APPENDIXES

Appendix-A STUDY AREA AND SELECTION OF PRIORITY AREAS

A.1 Study Area for CDPP

The nine areas selected as Communities for Disaster Prevention Plans (CDPP) are shown in Figures A.1.1 and A.1.2 and re-listed below:

No.	Village	VDC	District
1.	Phedigaon/Phatbazar	Palung	Makwanpur
2.	Kebreni	Dandakharka	Makwanpur
3.	Bimaltar	Raksirang	Makwanpur
4.	Namtar/Tilar	Namtar	Makwanpur
5.	Chisapani	Agra	Makwanpur
6.	Deukhel	Agra	Makwanpur
7.	Beluwa	Manhari	Makwanpur
8.	Betini	Mahadevsthan	Sindhuli
9.	Sahan	Karipabriksha	Sindhuli

In the Study, since Phedigaon and Phatbazar are so close to each other, they are treated as one village, and so are Namtar and Tilar. Seven areas are selected in Makwanpur District and two in Sindhuli District.

Table A.1.1 shows a brief description of the two district profiles. The literacy rates in both districts are low. Especially, almost all women who are over twenty years old are illiterate, according to the field survey by the Study Team. Regarding employment, more than 90% of the population is engaged in agriculture in both districts. Since Makwanpur District has larger cities and towns, such as Hetauda, than other districts, there are more people engaged in the service sector and the manufacturing sector. There are many different ethnic groups. The majorities are Nepali and Tamang. It is noticed that Tamang in Makwanpur District is the largest ethnic group, which does not coincide to the national picture of the ethnic group distribution in Nepal. Major export goods are mostly agro-products, no particular location-specific products are seen, though construction materials in Makwanpur District are really location-specific.

Topographically speaking, the 9 areas can be classified into two groups: Mountainous areas (Phedigaon/Phatbazar, Kebreni, Bimaltar, Namtar/Tilar, and Deukhel) and flat areas (Beluwa, Betini, and Sahan). The villages in mountainous areas are located on steep slopes, while those in flat areas are located along rivers.

Because of these topographic differences, the natures of disasters are also different. The villages in mountainous areas suffer from frequent landslides and slope failures (Kebreni, Bimaltar, and Deukhel), while those located along streams sometimes face debris flows which suddenly wash villages away (Phedigaon/Phatbazar and Namtar/Tilar). The villages in flat areas mostly suffer from floods and siltations over farmlands and houses (Beluwa, Betini, and Sahan).

There are many similarities among these nine areas. The people are mostly engaged in agriculture only, try to be self-sufficient in living, and there is no other industry. To earn cash income, they sometimes sell their agricultural products and work as daily labourers. They are basically very poor, especially since the 1993 disaster, their standard of living has been deteriorated and kept trapped in the situation where people can barely survive. They do not have any countermeasures to stand up against future disasters, leave dangerous situations as they are, and live their lives as they use to. They still live in disaster-prone areas, only fearing the next disaster.

Among nine areas, two are accessible by car in the dry season - Phedigaon/Phatbazar and Namtar/Tilar. There is an access road between the Tribhuvan Highway and Namtar/Tilar which is maintained by the people, but it seems hardly practicable during the rainy season. On the other hand, an access road to Phedigaon/Phatbazar is just a trail created along the dried river bed of the Palung Khola, and there is no chance to use it during the rainy season though it is very close to the Tribhuvan Highway. These two areas have a tremendous geographical advantage in that they are easily accessible from a national highway. Beluwa is located on the East-West Highway and there is no problem at all in transportation.

Other six areas are basically located in remote areas and have no easy access to the national transportation network. Because of this, economic activities in these six areas are inward-looking, i.e., a sustenance economy. The people living there are producing agricultural products enough to feed themselves and try to sell a fraction of products to generate cash income.

Table A.1.2 is derived from the interviews of thirty households in each area using the Questionnaire-I prepared by the Study Team. Although the data are not so reliable due to, among others, the bias in interviewers and interviewees as well as the violation of sampling theory, Table A.1.2 gives a general information on the nine areas and makes it easy to compare with each other.

In Beluwa, almost all households interviewed are landless because the village was completely washed away by the flood of the Manhari Khola in July 1993. Since they are all landless, most of information on Beluwa in Table A.1.2 is irrelevant. Unfortunately they can be regarded as squatters since they have no land, living in huts along the East-West Highway. Surprisingly, no household interviewed is landless in Kebreni, Bimaltar, Chisapani, and Deukhel.

Electricity is available only in Phedigaon/Phatbazar. The average number of family members is almost the same as the national average, except for Betini and Sahan where it is larger than the national average. Deukhel and Chisapani suffer from a longer time, forty to fifty minutes, to fetch drinking water, while other areas need twenty minutes or so. With respect to the collection of firewood and fodder, which is the most painstaking one in their routine, the conditions have been deteriorating due to deforestation in the areas. It takes four to six hours to collect firewood and fodder in most areas.

The results of the enquiry on development priorities show that the drinking water development project is given the first priority in Phedigaon/Phatbazar, Kebreni, Bimaltar, Namtar/Tilar, and Chisapani. The people in Betini and Sahan think that a disaster prevention project is most important for them, and a road development project is urgently necessary in Deukhel. Since Beluwa was washed away completely, the people in Beluwa hope to have new lands for them and they give the first priority to a settlement project. Though most people in the areas have suffered from disasters, what they really need now is not always a disaster prevention. A disaster happens once in a while. Generally speaking, what most people really need now is something good to improve their everyday life, not a thing that is useful someday in the future. The implication is that the people in the areas cannot afford to prepare for the future, rather they are so poor that they have to find a way to survive day by day.

The field observation by the Study Team gave a general perception that the land where water is available is mainly used as paddy field, and where water is not available, the land is used for producing upland crops, such as maize, millet, wheat, and vegetables. Betini, Sahan, and Namtar/Tilar are located along rivers and the farmers there can cultivate rice.

Other areas are basically located in mountainous areas and water is not much available, so their lands are mainly used for producing upland crops. The data on major agricultural products in Table A.1.2 almost coincide with the observation by the Study Team. Since Phedigaon/Phatbazar and Chisapani are close and have similar geographical conditions, their agricultural productions are similar.

A.2 IDPP for Road

A.2.1 Damage due to the 1993 Disaster, Cause and Mechanism of Phenomena

(1) Mahadev Beshi Bridge

The Mahadev Beshi Bridge is located in the lower reaches of the Agra Khola at its confluence with the Mahesh Khola. The bridge crossing over the Pritivi Highway has been destroyed by floods with large boulders brought by debris flow and sediments. Due to this damage, commutal systems connected by the bridge has been disconnected, therefore causing damage to the surrounding areas.

According to the results of field investigation by the Study Team, it seems that the damage caused to the Chalti Khola basin, which is a tributary of the Agra Khola, was concentrated in the geological areas which consist of slate of Tistung Formation composed of phyllite and meta sandstone, and Kulekhani Formation composed of alternation of micaceous quartize schist, as large damage by the 1993 Disaster is prevailing in these areas. Considering the fact that the geological formation of the mid-basin is relatively high in quartzite, it can be said that the source of damaging materials, which consist of large boulders carried by debris flow, lie within the damaged area in the mid-basin. However, considering the distance of 20.5 km between the source of materials and the Mahadev Beshi Bridge, the gentle river gradient of 5.2° and the meandering around the area, there is only a small possibility that the debris flow energy of the materials produced at the source could be maintained all the way to reach the Mahadev Beshi bridge.

Furthermore, it is considered that sediments repeat deposition and transportation by debris flow in the long river channel, as deposition of large boulders can be observed in the mid-channel. This fact also confirms the above-noted point about the possibility of insufficient debris flow energy to reach the Mahadev Beshi bridge.

Therefore, it is assumed that the damage to the bridge is caused by the second movement of sediments formed by deposition and transportation and of large boulders already deposited in the river bed due to the flood.

The damage of 1993 was not the first one occurred in the basin. It is reported that similar events happened in the years 1954, 1970, and 1974 mainly due to heavy rain. It is considered that most of the disasters, including the one in 1993, are mainly a continuation of the expansion of past disasters.

(2) Near Tistung Area

The area around Tistung along the Tribhuvan Highway is composed of Tistung Formation consisting of phyllite, quartzite and schist. Slides and erosion occur in the lower area where the filtration process has progressed due to cultivation and irrigation, i.e. the region where foundation rocks are deeply weathered by precipitation filtration.

As a result of this process, damage such as destruction of road banks, closing of road due to sediment transport from the upper part of slopes and destruction of roads along the river due to landslides along the Tribhuvan Highway.

The above-mentioned phenomena can be categorized into several types based on the geological conditions of slopes. Heavily weathered slopes would cause slump-type soil-slide or heavy weathered rock-slide, while rock-slide slopes would cause plane slide, and slopes with cracks would form wedge-failure. Moreover, slopes along the valley or steep slopes would cause failure of shallow-layers composed of movable deposits of debris and weathered rocks. Along the valley, these materials would mix with rainfalls and forms debris flow to downstream.

The direct cause of slide and wedge-failure depends on the increase in water pressure of the precipitated liquids which entered cracks between the movable layers during heavy rainfall. However, it is also considered that slide and wedge-failure along the roads on the hill slopes are caused indirectly by soil excavation during the construction of Tribhuvan Highway.

(3) Palung-Daman Area

The region along Palung-Daman is a granite zone. Weathering has progressed along slopes of this granite zone and onion-structures are formed by deposits of thin shells. Furthermore, many gullies run across the Tribhuvan Highway in the Palung-Daman area.

In the 1993 storm, rainfall flowed into these gullies, resulting in the erosion of regolith, debris, and alluvial deposits in the downstream area. Furthermore, the materials flown downstream formed a temporarily-constructed small-scale natural dam which later collapsed suddenly and caused debris flow to downstream. There are some indications of debris flow reaching the lowest point of the river, such as in Sankhamul or Kitini Khola, as the sediments in the riverbed were scoured, obstacles in the riverbed were removed. Because of this phenomenon, many portions of road bed have been destroyed and various parts of the river have been clogged due to the sediment transport. Furthermore, debris flow occurred in the Kitini Khola has been mixed with sediments transported in the past. The mixed debris flow at the confluence with the Palung River re-eroded the river banks which consist of large boulders, and thus generated further debris flow.

A.3 IDPP for the Kulekhani Reservoir

A.3.1 Selected Investigation Areas for IDPP Formulation

Based on the discussion among NEA, DOSC and the Study Team, the three investigation sites for IDPP for the Kulekhani reservoir were selected as follows:

(a) Garti Khola,
(b) Phedigaon Khola,
(c) Khanigaon Khola.

The above selected three sub-basins are the major sediment sources. The Darkot Khola was not selected, because all the sediment would be deposited in the dead storage and the designed sloping intake would solve the sediment inflow from the Darkot Khola.

Concerning the results of the Master Plan Study, the Study Team recommended to add one more site in the main stretch of the Palung Khola in Palung valley as this stretch is wide enough to detain sedimentation and the Master Plan Study identified the priority area for the sediment control works. The NEA and DOSC agreed with this idea.

(1) Conditions after the 1993 Disaster

The condition of the respective investigation sites is as follows:

[1] Garti Khola

The Garti Khola originates from the Mahabarat Range, flows eastward, joins the Phedigaon Khola in Palung village and becomes the Palung Khola. The drainage area is about 16.4 km^2, occupying 13% of the Kulekhani watershed. The river length is 5.2 km and the average gradient is 18%.

Geological formation of the basin has a contrast between the right and left banks of the river. The right bank is composed of granite of the Mahabarat Range. Debris flow terraces consisting of granite boulders are developed on the right bank forming cultivated land. The left bank is composed of schist from the Kulekhani Formation. Fewer landslides are found on the left bank because of the different geological formation.

Debris flows occurred in many places along the gullies in the granite zone during the storm of July 1993. However, the loss of human lives was not observed. Because the residential areas in the basin are mainly located on higher elevations of the alluvium fan while the debris flow occurred along the river course without overtopping the river channel. A large number of granite boulders with a diameter of 1 to 2 m are found in most parts of the Garti Khola except near the confluence with the Phedigaon Khola, where sand is deposited. Social structures such as schools and temples are located near the confluence and these were submerged by sand from the Garti Khola. It was observed that sand deposition near the confluence is gradually being transported by the river flow to the lower reaches and may deposit in the Kulekhani reservoir in future.

[2] Phedigaon Khola

The Phedigaon Khola originates from the western edge of the mountain at an elevation of 2,510 m in the Kulekhani watershed, flows eastward and meets with the Garti Khola in the Palung village. The drainage area is 5.6 km^2, occupying 4.4% of the Kulekhani watershed. The river length is about 4 km and the average river gradient is about 22%.

The basin is mainly formed by schist and sandstone, and the mountain on the right bank forms the upper slope of the river, where big landslides occurred and debris flows directly attacked the residential area of Phedigaon Village during the storm of July 1993. Many slope failures were observed along the upstream gullies with a gradient of about 47%, and the debris flow was trapped near Phedigaon Village with a slope of 8.7%. Also many small landslides were observed on the left bank of the river, however, debris flows did not occur because of the gentle gradients of the gullies on the left bank.

[3] Khanigaon Khola

The Khanigaon Khola originates from the Mangaleswar Than Range, located on the north-western edge of the Kulekhani watershed, flows to the south-east, and meets with the Palung Khola. The drainage is about 9 km^2, occupying 7.1% of the Kulekhani watershed. The river length is about 4 km with an average slope of 8.0%.

This basin is also one of the seriously damaged basins caused by slope failures due to the geological formation. According to the geological map, many geological faults developed in the basin and they are the main reason for the many slope failures observed. The depth of slope failures seems deeper than in other basins.

Sediment erosion in the basin appears remarkably high, and the sediment, mainly consisting of slate with a diameter of about 1 m, is deeply deposited along the whole river reach. Sediment discharge to the Palung Khola is also high and it is supposed that sediment supplied from the Khanigaon Khola is easily transported to the Kulekhani reservoir due to the size of sediment which is rather small (30 to 50 cm).

[4] Palung Mainstream in the Palung Valley

The section from the confluence of the Garti / Phedigaon tributaries to the Palung Bridge is located in the Palung Flat Valley. The river has a gentle slope and a wide channel. Fan formation of a debris flow terrace with at least two steps, which originates from the Mahabarat Range located in the south of the river course, is observed on the right bank, where paddy and corn fields are well developed.

A great deal of sand is deposited along the reach with a width of 100 to 500 m. The Band is from the Garti and the Phedigaon tributaries. The residential houses, schools, temples, and market located on the right bank are buried under about 1m by sand sedimentation. Gravel and boulders are not found in the reach because they were trapped in the upper reaches, which are too gentle to transport such big materials.

It was observed that a great deal of sand from the tributaries of Garti / Phedigaon were deposited and gradually transported downstream by subsequent flows. There is another major source of sand which comes from the small stream originating from the Mahabarat Range and meets with the Palung Khola about 500 m downstream of the Palung bridge.

Another section from the Palung Bridge to the lower end of the Palung Flat Valley is also located in the Palung Flat Valley. The river is relatively gentle with a wide channel. Low debris flow terraces are found on both banks and these are well developed, forming paddy and corn fields.

Debris flow of granite boulders, with a diameter of 1 to 2 m, was caused by the flood of July 1993 in the Kitini Khola, which meets with the Palung Khola just downstream of the Palung bridge. It was found that the debris head was trapped at the confluence, and no granite boulders have been transported to downstream due to the gentle slope of the Palung Khola.

(2) Estimated sediment yield from the respective areas

The Mater Plan Study estimated that the annual average sediment deposition in the reservoir is 355,000 m^3. The estimated annual sediment discharge at the downstream end of each investigation site is as follows:

[1]	Garti Khola	76,000 m^3 / annum.
[2]	Phedigaon Khola	78,000 m^3 / annum.
[3]	Khanigaon Khola	5,000 m^3 / annum.
[4-1]	Palung Khola (at No.5 site)	161,000 m^3 / annum.
[4-2]	Palung Khola (at No.4 site)	156,000 m^3 / annum.

The estimate results indicate that the sediment transportation of the Palung Khola from the Palung valley would be 156,000 m^3/annum., which is about 44 % of the estimated annual sediment deposition in the reservoir. Besides, the Garti Khola and the Phedigaon Khola provide each about 20% of the annual sediment deposition in the reservoir. The contribution of the Khanigaon Khola to sediment deposition in the reservoir is estimated to be very small.

A.4 Selection of Priority Areas

A.4.1 Procedures for Priority Assessment

(1) General

For assessment of the priority areas for proceeding the feasibility study, the objectives of the Study should be carefully considered, which are summarized as follows:

1) For Community Disaster Prevention Plans (CDPP), people's participation for planning and implementation should be taken into account, hence the selected villages should have capable leaders, high potential of people's cooperative activities.

2) For Infrastructure Disaster Prevention Plans (IDPP), the selected sites should be economically feasible. In addition to the economic feasibility, the disaster prevention measures are highly expected to trigger the regional economy, by applying appropriate technologies which include to utilize local materials, local contractors, and local people for project implementation.

Based on the above basic concept of the Study, the selection of the priority areas was made.

Firstly, the criteria for selection were determined in the steering committee meeting held on January 23, and 24, 1996, for Community Disaster Prevention Plans and Infrastructure Disaster Prevention Plans for road and the Kulekhani reservoir.

Based on the criteria, the weight of each criterion was determined in the steering committee meeting on the same date as above. The total weight of each plan is 50 points. The criteria in each plan are compared each other and the weights are distributed among the criteria in accordance with the importance in the Study.

After the determination of criteria and weights, the scoring is made by the Study Team. With respect to each criterion, each investigation site receives a score of either 2, 1, or 0. Based on the weight and the score, each candidate can receive a point for respective criteria by multiplying the weight by the score. The accumulation of the point for each criterion gives the total score of each candidate site. The maximum score is 100 points.

(2) Criteria and Weights

1) For Community Disaster Prevention Plan

Taking into consideration the necessary components of disaster prevention plans in the Study, such as the aspects of people's participation, development through disaster prevention, women in development, and so on, the categories of criteria and their weights are determined as shown below:

No.	Category of Criteria	Weight	Percentage
1)	Possibility of people's participation	12.5	25%
2)	Damages to the community by the disaster	7.5	15%
3)	Hazard potential in the community	12.5	25%
4)	Necessity of rehabilitation of the community	5.0	10%
5)	Possibility of community development	5.0	10%
6)	Possibility for women in development	2.5	5%
7)	Engineering merit	5.0	10%
	TOTAL	50.0	100%

In each category of the criteria, the criterion is determined. The weight for each criterion is determined based on the given weight in respective category. The list of criteria is distributed as follows:

No.	Criteria	Weight	Percentage
1)	Possibility of people's participation	12.5	25%
1-1)	Activities of the existing people's group	5.0	10%
1-2)	Previous successful activities of NGO in the area	5.0	10%
1-3)	Leader's capability for institutional set-up	2.5	5%
2)	Damages to the community by the disaster	7.5	15%
2-1)	Dead person	3.0	6%
2-2)	Damaged houses	1.0	2%
2-3)	Damaged farm land and agriculture income	2.0	4%
2-4)	Damaged rural infrastructure	1.5	3%
3)	Hazard potential in the community	12.5	25%
3-1)	Recent experience of disasters	4.0	8%
3-2)	Present hazard potential in the community	8.5	17%
4)	Necessity of rehabilitation of the community	5.0	10%
4-1)	Necessity of rehabilitation of damaged houses	1.0	2%
4-2)	Necessity of farm land rehabilitation	1.5	3%
4-3)	Necessity of community infrastructure rehabilitation	2.5	5%
5)	Possibility of community development	5.0	10%
5-1)	Possibility of agriculture development	2.5	5%
5-2)	Possibility of small industry development	1.0	2%
5-3)	Possibility of rural infrastructure development	1.5	3%
6)	Possibility for women in development	2.5	5%
6-1)	Current women's load in the family and community	1.0	2%
6-2)	Existing women's group and its activities	1.0	2%
6-3)	Leader's understanding for women in development	0.5	1%
7)	Engineering merit	5.0	10%
7-1)	Accessibility for implementation	1.5	3%
7-2)	Possibility for material procurement	1.5	3%
7-3)	Possibility for measures to hazard mitigation	2.0	4%
	TOTAL	50.0	100%

2) For Infrastructure Disaster Prevention Plan for Road

For road, disaster prevention, the priory and willingness of the responsible agency should be taken into account for an effective implementation of disaster prevention activities. The importance and hazard potential of the respective site should be known by the responsible agency. The following categories of the criteria and the weights are determined through the discussion among DOR, DOSC and the Study Team:

No.	Category of Criteria	Weight	Percentage
1)	Priority in DOR	15.0	30%
2)	Hazard potential of the area	10.0	20%
3)	Feasibility of the countermeasures	10.0	20%
4)	Economic impact on the region	15.0	30%
	TOTAL	50.0	100%

In each category of the criteria, the criterion is determined. The weight for each criterion is determined based on the given weight in respective category. The list of the criteria is described as follows:

No.	Criteria	Weight	Percentage
1)	Priority in DOR	15.0	30%
1-1)	DOR eagerness for technical assistance	10.0	20%
1-2)	Expecting DOR leadership	5.0	10%
2)	Hazard potential of the area	10.0	20%
2-1)	Scale of the disaster	3.0	6%
2-2)	Urgency of the countermeasures	2.0	4%
2-3)	Estimated rehabilitation period if disaster occurred	4.0	8%
2-4)	Previous rehabilitation works and its reliability	1.0	2%
3)	Feasibility of the countermeasures	10.0	20%
3-1)	Estimated safety factor against the disaster	2.0	4%
3-2)	Cost acceptability	4.0	8%
3-3)	Technical acceptability	4.0	8%
4)	Economic impact to the region	15.0	30%
4-1)	Traffic volume of the area	8.0	16%
4-2)	Impact on the communities by the countermeasures	5.0	10%
4-3)	Possibility for local participation for implementation	2.0	4%
	TOTAL	50.0	100%

3) For Infrastructure Disaster Prevention Plan for Kulekhani Reservoir

For sediment control of the Kulekhani reservoir, the priory and willingness of the responsible agency should be taken into account for effective implementation of the disaster prevention activities. The importance and hazard potential of the respective site should be known by the responsible agency. The following categories of the criteria and the weights are determined through the discussion among NEA, DOSC and the Study Team:

No.	Category of Criteria	Weight	Percentage
1)	Priority in NEA	15.0	30%
2)	Hazard potential of the area	10.0	20%
3)	Feasibility of the countermeasures	15.0	30%
4)	Possibility for the long term effect	10.0	20%
	TOTAL	50.0	100%

In each category of the criteria, the criterion is determined. The weight for each criterion is determined based on the given weight in respective category. The list of the criteria is described as follows:

No.	Criteria	Weight	Percentage
1)	Priority in NEA	15.0	30%
1-1)	NEA eagerness for technical assistance	10.0	20%
1-2)	Expecting DOR leadership	5.0	10%
2)	Hazard potential of the area	10.0	20%
2-1)	Sediment yield in the area	5.0	10%
2-2)	Distance from the reservoir	3.0	6%
2-3)	Previous activities for sediment control	2.0	4%
3)	Feasibility of the countermeasures	15.0	30%
3-1)	Estimated volume of sediment mitigation	5.0	10%
3-2)	Cost acceptability	5.0	10%
3-3)	Technical acceptability	5.0	10%
4)	Possibility for long term effect	10.0	20%
4-1)	Accessibility for maintenance	5.0	10%
4-2)	Impact on the communities by the countermeasures	3.0	6%
4-3)	Possibility for local participation for implementation	2.0	4%
	TOTAL	50.0	100%

(3) Scoring

The scoring for the respective criterion is made by the Study Team. The results of the sociological sampling survey, the focus group discussion, the field inspection, and the review of the previous studies related to the Study are mainly used for the determination of the score for respective criterion in each site. It is not to be given the limit for receiving score of 2, 1 or 0 in respective criterion. In some criteria no site may receive the score 2, but all sites receive the score 2 in the other criteria. It depends on the decision of the specialist of the Study Team. The details for the scoring are given in the following sections.

A.4.2 Priority Areas for CDPP

For further study, three priority areas for the CDPP were recommended based on the investigation and the analysis made by the Study Team during the first field investigation period, and determined by the second steering committee meeting. In the following subsections, firstly the three priority areas are indicated, then the method and the result of the scoring sheet are explained, and finally the evaluation and the conclusion of the selection of the priority areas by the Study Team are explained.

(1) Three Priority Areas Selected for CDPP

The Study Team evaluated all data and information collected by the middle of February, 1996, concerning the nine areas for the CDPP, and selected the three priority areas for the CDPP to be recommended for further study - the feasibility study. In the second meeting of the steering committee, the selection of the three priority areas for the CDPP recommended by the Study Team was discussed and agreed upon by the attendants of the meeting, and officially approved by having signed the minutes of meeting to the second meeting.

The three priority areas for the CDPP are as shown below:

(1) Phedigaon/Phatbazar
(2) Namtar/Tilar

(3) Chisapani

The Study Team will be carrying out the feasibility study on these three priority areas in the next study stage. In addiction to these three areas, one village has been selected for further study for the CDPP. The additional area for the CDPP is:

(4) Sahan

Instead of carrying out the feasibility study, however, the Study Team will be carrying out the preliminary feasibility study in Sahan. Since most villages located along Marin Khola have similar characteristics in the socio-economy and the nature of disasters, it is expected that it will be possible to duplicate this preliminary feasibility study in Sahan to other areas located along Marin Khola.

(2) Scoring Method and Result

For the selection of the three priority areas for the CDPP, the Study Team gathered socioeconomic data and made extensive discussions with INGOs and international aid agencies, and also subcontracted a local sociological survey firm and let it carry out sociological field investigations - the quantitative survey by questionnaires and qualitative survey by focus group discussion.

The questionnaires give us quantitative information - mainly socioeconomic information - on each area. Focus group discussion gives us qualitative information which contains those information that questionnaires cannot deal with.

Combining the results of the sociological field investigation by the local firm with the data and information gathered and the field reconnaissance made by the Study Team, a priority of each area for the CDPP was evaluated and determined by the Study Team.

It is said that an evaluation of social aspects is likely to be arbitrary and depends on each evaluator. In order to avoid such deficiency of the arbitrariness in social evaluation, the Study Team developed the evaluation criteria from which the Study Team tried to derive objective evaluation results. As explained in the previous section, the scoring method is to multiply a score in each subject by a corresponding weight and add up scores of all subjects. The total scores of nine areas are shown in Table A.4.1, but let us reiterate them below for convenience:

Rank	Village	Score
1.	Phedigaon/Phatbazar	76.5
2.	Namtar/Tilar	69.0
3.	Chisapani	57.0
4.	Kebreni	51.5
5.	Beluwa	48.5
6.	Bimaltar	36.5
7.	Deukhel	36.0
8.	Sahan	35.5
9.	Betini	33.0

The summary and the detail of the scoring on the basis of the evaluation criteria are shown in Table A.4.2 and Table A.4.3, respectively.

The Study Team used this scoring result as one of major information and analyses for selecting the priority areas for the CDPP. Note that the Study Team did not completely rely on the above scoring result to determine three priority areas for the CDPP.

Let us look at each subject in the scoring sheet and discuss characteristics of the scores. The subject of item 1 is, "Possibility for People's Participation." This is important from the aspect of community development and thus weighted by 25 % of the total score (the maximum score is 100). The more active social development programs by local people and NGOs are, the higher the score is. Since many such activities are observed in Namtar/Tilar, it received full and the highest score (25) of all. Deukhel is located at a remote place and few such activities are seen there, so that it received the lowest score.

There may be, in a sense, another argument that such an area where few activities are carried out should receive a higher score so as to do a social development program. However, the rationale adopted in the Study is to implement prospective CDPP projects in a cost-effective and minimal-risk way. Because of constraints to time and budget in those projects envisaged in the Study, it is unfortunate to say that it is not possible to implement CDPP projects from scratch to those areas where longer time and larger investment are necessary to implement a community development project.

Item 2, "Damages due to the 1993 Disaster," is to evaluate the magnitude of damages caused by the 1993 Disaster. Since the focus of the Study is to do something for those who have been severely affected by the 1993 Disaster, as the title of the Study implies, it is important to evaluate explicitly those damages in each area. The scoring weight is 15 % of the total. The more damaged, the higher the score is. Phedigaon/Phatbazar has the highest score due to the fact that they suffered from debris flows which killed many village people and washed away a large portion of their land.

While most evaluations in the scoring sheet are made by social scientists, engineering viewpoints prevail in item 3, "Hazard Potential," and item 7, "Engineering Merits." These items should be considered in the selection of the priority areas for the CDPP because it is not possible to cover all aspects of development only by using theories and methods in social sciences. Item 3 receives 25 % and item 7 receives 10 % of the total score. In case that there is a high hazard potential, something should be done immediately otherwise another disaster will happen in the near future with a high probability. What is evaluated by "Engineering Merits" is the easiness and the cost effectiveness of constructing structures for disaster prevention.

In item 3, possibility for future disaster is evaluated. Phedigaon/Phatbazar and Chisapani have the score of 21, which is the highest among those of the nine areas. In Phedigaon/Phatbazar, few disaster prevention measures are done to existing alluvial cones which have been formed by the past debris flows and highly likely to generate another disaster in the future. Many people in Chisapani still live in landslide-prone areas. In item 7, Phedigaon/Phatbazar receives the full score while Betini and Sahan receive the lowest. To do some structural measures in Sahan and Betini, Marin Khola on the whole must be taken care of. Any piecemeal structural measures around the two villages will be meaningless.

"Necessity of Rehabilitation of the Community" is evaluated in item 4. If many houses, farmlands, and infrastructures are severely damaged and the people feel a strong need for rehabilitation of those damaged ones, then a higher score is given.

Since most rural people are engaged in agriculture, agricultural development is considered in the Study as one of very important aspects for the CDPP. It is also considered in the

Study that it would be much better if agricultural development could be done through disaster prevention programs proposed in the Study. This is why item 5, "Possibility of Agricultural Development through Disaster Prevention Activities, " is chosen as one of evaluation items.

In the Study, women-in-development (WID) is one of specific objectives, and it is evaluated in item 6, "Possibility of Women-In-Development." The more the people are aware of WID and the more active they are doing something for it, the higher the score is.

(3) Evaluation

Now let us discuss about the subjective evaluation made by the Study Team. The Study Team consists of engineers and social scientists, and each staff member has a different skill and experience and a different opinion in the selection of the priority areas for the CDPP. The evaluation in this subsection was made under the initiative of a specialist in community development and people's participation. Although the staff members have their own evaluations, surprisingly they all have fully agreed to the selection of the three priority areas and agreed more or less to the scores derived from this scoring method.

From the viewpoints of social scientists, Phedigaon/Phatbazar and Namtar/Tilar have the biggest potential to carry out social and economic development. They are attractive in that they are so close to large markets. Many community activities have been observed there too, which implies that it seems easier to implement community development programs. Though they look richer than other villages, as mentioned before, the rationale in the selection of the priority areas in the Study is, among other things, to choose those areas where community development can be implemented with a low risk and with high and quick returns. In this respect, these two villages are appropriate to be chosen for further study. Since Chisapani is not far from Phedigaon/Phatbazar (one hour on foot), Chisapani can be developed effectively along with the development of Phedigaon/Phatbazar.

Kebreni, Bimaltar, and Deukhel are located at remote areas in the middle of mountains, few community activities are observed due to the reluctance of INGOs. Therefore, it is concluded according to the rationale in the Study that possibility of community development is low. Furthermore, there is low possibility for economic development due to geographical disadvantages and poor natural endowments.

The original location of Beluwa was completely wiped out. Most of the villagers have no land right now. Under these circumstances, if a community development program is implemented, almost all benefits will go to the other people. For instance, if an agricultural development program is implemented, profits from increased agricultural production will go to the landowners, not to the field workers of Beluwa. It is hard to think out an effective community development program for them because options for community development are really limited. The social scientists understand that the people of Beluwa are the most severely affected ones by the 1993 Disaster among the nine villages, but they cannot help but give low score to Beluwa.

Sahan and Betini are also located far from large market such as Sindhulimadi - five hours on foot. A large portion of their land was washed away by floods in Marin Khola, and they express that they are suffering from disasters very much. The social scientists, however, evaluated their situation and drew a tentative conclusion that they are basically better off than those in other areas. Floods destroyed their lands but they seem to have still larger lands than others. They look to have better experience and capability in community development, but two INGOs are about to implement their own development

programs over there. The Study Team must avoid any overlapping of efforts with those organizations in terms of efficient resource allocation. Hence the Study Team gives low scores to Sahan and Betini.

From engineers' viewpoints, Phedigaon/Phatbazar and Namtar/Tilar are good places to carry out structural measures. If resources are unlimited, it is possible to conduct any kinds and sizes of engineering countermeasures against any kinds and sizes of disasters. This is always untrue in fact. Resources are scarce in Nepal, so engineers must consider the financial and technical feasibility in structural measures. Regarding Sahan and Betini as well as Beluwa, the objects - Marin Khola and Manahari Khola - are overwhelmingly big to deal with. A piecemeal countermeasure will never give any satisfactory result. In this sense, it is impossible to do something over there. On the contrary, the objects to deal with can be confined to be small so that cost-effective and feasible structural measures can be carried out in Phedigaon/Phatbazar and Namtar/Tilar.

With respect to Kebreni, Bimaltar, Deukhel, and Chisapani, they are quite likely to face another landslide in the near future, but returns to investment are too poor to carry out any structural measure there. For example, a house is located at the tip of a gully where it is highly likely to have another landslide. To protect this house from landslide, it is necessary to construct five to ten of check dams and several works for slope protection along the gully. Consequently, it does not make sense to invest any money to structural measures, rather it is better to ask the people living in the house to resettle somewhere else.

Let us wrap up all evaluations made by social scientists and engineers. Both groups agree that Phedigaon/Phatbazar and Namtar/Tilar should be chosen as the priority areas for the CDPP and that Sahan and Betini should receive lower priority. Another coincidence in evaluations of both groups is that Beluwa is suffering most severely but has very low possibility for development.

A.4.3 Priority Area for IDPP for Road

The results of the scoring of the sites concerned are shown in Table A.4.4 and summarized as follows:

Rank	Location	Score
1.	Mahadev Beshi Bridge on Pritivi Highway	80.0
2.	Palung - Daman on Tribhuvan Highway	54.0
3.	Near Tistung on Tribhuvan Highway	41.0

The mahadev Beshi Bridge on the Prithivi highway received the highest score of 80, which is much higher than the other investigation sites. The main reason is the different importance of two highways in the country. As mentioned in Section 5.1, the traffic volume of the Prithivi Highway is much bigger than the Tribhuvan Highway, and the DOR puts much higher priority to the Prithivi Highway. Actually, the Prithivi highway is identified as the lifeline of Kathmandu for their food and energy supply. To maintain the route of the Prithivi Highway gives therefore more impact on both economic and sociological aspects in the national view point.

In category 1, "Priority in DOR", the Mahadevbesi Bridge received the score of 25 due to the criterion of "DOR eagerness for technical assistance". DOR is currently implementing the restoration works for three bridges including the Mahadev Beshi Bridge along the Prithivi Highway. They made an assessment on the damages to the bridges due to the 1993 Disaster, and some design modification were made such as changing the height of the clearance, and redesigning of shape of piers, and so on. Even then, they are still worried about damages by the further disaster, particularly by debris flow from the rivers. DOR wishes some technical assistance to protect the bridge against the debris flow by appropriate technologies. On the other hand, the slope stabilization and the slope protection method by appropriate technologies are developing in Nepal by the technical assistance of ODA, UK. The both sites in the Tribhuvan Highway seems to be able to be treated by DOR itself by applying their technologies such as gabion, wet masonry and bio-engineering measures, and so on. Therefore, the both sites on the Tribhuvan Highway received the score 20, 5 points lower than the Mahadev Beshi Bridge in this category.

In category 2, "Hazard potential of the area", the Mahadev Beshi Bridge received the highest score of 17 again. If the bridge is washed out by the debris flow again, it takes at least three weeks to restore it even by urgent remedial measures because no steel material for super-structure is available in Nepal. In addition, the assumed scale of disaster to the Mahadev Beshi Bridge was much bigger than the other two sites due to the much bigger catchment of the river. Taking into consideration the above two criteria, the Mahadev Beshi Bridge received the higher score than others. In respect to the restoration period, Palung - Daman on the Tribhuvan Highway would take a longer period since it is feared to have the whole road collesped by slope failures. The urgent restoration should be carried out by gabion works and it would take more or less two weeks. In case of Tistung on the Tribhuvan Highway, however, it would not take time for rehabilitation as the assumed disaster would be landslide on the slopes and the urgent restoration measures would be the clearance by bulldozer. According to such reasons, the Palung - Daman received score of 14, but Tistung received only the score of 1 in this category.

In category 3, "Feasibility of the countermeasures", the full score of 20 was given to both sites of the Tribhuvan Highway. All the countermeasures can be carried out by local contractors, and the technology to be applied is rather simple. The cost would not be so high, and most of the investment would be distributed within the national economy. On the other hand, the countermeasures for the Mahadev Beshi Bridge would be rather massive, considering the importance of the concerned structure and the disaster potential of Agra Khola, and it received the score of 12.

In category 4, "Economic impact by the countermeasure", no score was given to both sites on the Tribhuvan Highway. The road is currently not fully used and the affected population by the disaster in the site is very small. Also, the location is far from the community and the scale of the works are rather small. Considering such things, it would be difficult to give an impact on the surrounding communities. On the other hand, disaster prevention works for the Mahadev Beshi Bridge are expected by the people in the Kathmandu city, since the route is defined as the lifeline of Kathmandu. The impact of the countermeasures is much higher than the other sites, and the score received in this category is 26.

A.4.4 Priority Area for IDPP for Kulekhani Reservoir

The results of the scoring of the sites are shown in Table A.4.5 and summarized as follows:

Rank	Location	Score
1.	Palung Khola	80.0
2.	Phedigaon Khola	70.0
3.	Garti Khola	64.0
4.	Khanigaon Khola	57.0

Palung Khola received the highest score of 80, which is relatively higher than the other investigation sites. The main reason is the feasibility of the countermeasures, and the possibility of the long term effect. In the upstream of Palung Khola, the wide river channel spreads about 500 m to 1 km wide, which is suitable for sediment detaining basin. On the other hand, there is no sediment pocket in the other sub-basins. In addition, the river gradient of Palung Khola is gentle at more or less 1%, which implies the less sediment transportation capacity to the downstream. Considering such issues, the countermeasures on Palung Khola would be more effective than others.

In category 1, "Priority in NEA", the three investigation sites, Garti, Phedigaon, and Palung Khola, received the full score of 30. On the other hand, Khanigaon Khola received the score of 25. The reason that Khanigaon is lower than the others is NEA, responsible agency for reservoir maintenance, would not be interested in the river due to the less sediment discharge as shown in Sub-section 6.4.2.

In category 2, "Hazard potential of the area", the sites except for Phedigaon Khola received the score of 12, and the score of Phedigaon Khola was 5 in respect to the sediment yield and the distance from the reservoir. According to the Master Plan Study by NEA/Nippon Koei, Co., Ltd., the sub-basins which yield more sedimentation are Garti Khola and Darkot Khola on the northern basin consisting of granite mountains. The sediment yield from Phedigaon and Khanigaon Kholas was moderate and Phedigaon Khola was by far upstream from the reservoir.

In categories 3 and 4, "Feasibility of the countermeasures and Possibility of long term effect", Palung Khola received the highest scores of 20 and 18, respectively. In terms of category 3, Palung Khola has a wide river stretch on the upstream and a large capacity of sediment trapping in comparison with the other sub basins. In addition, an accessibility to the existing road is better than the others, so a periodical removal of deposited materials can be expected. On the other hand, Garti Khola and Khanigaon Khola have no suitable sites for sediment control except for groundsill which makes the river gradient gentle and protects river banks and river bed scouring. For Phedigaon Khola, the direct impact on sediment mitigation to the reservoir can not be expected very much. However, the impact on the community to mitigate the disaster potential can be highly expected by providing sediment control measures. Therefore, it received the high score of 15 and 18, respectively.

Table A.1.1 Profiles of Makwanpur and Sindhuli Districts in 1991

	Makwanpur	Sindhuli
Population in 1991	314,599	223,900
Population Density per sq, km	129.7	89.9
Literacy Rate of 6 years and above	37.1%	31.6%
Economically Active Population	135,461	93,935
Farm & Fishing	112,014	83,207
Sales, Services & Production	15,379	4,865
Administrative & Clerical	1,809	492
Teachers & Professors	1,732	477
Others	4,527	4,332
Major Linguistic Population		
Nepali	131,226	123,013
Tamang	139,198	50,607
Newari	19,241	6,308
Rai-Kirati	3,914	3,872
Magar	3,148	20,645
Danuwar	115	10,294
Major export goods		
	textile	potato
	cold drinks	fruit
	beer	ghee
	cement	oilseeds
	timber	paddy
	soap	rice
	humpipe	hides
	rice	herbs

"Nepal District Profiles," Nepal Research Associates, 1994

Table A.1.2 General Information from 30 Household Samples in Each Area

	Phedigaon/ Phatbazar	Kebreni	Bimaltar	Namtar/Tilar	Chisapani	Deokhel	Beluwa	Betini	Sahan
Landless	8	0	0	10	0	0	29	10	5
Electrification	22	0	0	0	0	0	0	0	0
Average family members	6	6	6	6	6	6	6	8	10
Agricultural output last year	less	less	less	less	less	less	NA	less	average
In-house toilet	5	1	1	6	0	0	0	0	1
Average time for water (min.)	20	8	24	12	38	50	16	18	18
Average time for firewood (min.)	820	250	270	310	320	400	380	140	280
Average time for fodder (min.)	520	270	330	360	550	510	420	110	290
First priority for development	water	water	water	water	water	road	settlement	disaster	disaster
Major agricultural Products (kg)									
Paddy	2,660	15,310	11,940	19,200	800	9,556	0	22,960	59,540
Maize	14,460	10,480	14,680	6,735	14,780	23,600	0	11,832	4,440
Millet	600	10,770	10,900	1,870	600	68,004	0	1,416	0
Wheat	0	2,482	600	4,130	28	1,000	0	160	800
Barley	0	0	0	115	0	0	0	0	0
Potato	28,300	5	102	368	16,820	200	0	136	1,046
Buckwheat	0	0	0	0	0	240	0	0	0
Lentils	0	12	0	72	33	0	0	216	0
Mustard	400	78	0	415	35	640	0	84	44
Soybean	700	63	43	832	0	0	0	0	0
Jute	2,100	0	0	0	0	0	0	0	0
Cauliflower	18,280	NA	NA	NA	8,300	NA	NA	NA	NA
Garlic	NA	NA	NA	800	NA	NA	NA	NA	NA
Major livestock (number)									
Buffalo	22	42	42	25	39	29	0	7	21
Chicken	26	115	157	27	156	125	57	179	272
Cow	12	633	47	30	24	29	46	51	108
Goat	6	182	101	53	136	56	42	42	33
Ox	26	43	51	20	26	17	14	39	50
Pig	29	0	0	0	0	0	0	12	9
Sheep	0	0	0	0	0	0	0	0	0

Notes: "Water" as the first priority for development represents a drinking water development project.
"Disaster" as the first priority for development represents a disaster prevention project.
"Settlement" as the first priority for development represents a human resettlement project.
In the item "agricultural output last year," a majority answer from three different ones, less, average, and better, is indicated.

Source: The Field Sampling Survey, Questionnaire I, Feb. 1996

Table A.4.1 Order of Priority for CDPP

Rank	Score	Community
1	76.5	Phedigaon
2	69.0	Namtar
3	57.0	Chisapani
4	51.5	Kebreni
5	48.5	Beluwa
6	36.5	Bimaltar
7	36.0	Deukhel
8	35.5	Sahan
9	33.0	Betini

Table A.4.2 Summary of Score Sheet for Selecting CDPP Priority Area

Item	Sub-Item	Criteria	Weight	Weighted Percentage	Reference Questionnaire	1 Kebrini	2 Bimaltar	3 Namtar	4 Phedigaon	5 Chisapani	6 Deokhel	7 Beluwa	8 Betini	9 Sahan
1		**Possibility for People's Participation**	12.5	25%		10	10	25	20	12.5	2.5	17.5	7.5	10
	1.1	Activities of the existing people's group in the community	5	10%		0	0	2	1	1	0	2	0	0
	1.2	Previous successful activities of NGO groups in the community	5	10%		1	1	2	2	1	0	1	1	1
	1.3	Leader's capability for institutional set-up for CDPP formulation	2.5	5%		2	2	2	2	1	1	1	1	2
2		**Damages to the Community due to 1993 Disaster**	7.5	15%		6.5	3.5	6	11.5	5.5	12.5	6	5	8
	2.1	Dead person	3	6%		1	0	0	2	1	2	0	0	1
	2.2	Damaged houses	1	2%		0	0	1	2	1	1	2	1	1
	2.3	Damaged farm land and agricultural income	2	4%		1	1	1	1	0	2	2	2	2
	2.4	Damaged rural infrastructures	1.5	3%		1	1	2	1	1	1	0	0	0
3		**Hazard Potential of The Area**	12.5	25%		17	8.5	12.5	21	21	4	8.5	8	8
	3.1	Recent Experiences of disasters	4	8%		0	0	1	1	1	1	0	2	2
	3.2	Present hazard potential in the community	8.5	17%		2	1	1	2	2	0	1	0	0
4		**Necessity of Rehabilitation of the Community**	5	10%		3	4	4.5	5	3.5	10	5	1.5	1
	4.1	Necessity of rehabilitation of damaged house and other private property	1	2%		0	0	2	1	1	2	2	0	1
	4.2	Necessity of farm land rehabilitation	1.5	3%		2	1	0	1	0	2	2	1	0
	4.3	Necessity of community infrastructrure rehabilitation	2.5	5%		0	1	1	1	1	2	0	0	0
5		**Possibility of Agri Development thru Disaster Prevention Activities**	5	10%		5.5	5.5	9	6	5	1.5	2	6.5	4
	5.1	Possibility for agriculture development	2.5	5%		1	1	2	1	1	0	0	2	1
	5.2	Possibility of small industry development	1	2%		0	0	1	2	1	0	2	0	0
	5.3	Possibility of rural infrastructure development	1.5	3%		2	2	2	1	1	1	0	1	1
6		**Possibility for Women-In-Development**	2.5	5%		4	1.5	3.5	3	2.5	2	3.5	1.5	1.5
	6.1	Current women's load in the family and the community	1	2%		2	1	1	0	1	2	2	1	1
	6.2	Existing women's group in the community and its activity	1	2%		1	0	2	2	1	0	1	0	0
	6.3	Leader's understanding for women-in-development	0.5	1%		2	1	1	2	1	0	1	1	1
7		**Engineering Merits**	5	10%		5.5	3.5	8.5	10	7	3.5	6	3	3
	7.1	Accessibility for implementation	1.5	3%		0	0	1	2	1	0	2	1	1
	7.2	Possibility for material procurement	1.5	3%		1	1	2	2	1	1	2	1	1
	7.3	Possibility for technical measures for hazard mitigation	2	4%		2	1	2	2	2	1	0	0	0
		TOTAL	50	100%		51.5	36.5	69	76.5	57	36	48.5	33	35.5

Table A.4.3 Detail of Score Sheet for Selecting CDPP Priority Area (1/4)

Item	Sub-Item	Criteria	Weight	Weighted Percentage	Reference Questionnaire	1 Kebrini	2 Bimaltar	3 Namtar	4 Phedigaon	5 Chisapani	6 Deokhel	7 Beluwa	8 Betini	9 Sahan
1		**Possibility for People's Participation**	12.5	25%		10	10	25	20	12.5	2.5	17.5	7.5	10
	1.1	Activities of the existing people's group in the community	5	10%		0	0	2	1	1	0	2	0	0
		*Any disaster prevention system (no.)			I-34	1	1	6	4	2	0	28	1	3
		*Indigenous/local groups (X)			II-9	X			X	X		X		
		*History of people's participation (X)			II-10	X	X	XX	X	XX	X	XX	X	X
		*Activities and experiences about disasters (X)			II-16	X	X	X	XX	X	X	X		
		*Activities for the last five years (X)			II-18A		X	X				X	X	X
	1.2	Previous successful activities of NGO groups in the community	5	10%		1	1	2	2	1	0	1	1	1
		*GO/NGOs working in the area (X)			II-15	X	X	XX	XX	X		X	X	X
		*NGOs in the area for th last two years (X)			II-18B	X	X	X	X	X		X	X	X
	1.3	Leader's capability for institutional set-up for CDPP formulation	2.5	5%		2	2	2	2	1	1	1	1	2
		*Leader's understanding and capacity (X)			II-18C	XX	XX	XX	XX	X	X	X	X	XX
2		**Damages to the Community due to 1993 Disaster**	7.5	15%		6.5	3.5	6	11.5	5.5	12.5	6	5	8
	2.1	Dead person	3	6%		1	0	0	2	1	2	0	0	1
		*Life threatening fear to disaster (no.)			I-41	28	29	25	29	30	30	30	26	25
		*Number of persons dead by 1993 disaster (no.)			II-17-1	14	0	0	58	4	43	1	0	12
	2.2	Damaged houses	1	2%		0	0	1	2	1	1	2	1	1
		*Fear to house being damaged by disaster (no.)			I-41	24	27	25	22	18	30	8	27	25
		*Number of houses damaged fully or partly by 1993 disaster (no.)			II-17-2	10	12	71	106	32	52	105	42	51
	2.3	Damaged farm land and agricultural income	2	4%		1	1	1	1	0	2	2	2	2
		*Fear to crop being damaged by disasters (no.)			I-41	24	27	20	18	10	30	11	28	30
		*Damage of crop as a serious problem caused by disasters (no.)			I-44	24	27	15	19	0	29	16	29	30
		*Quality of life changed after 1993 disaster (X)			II-12			X	X	X	X	XX	X	X
		*Total amount of damages to land by 1993 disaster (Million Rs.)			II-17-3	13.4	8.54	NA	NA	15.72	1.69	19.62	20	250.28
	2.4	Damaged rural infrastructures	1.5	3%		1	1	2	1	1	1	0	0	0
		*Damage of infrastrucrure as a serious problem by disasters (no.)			I-44	12	21	26	44	3	36	2	25	19

Table A.4.3 Detail of Score Sheet for Selecting CDPP Priority Area (2/4)

		*Total amount of damages to infrastructure by 1993 disaster (Million Rs.)			II-17-6	15.53	10.7	109	0.43	26.01	0.05	0.8	0.35	0.2
3		**Hazard Potential of The Area**	12.5	25%		17	8.5	12.5	21	21	4	8.5	8	8
	3.1	Recent Experiences of disasters	4	8%		0	0	1	1	1	1	0	2	2
		*Total number of disasters experienced last year (no.)			I-33	0	1	3	36	12	6	2	121	107
		*Number of people giving first priority to a disaster prevention (no.)			I-53	1	1	2	6	5	1	0	16	21
	3.2	Present hazard potential in the community	8.5	17%		2	1	1	2	2	0	1	0	0
		*Opinion of expert in disaster prevention (X)			Mr. Hirozumi	NA	X	X	XX	X	NA			
		*Opinion of expert in disaster prevention (X)			Mr. Sugimoto	XX		X	XX	XX		X		
		*Opinion of expert in disaster prevention (X)			Mr. Morishima	NA	NA	X	XX	XX	NA	XX	NA	NA
4		**Necessity of Rehabilitation of the Community**	5	10%		3	4	4.5	5	3.5	10	5	1.5	1
	4.1	Necessity of rehabilitation of damaged house and other private property	1	2%		0	0	2	1	1	2	2	0	1
		*Damage of houses as a serious problem by disasters (no.)			I-44	30	30	30	29	7	28	24	18	22
		*Necessity of rehabilitation of private house and property (X)			II-19-A		NA	XX	X	X	XX	XX		X
	4.2	Necessity of farm land rehabilitation	1.5	3%		2	1	0	1	0	2	2	1	0
		*Number of people who lost land by disasters (no.)			I-10-2-1	0	0	6	5	0	0	24	10	4
		*Number of people whose agri production decreased last year (no.)			I-13	28	27	15	15	26	29	NA	22	1
		*Damage of crop as a serious problem caused by disasters (no.)			I-44	24	27	15	19	0	29	16	29	30
		*Lack of self-sufficiency in agriculture (X)			II-14	XX	X		X	X	XX	XX	X	X
		*Necessity of rehabilitation of farm land (X)			II-19-B	X	NA	X	X	X	XX	XX		X
	4.3	Necessity of community infrastructrure rehabilitation	2.5	5%		0	1	1	1	1	2	0	0	0
		*Time to fetch water (minutes)			I-24	7.5	23.8	11.8	20	38	49.5	16	18	18
		*Damage of infrastructure as a serious problem by disasters (no.)			I-44	12	21	26	44	3	36	2	25	19
		*Number of people who gave first priority to road construtcion (no.)			I-53	6	9	11	0	2	18	0	0	1
		*Total amount of infrastructure damaged by 1993 disaster (Million Rs.)			II-17-6	15.53	10.7	109	0.43	26.01	0.05	0.8	0.35	0.2
		*Necessity of rehabilitation of community infrastructure (X)			II-19-C		NA	X	X	X	X			
5		**Possibility of Agri Development thru Disaster Prevention Activities**	5	10%		5.5	5.5	9	6	5	1.5	2	6.5	4
	5.1	Possibility for agriculture development	2.5	5%		1	1	2	1	1	0	0	2	1
		*Number of people who gave first priority to irrigation (no.)			I-53	2	2	2	3	0	11	0	1	0
		*Priority development projects related to agriculture (X)			II-8	X	X	X	X	X			XX	X

Table A.4.3 Detail of Score Sheet for Selecting CDPP Priority Area (3/4)

		*Activities of GO/NGOs related to agricultural development (X)			II-15			X	X	X				
		*Possibility to develop agriculture (X)			II-22-A	X	X	X	X	X			X	X
		*Opinion of expert in agricultural economics			Dr. Adhikari	X	X	XX	X	XX	X		XX	XX
	5.2	Possibility of small industry development	1	2%		0	0	1	2	1	0	2	0	0
		*Priority development projects related to small industry (X)			II-8			X	XX			XX		
		*Possibility to develop small industry (X)			II-22-B			X	XX	X		XX		
		*Opinion of expert in agricultural economics (X)			Dr. Adhikari			X	X			XX		
		*Opinion of expert in community development (X)			Mr. G. Gurung	X	X	XX	XX	XX	X			
	5.3	Possibility of rural infrastructure development	1.5	3%		2	2	2	1	1	1	0	1	1
		*People without electricity (no.)			I-25	30	30	30	8	30	30	30	30	30
		*People without toilet facilities in house (no.)			I-27	29	29	24	25	30	30	30	30	29
		*Priority development projects related to infrastructure (X)			II-8	XX	XX	XX	X	X	X		X	X
		*Possibility to develop infrastructure (X)			II-22-C	X	X	X	X					X
6		**Possibility for Women-In-Development**	2.5	5%		4	1.5	3.5	3	2.5	2	3.5	1.5	1.5
	6.1	Current women's load in the family and the community	1	2%		2	1	1	0	1	2	2	1	1
		*Wife's burden with daily works (X)			I-22	X	X	X	X	X	X	X	X	X
		*Segregated women's status and role (X)			II-11	XX	XX	X	X		X	XX	X	X
		*Poor awareness/literacy level of women (X)			II-20-B	XX	NA	X		XX	XX	XX	X	X
	6.2	Existing women's group in the community and its activity	1	2%		1	0	2	2	1	0	1	0	0
		*Indigenous/local groups (X)			II-9	X			X	X		X		
		*GO/NGOs in the area (X)			II-15	X	X	XX	XX	X		X	X	X
		*NGOs for women in the area (X)			II-20-A	X	NA	X	X	X		X		
	6.3	Leader's understanding for women-in-development	0.5	1%		2	1	1	2	1	0	1	1	1
		*Local leader's understanding in women-in-development (X)			II-20-C	XX	X	X	XX	X		X	X	X
7		**Engineering Merits**	5	10%		5.5	3.5	8.5	10	7	3.5	6	3	3
	7.1	Accessibility for implementation	1.5	3%		0	0	1	2	1	0	2	1	1
		*Opinion of expert in disaster prevention (X)			Mr. Hirozumi	NA		X	X		NA	XX		
		*Opinion of expert in disaster prevention (X)			Mr. Sugimoto			X	XX	X		XX	XX	XX
		*Opinion of expert in disaster prevention (X)			Mr. Yamakawa			X	XX	X		XX		
		*Opinion of expert in disaster prevention (X)			Mr. Morishima	NA	NA	X	XX	X	NA		NA	NA

Table A.4.3 Detail of Score Sheet for Selecting CDPP Priority Area (4/4)

	7.2	Possibility for material procurement	1.5	3%		1	1	2	2	1	1	2	1	1
		*Opinion of expert in disaster prevention (X)			Mr. Hirozumi	NA		X	X	X	NA	X		
		*Opinion of expert in disaster prevention (X)			Mr. Sugimoto	X	X	XX	XX	X	X	XX	XX	XX
		*Opinion of expert in disaster prevention (X)			Mr. Yamakawa	X	X	XX	XX	X	X	XX		
		*Opinion of expert in disaster prevention (X)			Mr. Morishima	NA	NA	XX	XX	X	NA		NA	NA
	7.3	Possibility for technical measures for hazard mitigation	2	4%		2	1	2	2	2	1	0	0	0
		*Opinion of expert in disaster prevention (X)			Mr. Hirozumi	NA		XX	X	X	NA			
		*Opinion of expert in disaster prevention (X)			Mr. Sugimoto	XX	X	X	X	X	X			
		*Opinion of expert in disaster prevention (X)			Mr. Yamakawa	X	X	X	XX	XX	X			
		*Opinion of expert in disaster prevention (X)			Mr. Morishima	NA	NA	XX	X	X	NA		NA	NA
		TOTAL	50	100%		51.5	36.5	69	76.5	57	36	48.5	33	35.5

Note: 1) The numbers, "2", "1", and "0" represent very much, fair, and poor, repectively.

2) The marks, "XX", "X", and "none" represent very much, fair, and poor, respectively.

3) "NA" respresents "Not available", or "Not Applicable".

4) The possible highest core is 100.

Table A.4.4 Score Sheet for Selecting Priority Disaster Prevention Area for Road

Item	Sub-Item	Criteria	Weight	Weighted Percentage	Tribhuwan H. Tistung	Tribhuwan H. Palung - Daman	Prithibi H. M. Bridge	Score Criteria 2	1	0
1		Priority in DOR	15	30%	20	20	25			
	1.2	DOR eagarness for technical assistance by JICA	10	20%	1	1	2	Demonstration PJT for Transfer of Technology, Watershed management for bridge protection, Financing	Bio-engineering measures	Rest
	1.3	Expecting DOR leadership for project implementation	5	10%	2	2	1	Bio-engineering measures, Urgent rehabilitation works	Appropriate technologies for road maintainance for low cost measures	Rehabilitation/Maintainance works concreted on massive structures
2		Hazard Potential of the Area	10	20%	1	14	17			
	2.1	Scale of the Disaster	3	6%	0	1	2	Very big and nationally damaged	Big and regionally damaged	Rest
	2.2	Urgency of the countermeasures	2	4%	0	1	1	Top urgent	Urgent	Rest
	2.3	Estimated rehabilitation period if disaster occuured	4	8%	0	2	2	More than 2 weeks	3 days to 2 weeks	within 3 days
	2.4	Previous rehabilitation works and its reliability	1	2%	1	1	1	No	Yes but urgent remedial measures	Yes with permanent measures
3		Feasibility of the countermeasures for mitigating hazard potential	10	20%	20	20	12			
	3.1	Estimated safety factor against the disaster	2	4%	2	2	2	Highly expected	Expected	Not so expected
	3.2	Cost acceptability	4	8%	2	2	1	Low cost applied all local materials and contractors	High cost applied mainly local material and contractors	Highest mainly applied foreign material and technologies
	3.3	Technical acceptability	4	8%	2	2	1	Applied all local technologies	Applied mainly local technologies	Applied mainly foreign technologies
4		Economic impact by the countermeasures	15	30%	0	0	26			
	4.1	Traffic volume of the area	8	16%	0	0	2	Prithibi Highway		Tribhuwan Highway
	4.2	Impact to the communities by the countermeasures	5	10%	0	0	2	Effect to KTM city	Effect to provincial capital cities	Rest
	4.3	Possibility for local participation for the implementation	2	4%	0	0	0	Highly expected	Expected	Less expected
		TOTAL	50	100%	41	54	80			

Table A.4.5 Score Sheet for Selecting Priority Disaster Prevention Area for Kulekhani Reservoir

Item	Sub-Item	Criteria	Weight	Weighted Percentage	Garti Khola	Phedigaon Khola	Khanigaon Khola	Palung Khola (Additional)	Score Criteria 2	1	0
1		Priority in NEA	15	30%	30	30	25	30			
	1.1	NEAs eagerness for technical assistance by JICA	10	20%	2	2	2	2	Highly expected	Expected	Not expected
	1.2	Expecting NEAs leadership for project implementation	5	10%	2	2	1	2	Highly expected	Expected	Not expected
2		Hazard Potential of the Area	10	20%	12	7	12	12			
	2.1	Sediment yield in the area	5	10%	2	1	1	2	Palung K, Garti K., Darkot K.	Phedigaon K., Khanigaon K., Kotru K., Tarung K., Chiliung K.	Rest
	2.2	Distance of the area from the reservoir	3	6%	0	0	1	0	Chalkhu K., Bisnkhet K., Chiliang K.,Setikhani K., Darkot K.	Tarung K., Kunchaul K., Khanigaon K., Kotru K.	Rest
	2.3	Previous activities for the sediment control in the area	2	4%	1	1	2	1	No	Yes but urgent remedial measures	Yes with permanent measures
3		Feasibility of the countermeasures for mitigating sediment inflow	15	30%	15	15	15	20			
	3.1	Estimated volume for sement mitigation	5	10%	1	1	1	2	Big sediment retarding basin is expected	Protection for river bed and bank erosion is expected	Difficult for construction of structures
	3.2	Cost acceptability	5	10%	1	1	1	1	Low cost applied all local materials and contractors	High cost mainly applied local materials and contractors	High costs mainly applied foreign materials and contractors
	3.3	Technical acceptability	5	10%	1	1	1	1	Applied all local technologies	Applied mainly local technologies	Applied mainly foreign technologies
4		Possibility for the long-term effect by the countermeasures	10	20%	7	18	5	18			
	4.1	Accessibility for maintainance	5	10%	1	2	1	2	Easy to access for periodical maintainance	Accessible for periodical maintainance	Required new maintainance road
	4.2	Impact to the communities by the countermeasures	3	6%	0	2	0	2	Expected economic impact and mitigating hazardous for communities		Rest
	4.3	Possibility for local participation for the implementation	2	4%	1	1	0	1	Expected construction and maintainance works by community/VDC	Expected maintainance works by community/VDC	Rest
		TOTAL	50	100%	64	70	57	80			

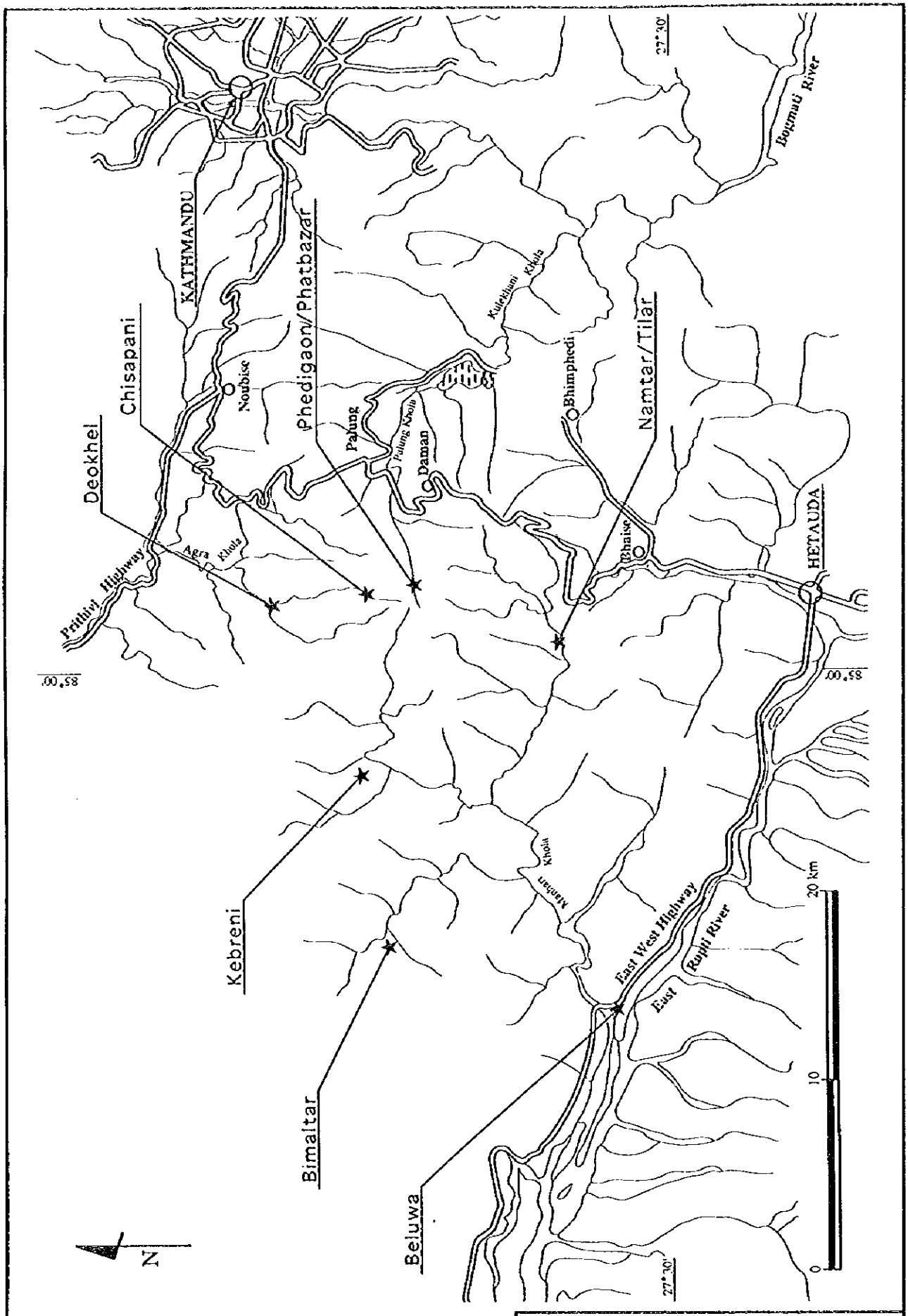


Fig.A.1.1
Location Map of Investigation Sites for CDPP (Makwanpur District)

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

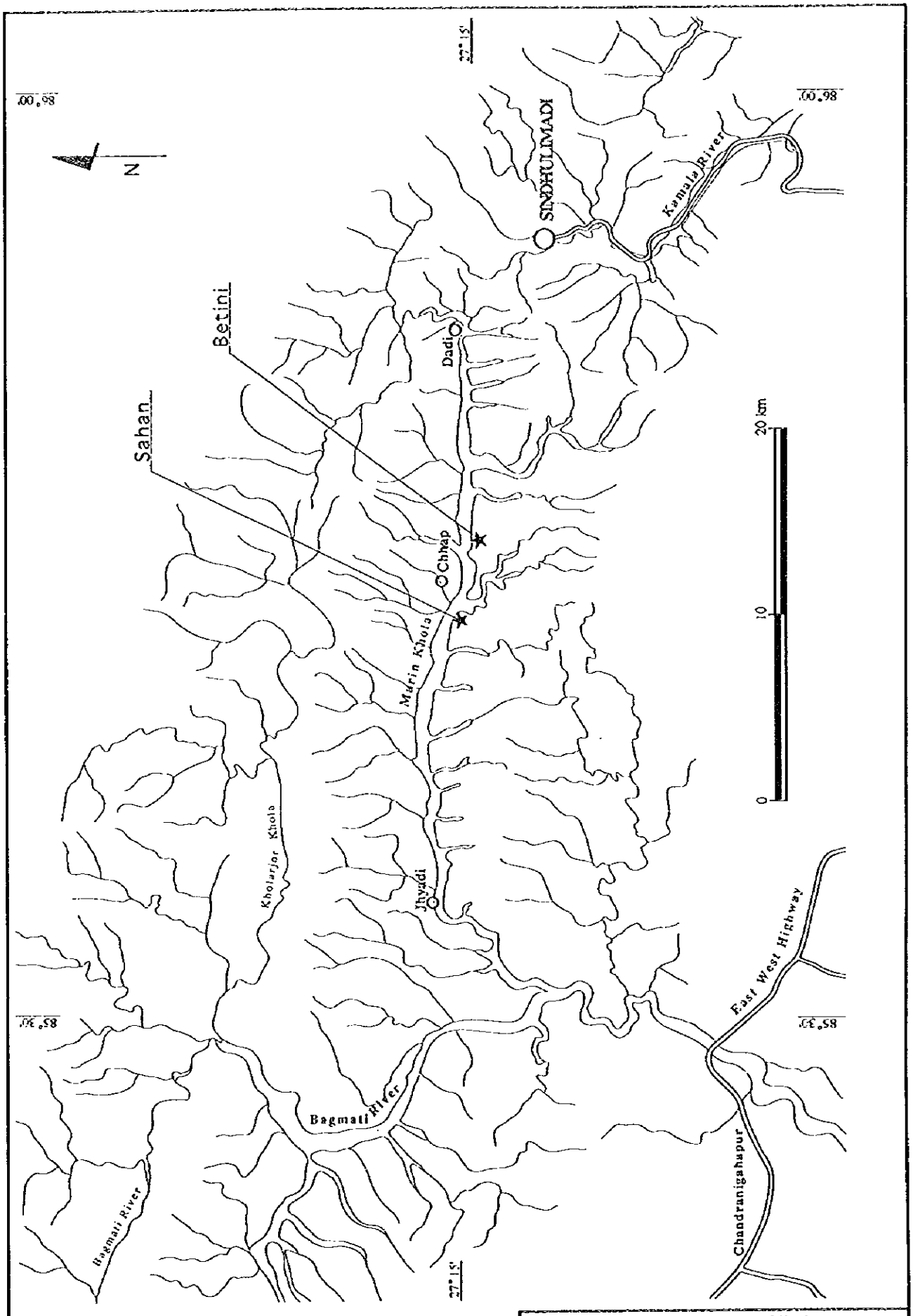


Fig.A.1.2
Location Map of Investigation Sites for CDPP (Sindhuli District)

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

Appendix-B COMMUNITY DISASTER PREVENTION PLAN FOR SAHAN (Semi-detailed Study)

B.1 Background of Community

The Sahan village is located in the Marin Khola catchment along the middle reacheas of the river, which is famous for paddy production in Sindhuli District. The location of the Sahan village is shown in Figure B.1.1, and the general view is given in Photo B.1.1.

Sahan is mainly a plain area surrounded by the Marin Khola to the north, the Churiya Range to the south, the Phoolbari and Kaukhare Khola to the east, and the Maruwa Khola to the west, as shown in Figure B.1.2. The area is ecologically homogeneous and has a very limited mountain area. The mountain of Sahan belongs to the Churiya Range with the Siwalik hills so it is very fragile and unstable from a geological viewpoint.

In winter, Sahan can be reached by car from Lalbandhi of Sarlahi District and from Sindhulimadi of Sindhuli District along the Marin Khola. The distance from Sindhulimadi to Sahan is about 25 km and it takes about three and a half hours by four-wheel drive car. However, it is not possible to access by car during the six months from June to December due to the increased river flow caused by the monsoon.

Terrace farming is practised in Sahan but not like the mountain terrace farming as the slope from the Churiya Range is so gentle that the condition of the farmland is better compared with the mountainous zone.

Drinking water problem is often observed and at present there are about six shallow wells constructed at the people's initiative. The water source is highly contaminated and water is insufficient in the dry season. Furthermore, due to flood and seepage of surface water, the well water becomes turbid during the monsoon season.

The population of the Sahan village is 631 with 52% males and 49% females and there are a total of 96 households with 6.5 members per household on average. The ethic composition is heterogeneous consisting of Majhi 54%, Brahmin/Chettri 36% and Tamang 10%.

The crops produced in the area are paddy, maize, wheat, millet, soybean, mustard, potato, onion, and garlic. The cropping patterns in irrigated farmland (lowland/khet) are as follows:

- rice, wheat, maize
- rice, vegetable crops (potato, cabbage, cauliflower, onion, garlic), maize

Likewise, the cropping pattern in upland (bari) is as follows:

- millet, maize

The details of agricultural activities in Sahan are described in Section B.4.

The following table shows the education level in the Sahan village according to the results of the 30-household sampling survey by Questionnaire (I) covering about 30% of the total village households, conducted by the Study Team in Feb. 1996.

Education Level in Sahan Village

Sex	Age	No. of Samples	Illiterate	Literate (Without schooling)	Primary (Class 5)	Lower Secondary (Class 8)	Secondary (Class 10)	Higher Education	Total
Male	50 & over	11	73%	18%	0%	9%	0%	0%	100%
	30 to 49	19	47%	26%	0%	11%	5%	11%	100%
	10 to 29	50	16%	18%	26%	22%	16%	2%	100%
	Total	80	31%	20%	16%	18%	11%	4%	100%
Female	50 & over	9	100%	0%	0%	0%	0%	0%	100%
	30 to 49	19	90%	0%	5%	5%	0%	0%	100%
	10 to 29	45	36%	20%	24%	9%	11%	0%	100%
	Total	73	58%	12%	16%	7%	7%	0%	100%
TOAL	Total	153	45%	16%	16%	12%	9%	2%	100%

Source : Sociological survey of 30 households by JICA Study Team, Feb. 1996

According to the survey, the literacy rate of the village is 55% which is much higher than the national average of 34%.

Differences in education level found between males and females reflect the national tendency in Nepal. The illiteracy rate of 58% of females is about twice the rate of 31% of males. The trend, however, has been decreasing substantially during the past twenty years. Since there is one primary school in the village, about 75% of the people aged 10 to 29 had opportunities to go to school. The education level of females has been dramatically improved during the past twenty years. The illiteracy rate of females aged between 10 to 29 has decreased to 36%, which is much less than the illiteracy rate of 90% of those aged 30 to 49.

At present, SPACE, a local NGO conducting its activities in this area, is running adult literacy classes in Sahan, upper Sahan and Maruwa Tole.

The practice of cattle raising in Sahan is quite popular compared with the other similar villages along the Marin Khola. For the farmland, the main fertiliser comes from animal manure. Cows, oxen, buffalo, goat, and pigs are the main livestock raised by the villagers. Pigs are only raised by the Majhi ethnic group. There were about 424 cows recorded in the survey report conducted by SPACE in 1994. Likewise, the same report further reported that there were only 140 goats, 72 buffaloes, and 53 pigs. The usage of animal fertiliser is excessive, while the usage of pesticide is very low.

The economic status of the people of Sahan after July 1993 has declined. Seventy percent of farmers had exported paddy before the flood disaster but now only a few people are exporting/selling paddy. In upper Sahan, there are seven landless families. The houses in Sahan are mostly made of timber and roofs are made of brick and cement tiles. Few thatch roofs are found in lower Sahan and upper Sahan.

There are no pit latrines, so the people go to open fields. The preventive and primary health services (services related to immunisation, nutrition, health education, etc.) in this area are provided by the sub-health post in Mathouli (3 km to the west). For minor treatments they go to Mathouli and to the health post located in Mahesotan.

B.2 Assessment of Damage Due to the 1993 Disaster

B.2.1 Damage due to the 1993 Disaster

The people of Sahan had never experienced a flood like the one in July 1993. This implies that the 1993 flood disaster was the biggest in their memory.

The flood due to heavy rain had flooded out 3,005 and 140 kattha of irrigated and non-irrigated farmland in Sahan, respectively (1 kattha is equal to 339 m^2). Similarly, 2,000 kattha of forest land and 2000 kattha of pasture land were washed away by the flood. Furthermore, about 13,667 cubic feet of timber were also swept away by the flood.

Two cows were killed and five persons were injured by landslide. Similarly seven houses were fully damaged and two partially damaged. A lot of gullies originating from Churiya can be observed all over Sahan.

According to the damage estimate by Sahan VDC, the loss caused by the July 1993 flood was Rs. 24,876,400.

In fact, the Marin Khola started cutting down the farmland in the north-eastern section of upper Sahan. This phenomenon has been increasing for the last two years during the monsoon season.

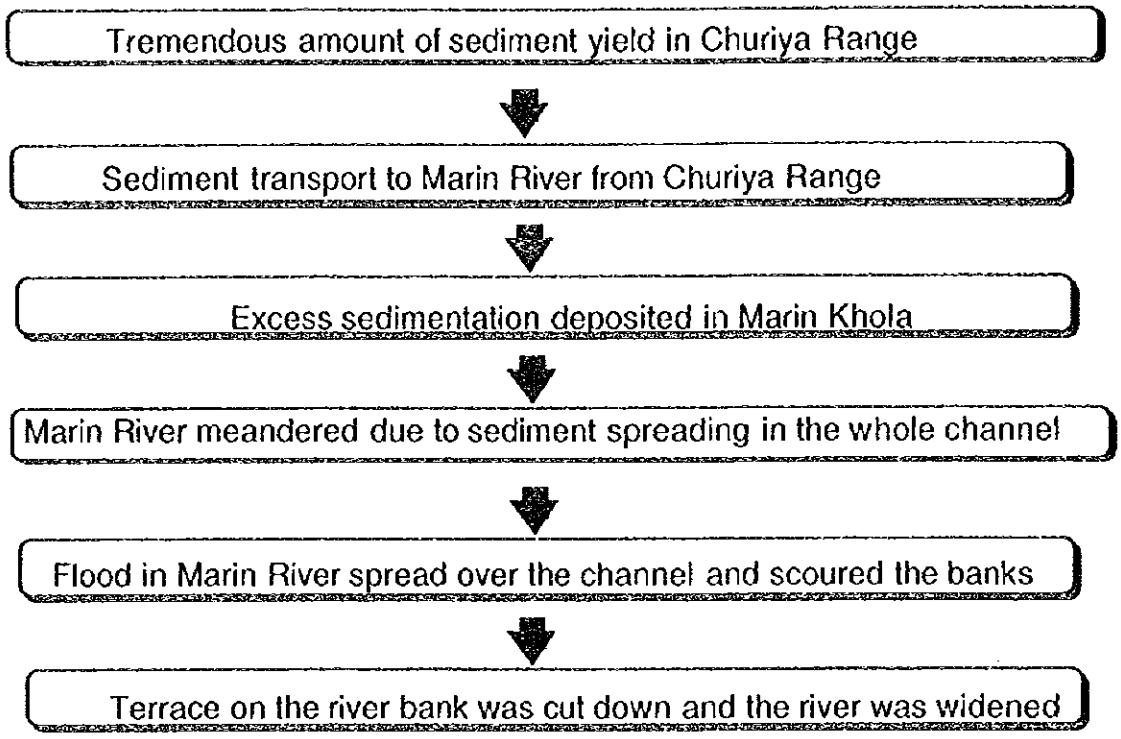
B.2.2 Current Condition

In July 1993, the flood started cutting farmland in the north-eastern corner of Sahan. This process continued in 1994 and 1995. In this context, for protecting the village and farmland (in front of the village), Sindhuli DDC provided 464 pieces of gabion wire nets. Moreover, a tractor and 72 quintals of rice were also provided for this activity.

At present, the farmers of Sahan have started slowly reclaiming the flooded land but they are not confident that the land can for a longer period. The gullies and landslides occurred during the flood have been slowly recovered by vegetation. In addition, the fertility of the soil which decreased due to the 1993 flood is slowly returning to the previous level. The people had fixed a spur dike to the north-eastern portion of the Sahan village in 1994 but the Marin Khola broke it. This protection measure was constructed by the local people (free labour). A large portion of the land located to the east of Sahan was also buried by debris, soil, and sand brought by the Phoolbari Khola.

B.3 Hazard Assessment

The hazard degree of the Sahan village is quite high and there is so far no permanent solution to control the hazard with people's participation. The cause of the hazard is mainly due to the natural characteristics of the Marin Khola basin, particularly fragility of geology of the Churiya Range on the southern part of the basin. The mechanism of disaster in the Marin Khola basin is shown in the following figure.



Disaster Mechanism in the Marin River Basin

The Churiya Range is, however, not a steep mountain; the highest peak is about 800 m above the sea level only. The crown cover of the range is also well maintained by the big efforts under the forest management programme, salwood which is good for timber is well grown everywhere and managed by a community users' group.

As sediment yield from the Churiya Range is very big, the width of the Marin River downstream of the Dadi Glass village is quite large with more or less than 1.5 km. The catchment area of the Marin Khola in the Sahan village is estimated at 252 km^2. The standard width of a river with a catchment area of 250 km^2 in Japan is more or less than 400 m only. The difference indicates that the amount of sediment yield in the basin is quite big and the width of the Marin Khola will be widened more and the cultivation and residential areas along the river will be cut down by another disaster like the flood of July 1993.

B.4 Agriculture and Community Forestry

B.4.1 Agriculture

It is said that the farmland in Sahan is most fertile among the various farmlands in Nepal. Occasional floods which bring fertile soil (clay) from the Marin Khola have enriched the land in the area. People have fresh memory of the 1983 flood which took away some farmland of Maruwa (a western section of Sahan). Right after the flood, the people constructed an embankment by using local resources (bamboo poles, tree logs/timber, etc.) and the reclamation of land was completed. The farmers of Maruwa found that the fertile clay brought by the flood has increased the productivity substantially. In fact, the farmers in this area obviously experienced the 1983 flood as a good fortune.

The crops grown in the area are paddy, wheat, maize, millet, mustard, potato, garlic, onion, cauliflower, cabbage, etc. The cropping pattern of Sahan is shown in Figure 6.4.1. As for horticulture, only a few trees of litchi, peach, pineapple, and lemon can be observed.

The other factor related to productivity is irrigation. At present, the farmland in upper Sahan and lower Sahan is irrigated by temporary canals from the Marin Khola. Due to the flood of the Phoolbari Khola, the irrigation system is buried by sand and debris. Likewise, the farmland in Maruwa (a western section of Sahan) is irrigated by the irrigation canal from the Maruwa Khola. The irrigation canal of Maruwa is also frequently damaged by floods of the Maruwa Khola.

Use of chemical fertiliser in Sahan is very low. In fact, the usage started only a few years ago. The people of Ramechhap who had migrated to Sahan a few years ago have introduced chemical fertiliser in this village. At present, farmers bring chemical fertiliser all the way from Mahesotan which is 4 km to the east of Sahan.

The farmers of Sahan have been using animal/cattle manure heavily compared to the farmers in similar settlements. The use of pesticide in Sahan is a recent phenomenon so the consumption is very low.

Productivity of the farmland prior to the July 1993 flood had been quite high, but due to heavy rains, the fertile surface soil had been flooded and washed away. This has reduced the fertility of the soil substantially. This ultimately has decreased the productivity substantially. However, the soil is slowly regaining its productivity to the level before the July 1993 flood.

B.4.2 Community Forestry

The Churiya hill located to the south of Sahan is still covered with dense forest. According to the local people, however, the forest was denser twenty years ago. But in the last twenty years, the depletion rate of forest has been very high. The cause of depletion was that people cut the forest in order to meet the demand of firewood, fodder, and timber. Bearing this fact in mind, the people of Sahan have taken initiative to protect the forest, and they worked for community forestry activities. At present, the people are protecting the forest under the community forestry programme. In July 1993, the district forest office handed over 166.25 ha of forest to the local users' group upon completion of all procedures required to certify the government forest as community forest. So far, the activities of the community forestry users' group are quite satisfactory according to the local people and the members of the users' committee. Protection, management, and utilisation of forest under the community forestry programme are quite promising.

The major timbers found in the forest are Saal (Shorea Robusta), Chilean (Schima Wallichii), Champ (Michelia Champaca), Jaamun (Ficus Retusa). Ninety five percent of timbers available in the community forest (Pasupati Community Forest) are of Saal (Shorea Robusta) species.

The fodder found in the forest and in the edge of farmland is Gayo (Bridelia Retusa), Kaangiyo (Grevilled Robusta), Janakikath, and Kabro (Ficus Lacor).

B.5 Development Needs and Issues in the Community

The development priorities and issues in the community have been refined through the discussions between the villagers' groups and the local consultants of the Study Team for about ten days. Following several discussions, the villagers' groups finally concluded the development priorities as shown below:

First Priority : Construction of Training Dike

Construction of a training dike in the north-western part of Sahan at the confluence of Phoolbari Khola and Marin Khola is the first priority determined by the people of Sahan. If a spur dike is not constructed in the proposed site, the people worry that Sahan will be flooded and bank erosion will continue in the coming years.

Therefore, the people of Sahan have requested all concerned authorities (the DDC, the CDO, and the DFO) and even the Study Team to provide appropriate measures to protect Sahan from floods. Besides, the people of Maruwa Tole are also expecting the construction of dikes on the Maruwa Khola near the confluence of the Maruwa Khola and Marin Khola where the flood of 1984 swept away big portions of farmland.

Second Priority : Construction of Irrigation Canal

At present the farmland in Sahan is irrigated from the Marin Khola, Phoolbari Khola, and Maruwa Khola. The Marin Khola and Phoolbari Khola irrigate the eastern portion of Sahan while the western portion is irrigated by the Maruwa Khola. Due to a large amount of sand brought by the Phoolbari Khola and Marin, the irrigation canal to Sahan is buried every year, so the farmers are obliged to construct a new irrigation canal at the same site every year. In this way, the same irrigation system should be constructed twice a year. Since a heavy workload is required to maintain the exiting canal system, the villagers' group is currently planning improvement measures for less maintenance requirement.

Third Priority : Establishment of Community Water Supply System

At present, the demand of drinking water for Sahan settlement is met by six shallow wells. These wells were constructed by the local people. The water in the well is highly contaminated due to multiple handling. Furthermore, mostly in the monsoon season, the water remains turbid due to flood and seepage of the flood water into the well. Due to such problem, the establishment of a water supply system from the Phoolbari Khola is highly needed by the villagers.

Fourth Priority : Conservation of Soil and Forest

The Churiya Range which lies in the south of Sahan has a very unstable geological structure. In recent years, many new gullies have been formed. In the dry season, these gullies contain no water. But in the monsoon, these are flooded, so gully erosion and debris flow occur flowing to downstream residential areas. This process has increased in recent years. In this context, those measures which are effective to control soil erosion should be implemented and some bio-engineering activities are also encouraged with some technical support. By mobilising the local community users' groups, a high

degree of community participation can be achieved. A nursery which can raise plants (especially those useful for conserving the soil) can be developed and the plants which can conserve the soil can be planted along the bank of the Marin Khola and Phoolbari Khola and in some parts of the barren land. Prior to plantation of trees along the Marin Khola and Phoolbari Khola, some grasses which can conserve the soil can be planted.

B.6 Activities in People's Group

All the formal and informal leaders and the general public are ready to contribute their physical labour forces if the projects which they feel necessary, are introduced to the village. However, to provide free labour forces for a long period is quite difficult for some landless people, because these people need minimum wages (Rs. 50 per day) to survive. In this context, it is quite important to remember that the landless people are entirely dependent on daily wages.

Major activities that the people have initiated and/or completed after July 1993 are explained below:

(1) Construction of the Milijuli Primary School

The Primary School which collapsed due to the heavy rain of July 1993 has been reconstructed. For the reconstruction work, Sindhuli DDC gave Rs. 8,000 and this amount was spent for levelling the ground, and the rest of the activities were accomplished through community participation. The condition of the newly built primary school is not satisfactory because of a poor ventilation and lighting system.

(2) Construction of the Pashupati Temple

The small Pashupati temple has been constructed recently with community participation and a donation from a social worker.

(3) Construction of a gabion-made training dike

The flood of July 1993 started devastating the farmland from the north-eastern corner of Sahan. Large pieces of farmland were flooded and this process continued in 1994. To control this, the DDC provided 464 pieces of gabion wire nets. In addition, a tractor and 70 quintals of rice were also provided to construct the protection dike using gabions and boulders. This grant was not sufficient to accomplish the tasks, so the people of Sahan contributed free labour forces for many days during the monsoon season. Unfortunately, this protection dike could not protect the farmland as the people expected. The protection dike constructed out of gabions and boulders was broken at the centre in the monsoon season.

(4) Community Forestry

In July 1993, 166.25 ha of forest situated to the south of the Sahan settlement were handed over to the people of Sahan. The users' committee has been considered as a model committee in the district in terms of its performance on forest protection and promotion activities. The people have experienced that forest activities are better after formation of the present users' group. Pasupati

Samudahik Ban is the name of community forestry in Sahan. In fact, people's activities for the promotion of the forest have been quite promising and impressive in Sahan.

(5) People's Activities through NGO

The Society for Participatory Culture Education (SPACE) has been working with the people of Sahan from the beginning of 1993. SPACE has assigned two female community development workers to Sahan. These two female workers are responsible for execution of all SPACE activities in Sahan. At present, the people whose economic status is very low, are organised and various revenue-generating skill-oriented training activities are carried out. The major activities launched by the people's group are as follows:

- Two literacy classes have been completed. In these classes two groups of about 50 adults each were made literate. Majority of the people who attend literacy classes are females.
- A three-month sewing training was provided to a local female and upon the completion of her training, she, as a tutor, has conducted a similar training to seven Majhi women. SPACE has provided a sewing machine to the tutor who completed her first three-month sewing training successfully at free of cost. Due to the lack of sewing machines, trainees are facing difficulties in sewing practices.
- SPACE has been also launching debt alleviation activity under this programme. Ten very poor Majhi women have been given ten piglets (one for each) by forming a group. All the group members who got piglets benefited substantially after one year from raising piglets.
- Most of the group members formed by SPACE are very poor and few of the members own small pieces of land. These very poor families are heavily dependent on wages. Usually the grains in the monsoon season are very expensive, so the poor farmers are forced to buy grains at high prices, in order to survive. Therefore, to improve this worst situation, SPACE invested approximately Rs 32,000 to buy paddy at cheaper rates in November. In this way, the group members can buy paddy during the monsoon at cheaper rates which are fixed by the group itself.

B.7 Proposed Disaster Prevention Measures

Figure B.7.1 shows the current situation of the Sahan village and the Marin Khola. As the sediments, transported from the Marin Khola and Phoolbari Khola, widely spread out, the river meandering is so fierce that bank erosion and river widening have accelerated.

As the Marin Khola catchment has high potential in sediment yield, the current issues in Sahan are not location-specific matters but general matters for all the villages along the Marin Khola. The countermeasures are therefore to be disseminated to the other villages and basin-wide approaches are required to manage the sediment and river control activities.

However, it is so costly to provide the basin-wide river training and sediment control works at once. As flood control and bank protection in Sahan are quite urgently required for maintaining the existing cultivation land along the river, the practical measures with local materials and equipment should be considered.

Considering the urgency of the flood control and further development potential in the Marin Khola catchment, the stepwise disaster prevention measures, immediate measures, and long term measures are proposed as summarised in Figures B.7.2 and B.7.3, respectively. Photo B.7.1 shows a seance of discussion between the villagers and the Study Team about disaster prevention measures.

B.7.1 Immediate Measures

Immediate measures for disaster prevention shall be carried out as soon as possible to protect the existing farmlands along the river. Otherwise, the cultivation land will disappear continuously even by regular floods every year.

The objective of the countermeasures is to prevent the river from overflowing the left bank by providing a training dike and spur dike along the left bank.

A detailed explanation is given below:

(1) Training dike at the confluence

At the confluence, a massive training dike is required. The gabion spur-dike was constructed with people's participation. 464 bundles of gabion wires were provided at the exact place. However, the dike was damaged and buried mainly by scouring of the toe portion and tilting of the gabion boxes.

This is because the foundation of the spur dike was scoured by the river flow and the gabion spur dike was tilted due to unstable foundation. Considering the above, the foundation shall be constructed by gravel bedding and the key at the toe portion shall be provided with bounders.

As it is not easy to procure gabion wires, it is recommended to utilise timber for fabrication of gabion boxes, as timber is easily available in the community forest behind the village. In addition, tree planting behind the training dike is recommended to support the training dike as well as to prevent floods from attacking the village directly.

A similar structure is also preferable to protect the Maruwa village from the Maruwa Khola. The north-western part of the Maruwa village is most vulnerable to floods of Maruwa Khola. This section was completely flooded by the 1984 flood. For the construction of the training dike with gabion wires or timber boxes and boulders, people's participation in term of labour forces should be also obtained at a substantial level in both the upper Sahan and Maruwa villages.

(2) Vegetated spur dike along the river bank

On the left bank downstream of the training dike, a vegetated spur dike shall be constructed, which will be provided by embanking a small mound to a height of about one meter, and covering it with boulders and seeds. The spur dike will become stronger after a few years by rooting of the bushes. The spur dike will be effective in preventing the river from flowing between spur dikes and depositing the sediments in between, and finally in creating new cultivation land on the left bank.

The measure aims at not only protection of the existing land but also reclamation of new cultivation land along the current river channel. All the materials required for the disaster prevention works are available around the Sahan village. The people's participation is, therefore, highly expected and sustainable activities for repairing will be highly realisable.

(3) Animal power utilisation

The boulders to be used for the training dike and spur dike are, however, not available near the village. It is required to transport them from about 5 km upstream area to Sahan. As there is no mechanical force to transport such boulders to the construction site, it is recommended to apply buffalo carts as heavy equipment. In Nepal, there are many farming/transporting instruments used in many places. For example, animal carts are fully used in the Terai plain. Many domestic animals are available in Sahan.

(4) Gully control works

Many gullies are formed in the fragile Churiya hill and drained into the Marin Khola. Most of these gullies were formed by the 1993 flood and the width of the gullies is becoming wider and wider in the following years. These gullies remain dry for most of the time and water can be seen only in the monsoon season. Due to a weak geological structure of Churiya, these gullies have been increasing. If no countermeasures are done timely, the gullies will be eroded and debris flow will occur during the monsoon season.

Therefore, these gullies must be protected immediately. Some bio-engineering works should be promoted in the area by training the villagers on vegetated stone masonry works, dry masonry groundsill works, and so on. Bamboo and some other trees which can conserve soil effectively, shall be planted along the gully routes. The local community forestry users' group could be also mobilised to complete this task.

B.7.2 Long term measures

The riversides of the Marin Khola are quite fertile and they have high potential for agriculture development together with river training works and expansion of a feeder road related to the Sindhuli Road Project. The Sindhuli Road, which is currently under planning, will connect Bardibas located along the East-west Highway to Kathmandu, over a total length of 112 km. The route will pass Sindhulimadi which is about 25 km east of Sahan. If a feeder road from Sindhulimadi is developed along the Marin Khola, the area must be highly developed as paddy field for supplying paddy to Kathmandu City through the Sindhuli Road.

A basin-wide comprehensive master plan study involving sediment control, river control, road construction, and agricultural development shall be conducted from the long term development viewpoints.

B.8 Community Development Measures

As the people's activities in Sahan are quite vital, Sindhuli DDC as well as the DFO regard their previous village improvement activities highly. The people's participation in

community development is therefore not a new issue for the villagers of Sahan. They are planning and trying some financial arrangements for the following works:

(1) Irrigation intake and canal development from Aainapaharo

As it is very difficult to maintain the current irrigation system in view of sediment deposition in the canal, which is running on the left side of the river bed along the Phoolbari Khola, the villagers' group is planning to cover the canal by concrete slabs to avoid sand falling into the canal. The countermeasure, however, will not sustain for a long time, and it is proposed to have the irrigation canal on the river bank, although some river cross structures will be required.

Such improvement works will be easily carried out by the villagers' group if some material and labour charges are borne by the local government.

(2) Water supply from Marin Khola

Since current water sources are shallow wells and contaminated, they are not suitable for potable water. The villagers' group is planning to construct intake structures at Lamidamar on the Phoolbari Khola, which is located 3.5 km upstream of the confluence of the Marin Khola and Phoolbari Khola. The water source is quite big and can meet the water demand of Sahan easily. In addition to the Sahan village, the surrounding villages of Wards No. 1, 2, and 3 can be covered by the same water sources.

(3) Installation of biogas plant

Although there is no discussion about biogas with the people in Sahan, installation of biogas plants would be highly promising and improve the people's living standard. Biogas plants can be easily installed in Sahan for cooking and lighting purposes, in view of availability of livestock wastes. The availability of livestock in Sahan is shown below:

Availability of Livestock in Sahan Village

Livestock	Head	Head / HH
Cow	424	4.4
Buffalo	72	0.75
Goat	140	1.5
Pig	53	0.55

Source : Survey by the Study Team

The potential of developing biogas plants in Sahan to provide enough gas for cooking and lighting for all the households in the village is quite high. According to the previous study, a biogas plant of 6 ms capacity requiring 36 kg of animal dung per day, will be needed for each household to have enough cooking gas as well as lighting gas. 36 kg of dung can be produced by two or three cows or buffaloes.

In fact, it is reported that about forty biogas plants are operating in the Dadi Glass village, located about 20 km upstream of the Sahan village. Technical seminars on biogas installation and funding support would be effective to disseminate such local technologies.

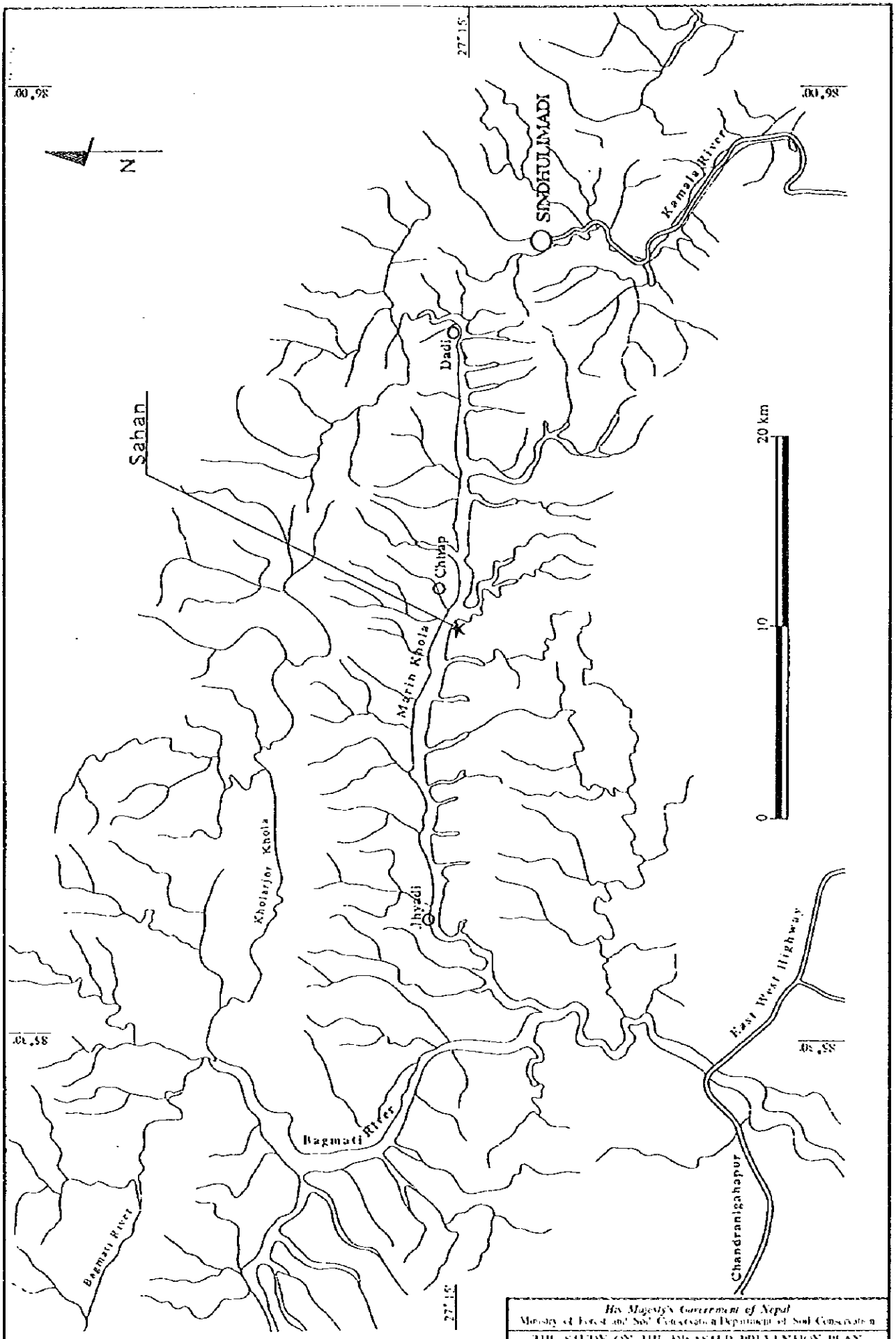


Fig. B.1.1
Location Map of Sahan Village

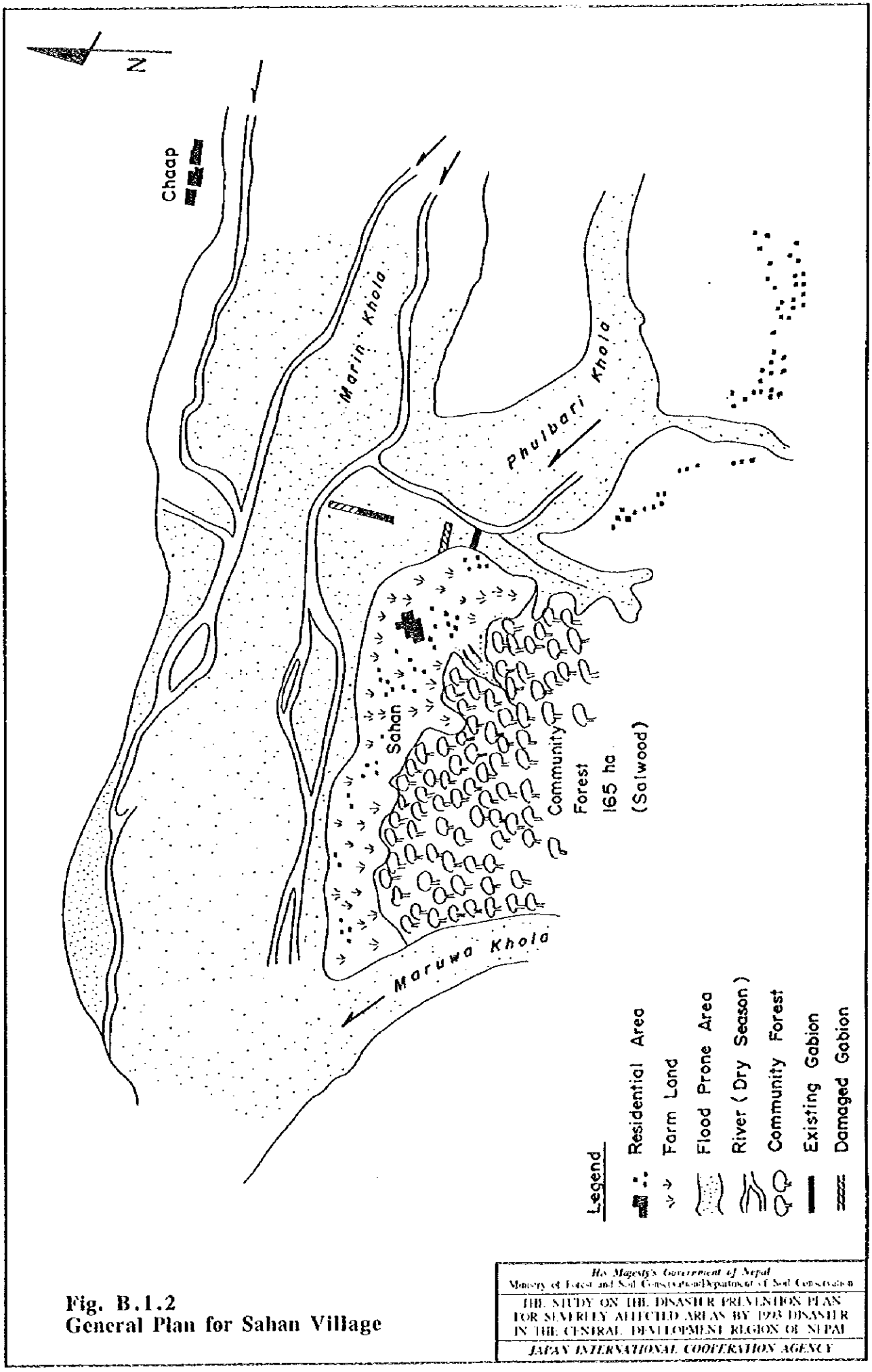


Fig. B.1.2
General Plan for Sahan Village

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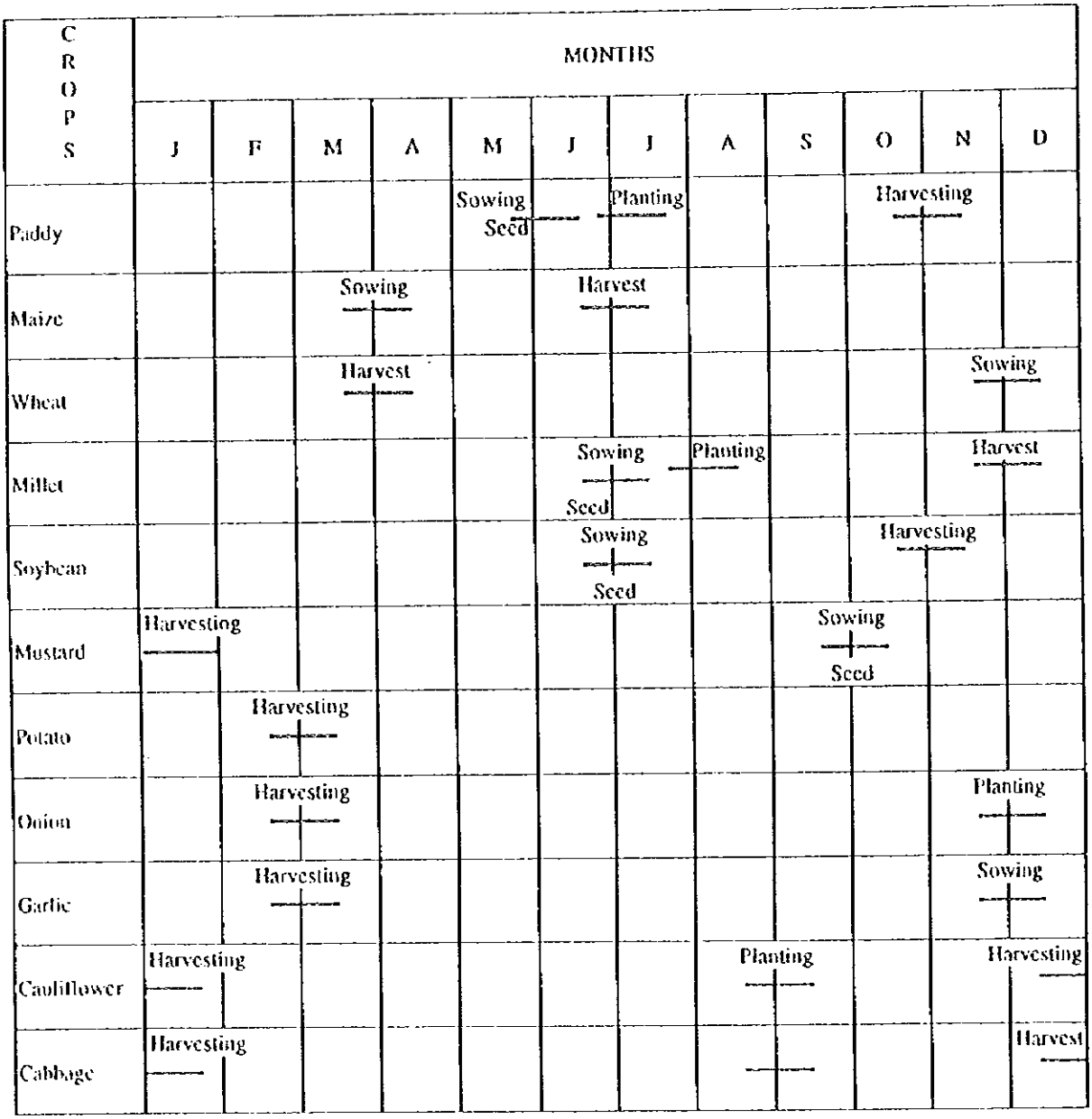

The farmland of Sahan generally follow following cropping pattern :
Type 'A' Pattern : Paddy; Wheat; Maize/Paddy (Irrigated land)
Type 'B' Pattern : Paddy, Potato, Maize/Paddy (Irrigated Land)
Type 'C' Pattern : Onion/Garlic/Paddy/Maize (Irrigated Land)
Type 'D' Pattern : Millet, Maize (Upland)

Fig. B.4.1
Cropping Pattern at Sahan

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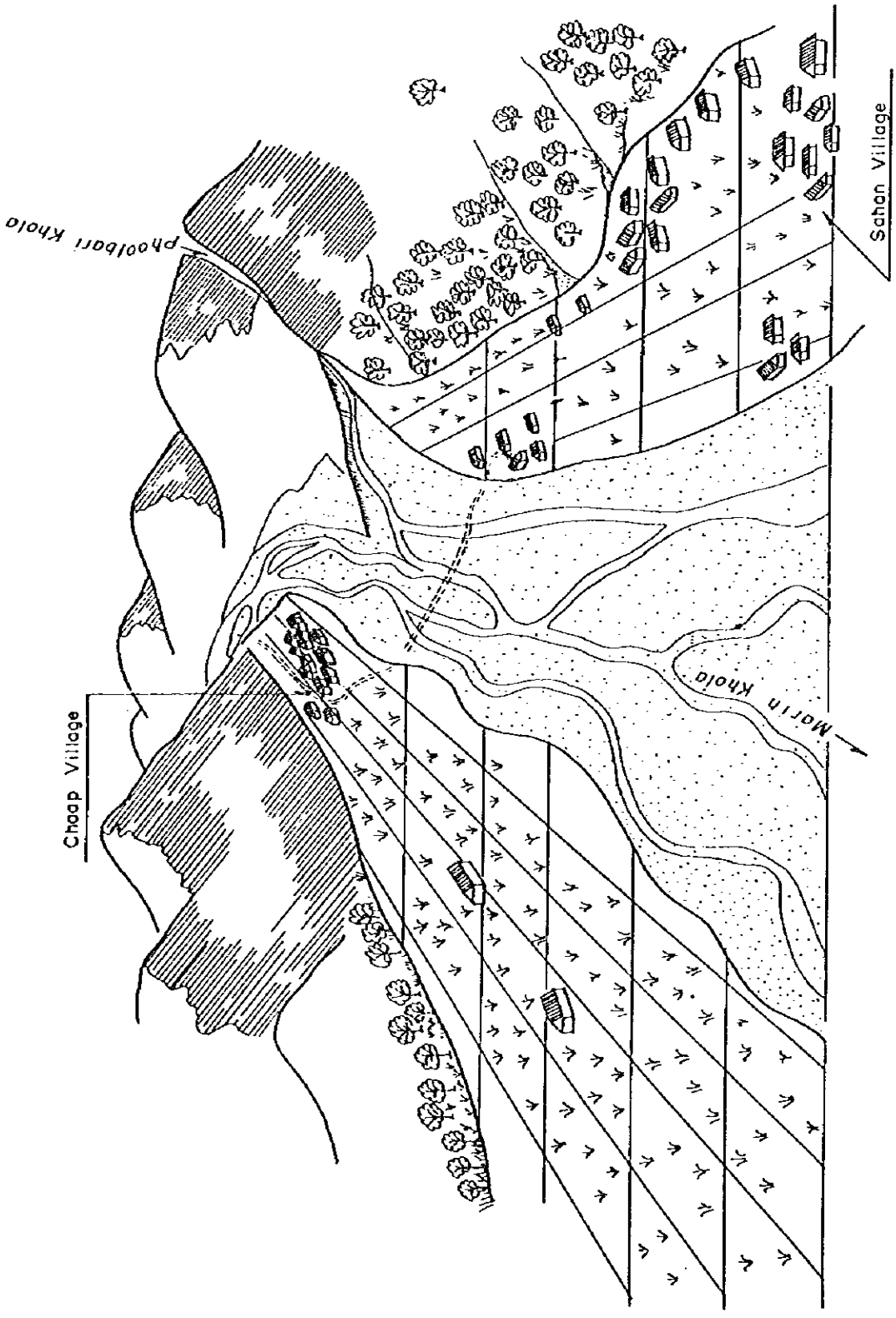

Fig. B.7.1
Current Condition at Sahan Village

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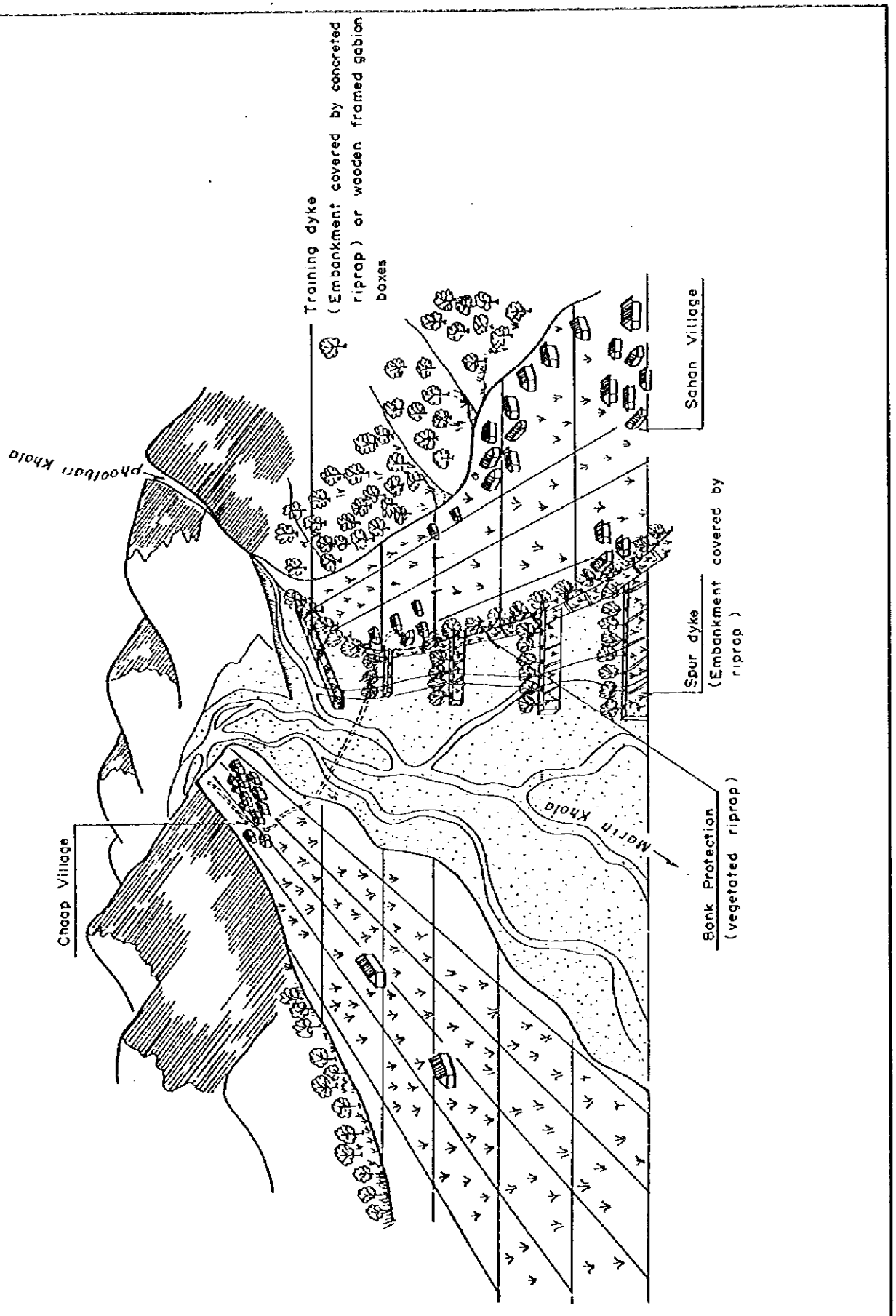

Fig. B.7.2
Immediate Measures for Disaster Prevention at Sahan

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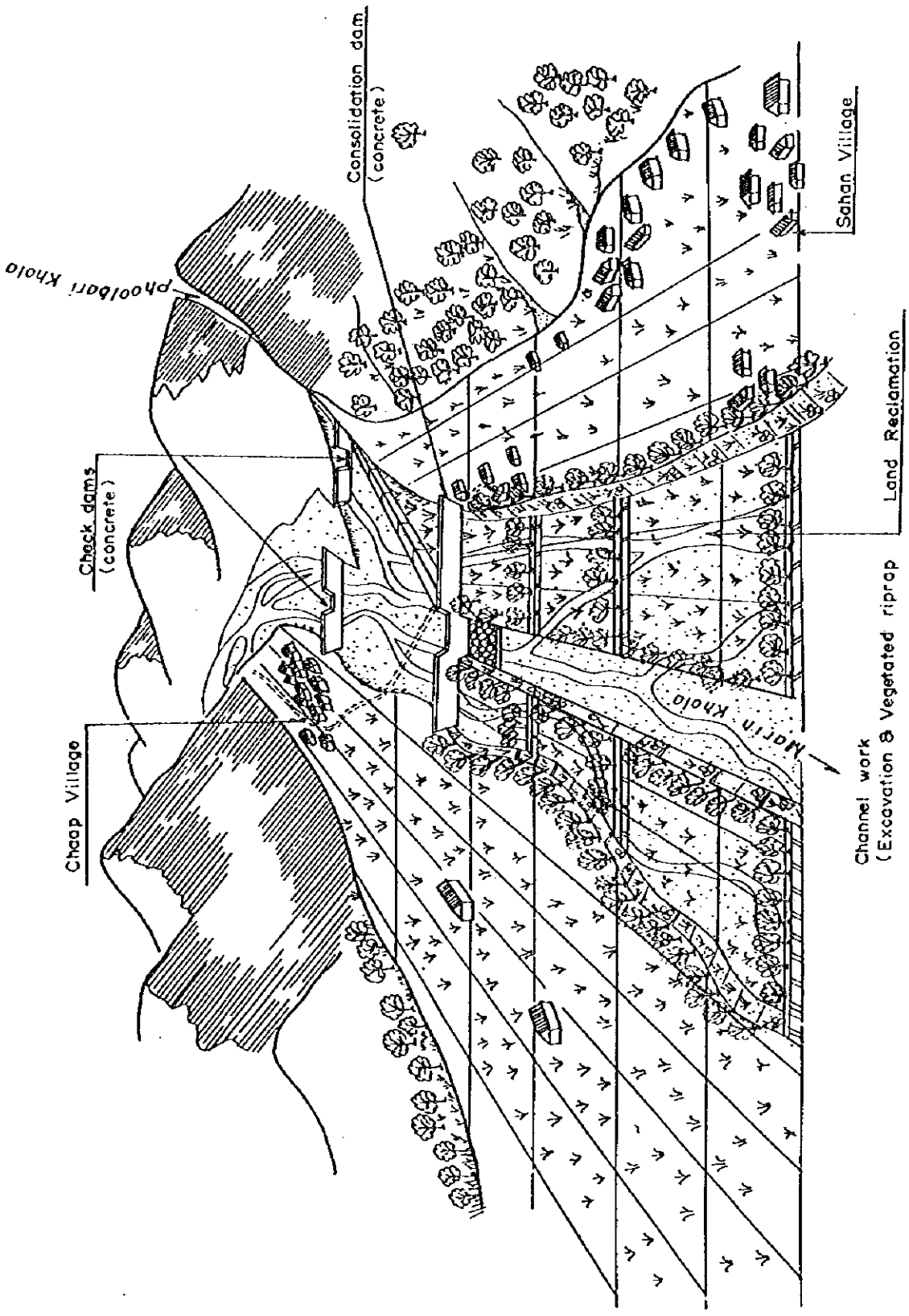

Fig. B.7.3
Long Term Measures for Disaster Prevention at Sahan Village

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Photo B.1.1 General View of Sahan

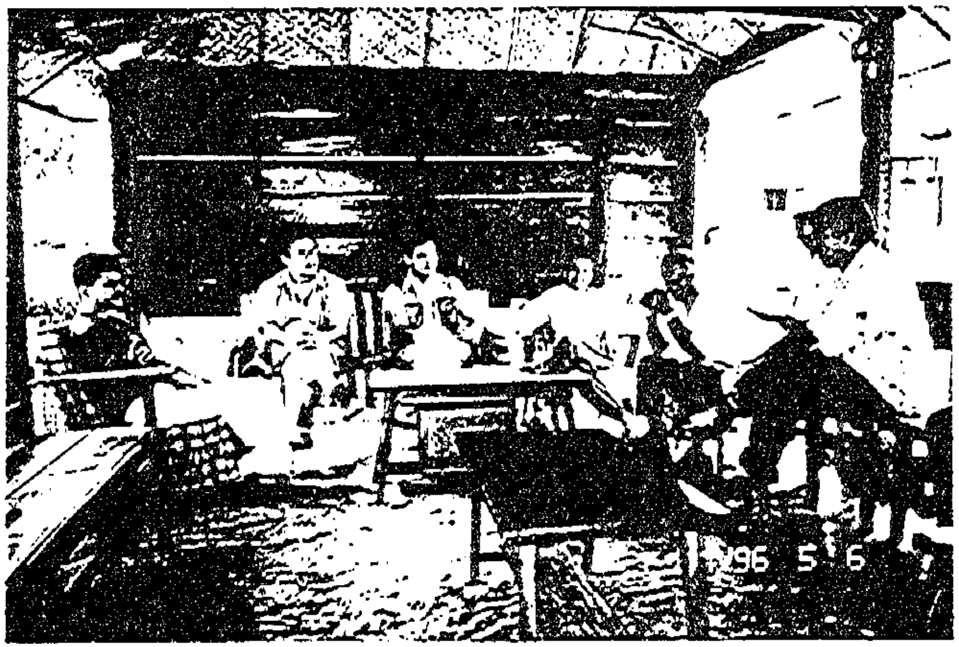

Photo B.7.1
Discussion with the Sahan People

JICA