	0.31 m3 / m	m	6	side-ditch, stone
	Surface Drainage	Stone-Pitching	3 nos.	3.00	5.00	15.00 m2/ nos.	m2	45	piching, and
	Drainage pipe culvert pipe d = 200 mm	Aggregates, RCC pipe, etc.	3 nos.	-	5.00	- -	nos	3	3 drain culvert across the road
	Drop-Chute	Vegetated Riprap	3 nos.	2.00	5.00	10.00 m2/ nos.	m2	30	will be effective
	Vegetation	Rooted Cuttings	As per required						
3.	**Site - 3**								
	Gabion checkdam (Upper)	Gabion box	2 rows	-	50.00	2.50 m3 / m	m3	125	Prop wall can be
	Gabion prop wall (vs)	Gabion box	5 rows	-	60.00	9.00 m3 / m	m3	540	based on the
	Side-ditch (Type-B)	Rubble stone	1 nos.	-	60.00	0.31 m3 / m	m	19	weathered rock
	Vegetation	Rooted Cuttings	As per required						
4.	**Site - 4**								
	Gabion checkdam (Upper)	Gabion box	2 rows	-	80.00	2.50 m3 / m	m3	200	
	Gabion prop wall (ms)	Gabion box	2 rows	-	50.00	2.50 m3 / m	m3	125	
	Gabion prop wall (vs)	Gabion box	4 rows	-	25.00	6.50 m3 / m	m3	163	
	Side-ditch (Type-A)	Wet masonry	1 nos.	-	50.00	0.31 m3 / m	m	16	Drainage of
	Surface Drainage	Stone-Pitching	3 nos.	3.00	5.00	15.00 m2/ nos.	m2	45	rain water
	Drainage pipe culvert pipe d = 200 mm	Aggregates, RCC pipe, etc.	3 nos.	-	5.00	- -	nos	3	is very important
	Drop-Chute	Vegetated Riprap	3 nos.	2.00	5.00	10.00 m2/ nos.	m2	30	
	Vegetation	Rooted Cuttings	As per required						
5.	**Site - 5**								
	Gabion prop wall (ms)	Gabion box	2 rows	-	10.00	2.50 m3 / m	m3	25	Road-shoulder
	Gabion prop wall (vs)	Gabion box	2 rows	-	10.00	2.50 m3 / m	m3	25	should
	Side-ditch (Type-A)	Wet masonry	1 nos.	-	10.00	0.31 m3 / m	m	3	be protected
	Surface Drainage	Stone-Pitching	3 nos.	3.00	5.00	15.00 m2/ nos.	m2	45	by gabions
	Drainage pipe culvert pipe d = 200 mm	Aggregates, RCC pipe, etc.	3 nos.	-	5.00	- -	nos	3	
	Drop-Chute	Vegetated Riprap	3 nos.	2.00	5.00	10.00 m2/ nos.	m2	30	
	Vegetation	Rooted Cuttings	As per required						
6.	**Drainage Facilities Development Over all Area**								
	Side-ditch (Type-B)	Rubble stone	- m	-	6,000.00	0.31 m3 / m	m3	1,860	Drainage Structures
	Surface Drainage	Stone-Pitching	30 nos.	3.00	5.00	15.00 m2/ nos.	m2	450	Are Proposed
	Drainage pipe culvert pipe d = 200 mm	Aggregates, RCC pipe, etc.	30 nos.	-	5.00	- -	nos	30	to be provided every 200 m
	Drop-Chute	Vegetated Riprap	30 nos.	2.00	5.00	10.00 m2/ nos.	m2	300	along the Road
	Vegetation	Rooted Cuttings	As per required						

Note: 1. Quantity is rounded to integer
2. vs = Valley side; ms = Mountain side

Longitudinal Profiles of the Manhari Khola

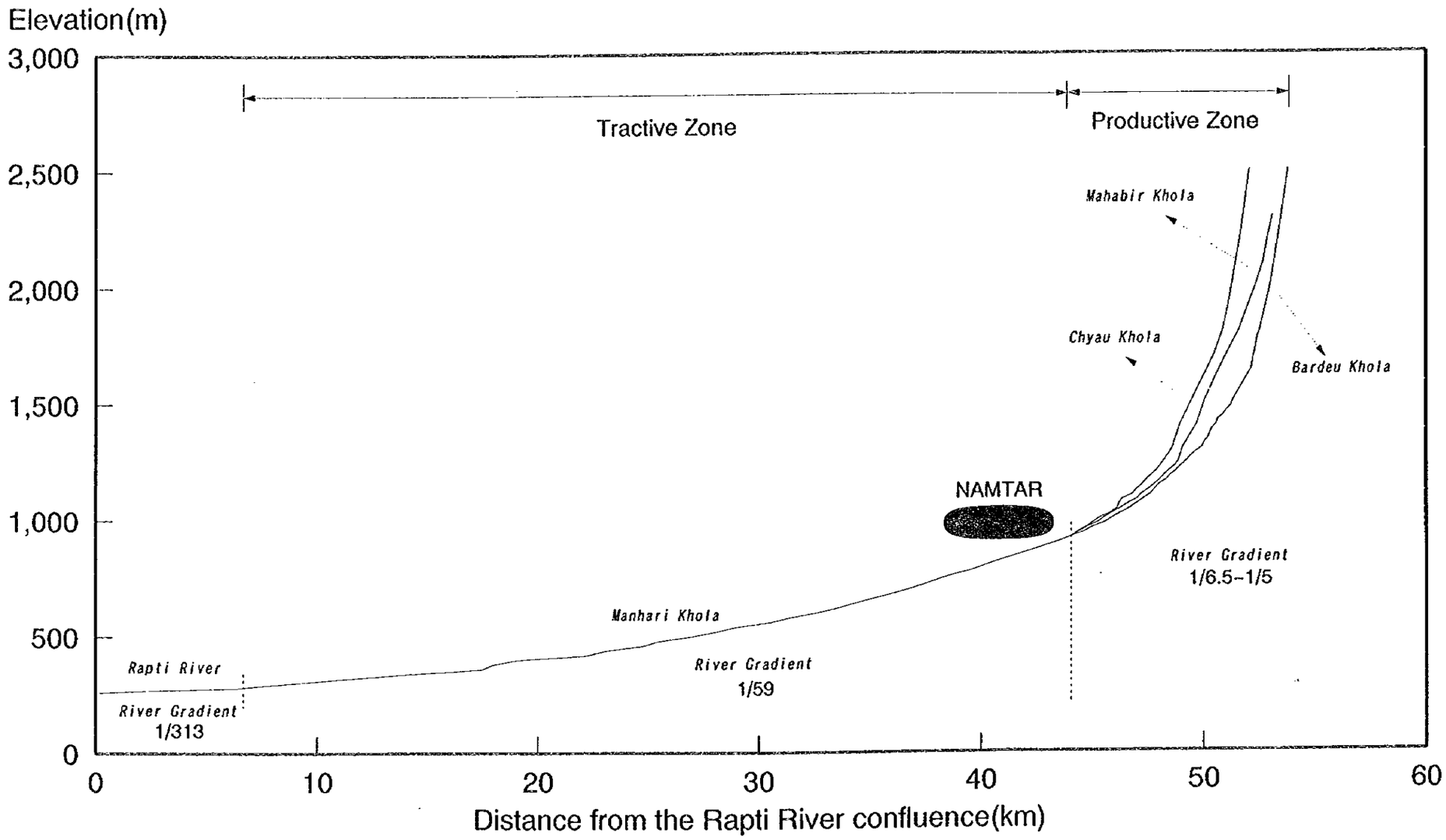


Fig. 4.1.1 River Profile of Manhari Khola

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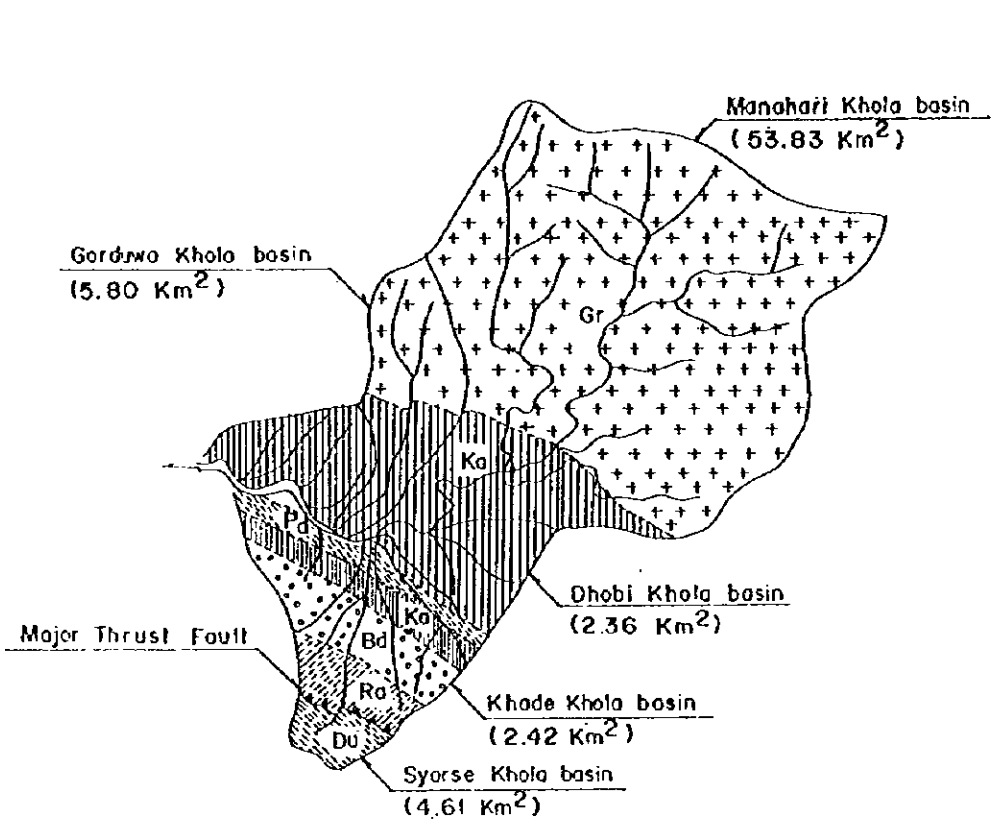

Km. 1 0 1 2 3 4 5 Km.

FORMATION	IN	ROCK	PATTERN
(UPPER NUWAKOT GROUP)			
Dunga Quartzite Beds	Du	quartzite	
(BHIMPHEDI GROUP)			
Kalitar Formation	Ka	biotite schist quartzite	
Pandrang Quartzite Member	Pd	quartzite	
Bhainsedobhan Marble	Bd	marble	
Raduwa Formation	Ra	schist	
Biotite and tourmaline granite	Gr	granite	

Fig. 4.1.2
Geological Map of Manhari Catchment Area

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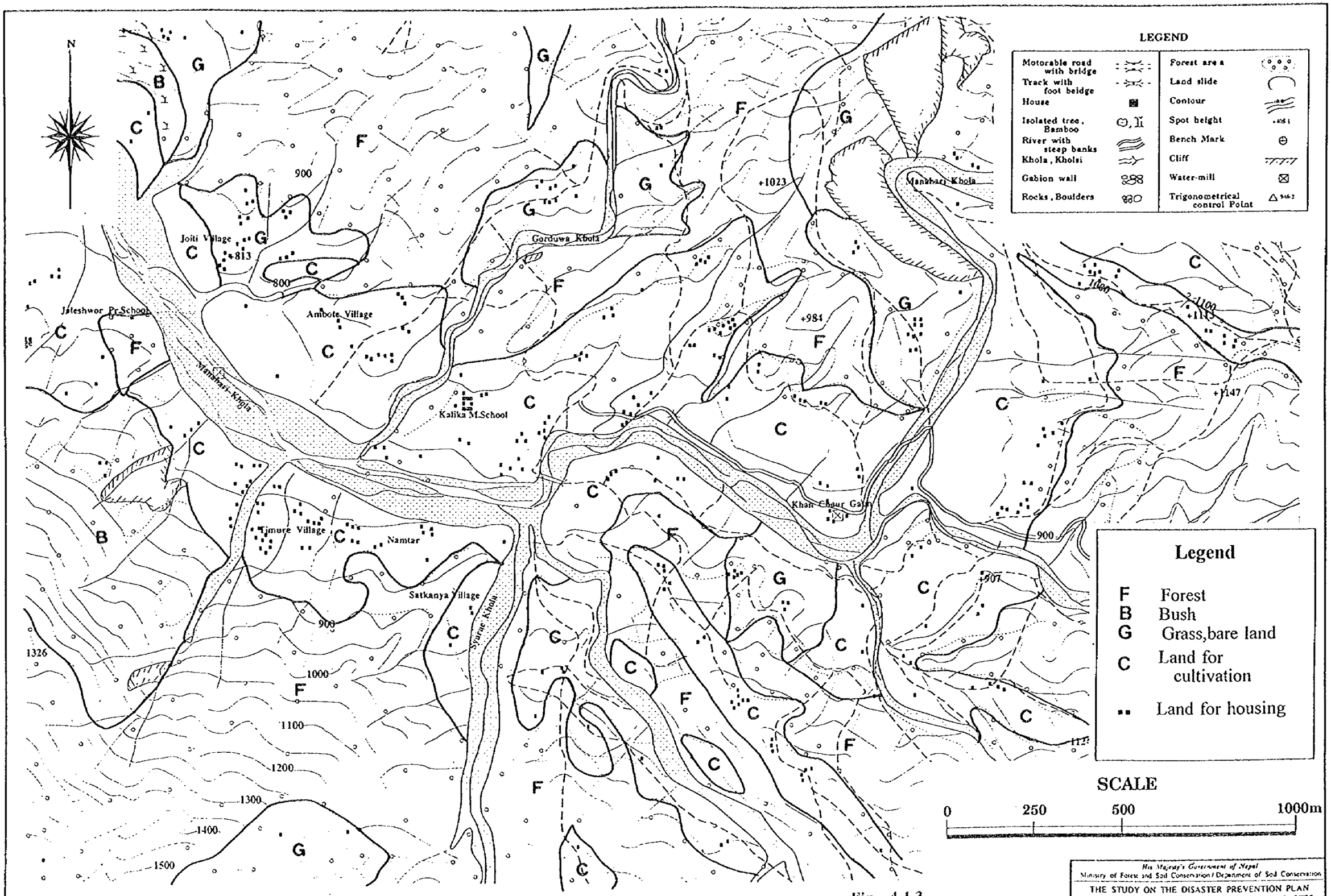

Fig. 4.1.3
Land Use Map for Namtar

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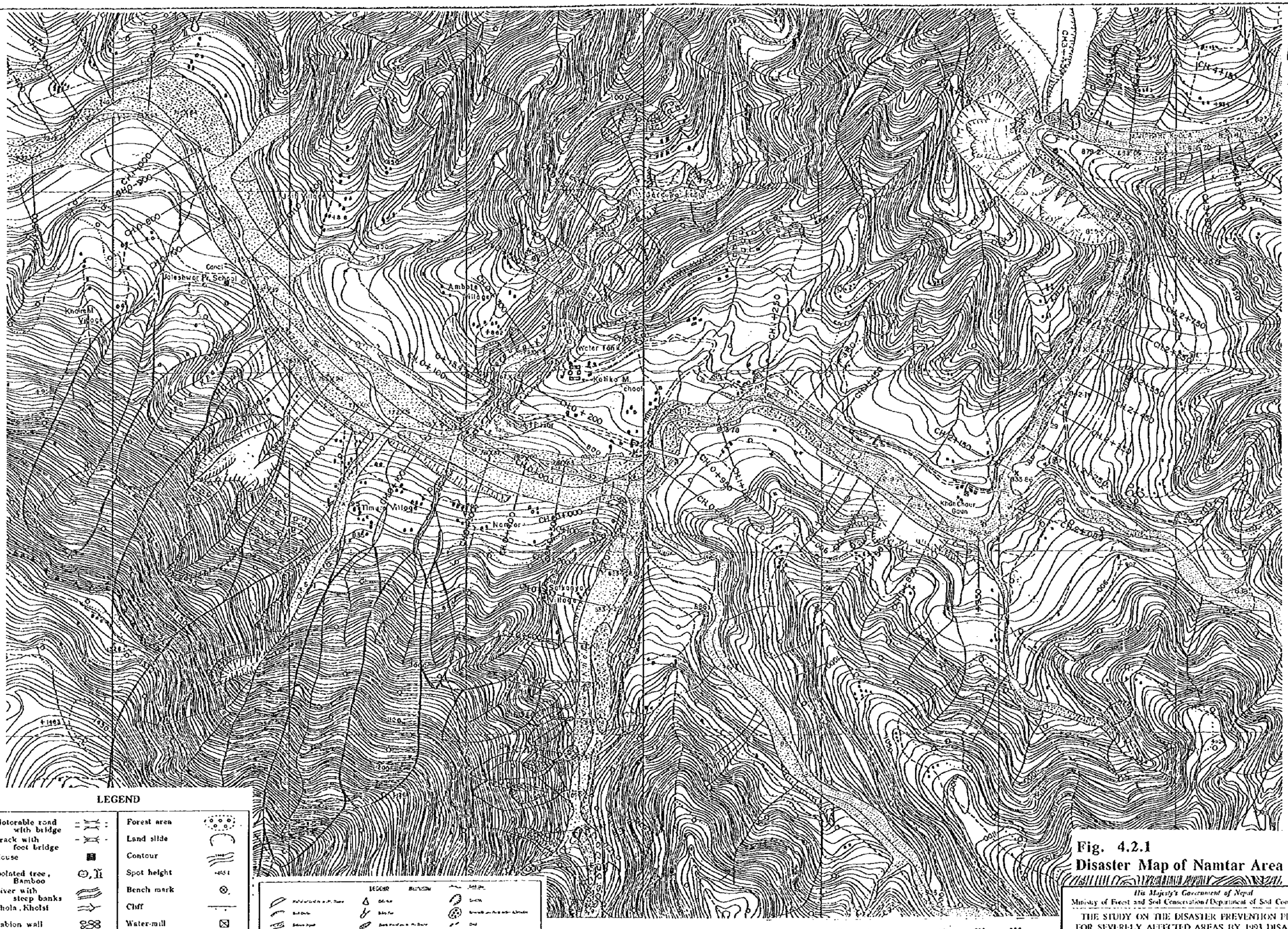

Fig. 4.2.1
Disaster Map of Namtar Area

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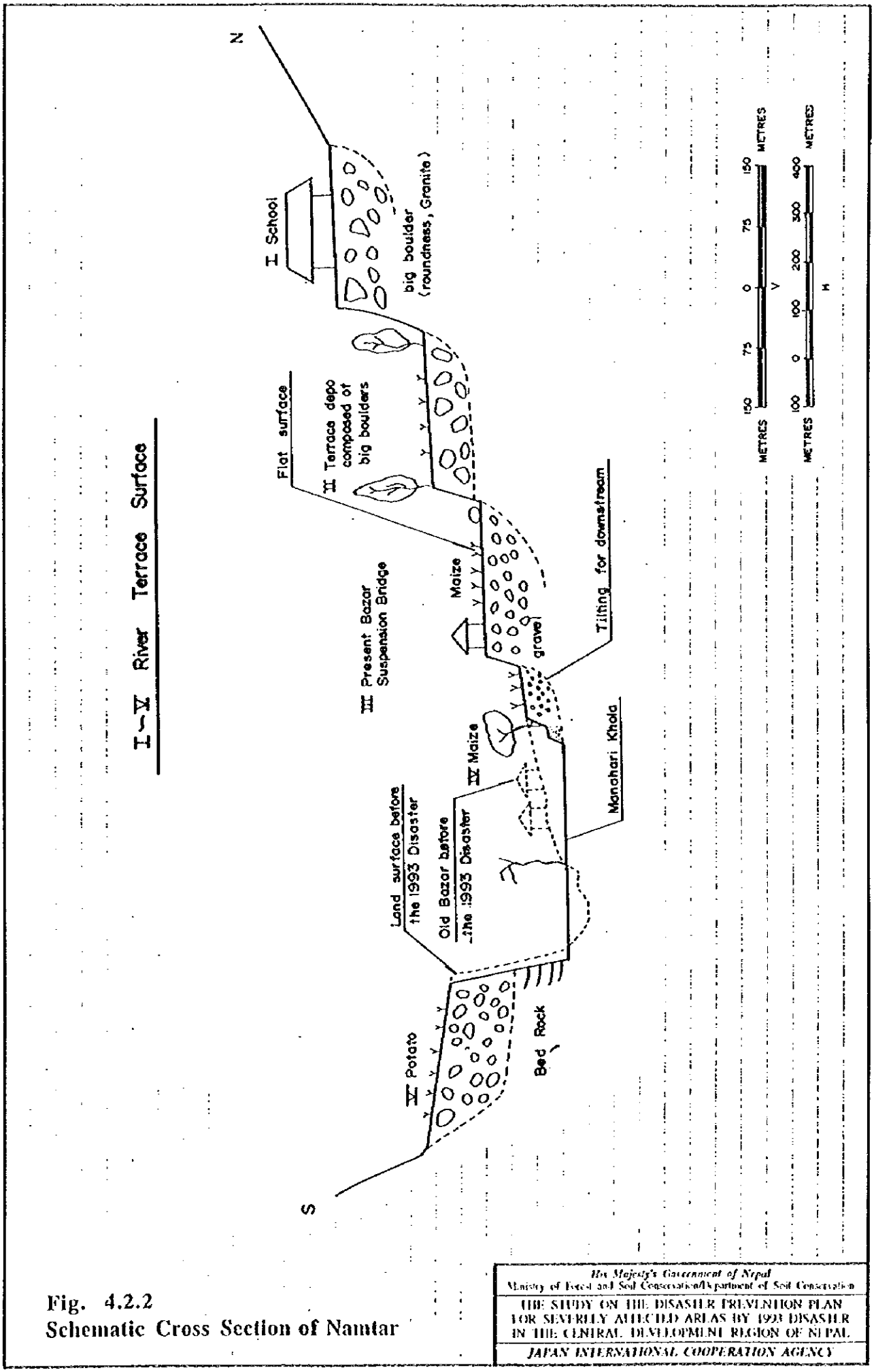
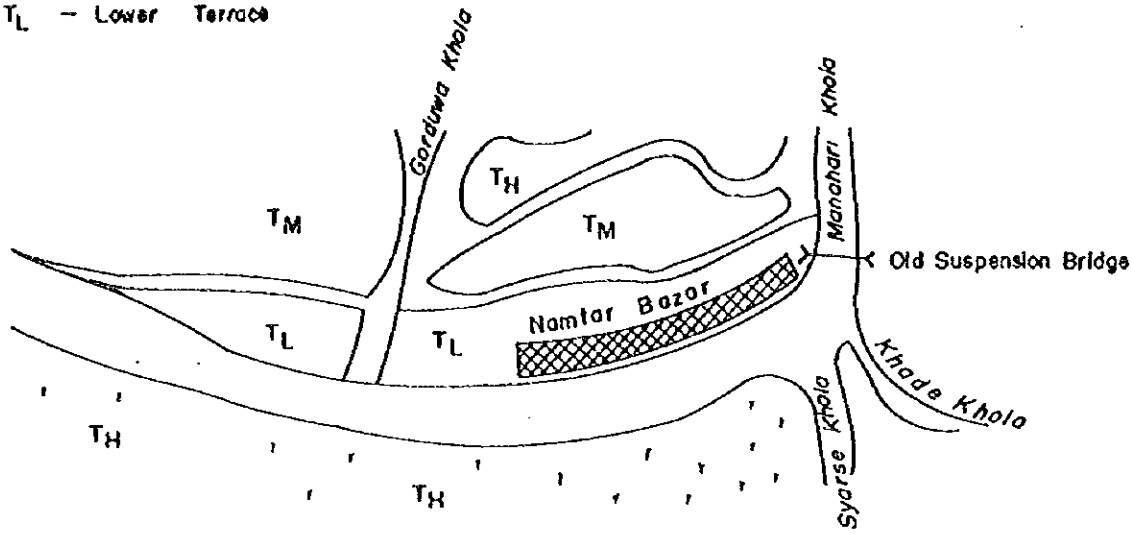


Fig. 4.2.2
Schematic Cross Section of Namtar

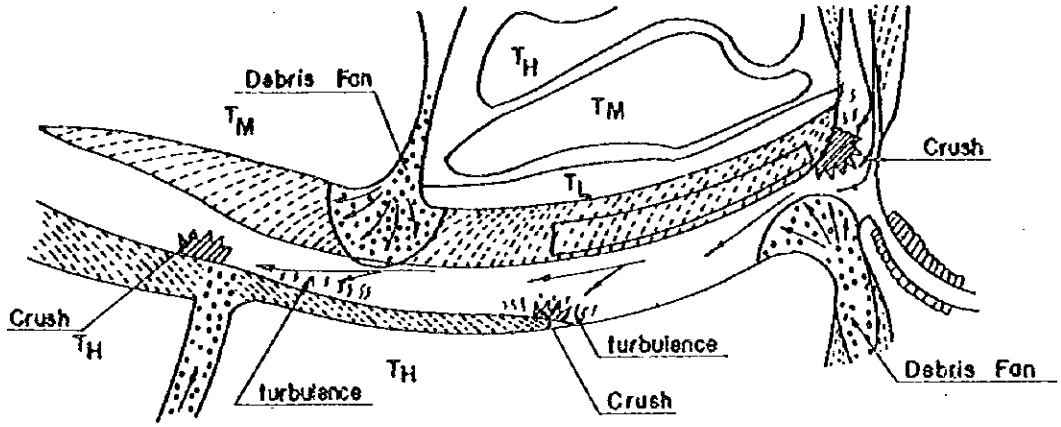
(1) Before the 1993 Disaster

T_H – Higher Terrace

T_L – Lower Terrace



(2) Erosion and Sediments during the 1993 Disaster



(3) Present River Channel

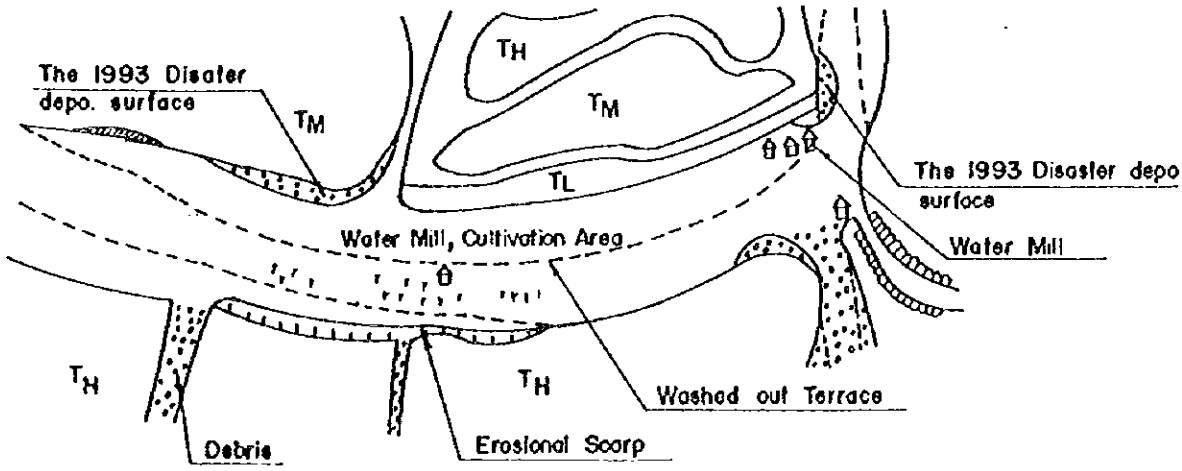


Fig. 4.2.3
Landform Changing Map before and after 1993 Disaster

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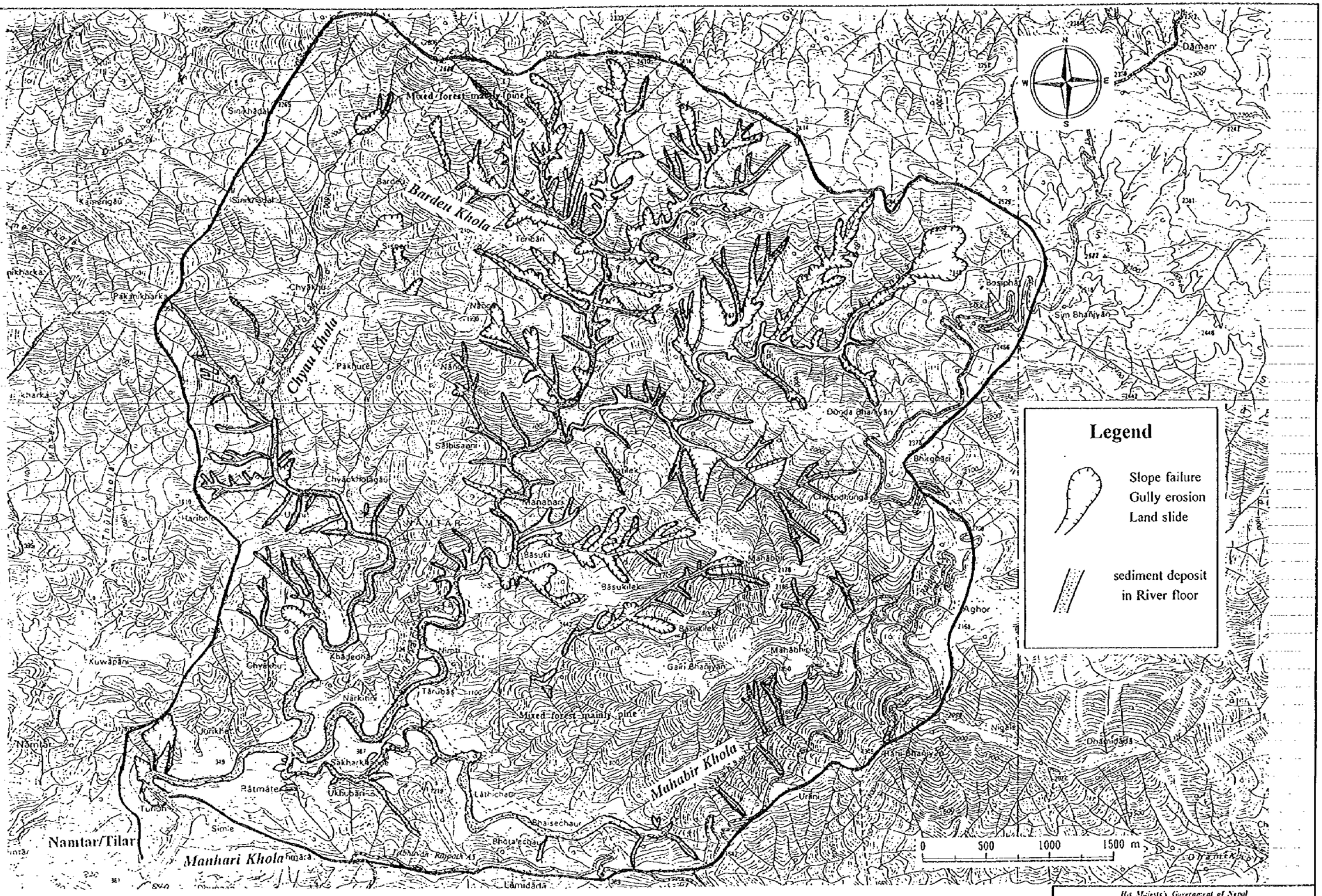

Fig. 4.2.4
Detailed River Conditions at Upstream Part of Manhari Khola

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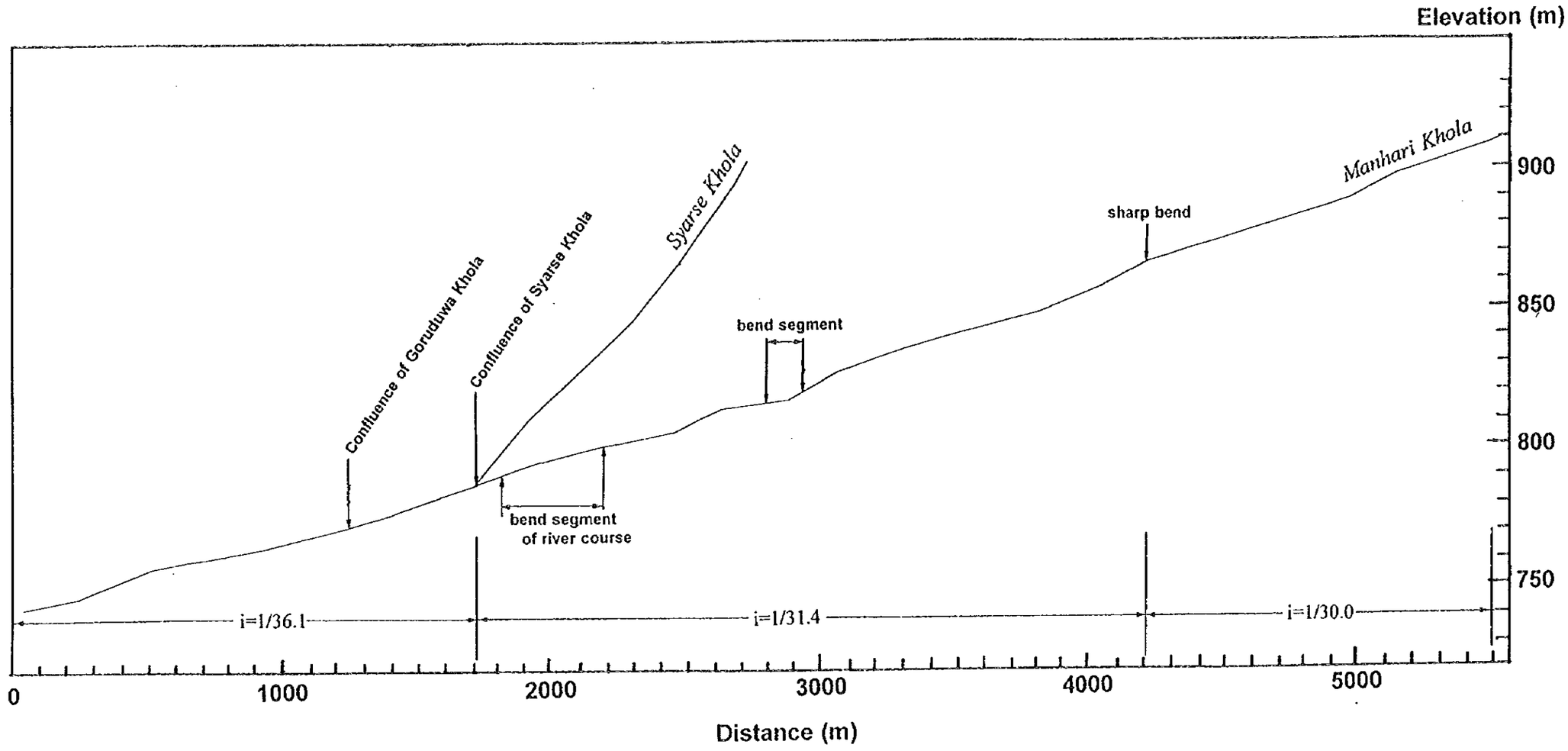

Fig. 4.2.5
Detailed River Profile of Manhari Khola near Namtar

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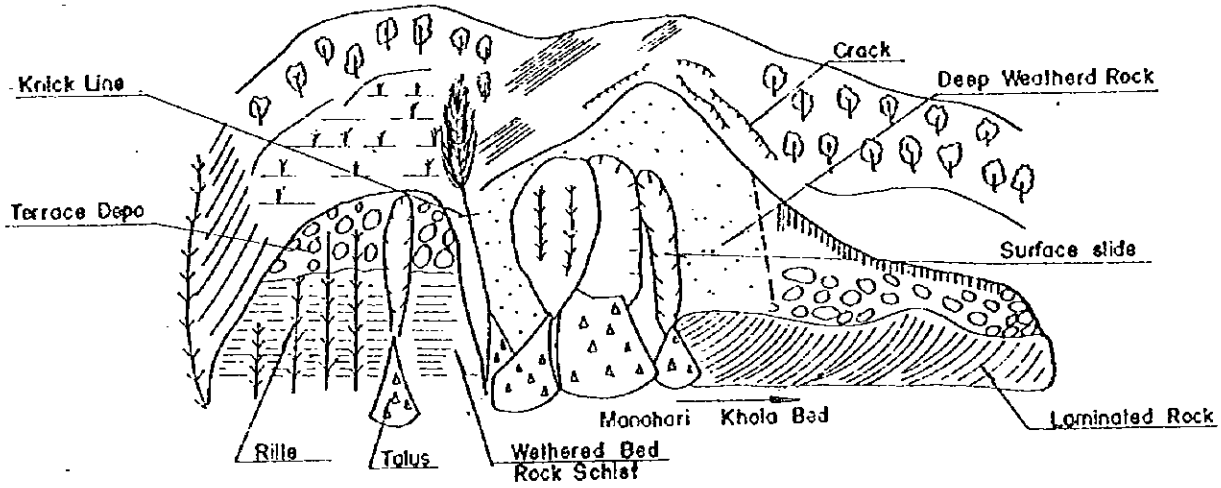

Fig. 4.2.6
Sketch of Bank Scouring in Manhari Khola

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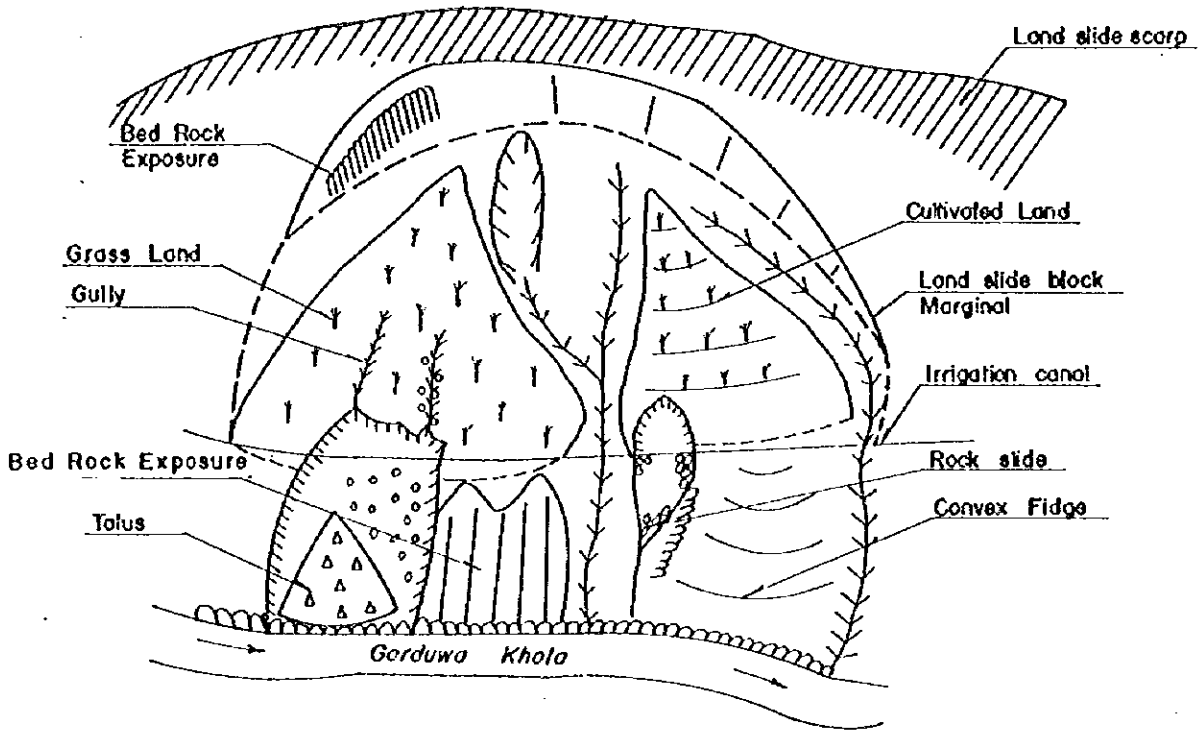

Fig. 4.2.7
Sketch of Landslide and Collapsed Area in Gorduwa Khola

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