5.3 Implementation of Pilot Project I

5.3.1 Operation of Road Early Information System

(1) Operation Unit and Staff

This pilot project was carried out by DWIDP and DOR and concerned operation unit that were formulated in DPO, DRO, Kabilash VDC and Kalika FM as shown Tables below.

Table 5.3.1 Staff of DPO Unit

Position	Name	Role	Remark
General Leader	Ghyan Bikram Shah	Responsible for activities in DPO	SP
Deputy Leader	Rana Bahadur Rayamaji	Leader for Bharatpur Apatari	DSP
Deputy Leader	Firoj Basnet	Leader for Mugling	Inspector
Staff	Jhalak Bahadur Shrestha	Data management	Assistant Inspector
Staff	Krishna Bahadur Chetri	Manager for Aptari Notice Board	Assistant Inspector
Staff	Kamal Khadka	Manager for Mugling Notice Board	Constable
Staff	Dhal Bahadur Shrestha	Operator for webpage information	Constable

Table 5.3.2 Staff of DRO Unit

Position	Name	Role	Remark
Leader	Rajendra Raj Sharma	Responsible for activities in DRO	Division Chief
Staff	Bijaya Chapagain	Operator for webpage information	Engineer
Staff		Data collection of 0KM	Staff
Staff		Data collection of 11 KM	Staff
Staff	Bharat Gurung	Data collection of 21 KM	Villager
Staff	Bimala Kandel	Data collection of 31 KM	Villager

(2) Operation of System

The rainfall monitoring by automatic/manual raingauges was carried out properly without difficulty. Monitored rainfall data were then uploaded to the web site as shown in Table 5.3.3 and 5.3.4. Upload by DPO was only two times, because traffic closure was only once which was induced by a rock mass failure on 14th August at 29km+850. Access to the web site was 1952 times as of the end of October.

Table 5.3.3 Uploading Status for Road Early Information System in DPO Unit

No.	Date	Name	Reason
1	2008/8/14	Dhal Bdr Shrestha	Update of Road blocked information
2	2008/8/15	Dhal Bdr Shrestha	Update of Road open information

Table 5.3.4 Uploading Status for Road Early Information System in DRO Unit

No.	Date	Name	Reason
1	2008/6/26	Bijay Chapagain	Update of Modified rainfall amount
2	2008/6/27	Bijay Chapagain	Update of Modified rainfall amount
3	2008/7/13	Bijay Chapagain	Update of Modified rainfall amount
4	2008/7/18	Bijay Chapagain	Update of Modified rainfall amount
5	2008/7/24	Bijay Chapagain	Update of Modified rainfall amount
6	2008/7/29	Bijay Chapagain	Update of Modified rainfall amount
7	2008/8/21	Bijay Chapagain	Update of Modified rainfall amount
8	2008/8/24	Bijay Chapagain	Update of Modified rainfall amount
9	2008/8/29	Bijay Chapagain	Update of Modified rainfall amount
10	2008/9/4	Bijay Chapagain	Update of Modified rainfall amount
11	2008/9/11	Bijay Chapagain	Update of Modified rainfall amount
12	2008/9/22	Bijay Chapagain	Update of Modified rainfall amount
13	2008/9/28	Bijay Chapagain	Update of Modified rainfall amount
14	2008/10/1	Bijay Chapagain	Update of Modified rainfall amount
15	2008/10/20	Bijay Chapagain	Update of Modified rainfall amount

5.3.2 Traffic Closure Induced by Rock Mass Failure at 29km+850

Rainfall amount during execution of pilot project from July to September 2008 was so small that sediment related disaster occurred only once in 14th August 2008. The process and response for the disaster were as follows.

(1) Place of Rock Slope Disaster: N-M Highway km 29＋850

(2) Process of Slope Failure

A rock fall with a rock mass failure started to occur on 13th August 2008, at 12:00 p.m.. A road worker found the rock fall and reported to DRO, who ordered to prepare the heavy equipment while continuously monitoring the failure event. The rock mass failure ended on the 14th August 2008 at 0:00 a.m.

- ✧ Type of Failure: (Small) Rock Mass Failure
- ✧ Scale of Failure: (Length*Width*Thickness)= 20m*10m*15m=300m^3
- ✧ Cause of Failure: Loosened rock mass slipped down along discontinuity of rock mass. It is supposed that rainfall around 40mm from 13th to 14th acted as trigger of slope failure

- ✧ Casualty: No casualty

Figure 5.3.1 The Slope where rock mass failure occurred

(3) Reopening Work

After slope failure ended, two loaders from DRO, Baharatpur commenced reopening works. Additional heavy equipment (excavator) from Hetauda was mobilized for the reopening works.

- ✧ Half Lane Reopening: 14th August PM 5:00
- ✧ Full Lane Reopening: 15th August PM 4:00
- ✧ Reopening Cost (fuel and labor): Around 95,000Rs.

(4) Notification through Road Information System

Notification of road closure at 29 km was carried accordingly as follows.

- ✧ Display on Notice Board (road closure): 14th August 2008, AM 6:00
- ✧ Broadcast by Kalika FM: 14th August 2008, 7:00 AM
- ✧ Upload to the Web Site by DPO (road closure information): 14th August 2008, 8:00 AM
- ✧ Upload to the Web Site by DPO (reopening information): 15th August 2008, 4:00 PM
- ✧ Display on Notice Board (road Reopening): 14th August 2008, PM 6:00

Road early information system was utilized for notifying the traffic condition. However notice timing was not immediate enough, and should be improved for future events.

5.3.3 Weather Condition during Pilot project

Rainfall during execution of pilot project was very small compared with past records. Largest one day rainfall was 51mm/day in 12th July 2008. This was lower than rain fall data of past 10 years. Hence, rainfall intensity has not reached the warning level.

Division Road Office, Bharatpur (July 1 – October 20, 2008)

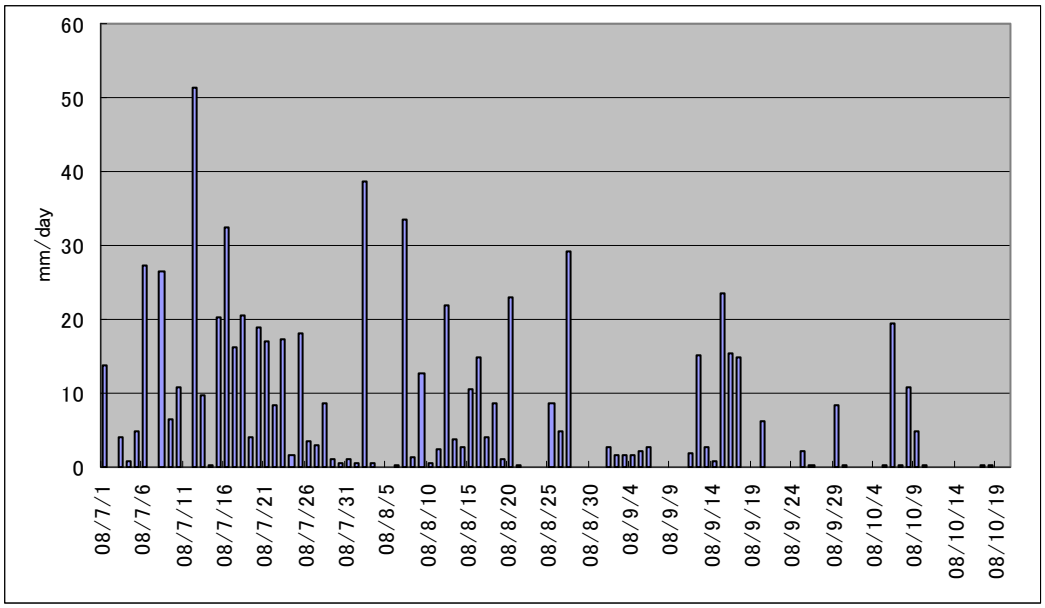


Figure 5.3.2 Daily rainfall data by Automatic Raingauges

5.4 Evaluation of Pilot Project I

5.4.1 Summary of Evaluation

Summary of the evaluation is as follows.

Table 5.4.1 Summary of Evaluation for Pilot Project I: Road Early Information System

Narrative Summary	Objectively Verifiable Indicators	Verification Methods	Evaluation Result
Overall Goal			
Loss reduction of road users by selecting appropriate action (waiting, detour, cancellation) for road closure using timely information	➢ ASLp：Potential annual suspension loss of vehicles (Rs/year)	Questionnaire survey for road user after system installment and data analysis	**The system may provide 10% reduction of ASLp = 11 million Rs/year**
Improvement of traffic safety from road slope/water induced disaster	➢ Actual human lives loss and vehicles loss by road slope/water induced disaster	Disaster record (district police office)	**There were no human lives loss and vehicle loss during pilot project**
	➢ AHLLp: annual potential values of human lives lost (Rs/year)	Questionnaire survey for road user after system installment and data analysis	**The system may provide 50% reduction of AHLLp = 4,000 Rs/year**
	➢ AVLp: annual potential values of vehicles loss (Rs/year)		**The system may provide 50% reduction of AVLp = 8,000 Rs/year**
Project Purpose			
Usage of timely information on early warning and traffic obstacle	Recognition/action rate for the information of road user	Questionnaire survey for road user after system installment and data analysis	**Approximate 80% driver can understand, and take appropriate action**
Output			
Installation of workable system	Understanding level of participants of the system drill	Drill record	**Almost all staff can recognize the meaning of the system**
	Actual performance	Check by list in November 2008	**Related organizations performed smoothly except communication issue**
	Numbers of information provided	Operation record	**More than 15 times was uploaded during 4 months**
	Capacity of the organization related	Check by list in November 2008	**Concerned about lack of manpower in the future**

5.4.2 Evaluation of Project Output

(1) Hearing Investigation

Hearing investigations were initiated to measure objectively the verifiable indicators for road early information system and early warning/evacuation system for Kabilash Village. First evaluation was carried out to measure the understanding level of the operation staffs and the participants on the system during the joint drill in June 26th 2008. Second evaluation was carried out to consider the actual performance and the capacity of the concerned organization during execution of pilot project, in November 2008.

The result of first evaluation is summarized in Table 5.4.2 and Table 5.4.3. Outline of the result for the system is described as follows.

For Operation Staff: The operation staff basically understood the meaning of the system and its operation method, though 12 hour half-value rainfall calculation program is difficult to understand for them. Moreover, there is concerned about intercommunication in the Kabilash VDC.

For Villager: Although all villagers managed to evacuate in the drill, some villagers are difficult or impossible to confirm the evacuation route and/or place by themselves.

Table 5.4.2 Result of Hearing for DOR, DPO and Kabilash VDC after Joint Drill

Hearing Item for Staff	Answer
1) Confirmation of Hourly Rainfall (4 Staff)	Easy 100 % Difficult 0 %
2) Operation of 12 hour half-value rainfall calculation program (4 Staff)	Easy 25 % Difficult 75 %
3) Uploading to Web page (4 Staff)	Easy 100 % Difficult 0 %
4) Request of warning for heavy rain (4 Staff)	Easy 100 % Difficult 0 %
5) Intercommunication on Kabilash VDC (13 Staff)	Easy 54 % Difficult 46 %

Table 5.4.3 Result of Hearing for Kabilash Villager after Joint Drill

Hearing Item for Participants of Practice (70 Participants)	Answer
1) Implementation of evacuation	Yes 100 % No 0 %
2) Confirmation of evacuation route	Easy 29 % Difficult 61 % Impossible 10 %
3) Confirmation of evacuation place	Easy 27 % Difficult 60 % Impossible 13 %

The result of second evaluation is summarized in Table 5.4.4 for Road Early Information System and Table 5.4.5 for Early Warning/ Evacuation System for Kabilash Village. The outline of the result for each system is described as follows.

(a) Result of Second evaluation for NMHEIS

1. Function of Equipment: Some leaves chocked twice the measurement on the automatic raingauge in DRO. The measuring cylinder of manual raingauge in 11km has been broken. However these minor failures can be recovered a short time later. The main computer in DPO has been broken and need to be repaired as soon as possible. Other equipments and device is working good condition.

2. Operation of Equipment/System: Some officer in Mugling police station does not recognize the procedure on Notice Board. Although DWIDP has the web-server for the system, they will be expected the initiative for the system from now on. Data re-analysis from disaster management viewpoints such as modifying warning criteria is not conducted because there is not enough data to do it yet so far. It should be conducted every 5 years after obtaining enough disaster data.

3. Information Network: There is concerned about information network among DRO-DPO-Kalika FM. It would be expected that provision and acceptance for information should be more timely and smoothly. Kalika FM is pretty good access and broadcast for information. However hotels and transportation companies have little or no access and provide the information for the system. It needs to be enlightened for the system.

4. Utilization by User: Traffic researches for drivers passing the Highway had been carried out on the Road Early Information System in Anptari (46 drivers) and Mugling (180 drivers) in June 26th and August 27th, 2008 where notice boards were installed. Most drivers (approximately 80%) can recognize the board and its contents. Moreover it will be expected that almost all drivers (approximately 90%) takes appropriate response for the road obstacles. The detail is described in "5.4.3 Evaluation of Project Purpose".

Table 5.4.4 (1) Evaluation for Road Early Information System during the Pilot Project (1)

Item	Organization	Good	Fair	Not good	Remark
1. Function of Equipment					
1-1. Automatic recording rain gauge	Division Road Office		V		0mm is recorded even under rainfall due to small reaf clog the funnel (2 times).
	Kabilash Village	V			
1-2. Manual (Non automatic) rain gauge	Division Road Office		V		Measuring cylinder for 11km has been broken.
	Kabilash Village	V			
1-3. Computer	District Police Office			V	It has been broken.
	Division Road Office	V			
	Kabilash Village	V			
1-4. CDMA pone	District Police Office	V			
	Division Road Office	V			
	Kabilash Village	V			
1-5. Notice Board for NMHEIS	District Police Office	V			
2. Operation of Equipment/System					
2-1. Calculation of modified rainfall amount	Division Road Office	V			
	Kabilash Village	V			
2-2. Upload of modified rainfall amount to web-page	Division Road Office	V			
	Kabilash Village	V			
2-3.Patrol/site confirmation for the serious disturbance/road closure	Division Road Office	V			
	District Police Office	V			
2-4. Upload road early information to web-page	District Police Office	V			
2-5. Posting road early information on notice board	District Police Office		V		Some staff does not recognize the procedure (Mugling police station)
2-6. Maintenance of the NMHEIS system	DWIDP		V		DWIDP provides the web-server. Initiative for the system are expected in the future
2-7. Data repository	DWIDP	V			
	District Police Office	V			
	Division Road Office	V			
	Kabilash Village	V			
2-8. Analyzed data from disaster management viewpoints such as modifying warning criteria	DWIDP	Not applicable			It should be conducted five year later
	Division Road Office		V		It should be conducted five year later DRO conducted comparison of manual rain gauges 11, 21, 31km and rain gauges of division road office
	District Police Office	Not applicable			It should be conducted five year later
3. Information Network					
3-1. Information to division police office when danger situation (modified rainfall amount is over the warning criteria, or serious disturbance/road closure is recognized)	Division Road Office		V		It is expected that more timely information
	Kabilash Village	V			
3-2. Information receive of heavy rain, serious disturbance, and road closure from related organizations and/or road user	Division Police Office	V			

Table 5.4.4 (2) Evaluation for Road Early Information System during the Pilot Project (2)

Item	Organization	Good	Fair	Not good	Remark
3-3. Information to Kalika FM (early warning and/or road closure)	Division Police Office		V		It would be better more timely information. Information should be road closure/traffic jam by accident.
3-4. Access to web-page of NMHEIS	Kalika FM		V		It is good after September.
	Hotels			V	It was not conducted so far.
	Transportation company			V	It was not conducted so far.
3-5. FM radio broadcast	Kalika FM	V			Informed by 'Traffic update' 9:15-9:20 AM Irregularly as emergency
3-7. Notice to hotel users	Hotels			V	It was not conducted so far.
3-8. Notice to drivers employed	Transportation company		V		8 in18 companies confirmed the board
4. Utilization by User					
4-1. Cognizance of notice board by driver	Road User		V		by interview on June and August
4-2. Visibility of letters of notice board to read by driver	Road User		V		by interview on June and August
4-3. Understanding for notice board by driver	Road User		V		by interview on June and August
4-4. Response for notice board by driver (to select appropriate action, or ignore the information)	Road User		V		by interview on June and August
4-5. Access to web page of N-M RIS	Road User		V		by interview on June and August

(b) Result of second evaluation for WIDMSKV

1. Function of Equipment: There is no problem for the function of the equipment on the system. Although CDMA phone had a trouble, it is working good condition after changing the one.

2. Operation of Equipment/System: Modified rainfall amount calculation software which had a trouble, is now working good condition after re-install. Although DWIDP has the web-server for the system, they will be expected the initiative for the system from now on. Data re-analysis from disaster management viewpoints such as modifying warning criteria is not conducted because there is not enough data to do it yet so far. It should be conducted every 5 years after obtaining enough disaster data.

3. Information Network: There is no opportunity of the preparation and evacuation for the rainfall disaster over the criteria in this pilot project period. The drill was basically success in Kabilash Village in June 2008.

4. Utilization by User: Some villagers were difficult or impossible to confirm the evacuation route and/or place by themselves in drill in June 2008. However, disaster education has been conducted in all wards in August 2008.

Table 5.4.5 Evaluation for Early Warning/ Evacuation System for Kabilash Village during the Pilot Project

Item	Organization	Good	Fair	Not good	Remark
1. Function of Equipment					
1-1. Automatic recording raingauge	Kabilash Village	V			
1-2. Manual (Non automatic) rainfall monitoring	Kabilash Village	V			
1-3. Computer	Kabilash Village	V			
1-4. CDMA phone	Kabilash Village	V			Some problems. After changing the phone, no probrem.
2. Operation of Equipment/System					
2-1. Calculation of modified rainfall amount	Kabilash Village	V			
2-2. Maintainance the WIDMSKV system	DWIDP		V		DWIDP provides the web-server. Initiative for the system are expected in the feature
	Kabilash Village		V		Rainfall calculation software has error. Need to be re-installed
2-3. Data repository	DWIDP	V			
	Kabilash Village	V			
2-4. Analyzed data from disaster management viewpoints such as modifying warning criteria	DWIDP	Not applicable			It should be conducted five year later
3. Information Network					
3-1. Information to Kalika FM (when modified rainfall amount is over the warning criteria of inhabitants)	Kabilash Village	V			So far, no opportunity. Drill was successed.
3-2. FM Radio broadcast	Kalika FM	V			So far, no opportunity. Drill was successed.
3-3. Information/Communication from rainfall monitor to Early Warning/Evacuation Team	Kabilash Village	V			So far, no opportunity. Drill was successed.
3-4. Information/Communication from Early warning/Evacuation Team to ward representative	Kabilash Village	V			So far, no opportunity. Drill was successed.
3-5. Information/Communication from ward representative to villagers	Kabilash Village	V			So far, no opportunity. Drill was successed.
4. Utilization by User					
4-1. Cognizance of WIDMSKV by villagers	Kabilash Villager	V			
4-2. Cognizance of early warning information by villagers	Kabilash Villager	V			
4-3. Evacuation action	Kabilash Villager	V			

(2) Information provision

The rainfall monitoring by automatic/manual raingauges was carried out successfully without serious trouble and monitored rainfall date were uploaded to the web site as shown in "5.3.1 Implementation of Pilot Project".

5.4.3 Evaluation of Project Purpose

A traffic research for drivers passing the highway had been carried out with hearing investigation on NMHEIS in Anptari (46 drivers) and Mugling (180 drivers) in 26th June and 27th August 2008, where notice boards were installed. The result is summarized in Table 5.4.6 and Table 5.4.7.

Around 80% of drivers were able to understand the letters, notification and contents on the notice board during the hearing investigation. About 90 % of the drivers replied that they will wait until the indicated traffic warning on the notice board is lifted. Hence, it is considered that the road early information will be useful tool to mitigate traffic accidents induced by sediment related disasters and other traffic obstacles.

Table 5.4.6 Result of Research on Road Early Information System in June, 2008

Hearing Item	Mugling (46 drivers)	Anptari (180 drivers)
1) Understanding of Notice Information	Understood 50 % Did not understand 50 %	Understood 89 % Did not understand 11%
2) Response for Warning Notice	See and wait 72% Ignore 4% Hesitate 15% No answer 9%	See and wait 98 % Hesitate 2%

Table 5.4.7 Result of Research on Road Early Information System in August, 2008

Hearing Item	Mugling (46 drivers)	Anptari (180 drivers)
1) Understanding of Notice Information	Understood 78% Had difficulty understanding 17% Did not understand 4% No answer 1%	Understood 88% Had difficulty understanding 7% Did not understand 4% No answer 1%
2) Response for Warning Notice	See and wait 96% Ignore 4% Hesitate 1% No answer 1%	See and wait 95% Ignore 1% Hesitate 4%

5.4.4 Evaluation of Overall Goal

The overall goals of this project are to 1) Reduce losses of road users by selecting appropriate action selection (waiting, detour, cancellation) for road closure, using timely information and 2) Improve traffic safety against slope disaster/water induced disaster. The evaluation for overall goal is as follows.

(1) Loss reduction of road users by selecting appropriate action for road closure using timely information

- Actual loss of human lives as well as vehicles due to road slope/water induced disaster

There were no human lives and vehicles lost after the system installation. However, heavy rains that meet the warning criteria level did not occur during the rainy season of 2008 hence, no disasters occurred on N-M highway. Therefore the effect of the system it is not yet assured.

- ASLp: Annual Potential suspension loss (Rs/year)

Evaluation results of project purpose shows that approximately 80% of drivers recognize and understand the early road information, and more than 90% will take appropriate action based on the information. Therefore following scenario and improvement of objectively verifiable indicators are expected.

It is expected that 10% loss reduction of road users from current situation will be realized through the selection of appropriate actions (waiting, detour, cancellation) for road closure, based on timely information. Loss reduction is approximately 11 million Rs per year.

(2) Improvement of traffic safety from road slope/water induced disaster

Following scenario and improvement of objectively verifiable indicators are expected.

- AHLLp: Annual potential values of human lives loss

Approximately 50% of AHLLp is saved and it is 4,000 Rs per year.

- AVLp: Annual potential values of vehicle loss

Approximately 50% of AVLp is saved and it is 8,000 Rs per year.

5.4.5 Evaluation of Organization

The organizations for the pilot project were evaluated based on both "2nd Committee Meeting of Chitwan District Disaster Management Partnership Committee for the Pilot Projects Early Road Information System and Disaster Management for Kabilash Village" and "Result of Pilot Project and Plan of Operation Next Year".

Figure 5.4.1 2nd Committee Meeting of Chitwan District Disaster Management Partnership Committee on November 2008 in Royal Century Hotel, Narayangharh

The result of the evaluation for each organization is summarized as in Table 5.4.8. Items for this evaluation are explained subsequently.

1. Extent of efforts for pilot project: This mean that comprehensive efforts and positive attitude for the pilot project from June to November in 2008, which is judged based on above twice hearing investigation in "5.4.2 Evaluation of Project Output".

2. Budget for implementation: This mean that budget in the organization for the sustainable implementation in the future, which is judged based on "Result of Pilot Project and Plan of Operation Next Year".

3. Capacity for implementation: This mean that personnel and development of human resources in the organization for the sustainable implementation in the future, which is judged based on "Result of Pilot Project and Plan of Operation Next Year".

4. Plan for future operation: This mean that prospective plan for the sustainable implementation in the future, which is judged based on following "Budget for implementation" and "Capacity for implementation".

Table 5.4.8 Evaluation of Organization on Pilot Project

Organization	Item	Good	Fair	Not good	Remark
DPO (District Police Office)	1. Extent of efforts for pilot project in 2008	V			
	2. Budget for implemantation		V		Rs. 93000 in 2009.
	3. Capacity for implemantation		V		8 staffs. Computer operator is very limited. It is requred for manpower enfocement.
	4. Evaluation for future operation		V		
DRO (Division Road Office)	1. Extent of efforts for pilot project in 2008	V			
	2. Budget for implemantation	V			Rs. 117460 in 2009.
	3. Capacity for implemantation		V		7 staffs. They are too busy for ordinary road maintenance to operate the system
	4. Evaluation for future operation	V			
Kabilash VDC	1. Extent of efforts for pilot project in 2008	V			
	2. Budget for implemantation		V		Rs. 243590 in 2009. The budget plan should be revised more realistic one.
	3. Capacity for implemantation		V		3 staffs. Computer operator is very limited. It is requred for manpower enfocement.
	4. Evaluation for future operation		V		
Kalika FM	1. Extent of efforts for pilot project in 2008	V			
	2. Evaluation for future operation	V			Informed by "Traffic update"9:15-9:20 AM. Irregulary as emergency

The result in detail of the evaluation for each organization is described as follows.

(1) DPO

(a) Budget for implementation

DPO proposes 93,000 Rs/year on the budget for the implementation of the system in the future. However, they do not secure a steady budget for the system at present. It is preferable to secure a steady budget for the system to do sustainable implementation in the future.

(b) Capacity for implementation

DPO assigns 8 staffs for the total implementation of the system at present. However, personnel who possess capability in operating the computers are very limited. Therefore more personnel should be trained to operate the computers in the future.

(c) Evaluation for future operation

DPO was evaluated as "Fair". Although they basically have the ability to sustain the implementation of the system, personnel who possess capability in operating the computers are very limited.

(2) DRO

(a) Budget for implementation

DRO proposes 117,460 Rs/year on the budget for the implementation of the system in the future. They are able to secure a steady budget for the system.

(b) Capacity for implementation

DRO assigns 7 staffs for the total implementation of the system. However, personnel who are capable of operating the computers are not enough in the organization. The staffs seem too busy carrying out ordinary road maintenance works and have less time operating the system, especially during rainy season. Therefore more personnel should be trained to operate the system in the future.

(c) Evaluation for future operation

DRO was evaluated as "Good". They basically have enough ability and moderate budget for sustainable implementation of the system. However, there are some problems about personnel who are capable of operating the system.

(3) Kabilash VDC

(a) Budget for implementation

Kabilash VDC proposes 243,590 Rs/year as budget for the implementation of the system in the future. However, it is difficult to secure the amount for their needs. The budget plan should be revised aiming for a more feasible amount..

(b) Capacity for implementation

Kabilash VDC assigns 3 staffs for the total implementation of the system. However, persons who are capable of operate the computers are very limited in the organization. Therefore more persons should be trained to operate the computers in the future.

(c) Evaluation for future operation

Kabilash VDC was evaluated as “Fair”. There are some concerned about the budget and the capacity for the implementation.

(4) Kalika FM

(a) Evaluation for future operation

Kalika FM was evaluated as “Good”. It broadcasts “Traffic update" at 9:15-9:20 a.m. everyday. Information during emergency situation is broadcasted on a case to case basis. They have the ability and capacity to broadcast the road information both during regular and emergency situations in the future.

(5) Communication among organizations

According to the results of joint drill and hearing investigations, there were some problems with communication between organizations. It should be noted that smooth and timely communication is vital for the system operation. DRO and Kabilash VDC should obtain the information such as heavy rainfall and road obstacle as immediate as possible, while DPO provides Kalika FM without delay, information for uploading to the web page. The conceptual image on information flow for the system operation is shown in the following figure.

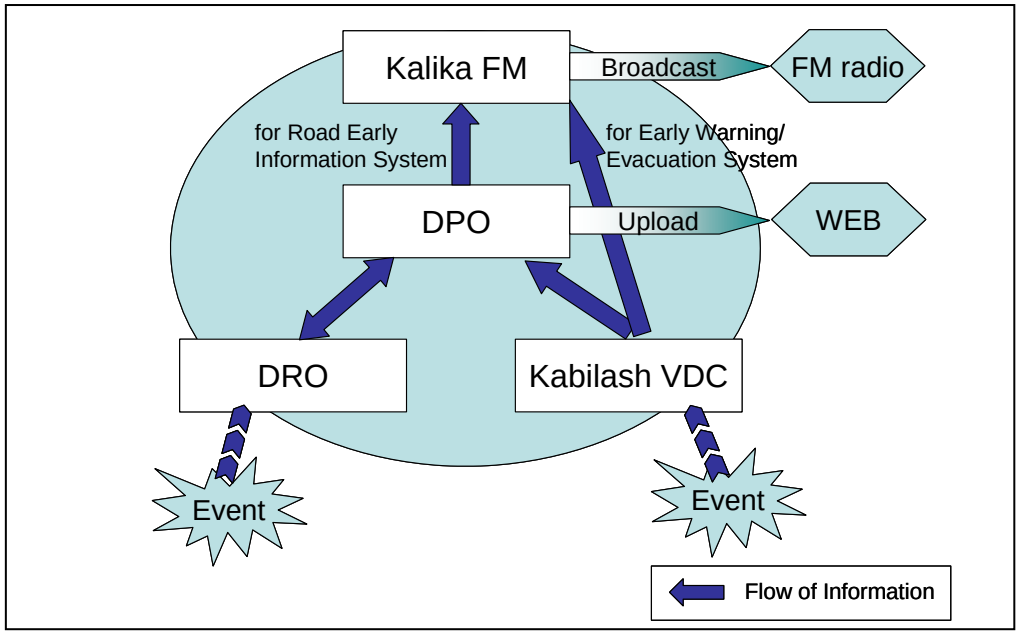


Figure 5.4.2 Conceptual Image on Information Flow for the System Operation

CHAPTER 6

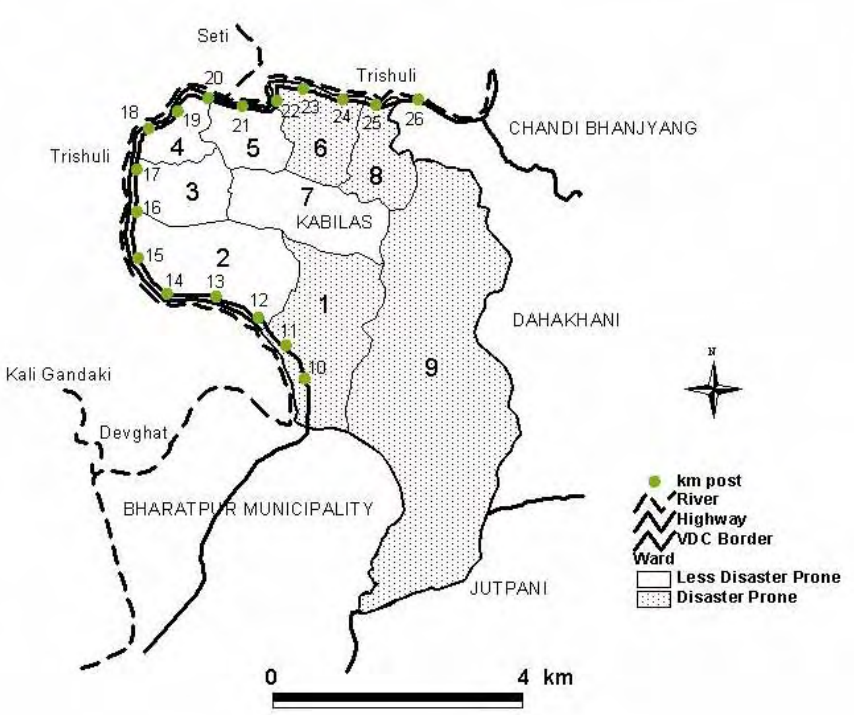
PIROT PROJECT II: DISASTER MITIGATION ACTIVITIES IN KABILASH VILLAGE

6.1 Objective and Target Area of Pilot Project II

Table 6.1.1 shows the objectives and the target area of water-induced disaster mitigation activities in Kabilash Village, which extends to the majority of the planned route extension.

Table 6.1.1 Objective and Target Area of Disaster Mitigation Activities in Kabilash Village

Item	Description
Objective	(1) Reduce water-induced disaster risk of inhabitants area, agricultural land, forest by villagers with appropriate activities (Some of the activities also affect the risk reduction of road slope disasters). (2) Avoid human lives lost by Early Warning/ Evacuation System using rain gauges.
Target Area	whole area of the operational district in Kabilash Village is divided into nine wards.



6.2 Items of Pilot Project II

This pilot project consists of five relevant units as follows:

1) Hazard mapping
2) Disaster education
3) Early Warning/ Evacuation System
4) Simple structural measures
5) Forestation planning and countermeasure planning

The disaster mitigation organization in Kabilash Village was formulated before the implementation of the pilot project. After the evaluation of the pilot project, the Team recommends and proposes continuous implementation and application of community-based disaster management to other communities. Table 6.2.1 shows work stages and inputs for the pilot project.

Table 6.2.1 Work Stage and Inputs for the Water-Induced Disaster Management in Kabilash Village

Item	Description
Item and work stage	**【First Stage】 Mid-May to late-May 2008** - Formulation of disaster management organization which based on village development committee (VDC) in Kabilash Village. Recruitment of execution participant of simple slope protection works. **【Second stage】 From early-June 2008** - Formulation of hazard map. - Preparation of educational materials for disaster management for inhabitants and students of the Kabilash school (regarding 'improvement of inappropriate land & water usage for water-induced disaster occurrence, introduction of effectiveness of simple slope protection works and vegetation for slope disaster prevention, relationship between slope disaster risk and rainfall, etc.). - Installation of raingauge in a village clinic and formulating of Early Warning/ Evacuation System. - Simple slope protection works including mulberry planting at crossing stream of CH 11km+500m of N-M highway (restoration of surface soil erosion and reducing of incidence of slope failure by strengthening effect of mulberry roots, utilizing of mulberry leaves as feeding for livestock). - Planning of forestation which also affects to slope disaster prevention. **【Third stage】 From late-June** (by disaster management organization) - Operation of Early Warning/ Evacuation System. - Maintenance of simple slope protection works and mulberry planting **【Forth stage】 Mid-Nov to late-Nov 2008** - Evaluation of community based activities for disaster prevention - Recommendation/proposal for continuous implementation and spreading to the other communities of community-based disaster management
Inputs	- Raingauge, computer, CDMA phone - Text (Nepalese, using many drawing & figures) - Materials, hacks, and tools for simple structural countermeasure works - Mulberry nursery
Other	- Partnership with NPO Shaplaneer

6.3 Organization of Pilot Project II

Disaster management activities are implemented by inhabitant's disaster management organization formulated under the village development committee (VDC) in Kabilash Village.

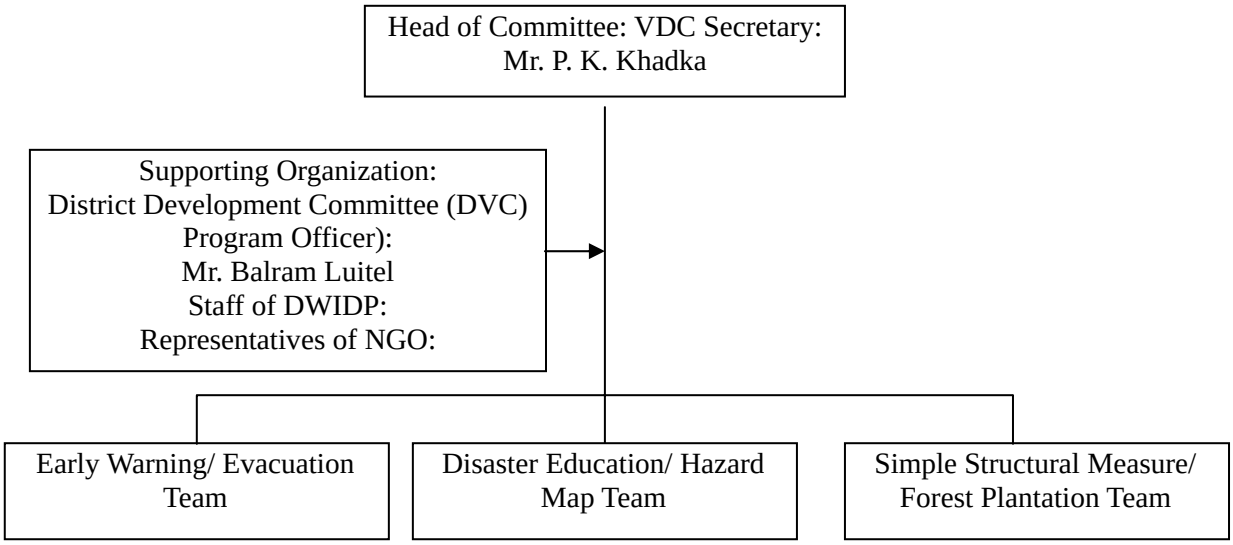


Figure 6.3.1 Disaster Mitigation Organization in Kabilash Village

VDC secretary will head the committee. The following three teams would be formulated by ward representative etc. Table 6.3.1 to Table 6.3.3 show each team member.

1) Early Warning/ Evacuation Team: The team administrates formulation and operation of the Early Warning/ Evacuation System. The team will be composed staffs from clinics, ward representatives, school teachers, etc.
2) Disaster Education/ Hazard Map Team: The team administrates hazard mapping and its revision (including the one intended for educational use), disaster education for school students and inhabitants in the village. The team will be composed of ward representatives, school teachers, etc. The team will also collaborate with NPO Shaplaneer.
3) Simple Structural Measures/ Forest Plantation Team: The team administrates simple slope protection works and planning for slope forestation in the village. The team will be composed of selected persons from wards and other volunteers. The team will also collaborate with NPO Shaplaneer.

Table 6.3.1 Member of Early Warning/ Evacuation Team

	Name	Ward No.	Telephone Number	Remarks
1	Bhov Bahadur Gurung	1	9845082063	Teacher
2	Shree Prasad Gurung	1	9845063322	Teacher
3	Tek Bahadur Gurung	9	9845063441	
4	Bikash Gurung	1	9845154694	
5	Krishna Bahadur Ghale	1	9845046160	
6	Padmapani Poudel	1	9845067346	
7	Krishna Maya Gurung	1		
8	Bhakta Bahadur Gurung	1	9806852018	
9	Sukman Tamang	9	9845088994	
10	Bhata Bahadur Baral	1		
11	Ganesh Lamichhane	1		
12	Santosh Shrestha	1		First Aid
13	Laxmi Lama	1		First Aid
14	Birendra Gurung	1		First Aid

Remarks: If member is school teacher/health post worker/health person, record it.

Table 6.3.2 Member of Disaster Education/ Hazard Map Team

	Name	Ward No.	Telephone Number	Remarks
1	Bhov Bahadur Gurung	1	9845082063	Teacher
2	Shree Prasad Gurung	1	9845063322	Teacher
3	Santosh Shrestha	1		
4	Eitraj Gurung	2		
5	Bishnu Sapkota	3		
6	Radhika Bhattarai	4		
7	Cheej Kumar Shrestha	5		
8	Dev Bahadur Gurung	5		
9	Kul Bahadur Gurung	6		
10	Rupa Pandey	7		
11	Purna Bahadur Gurung	8		
12	Deepak Sapkota	9		
13	Jagat Malla	9		

Remarks: Record the school name, if member is school teacher. And, if member is science teacher, sign it.

Table 6.3.3 Member of Simple Structural Measure/ Forest Plantation Team

	Name	Ward No.	Remarks
1	Tul Bahadur Gurung	2	
2	Tej Bahadur Ale Magar	2	
3	Sitaram Bhattarai	2	
4	Aaeta Bahadur Gurung	9	Head, Bageshori Community forest
5	Som Bahadur Gurung	1	Head, Indreni Community forest
6	Prem Bahadur Gurung	2	Head, Akaladevi Community forest
7	Chees Kumar Gurung	1	Head, New Star Club
8	Jalu Bhujel	4	Head, Bhorle Aama Shamuha
9	Top Narayan Shrestha		Head, Climate Change
			# No 4 to No 9 to be conformed

Remarks: Record the experience of construction work and so on.

6.4 Collaboration with Grassroots Activity

Water-induced disaster mitigation activities in Kabilash Village are implemented in collaboration with NPO Shaplaneer. Table 6.4.1 shows the policy proposed by the Team and a collaboration technique with grassroots activities for each relevant item.

Table 6.4.1 Collaboration Contents with Grassroots Activity

Items	JICA Study Team	Grass Roots Activity	Collaboration Contents
Hazard Mapping	- Hazard mapping by satellite image (9 Wards). - Hazard mapping by topographical map (9 Wards).	Results: - Trainings for the risk assessment. - Hazard mapping. - Selection of countermeasure sites by the hazard maps. Follow-up: - Under consideration.	- Inspection of the hazard map by community, comparing the one by the Team. - Transfer of the technique to RRN. - Revision regularly of the hazard map (inspection before/ after rainy season).
Disaster Education	- Preparation of instruction materials. - Education to leader. - Education to students and villagers (7 schools/ 175 students, 9 Wards/ 429 villagers).	Results: - Speech competition at school in February and June. - Training at school by RRN staff. Follow-up: - Continuously execution of speech competition. - Utilization of the instruction materials by the Team.	- Education in Kabilash Village with instruction materials prepared by the Team. - Implementation of the education before rainy season every year. - Utilization of the leaders who were trained during the Study - Coordination by DWIDP.
Early Warning/ Evacuation System	- Formulating of Early Warning/ Evacuation Team. - Establishment of Early Warning/ Evacuation System. - Implementation of evacuation drill. - Operation of the system.	Results: - Formulation of committee for community disaster prevention. - Under preparation of action plans by the committee. Follow-up: - Formulation of information network on warning for the committee members.	- Collaboration between the disaster information system by the Team and the committee by grass roots. - Strengthening the transmission of information on the system. - Implementation of training drill. - Assistance for Chitwan District Disaster Management Preparedness Committee.
Simple Structural Measures	- Implementation of simple structure measure at CH 11km+500m on N-M highway. - Selection of structural measures points, and estimation of the cost.	Results: - 26 gabions were installed with hazard map by RRN staffs. Follow-up: - Under consideration.	- Inspection of the wickers - Technical evaluation of the gabions. - Operation of structural measure in the list prepared by the Team
Forestation Planning and Countermeasure Planning	- Formulation of forestation plan which is reforestation for places slash-and-burn by RRN and Simple Structural Measure/ Forest Plantation Team	Results: - Around 2000 trees were planted. - Establishment of community nursery Follow-up: - Continuously implementation - Under consideration for the diversity of the tree	- Implementation of the plantation on the site the Team selected. - Technical transfer trough the selection of the site.

6.5 Implementation of Pilot Project II

6.5.1 Hazard Mapping

The following two types of hazard map for nine wards was made based on collaboration between the Team and Disaster Education/ Hazard Map Team of Kabilash VDC, with cooperation from NPO Shaplaneer and NGO Rural Reconstruction Nepal (hereinafter described as RRN), which is conducting the "Disaster Preparedness and Sustainable Livelihood Development Project" in Kabilash Village.

A) Hazard maps based on satellite images

B) Hazard maps based on 1/25,000 topographic maps

Information on hazard maps was introduced along with the specifications in Table 6.5.1.

Table 6.5.1 Specification of the Hazard Map

Items	Description
Objective Ward	All wards of Kabilash Village
Description items of the hazard map	- Historical Disaster Situation: location, date/ time, causality, damaged situation, primary/ induced cause etc. - Hazard: potential disaster due to toe-cutting/ seepage/ streams/ roads/ fallen tree etc. - Risky buildings under heavy rains: dowelling houses, tool shed, animals shed etc. - Adverse affect slopes: inappropriate land use area (ex. slash-and-burn field, deforestation area), inappropriate water use (ex. great amount leakage irrigation), etc. - Expected forestation area: possible forestation area (ex. Community forest[1], Leased hold forest[2]). (Corroboration with NPO Shaplaneer) - Evacuation site/ route: Main evacuation route, evacuation site
Consideration	If one map with many descriptive items appears complicated, thematically separated maps would be made.
Updating of hazard map	Hazard map will be updated every few years depending on disaster occurrence or situation change. The Disaster Education/ Hazard Map Team should be in charge of the updating of the hazard map. The system formulation and education for hazard map updating would be conducted in the pilot project.

[1] Community forest: Resident's common forest.

[2] Leased hold forest: Forest where national forest has been loaned as resident's common forest for a certain period.

Examples of hazard maps are shown in Figure 6.5.1 and 6.5.2 (Refer to Volume III: Hazard Map). These hazard maps can be utilized for disaster management for water induced disasters and disaster education.

Figure 6.5.1 Kabilash Village Hazard Map (Satellite Image Base) Ward No.1

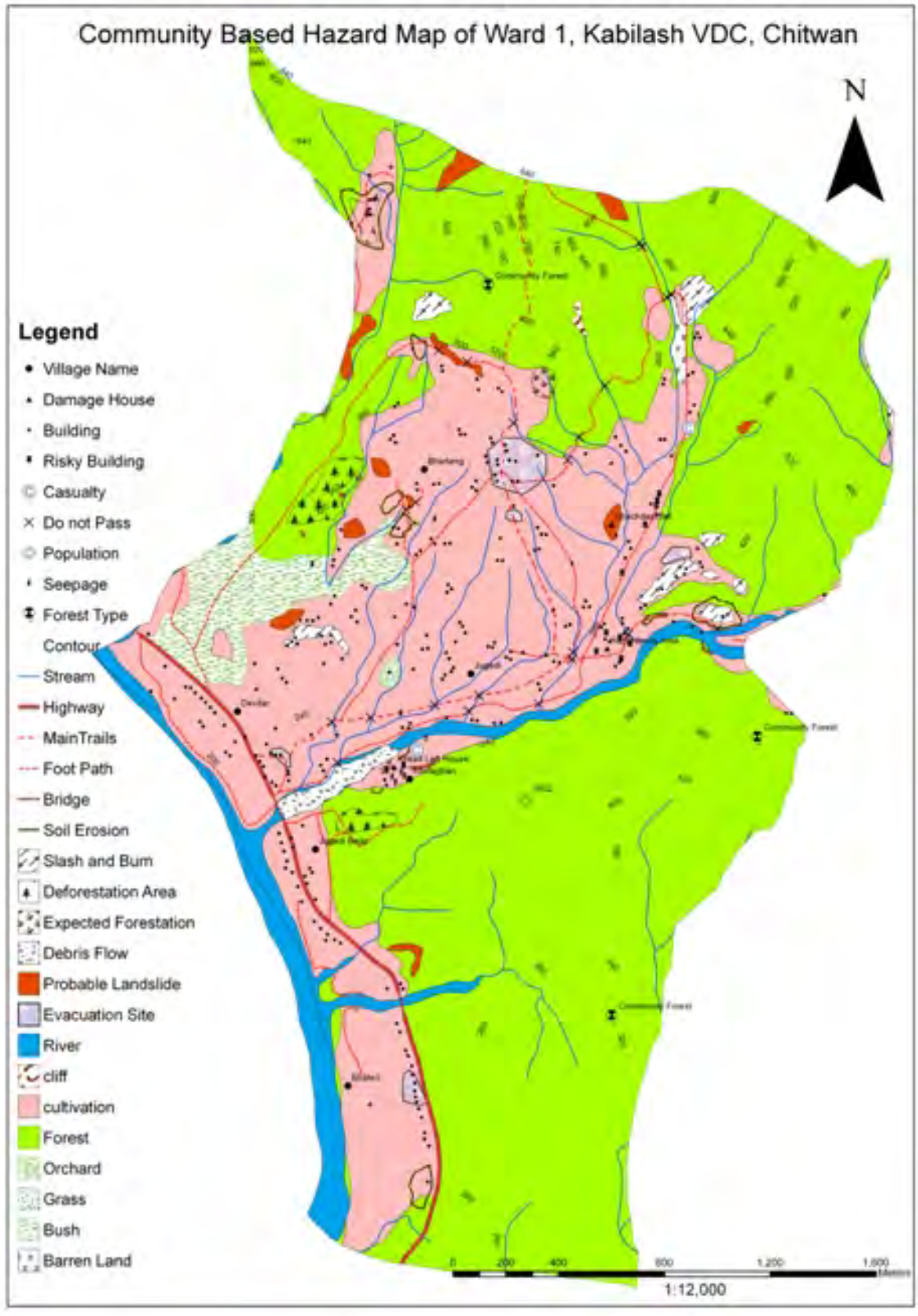


Figure 6.5.2 Kabilash Village Hazard Map (Topographic Map Base) Ward No.1

6.5.2 Disaster Education

(1) Preparation of Education Material

For education on disasters, the following materials (text book) were prepared:

A) Text book for leaders

B) Text book for students

C) Text book for villagers

In the text book for leaders, scientific knowledge and knowledge on actual disaster management are described in Table 6.5.2.

Table 6.5.2 Major Content of Education Material

Chapter: Title	Description Content
1: Introduction	General Method of Disaster Management/Importance of Disaster Management by Village/Purpose of Education on Disaster
2: Basic Knowledge for Water-induced Disaster	Topography and Geology of Kabilash Village and its Vicinity /Sediment-related Types of Disaster along N-M Highway and its Vicinity/Climate of Chitwan District/Rainfall and disaster in Chitwan district/Land, Water use in Nepal
3: Preventive Measures for Sediment-related Disasters in Kabilash Village	Simple preventive measures applicable for Kabilash Village
4: Hazard Map in Kabilash Village	Method of Hazard Mapping/Base Map/ Type of Dangerous Disasters in Kabilash Village
5: Early Warning and Evacuation	Warning Sign from Nature/ Early Warning and Evacuation System in Kabilash Village
Appendix	Hazard map of nine wards

Text book for students and villagers are re-edited based on the text book prepared for leaders. (Refer to Volume III Data and Drawing: Education Material and Volume V: Textbook of Disaster Education)

(2) Implementation of Disaster Education

Education on disasters was carried out for leaders of the village at first, in 27th August 2008. And, considering comments and requirements on disaster education material and methodology by leaders, education for students and villagers were planned and executed.

(a) Disaster Education for Leaders

Education on disasters intended for leaders was carried out in 27th August 2008 at the Meeting Hall of Kabilash village.

Participants were forty-four (44) persons; thirteen (13) school teachers, eleven (11) representative of wards, three (3) VDC staffs including VDC secretary, three (3) engineers

and one (1) translator of DWIDP, six (6) staffs of NGO RRN and five (4) staffs of the Study Team including team leader (Refer to Volume III Data and Drawing: Education, Participant List of Disaster Education for Leaders). Figure 6.5.3 shows the photos of the lecture for leaders.

Figure 6.5.3 Disaster Education for Leaders

The lecture was carried out based on the education material mentioned above and education program is shown in Table 6.5.3.

Table 6.5.3 Program of Disaster Education for Leaders

Lecture	Lecture Item	Lecturer
1. Introduction	General method of disaster management/ Importance of disaster management by village/ Purpose of disaster education	Mr.Masatoshi Eto (The Study Team)
2. Basic Knowledge-1: Geology and topography	Topography and geology of Kabilash Village and its vicinity area/ Sediment-related disaster types along N-M Highway and its vicinity area	Dr. Ramesh M.Tuladar (DWIDP)
3. Basic Knowledge-2: Climate related with Disaster	Climate of Chitwan district/ Rainfall and disaster in Chitwan district/ Land, wateruse of Nepal/ Threshold of early warning	Mr. Ralendra Sharma (DWIDP)
4. Simple Countermeasures for Disaster Prevention	Simple countermeasures for sediment-related disasters applicable in Kabilash Village	Mr. Nutan Dev Pokharel (RRN)
5. Hazard Map	Method of hazard mapping/ Base map/ Method of hazard mapping/ Dangerous place in Kabilash Village	Mr. Sujan Raj Adhikari (The Study Team)
6: Early Warning and Evacuation	Warning sign from nature/ Early Warning and Evacuation System in Kabilash Village	Dr. Hiroyuki Ohno (The Study Team)

After lecture on disaster education, operation method of computer system was instructed. And, site excursion for the site where simple counter measure to protect slope collapse next day in 28th August 2008.

(b) Disaster Education for Students and Villagers

Considering comments and requirements of participants for leader's education mentioned above, text book for students and villagers were edited including related contents. Corresponding syllabus to be implemented was planned as shown in the table.

- Content for students: Introduction/ Topography and geology in Nepal/ Sediment-related disaster types along N-M Highway and its vicinity area/ Rainfall related to sediment disaster/ Map reading/ Hazard map /Early Warning and Evacuation System in Kabilash Village/ Appendix: hazard map of Kabilash Village
- Contents for villagers: Introduction/ Map reading/ Hazard map/ Early Warning and Evacuation System in Kabilash Village

Table 6.5.4 Syllabus of Disaster Education for Students (1 Day Study)

No.	Subject
1	Topography and Geology in Nepal (30 minutes)
2	Sediment-related Disaster Types along N-M Highway and its Vicinity Area (30 minutes)
3	Rainfall Related to Sediment Disaster (30 minutes)
4	Map Reading: Topographic Map & Satellite Image (30 minutes)
5	Hazard Map (30 minutes)
6	Early Warning and Evacuation System in Kabilash Village (40 minutes)
7	Site Visit/ Explanation of Early Warning and Evacuation System: Critical Sites and Forestation/ Countermeasure Site/ Explanation of Computer System/ Raingauge (60 minutes)
8	General Knowledge: Quiz Contest (30 minutes)

Table 6.5.5 Syllabus of Disaster Education for Villagers (Half Day Study)

No.	Subject
1	Map Reading: Topographic Map (30 minutes)
2	Hazard Map: Where is hazardous point? (30 minutes)
3	Early Warning and Evacuation System in Kabilash Village: When we evacuate? (45 minutes)
4	Site Visit: Critical Sites under heavy rain (60 minutes)

Considering availability of students and villagers, disaster education for student and villagers was carried out following two phases.

- Phase I: 23rd to 26th September, 2008
- Phase II: 15th to 26th October, 2008

Outline of disaster education for students and villagers is shown in Table 6.5.6 and 6.5.7. Disaster education was carried out for total 7 schools, 175 student and 429 villagers of all wards. Instructors for education were teachers of schools, staffs of the Team, an engineer of NGO RRN and an engineer of DWIDP (refer to Volume III Data and Drawing: Disaster Education). Figure 6.5.4 and 6.5.5 show the photos of the lecture for students and villagers respectively.

Table 6.5.6 Implemented Schedule of Disaster Education for Students

Phase	School(Class)	Date	Participant	Instructor
I	Kabilash Higher Secndary School (5)	9/23	78	Teacher of schools, two staffs of the Team, one engineer of RRN and one engineer of DWIDP
I	Primarily School Lamagau, Ward 8 (4,5)	9/24	16	
I	Primarily School Chauki, Ward 7 (4,5)	9/25	12	
I	Primarily School Dhodeni, Ward 9 (4,5)	9/26	17	
II	Primarily School Bhorle, Ward 4 (4,5)	10/15	15	
II	Primarily School Syauli, Ward 2 (4,5)	10/15	21	
II	Primarily School Kamalpur, Ward 3 (4,5)	10/19	16	

Table 6.5.7 Implemented Schedule of Disaster Education for Villagers

Phase	Place/Ward	Date	No	Instructor
I	Khola Ghari, Ward 1,9	9/27	28	Two staffs of the Team, one engineer of RRN and one engineer of DWIDP
II	Bhorle, Ward 4	10/15	20	
II	Shauli, Ward 2	10/16	26	
II	Road Side 17km, Ward 3	10/17	8	
II	Road Side 21km+500, Ward 5&6	10/17	17	
II	Tnadarang, Ward 2	10/17	28	
II	Road Side Khare and Das Khola, 1&2	10/18	40	
II	Kamalpur, Ward 3	10/19	38	
II	Ratomate and Kipot, Ward 5	10/20	35	
II	Dumure Gaun, Ward 6	10/21	19	
II	Dumre Besi, Ward 6	10/21	11	
II	Road Side Simaltal Ward 6 & 8	10/22	25	
II	Bangesal & Lamagaun Ward 8	10/22	30	
II	Dhodeni, Ward 9	10/23	39	
II	Chaiki, Ward 7	1024	21	
II	Isti Khola Ward 1	10/25	11	
II	Biretar & Kusumtar	10/26	33	

Figure 6.5.4 Disaster Education for Students

Figure 6.5.5 Disaster Education for Villagers

6.5.3 Early Warning/ Evacuation System

(1) Installation of Early Warning/ Evacuation System

Automatic recording raingauge and manual (non-automatic recording) raingauge were installed. Early Warning/ Evacuation System was formulated for actual operation. In addition, operation drill was carried out. Figure 6.5.6 shows the schematic diagram of the Early Warning/ Evacuation System.

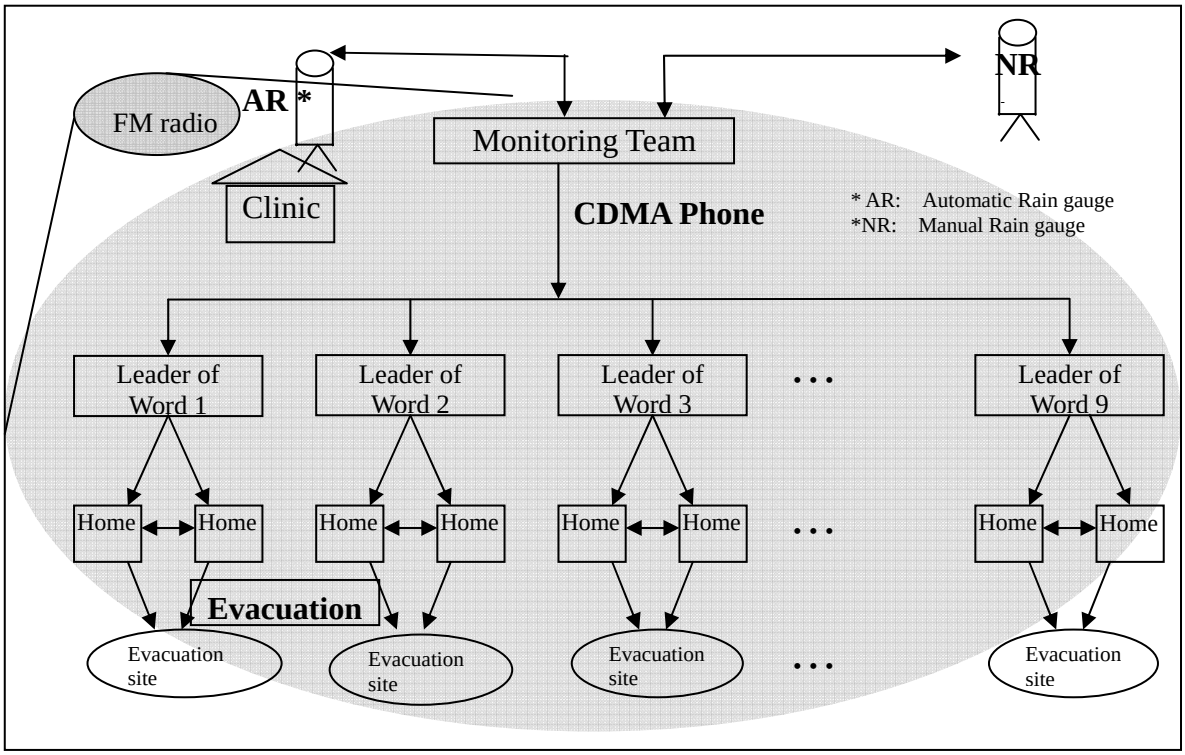


Figure 6.5.6 System of Information Transmission under Heavy Rainfall in Kabilash Village

The system is continuously operated until this project ends. The automatic recording rain gauge was set up in the health post in Kabilash Village, while the computer was set up in its VDC office. Figure 6.5.7 shows the installation situation of the automatic recording rain gauge and the computer. The Early Warning/ Evacuation Team of the resident disaster prevention organization was tasked to manage it.

In addition to the oral transition of the information to the villagers by the Early Warning/ Evacuation Team, the Kakika FM broadcast the disaster information in the area. The villagers can get the information for Early Warning/ Evacuation with the radio news.

Figure 6.5.7 Rain Gauge (Left) and Computer System (Right) in Kabilash Village

Table 6.5.8 Threshold of Early Warning by Modified Rainfall Amount (Draft)

Warning level	Threshold of rainfall	Action
Level 1	12 hour half-value rainfall amount = 60mm (1 year return period)	Set into preparation - Announce to ward representatives - Check/ upload to web-page of modified rainfall amount every one hour
Level 2	12 hour half-value rainfall amount = 80mm (2 year return period)	Caution Notice - Recommendation of preparation for evacuation
Level 3	12 hour half-value rainfall amount = 140mm (5 year return period)	Warning Notice - Recommendation of evacuation

Table 6.5.9 shows the role of everybody of the Early Warning/ Evacuation System. Table 6.5.10 shows the action flow of the system under the heavy rainfall.

Table 6.5.9 Participants' Role on Early Warning / Evacuation System (Draft)

Prticipants	Role
(1) Kabilash VDC Secretary	✓ Declare recommendation of preparation for evacuation (at reaching Level2) and release ✓ Declare recommendation of evacuation (at reaching Level3) and release
(2) Kabilash VDC Assistant Secretary	✓ Act as VDC Secretary (when VDC Secretary cannot play his role)
(3) Kabilash VDC Early Warning/ Evacuation Team	✓ Check rain gauge (everyday) ✓ Report to VDC Secretary about rainfall information
(4) Kabilash VDC Staffs	✓ Gather at the VDC office (at reaching Level1) ✓ Check rain gauge with Early Warning/ Evacuation Team (after reaching Level1) ✓ Inform Caution Notice/ Warning Notice to each Ward Representatives, PO and DRO
(5) Ward Representatives	✓ Inform Caution Notice/ Warning Notice to villagers ✓ Grasp the situation of evacuation
(6) Villagers	✓ Inform Caution Notice/ Warning Notice to neighborhood ✓ Evacuation

Table 6.5.10 Action Flow of the System under the Heavy Rainfall (Draft)

Level	Action of each players
Before Level 1	■Kabilash VDC Early Warning / Evacuation Team 【at non-rainfall】 ✓ Check rain gauge (only Automatic recording rain gauge) once /day (8:00) (by shift operation) 【at rainfall】 ✓ Check Automatic recording rain gauge 4 times /day (8:00 / 12:00 / 16:00 / 20:00) and Manual rain gauge once /day (8:00) (by shift operation)
Level 1 Set into preparation	■Kabilash VDC Early Warning / Evacuation Team ✓ Report to VDC Secretary about rainfall information ✓ Check Automatic recording rain gauge every hour and Manual rain gauge once /day (8:00) (by shift operation) ■Kabilash VDC Staffs ✓ Gather at the VDC office VDC (a partial staffs) ✓ Inform to PO & DRO to reach Level1 (by CDMA phone) ✓ Check Automatic recording rain gauge every hour and Manual rain gauge once /day (8:00) with Early Warning / Evacuation Team (by shift operation) ✓ Prepare for information of recommendation of preparation for evacuation
Level 2 Caution Notice	■Kabilash VDC Early Warning / Evacuation Team ✓ Report to VDC Secretary about rainfall information ✓ Continuously, check Automatic recording rain gauge every hour and Manual rain gauge once /day (8:00) (by shift operation) ■Kabilash VDC Staffs ✓ Gather at the VDC office VDC (all staffs) ✓ Inform to PO & DRO to reach Level2 (by CDMA phone) ✓ Check Automatic recording rain gauge every hour and Manual rain gauge once /day (8:00) with Early Warning / Evacuation Team (by shift operation) ■Kabilash VDC Secretary ✓ Declare recommendation of preparation for evacuation ■Kabilash VDC Staffs ✓ Inform recommendation of preparation for evacuation to each Ward Representatives (by CDMA phone) ■Ward Representatives ✓ Inform recommendation of preparation for evacuation to villagers in each ward (by Siren, Drum etc.) * priority to hazardous area under heavy rainfall ■Villagers ✓ Inform to neighborhood each other ✓ Prepare for evacuation
Level 3 Warning Notice	■Kabilash VDC Early Warning / Evacuation Team ✓ Report to VDC Secretary about rainfall information ✓ Continuously, check Automatic recording rain gauge every hour and Manual rain gauge once /day (8:00) (by shift operation) ■Kabilash VDC Staffs ✓ Inform to PO & DRO to reach Level3 (by CDMA phone) ✓ Check Automatic recording rain gauge every hour and Manual rain gauge once /day (8:00) with Early Warning / Evacuation Team (by shift operation) ■Kabilash VDC Secretary ✓ Declare recommendation of evacuation ■Kabilash VDC Staffs ✓ Inform recommendation of evacuation to each Ward Representatives (by CDMA phone) ■Ward Representatives ✓ Inform recommendation of evacuation to villagers in each ward (by Siren, Drum etc.) * priority to hazardous area under heavy rainfall ■Villagers ✓ Inform to neighborhood each other ✓ Start evacuation ✓ Grasp the situation of evacuation (roll-calling)

(2) Operation of Early Warning/ Evacuation System

Pilot project on the early warning/ evacuation system commenced after a joint drill conducted on 26th June, and was completed on 20th November 2008.

Rainfall monitoring by automatic/manual rain raingauges were was carried out properly without trouble as shown in Table 6.5.11 and the monitored rainfall date were uploaded to the web site as shown in Table 6.5.12.

Table 6.5.11 Staff of Kabilash VDC

Position	Name	Role	Remark
Leader	Pradhunya Khadka	Responsible for activities in Kabilash VDC	Secretary
Staff	Saraswati Adhikari	Operator for webpage information	Staff
Staff	Sukaman Tamang	Data collection for manual rainfall	Staff

Table 6.5.12 Uploading Status for Road Early Information System in Kabilash VDC

No.	Date	Name	Reason
1	2008/6/25	Saraswati Adhikari	Update of Modified rainfall amount
2	2008/6/26	Saraswati Adhikari	Update of Modified rainfall amount
3	2008/7/18	Saraswati Adhikari	Update of Modified rainfall amount
4	2008/7/23	Saraswati Adhikari	Update of Modified rainfall amount
5	2008/7/28	Saraswati Adhikari	Update of Modified rainfall amount
6	2008/8/3	Saraswati Adhikari	Update of Modified rainfall amount
7	2008/8/8	Saraswati Adhikari	Update of Modified rainfall amount
8	2008/8/14	Saraswati Adhikari	Update of Modified rainfall amount
9	2008/8/20	Saraswati Adhikari	Update of Modified rainfall amount
10	2008/8/26	Saraswati Adhikari	Update of Modified rainfall amount
11	2008/8/29	Saraswati Adhikari	Update of Modified rainfall amount
12	2008/9/5	Saraswati Adhikari	Update of Modified rainfall amount
13	2008/9/9	Saraswati Adhikari	Update of Modified rainfall amount
14	2008/9/15	Saraswati Adhikari	Update of Modified rainfall amount
15	2008/9/24	Saraswati Adhikari	Update of Modified rainfall amount
16	2008/9/26	Saraswati Adhikari	Update of Modified rainfall amount
17	2008/10/3	Saraswati Adhikari	Update of Modified rainfall amount
18	2008/10/19	Saraswati Adhikari	Update of Modified rainfall amount

(3) Weather Condition During Pilot Project Execution

The rainfall during the execution of pilot project was minimal as compared to previous records. Due to this weather condition, rainfall intensity has not reached the warning level. Figure 6.5.8 shows the dairy rainfall amount by automatic raingauge on Kabilash VDC on September 1 – October 20, 2008.

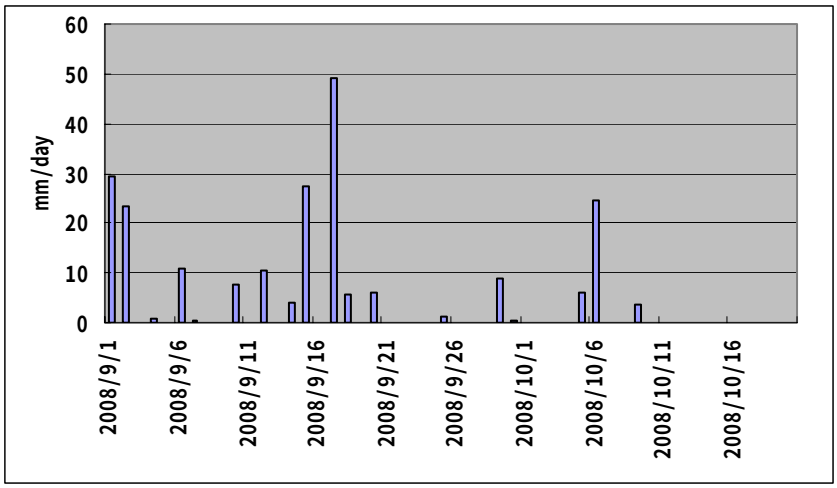


Figure 6.5.8 Daily rainfall data by Automatic Raingauge

6.5.4 Simple Structural Measures

It is preferable that villagers themselves carry out simple slope protection works including its maintenance. Therefore, Simple Structural Measure/ Forest Plantation Team should be designated for its construction in order to acquire working plan/ technology and the management method for the countermeasures. Considering this, it is realized that it is possible to perform easy repairs when maintenance is properly conducted. Figure 6.5.9 shows the outline of a simple countermeasure work at Crossing Stream of N-M Highway CH 11km+500m. Table 6.5.13 shows the required procurement material for the pilot projects.

Figure 6.5.10 shows the construction situation of a simple countermeasure work at the crossing stream of N-M Highway Chainage km 11+500m. Table 6.5.11 meanwhile shows the required procurement materials for the pilot projects.

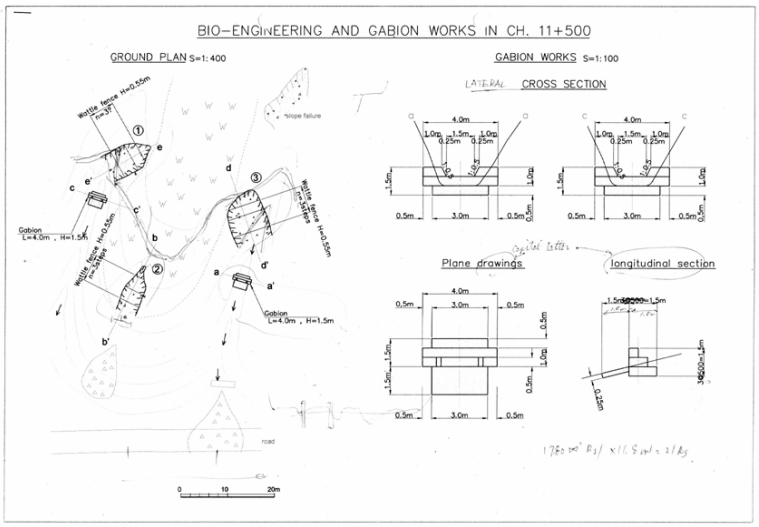


Figure 6.5.9 Simple Slope Protection Works at Crossing Stream of N-M Highway CH 11km+500m

Table 6.5.13 Required Procurement Materials for the Pilot Projects (These are included in te contract with RNGO)

Item	Description	Unit	Quantity
Shovel		nos.	10
Pickax		nos.	10
Big wooden hammer		nos.	10
Small wooden hammer		nos.	10
Gabion material	for selvaged zinc coated gabion boxes	m^2	100
Rounded wood	1.2 m length, φ 0.11 m	nos.	260
Rounded wood pile	2.0 m length, φ 0.11 m	nos.	350
Mulberry sapling		nos.	610

Working Situation of Simple Structural Measure (Wicker & Gabion work)

Wicker Work

Gabion Work

Figure 6.5.10 Construction Situation of Simple Slope Protection Work (June, 2008)

Figure 6.5.11 After Construction of Simple Slope Protection Work (August, 2008)

6.5.5 Forestation Planning and Countermeasure Planning

Forestation and simple countermeasure planning was carried out in the pilot project. But, the Study Team did not take part directly in the forestation planning. This work was carried out by cooperation of the Simple Structural Measure/ Forest Plantation Team of disaster mitigation organization in Kabilash and NGO RRN. The Team advises the joint team composed of Simple Structural Measure/ Forest Plantation Team and NGO RRN.

(1) Forestation Plan

NGO RRN and Simple Structural Measure/ Forest Plantation Team made up the following forestation plan which involves reforestation for slash-and-burn places.

- Area of reforestation: Around 25,600 tree planting planned for 55 sites in 8 wards of 27 ha for slash-and-burn places which are shown in Table 6.5.13, 6.5.14 and Figure 6.5.12.
- In addition to reforestation, the following programs are also being studied.

  A) Alternative Wood Fuel Provision Program; briquettes provision and improved stove provision.

  B) Reduction of local alcohol production

  C) Control timber fire wood selling

The Team assisted only in the preparation of tables for planning and identifying locations in hazard maps. Implementation of above plan is being studied by both NGO RRN and Simple Structural Measure/ Forest Plantation Team.

Table 6.5.14 shows list of the reforestation sites and Table 6.5.15 shows the list of the nursery sites for the reforestation. The location of the reforestation is shown Figure 6.5.12.

Table 6.5.14 List of Reforestation Site

SN	Location	Area (ha)	Trees	Nos.
1F-A	Jugedi	0.5	Sisso, bakaino, chueri	500
1F-B	Jugedi	0.5	Bakaino, sisso, sal,	500
1F-C	Jugedi	0.5	Lapsi, bamboo, chueri, nigalo, dale ghans	500
1F-D	Jugedi	0.5	Sal,sisso, bamboo, nigalo, bakaino	500
	Subtotal (3)	2.0		2,000
2F-A	Khahare Khola Gaun	0.5	Guava, chueri, bakaino, lapsi, dale ghans, bamboo, nigalo, pineapple, bayer	500
2F-B	Khahare Khola Gaun	0.5	Guava, chueri, bakaino, lapsi, dale ghans, bamboo, nigalo, pineapple, bayer	500
2F-C	Khahare Khola Gaun	0.5	Bamboo, nigalo, guava, mulberry, dale ghans	500
2F-D	Khahare Khola Gaun	0.5	Bamboo, nigalo, mulberry, badar, kapro	500
2F-E	Khahare Khola Gaun	0.5	Bamboo, nigalo, mulberry, badar, kapro	500
2F-G	Khahare Khola Gaun	0.5	Bamboo, nigalo, mulberry, badar, kapro	500
2F-H	Khahare Khola Gaun	0.5	Bamboo, nigalo, mulberry, badar, kapro	500
	Subtotal (7)	3.5		3,500
3F-A	Dui Ghare Gaun	0.5	Mango, bamboo, naspati, khayer, guava, pineapple, nigalo	500
3F-B	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-C	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-D	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-E	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-F	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-G	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-H	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-I	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
3F-J	Dui Ghare Gaun	0.5	Sal, sisso, bakaino, bamboo, nigalo, khyer	500
	Subtotal (10)	5.0		5,000
4F-A	Ghumaune Gaun	0.5	Bamboo, nigalo, chueri, naspati, daleghans, badar, bakaino, kutmero, mulberry	500
4F-B	Ghumaune Gaun	0.5	Sal, sisso, khayer, chueri, naspati, daleghans, badar, bakaino, kutmero, mulberry	500
4F-C	Ghumaune Gaun	0.5	Sal, sisso, khayer, chueri, naspati, daleghans, badar, bakaino, kutmero, mulberry	500
4F-D	Ghumaune Gaun	0.5	Sal, sisso, khayer, chueri, naspati, daleghans, badar, bakaino, kutmero, mulberry	500
4F-E	Ghumaune Gaun	0.5	Sal, sisso, khayer, chueri, naspati, daleghans, badar, bakaino, kutmero, mulberry	500
	Subtotal (5)	2.5		2,500
5F-A	Ratamate Gaun	0.5	Naspati, bayer, guava, lapsi, sisso, bakaino, bamboo, nigalo	500
5F-B	Ratamate Gaun	0.5	Naspati, bayer, guava, lapsi, sisso, bakaino, bamboo, nigalo	500
5F-C	Ratamate Gaun	0.5	Naspati, bayer, guava, lapsi, sisso, bakaino, bamboo, nigalo	500
5F-D	Ratamate Gaun	0.5	Naspati, bayer, guava, lapsi, sisso, bakaino, bamboo, nigalo	500
5F-E	Ratamate Gaun	0.5	Naspati, bayer, guava, lapsi, sisso, bakaino, bamboo, nigalo	500
	Subtotal (5)	2.5		2,500
6F-A	Dumre Gaun	0.5	Ibillibil, khayer, bakaino, bamboo, nigalo, kapra, saj, bijaysal	500
6F-B	Dumre Gaun	0.5	Ibillibil, khayer, bakaino, bamboo, nigalo, kapra, saj, bijaysal	500
6F-C	Dumre Gaun	0.5	Ibillibil, khayer, bakaino, bamboo, nigalo, kapra, saj, bijaysal	500
6F-D	Dumre Gaun	0.5	Ibillibil, khayer, bakaino, bamboo, nigalo, kapra, saj, bijaysal	500
6F-E	Dumre Besi	0.5	Naspati, kafal, guava, lapsi, chueri, bayer, amla	500
6F-F	Dumre Besi	0.5	Naspati, kafal, guava, lapsi, chueri, bayer, amla	500
6F-G	Dumre Besi	0.5	Naspati, kafal, guava, lapsi, chueri, bayer, amla	500
6F-H	Dumre Besi	0.5	Naspati, kafal, guava, lapsi, chueri, bayer, amla	500
	Subtotal (4)	4.0		4,000
7F-A	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
7F-B	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500

SN	Location	Area (ha)	Trees	Nos.
7F-C	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
7F-D	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
7F-E	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
7F-F	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
7F-G	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
7F-H	Chauki Gaun	0.5	Bakaino, sisso, bamboo, nigalo, khayer, lapsi, daleghans, naspati, mayel, amla	500
	Subtotal (8)	4.0		4,000
8F-A	Lama Gaun	0.6	Mulberry, chueri, bakaino, halabed, aru-alubakhada, naspati, bakaino, bijaysal, daleghans	600
8F-B	Lama Gaun	0.6	Mulberry, chueri, bakaino, halabed, aru-alubakhada, naspati, bakaino, bijaysal, daleghans	600
8F-C	Lama Gaun	0.6	Mulberry, chueri, bakaino, halabed, aru-alubakhada, naspati, bakaino, bijaysal, daleghans	600
8F-D	Lama Gaun	0.6	Mulberry, chueri, bakaino, halabed, aru-alubakhada, naspati, bakaino, bijaysal, daleghans	600
8F-E	Lama Gaun	0.6	Mulberry, chueri, bakaino, halabed, aru-alubakhada, naspati, bakaino, bijaysal, daleghans	600
8F-F	Lama Gaun	0.6	Mulberry, chueri, bakaino, halabed, aru-alubakhada, naspati, bakaino, bijaysal, daleghans	600
	Subtotal (6)	3.6		3,600
9F-A	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
9F-B	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
9F-C	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
9F-D	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
9F-E	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
9F-F	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
9F-G	Bhote Dhap	0.5	Bakaino, bamboo, nigalo, daleghans, pineapple, naspati, banana, amla, khayer, sisso, tanki, guava, chueri	500
	Subtotal (7)	3.5		3,500
	Total	25.6		25,600

Table 6.5.15 List of Nursery Site

SN	Location	Area (m^2)	Trees	Remarks
1N	Indremi C/F	750	Lapsi, sal, sisso, bakaino, guava, dale ghans	planning
4N	Akakl devi CF	1500	Sal, bakaino, sisso, khayer, bamboo, nigalo, dale ghans, guava, naspati, lapsi, pineapple, amla	planning
9N	Bageshwari CF	500	Bamboo, sal, sisso, khayer, nigalo, naspati, bijaysal, daleghans, saj, nibara	planning

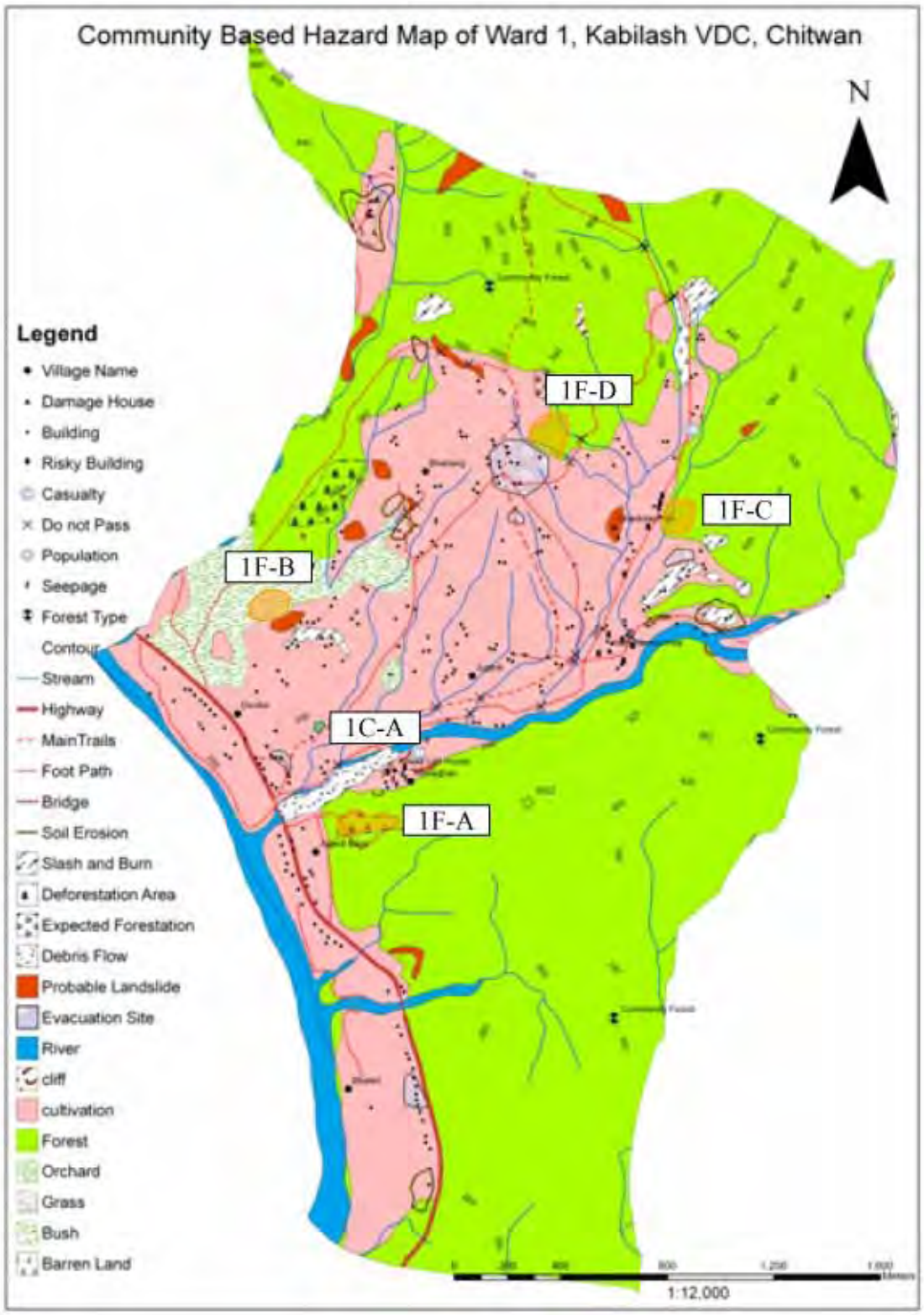


Figure 6.5.12 (1) Location Map of Reforestation site on Ward 1

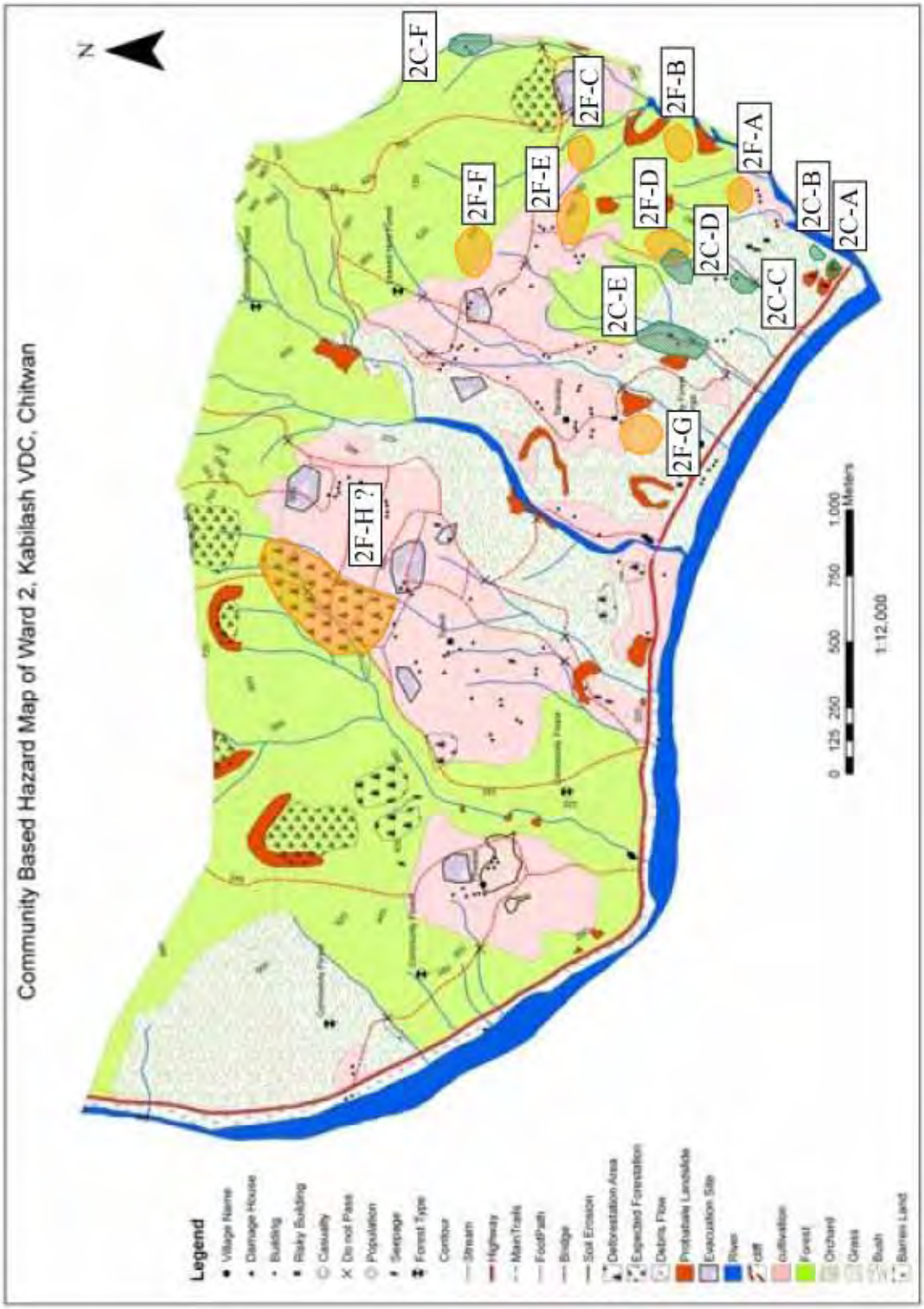


Figure 6.5.12 (2) Location Map of Reforestation site on Ward 2

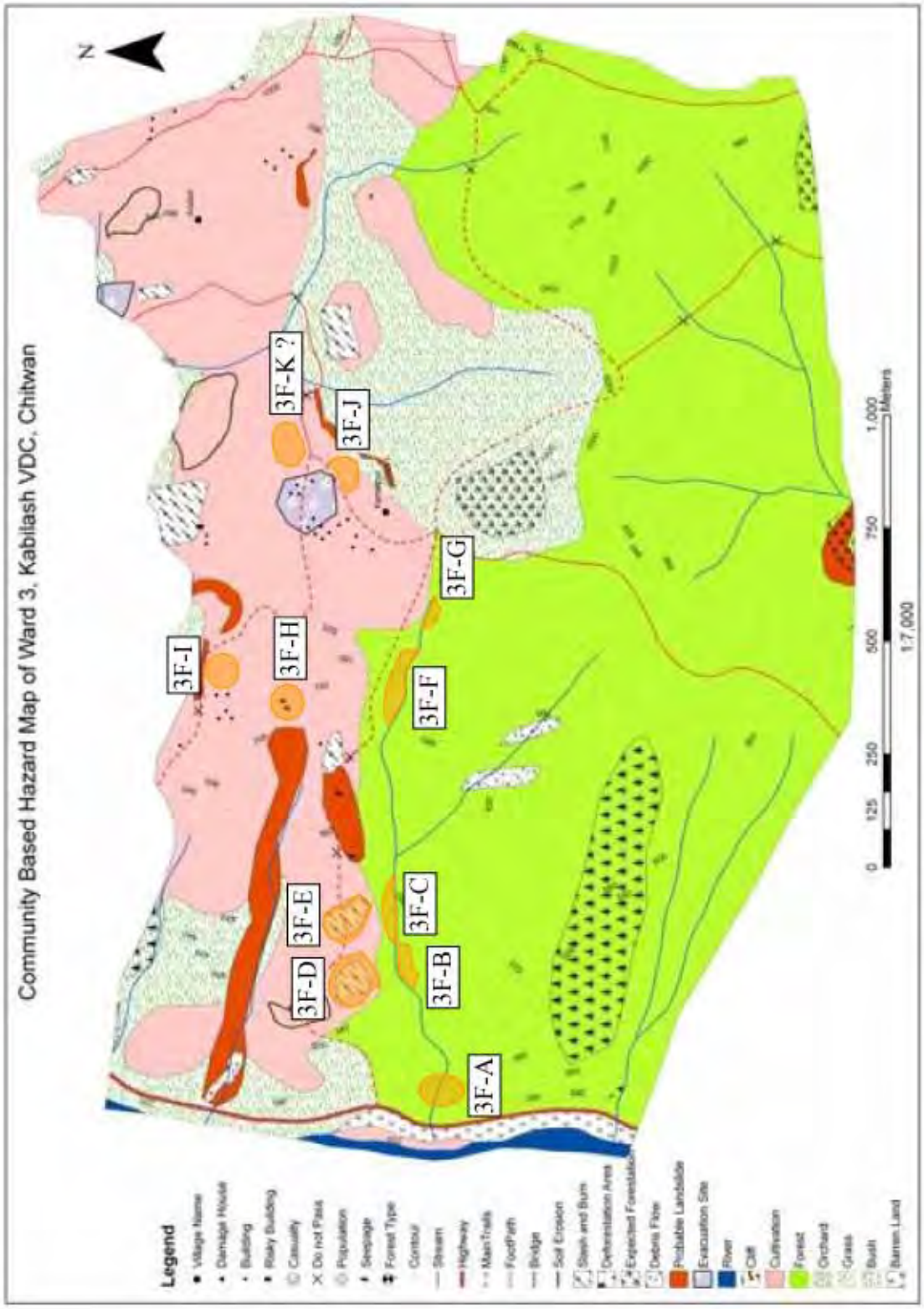


Figure 6.5.12 (3) Location Map of Reforestation site on Ward 3

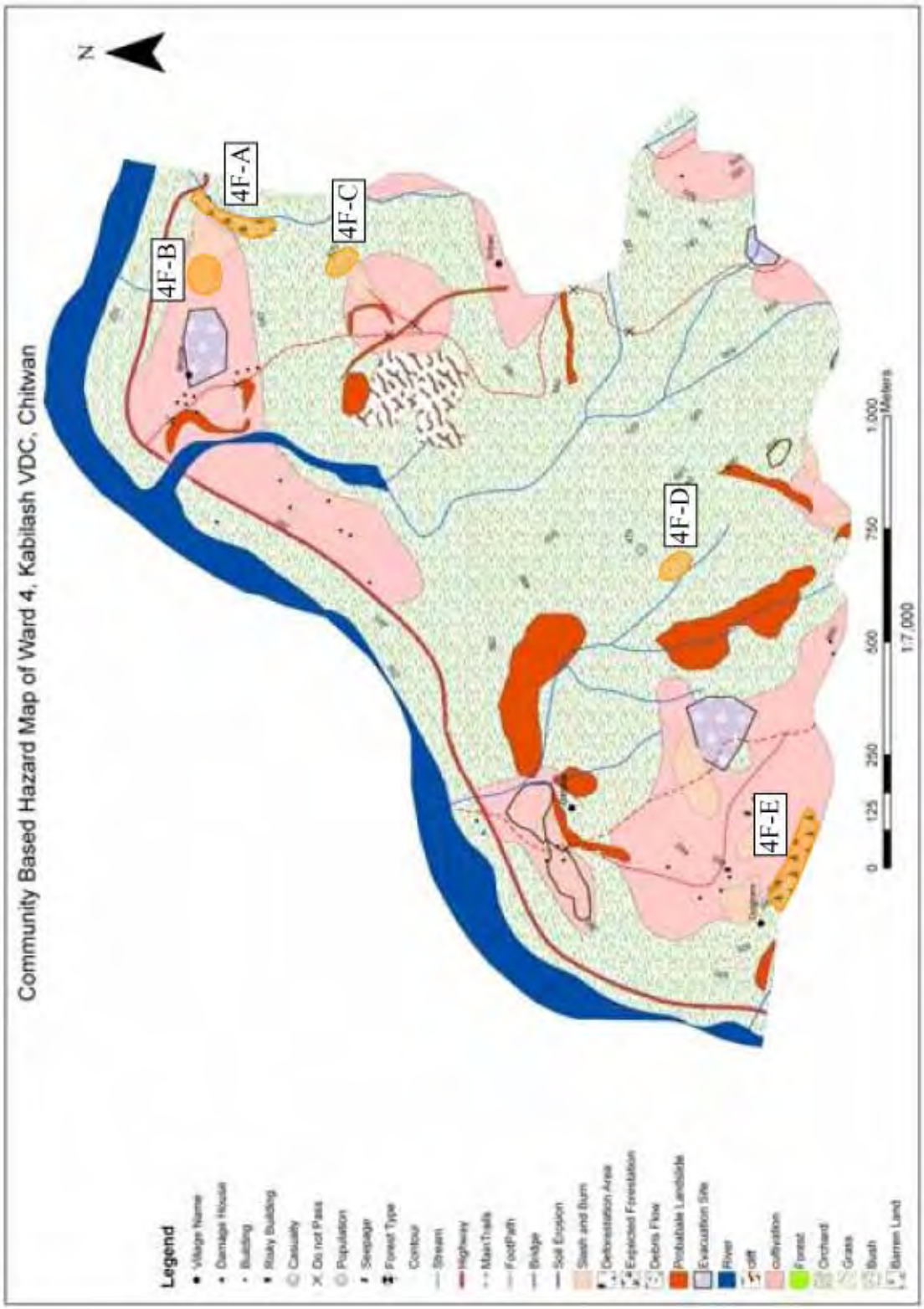


Figure 6.5.12 (4) Location Map of Reforestation site on Ward 4

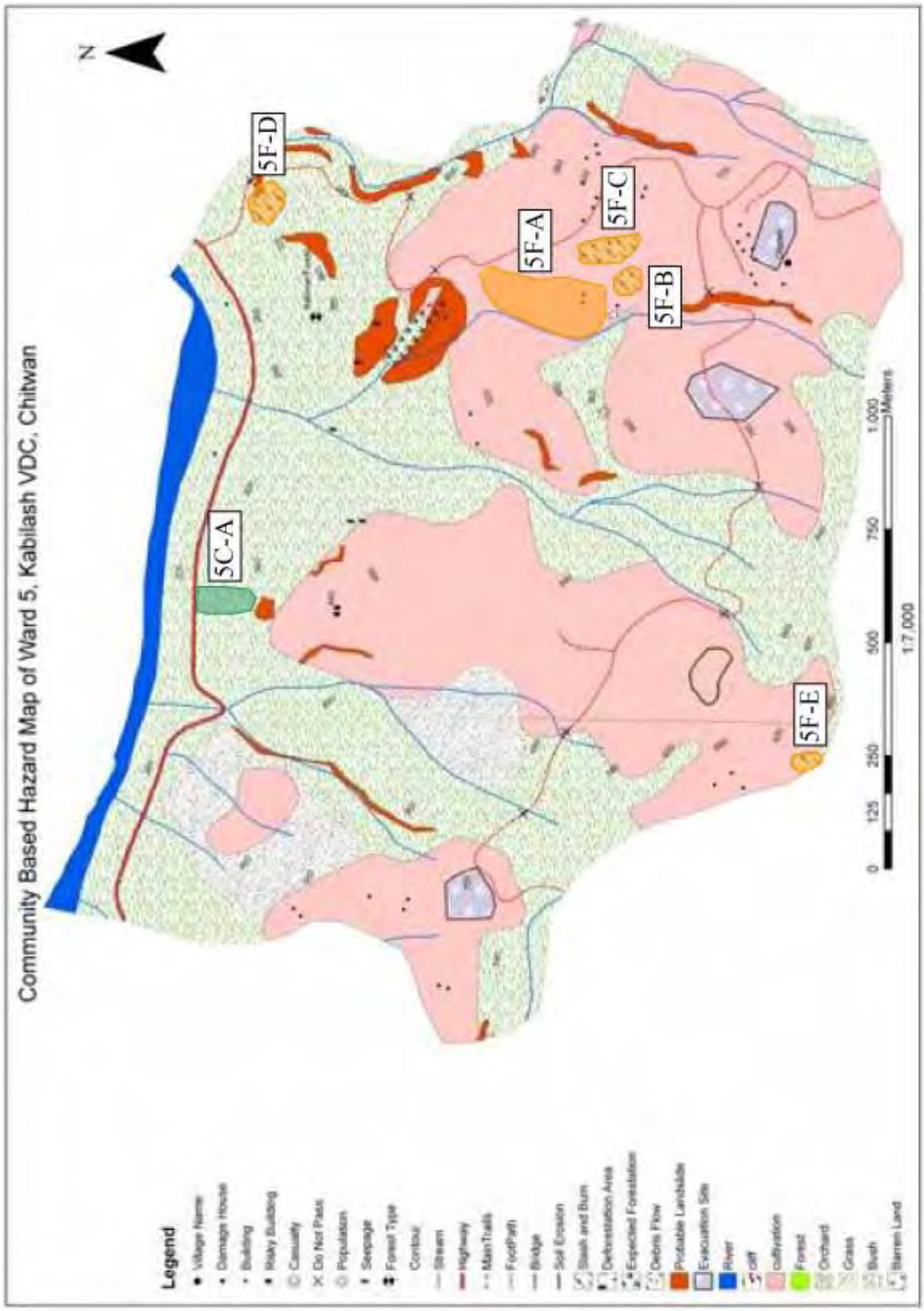


Figure 6.5.12 (5) Location Map of Reforestation site on Ward 5

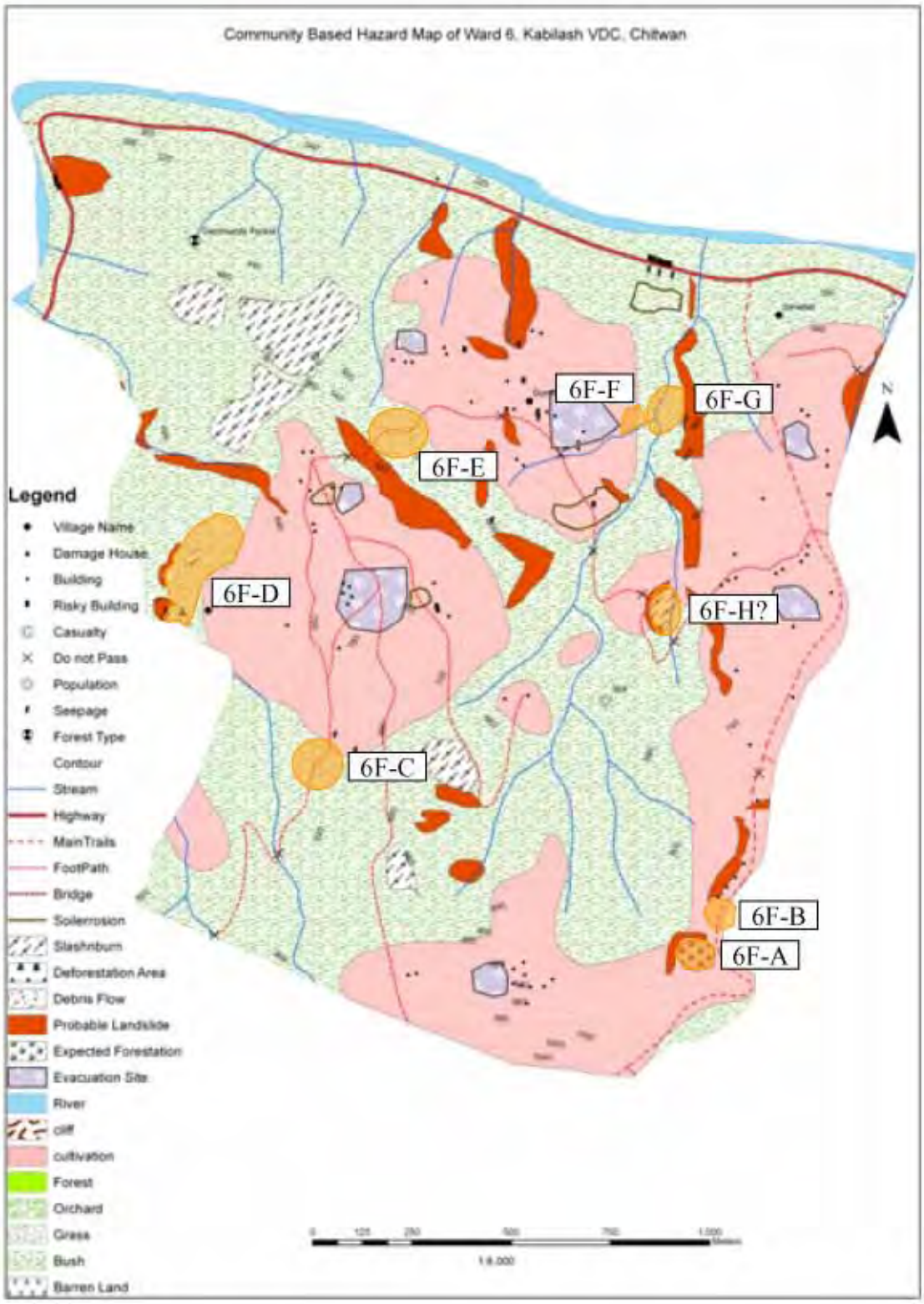


Figure 6.5.12 (6) Location Map of Reforestation site on Ward 6

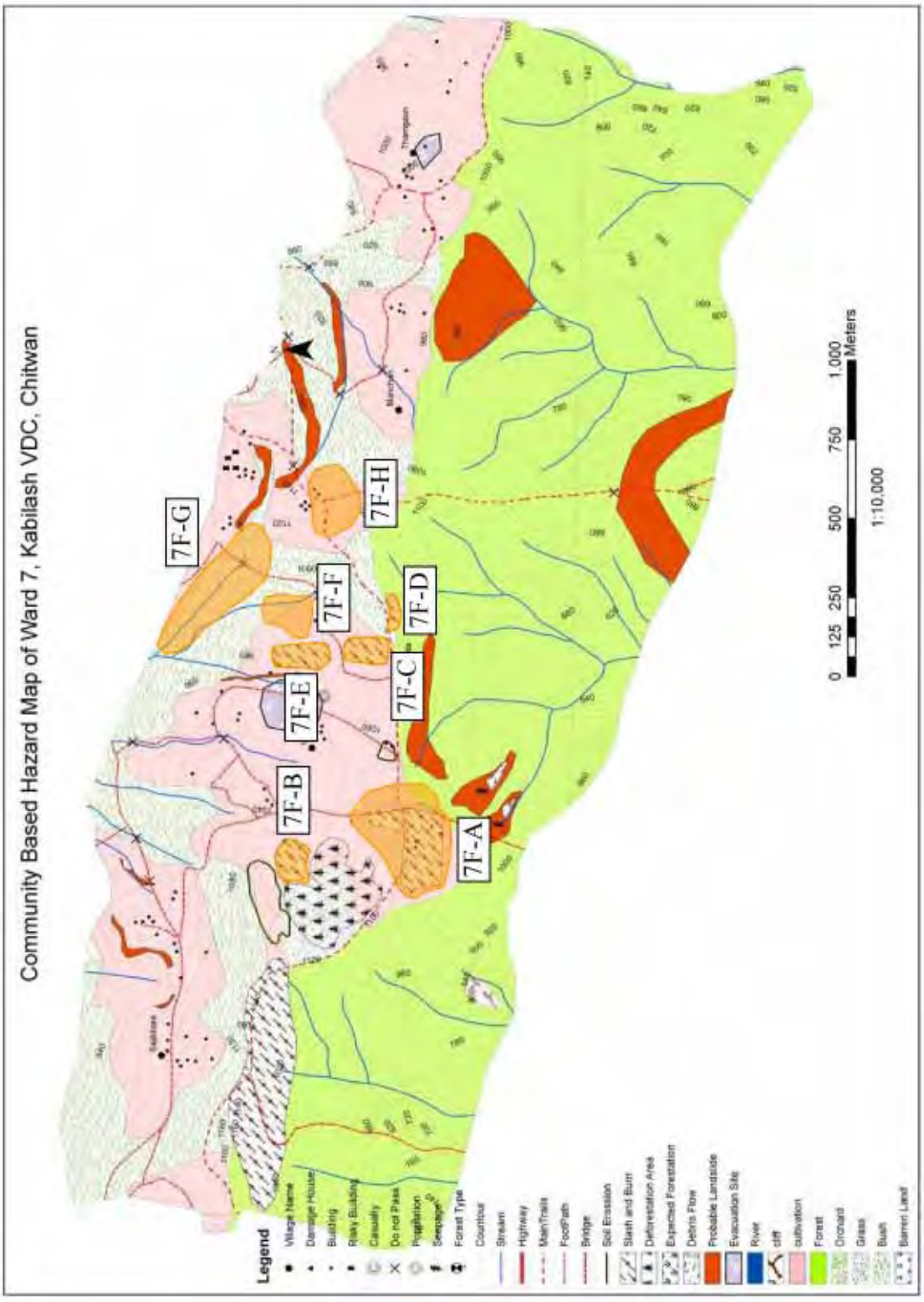


Figure 6.5.12 (7) Location Map of Reforestation site on Ward 7

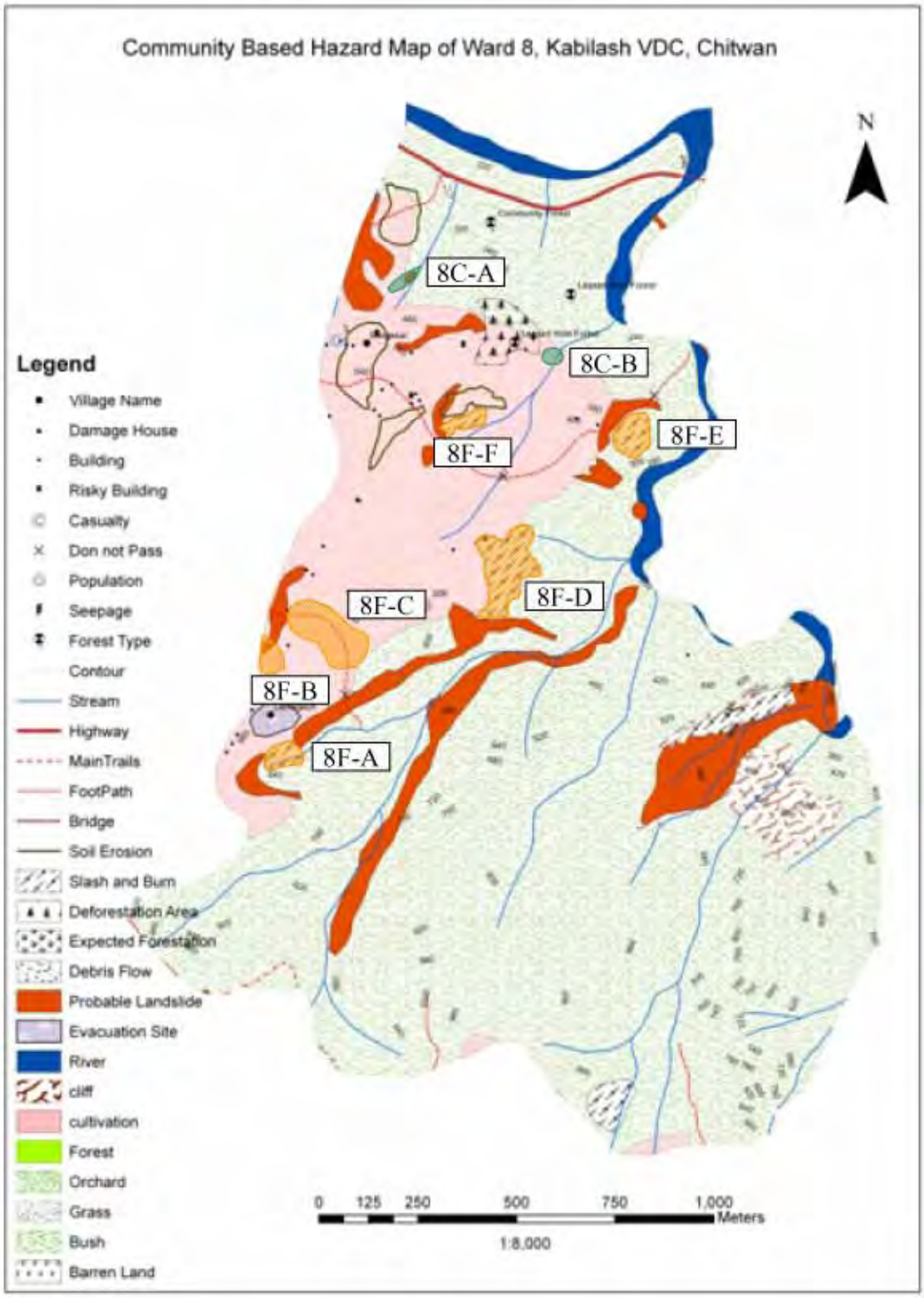


Figure 6.5.12 (8) Location Map of Reforestation site on Ward 8

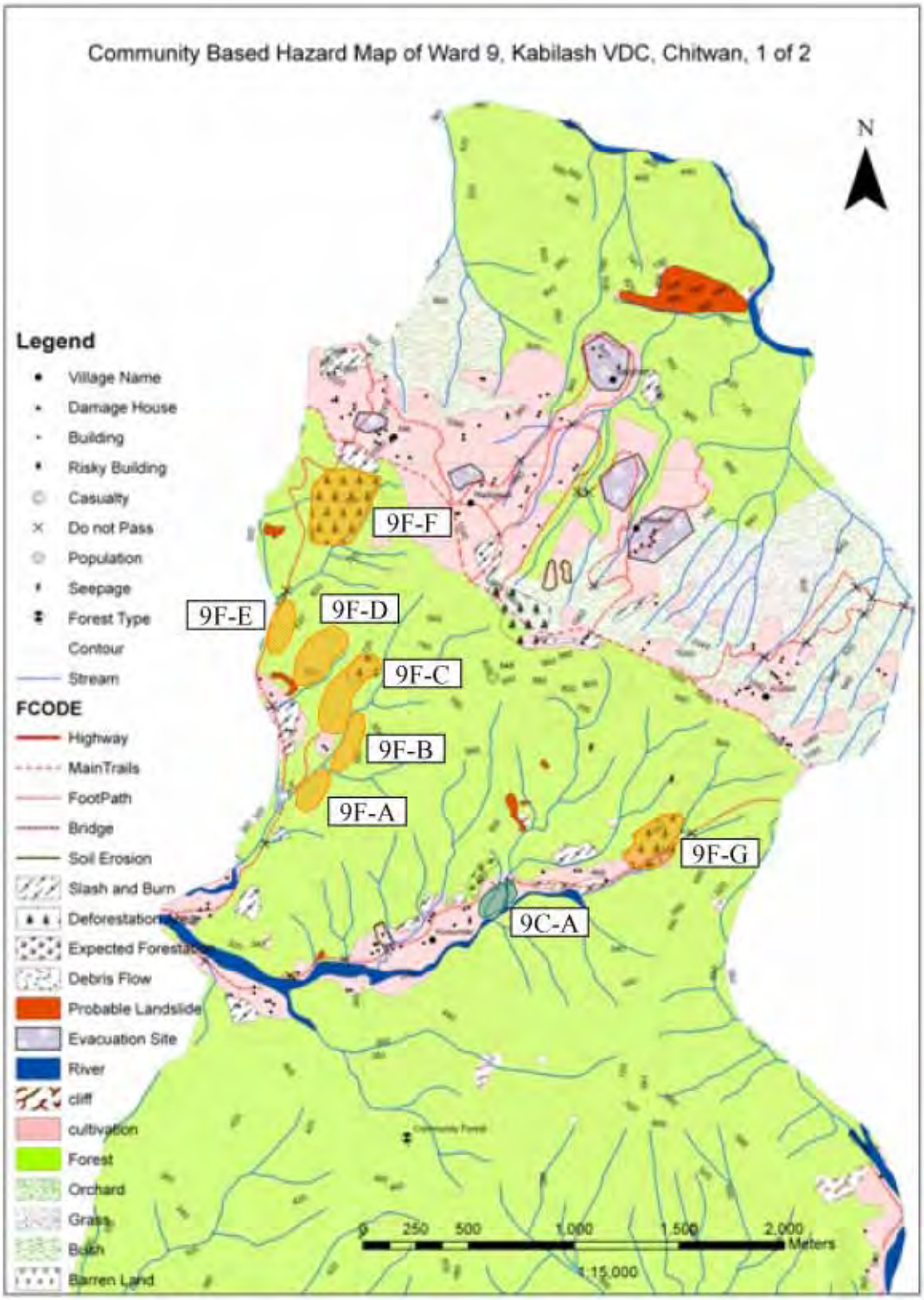


Figure 6.5.12 (9) Location Map of Reforestation site on Ward 9

(2) Simple Countermeasure Plan

Eleven sites are selected for implementing the simple countermeasure considering requirement of the village people (Table 6.5.16). Total cost of countermeasure is around 4 million Rs. The Team assists and advises on plans of countermeasures for each site.

Countermeasure work for each site can be implemented through the skills of the village people. However, more practical plan shall be elaborated considering prioritization of sites and village's availability of budget.

Table 6.5.16 List of Simple Countermeasure Implementation Site

SN	Location	Countermeasure	Qty	U/P(Rs)	Cost(Rs)	Purpose
1C-A	Devitar	➢ Vegetation with Wicker	300m	520	156,000	A, B, C
2C-A	11km +350	➢ Gabion ➢ Wicker	225m^3 150m	2,200 520	495,000 78,000 573,000	A, B, C, F
2C-B	Khare khola	➢ Sandbag ➢ Gabion ➢ Wicker	550nos. 12m^3 300m	20 2,200 520	11,000 26,400 156,000 183,500	B, A, F
2C-C	PP site-1	➢ Sandbag ➢ Wicker	200nos 110m	20 520	4,000 56,160 60,160	B
2C-D	PP site-2	➢ Sandbag ➢ Wicker	70nos. 40m	20 520	1,400 20,800 22,200	B
2C-E	PP site-3	➢ Sandbag ➢ Wicker ➢ Gabion dam ➢ Transportation	400nos. 150m 100m^3	20 520 2,200	8,000 78,000 220,000 88,000 394,000	A, B
2C-F	Patalebas-2	➢ Gabion wall	270m^3	2,200	594,000	B
5C-A	21km+200	➢ Wicker ➢ Soil netting	480m 1,200m^2	520 (1,000)	249,600 1,200,000 1,449,600	C
8C-A	24km+300	➢ Sandbag ➢ Drainage ➢ Wicker	3,000nos. 21m^3 200m	20 1,300 520	60,000 27,300 104,000 191,300	A, B, C
8C-B	25km trail	➢ Wicker ➢ Sandbag	40m 300nos.	520 20	20,800 6,000 26,800	C
9C-A	Kusumtar	➢ Gabion wall	30m^3	2,200	66,000	B, C
Total 11site					3,726,460	

Purpose; A: protection of house, B: protection of cultivated land, C: protection of road/ trail, D: reduce soil erosion, E: reduce deforestation area, F: protection of bridge

6.6 Evaluation of Pilot Project II

6.6.1 Summary of Evaluation

Summary of the evaluation is as follows.

Table 6.6.1 Summary of Evaluation for Pilot Project II: Disaster Mitigation Activities in Kabilash Village

Narrative Summary	Objectively Verifiable Indicators	Verification Methods	Evaluation Result
Overall Goal			
Reduction of resident's water induced disaster risk	ANHLLp : Potential annual number value of human lives loss (persons/year)	Interview survey for villager after installation of the Early Warning/ Evacuation System and data analysis is performed	**The system may provide 50% reduction of ANHLLp = 2.1-1.1 persons/year**
	Note: Evaluation is for Early Warning/ Evacuation System only. Because other items of pilot project II is difficult to evaluate so far.		
Project Purpose			
Improvement of slope stability level by simple structural measure	Situation of the simple structural measure site (crossing stream of km 11 +500 of N-M Highway)	Check after installation of simple structural measures	**Slope stability work on the site was successfully conducted**
Improvement of knowledge for disaster management activities	Reorganization level of the Early Warning/ Evacuation System	Record of early warning/evacuation drill	**Project activity has greatly sensitized the community people about disaster**
	Residents' understanding level of disaster education material	Record of hazard map creation/disaster education	
Strengthening of disaster risk management	Residents' understanding level for overall disaster risk management	Consideration of evaluation for the output	**Disaster risk management has been strengthened with some activities**
Output			
Hazard map	Number of participants, Understanding level of participants	Record of hazard map creation	**One-third of around 20 participants understood what is hazard map**
Material and activities related to disaster education	Number of participants, Understanding level of participants	Record of disaster education	**Half of around 600 participants understood the educational contents**
Early Warning/ Evacuation System	Understanding level of participants on the system drill	Record of warning/evacuation drill	**Almost all staffs understood the meaning of the system**
Simple structural measures	Situation of the simple structural measure site.	Site inspection, Photograph	**Slope stability work on the site was successfully conducted**

6.6.2 Evaluation of Project Output

Project output is classified into 1) Hazard map, 2) Disaster education material and education activities, 3) Early Warning/ Evacuation System, and 3) Simple structural measures,. The evaluation is conducted for each output.

(1) Hazard map

Method:

Hazard map is evaluated by the participants. Understanding level of participants for the creation of the hazard map was determined. The understanding level is judged by the lecturer since the related questionnaires have not been done for the participants.

Evaluation:

When the Team collected information for preparation of hazard maps, more than 20 villagers including a representative from ward, staff and normal villager participated in the meeting.

During this period, the Team explained to the villagers the significance and the preparation method of hazard map in order to obtain sufficient information. After explanation was carried out, one-third (approximately 33%) of the villagers were able to provide appropriate information to the Team related to making the hazard map. This means that said one-third of the participants understand the meaning of hazard map. The method of detailed preparation of hazard map would be explained to villagers that have education on disasters, as disucussed below.

(2) Material and activities related to disaster education

Method:

Education on disaster is evaluated by the participants while their understanding level is determined. The understanding level is judged by the lecturer since the corresponding questionnaires required for investigation have not been done.

Evaluation:

The session for the education on disasters for leaders include 44 participants composed of school teachers, ward representatives, VDC staffs and engineers. Meanwhile, the session for the education on disasters include a total of 7 schools, 175 students and 429 villagers from all wards.

During the lecture, there was a question-and-answer portion wherein the lecturer asked the participants about disaster-related activities including hazard mapping, to confirm their understanding level. It was judged that around half of the participants were able to answer the questions.

(3) Early Warning/ Evacuation System

Method:

The understanding level of participants on the early warning/ evacuation system is evaluated after carrying out a drill. The understanding level of participants in Kabilash Village is judged based on questionnaires handed after the conducted drill discussed in chapter "5.4.2 Evaluation of Project Output".

Evaluation:

Thirteen operation staffs, composed of secretary and representative from ward, and 70 or more villagers participated in the drill for the early warning/ evacuation system on June 2008.

Almost all the operation staffs understood the meaning of the system and its operation method. Although some villagers found difficulty in identifying the evacuation route and/or places by themselves, they managed to evacuate during the drill. The detail is described in chapter "5.4.2 Evaluation of Project Output".

(4) Simple Structural Measures

Method:

Simple slope countermeasure is evaluated through site inspection and photographed observation of the situation after construction.

Evaluation:

The countermeasure was conducted at crossing stream of N-M Highway Chainage km 11+500 on middle of June 2008. The Team has checked the structure at the site on late August and late November, 2008. Judging from the observation, the countermeasure is stable on the slope. The simple countermeasure work was successfully completed and contributed to the stability of the slopes. Stabilization was also attributed to some vegetation at site.

Figure 6.6.1 Situation of Simple Slope Protection Work (November 2008)

6.6.3 Evaluation of Project Purpose

Project purposes, which are classified into 1) Improvement of slope stability level by simple structural measure, 2) Enhancement of knowledge for disaster management activities and 3) Strengthening of disaster risk management, are evaluated based on the evaluation of project output.

(1) Improvement of slope stability level by simple structural measure

The simple countermeasure work at chainage km 11 km+500 was successfully completed and contributed to the stability of the slopes as previously mentioned. Further simple countermeasure work for slope stability was proposed as part of continuous implementation and dissemination to other communities.

This means that the slope stability level in the area has been improved by simple structural measures introuduced trough this project.

(2) Enhancement of knowledge for disaster management activities

Judging form the results of record on hazard map creation/ disaster education/ early warning and evacuation drill, the project has been able to achieve the target for enhancing knowledge for disaster management activities in the community. At the same time, it has sensitized the community to a great extent realizing their curiosity on water induced disasters during consultations with the project staff and other staff working in the GON. In this sense, the first goal of the project has been well accomplished which has opened straightforward scope for further works in the site. This is not merely realized by asking with the concerned stakeholders but also from the response of the concerned GON employees.

In general, the project activity has greatly sensitized the community on water induced disaster management. However, there are still more work to be done with regards to education on disaster. This aspect needs to be well covered in future programs.

(3) Strengthening of disaster risk management

The ability of the disaster risk management in Kabilash Village is judged based on the evaluation of the project outputs. The disaster risk management has been strengthened with the activities in this project during the implementation of the following.

- Consideration of the simple countermeasure for slope stability
- Preparation of hazard map and data collection for it
- Comprehensive disaster education

- Establishment of Early Warning/ Evacuation System
- Adequate evacuation by villagers themselves
- Effective forestation planning and countermeasure planning

As mentioned in previous session, these activities have greatly improved the community, their organizations and the related system in the village with regards to disaster risk management.

6.6.4 Evaluation of Overall Goal

(1) Overall goals and evaluation method

Evaluation of overall goals is conducted for early warning/ evacuation system only since it was still difficult to evaluate other items of the pilot project II. But hazard mapping, education on disasters and simple structural measures can already contribute to saving human lives.

Overall goals are evaluated by considering the outputs and achievement of the project purpose.

(2) Objectively verifiable indicators and evaluation results

Objectively verifiable indicator is AHLLp which relates to annual potential value of human lives loss (Rs/year).

The early warning/ evacuation system may save 50% of current AHLLp = 70,000 Rs/year. The saved percentage will further increase by continuously achieving efficient hazard mapping and disaster.

Current AHLLp is estimation by manipulation of ‘current annual potential numbers of human lives loss’ and unit value of human lives loss (UHL).

Current annual potential number of human lives lost is estimated to be 2.1 persons per year, based on 21 persons who died in the past ten years. Consequently, UHL is 674,000 Rs/person, which is determined based on ‘the number of years/days of work lost due to death, and ‘the average annual income of the person who died’.

This indicator is just based from income of the person, without considering the mentality lost of the lost persons.

CHAPTER 7

STRUCTURAL COUNTERMEASURES FOR RUWA KHOLA/MARSYANGDI HYDROPOWER PLANT

7.1 Concept and Design

7.1.1 Concept of Design

(1) Basic Concept

Plan and design of the additional countermeasures would follow the following concepts:

(a) The object to be protected is the Marsyangdi Hydropower Plant.

(b) The size or scale of the additional countermeasures is determined considering that the additional countermeasures cope with the 2003 heavy rainfall.

(c) No modification with the existing appurtenant facilities for the power plant such as its intake and access.

(d) No modification with the existing sabo dams. Hence, the existing facilities are used to maximize the capacity by improving their functions.

(e) The additional countermeasures were proposed on the downstream area because of difficulty in accessing the upstream area.

(2) Target of Additional Countermeasures

Taking account of the 2003 debris flow and associated damage, the additional countermeasures are planned to achieve the following targets:

(a) To prevent lateral spread of debris flow sediments by controlling the deposition of sediments on the riverbed and subsequent rising of riverbed

(b) To sustain the function of the existing sabo dams and to increase the flow section of flooding and debris flow by removal of unstable deposits behind the sabo dams

(c) To ensure the section of debris flow without overflow and to guide debris flow into the downstream for the purpose of protecting the Power House and related facilities from the hit of debris flow

(d) To demolish the existing concrete revetment works that facilitate deposition of

sediment on the riverbed and promote the rising of riverbed. This can be beneficial to the fast and smooth flow of sediments in the Ruwa Khola and the Marsyangdi rivers, maintaining the safe operation of the power house and the tailrace tunnel.

(3) Selection of Additional Countermeasures

Figure 7.1.1 conceptually shows the effectiveness of debris flow guide concrete wall. The additional countermeasures are selected and designed as follows:

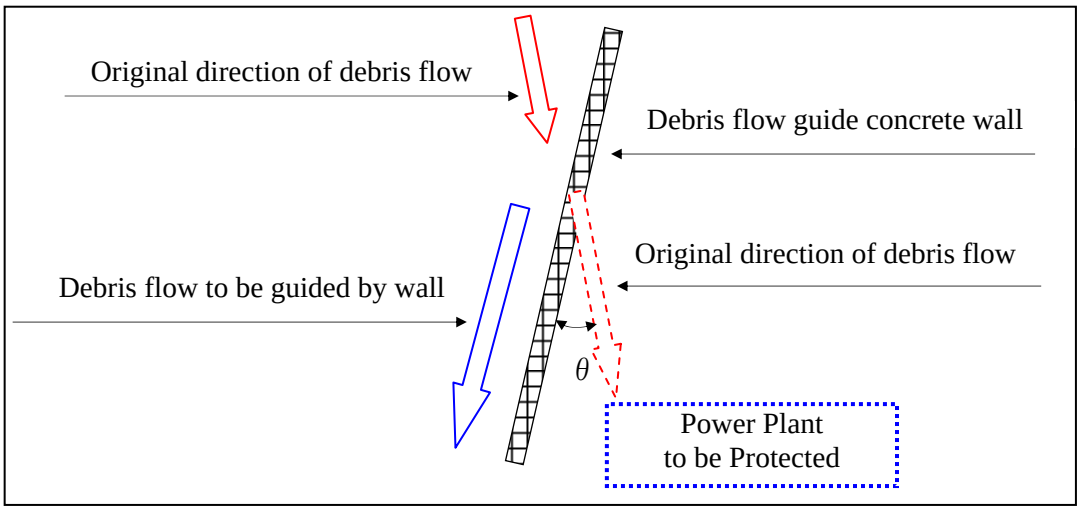


Figure 7.1.1 Conceptual Illustration of the Effectiveness of Debris Flow Guide Concrete Wall

(a) Removal of unstable deposits behind the existing sabo dams was proposed to increase their capacity. The amount of sediments to be removed was roughly estimated to be about 8,500 m^3.

(b) Revetment-type guide wall works on both banks were planned to ensure the section of debris flow, thereby protecting the power house from debris flow.

(c) Guide wall was planned to be along the existing concrete revetment on the valley side of the access road.

(d) Flow section was determined based on the rainfall intensity (95 mm/hr) in 2003 year with a freeboard of 60 cm.

(e) Penetration depth for the proposed guide wall would be 1.0 m below the present riverbed. At detailed design stage, depth of bedrock should be checked by borehole investigation or trench and penetration depth for the guide wall should be revised.

7.1.2 Design of Structural Countermeasures

(1) General Design Conditions and Criteria

The design data and conditions are determined on the basis of common engineering practice as well as some conclusion obtained in the study. The 2003 year rainfall (rainfall intensity, 95 mm/hr) was used to determine the flow section to be required. They are mainly applied for determination of structure size.

1) Unit Weight

Table 7.1.1 Unit Weight

	Material	Unit Weight (kN/m^3)
1.	Reinforced concrete, common	24
2.	Plain concrete	23
3.	Common soil (foundation ground)	18
4.	Riverbed gravel	20
5.	Water	10

Note: 1 tf/m^3 = 10 kN/m^3.

2) River Conditions

Table 7.1.2 River Conditions

Setting of river condition for design of concrete wall		
1.	Catch basin area (referring to Chapter 3), A	2.75 km^2
2.	Average rainfall intensity (2003 rainfall), r_e	95.0 mm/hr
3.	Discharge coefficient, f = 0.8	0.8
4.	Internal friction angle of accumulated sediment (ϕ =30 to 40)	35 degrees
5.	Volumetric density of accumulated sediment (generally Co=0.6)	0.6
6.	Average inclination of riverbed (along arrangement of wall), θ	5 degrees
7.	Average width of river along concrete wall, B (D-D section)	8.0 m
8.	Average grain size of riverbed deposit	0.5 m

3) Foundation Ground Conditions for Concrete Wall

Table 7.1.3 Slope Conditions

Setting of slope conditions for design		
1.	Allowable bearing capacity (Gravel ground), q_a	400 kN/m^2
2.	Internal friction angle of foundation ground (gravel ground), ϕ	30.0 degrees
3.	Friction coefficient of wall base and ground, f_1	0.6

4) Standard Stability Condition of Concrete Wall

Table 7.1.4 Standard Stability Condition

Stability condition at debris flow		Remarks
1. Sliding (between wall and foundation ground)	Fs ≧1.5	
2. Overturning of wall (external force acts within middle 1/3 of section base e=B/6)	e ≦ B/6	
3. Settlement of foundation ground (q: design external force)	q ≦ q_a	Qa = 400 kN/m^2
4. Shear deformation of concrete wall	Fs ≧ 1.5	

(2) Structural Calculation of Concrete Wall

The concrete wall is planned to direct debris flow to a safe place and to protect the Power House from debris flow, its height, H, is thus determined to be the sum of water depth, h, of debris flow and freeboard, ΔH, as follows.

$$H = h + \Delta H$$

The freeboard is generally determined depending upon the water discharge. It is set out as 0.6 in the case of discharge of 200 m3/s or below, and as 0.6 in other cases.

1) Calculation of peak discharge of clear water

The peak discharge, Q_p, of clear water due to rainfall is calculated as follows:

$$Q_p = \frac{1}{3.6} \times f \times \gamma_e \times A$$

$$= \frac{1}{3.6} \times 0.8 \times 80 \times 2.75 = 58.06 \quad (m^3/s)$$

2) Calculation of density of debris flow

The density of debris flow, C_d, is calculated below:

$$C_d = \frac{\rho_w \times \tan\theta}{(\rho_g - \rho_w) \times (\tan\phi - \tan\theta)}$$

$$= 0.14$$

Where,

ρ_g : Density of debris gravel, generally ρ_g = 2.6 t/m^3

ρ_w : Density of water, generally ρ_w = 1.2 t/m^3

ϕ : Internal friction angle of accumulated sediment , ϕ =35 degrees

θ : Average inclination of riverbed, θ = 5 degrees

3) Calculation of peak discharge of debris flow

The peak discharge of debris flow, Q_{sp}, is calculated using the following relationship with peck discharge of clear water:

$$Q_{sp} = \alpha \times Q_p = \frac{C_o}{C_o - C_d} \times Q_p$$

$$= 75.72 \text{ m3/s}$$

Where,

C_o : Volumetric density of accumulated sediment, generally Co=0.6

C_d : Density of debris flow

4) Calculation of water depth of debris flow

The water depth of debris flow, h, is calculated using the following equation:

$$h = \frac{Q_{sp}}{B \times U} = \left\{ \frac{n \times Q_{sp}}{B \times (\sin\theta)^{0.5}} \right\}^{3/5} = 1.71 \text{ m}$$

Where,

B : Width of debris flow, B = 8.0 m (minimum section, D section)

U : Flow velocity of debris flow (m^3/s)

n : Coefficient of roughness of debris flow, generally n = 0.01 to 0.06, here, n = 0.03

θ : Average inclination of riverbed, θ = 5 degrees

5) Determination of height of concrete wall

The height of concrete wall, H, is calculated according to the following equation:

$$H = h + \Delta H = 1.8 + 0.6 = 2.4 \quad \text{(m)}$$

Therefore, the height of concrete wall is determined to be 2.4 m.

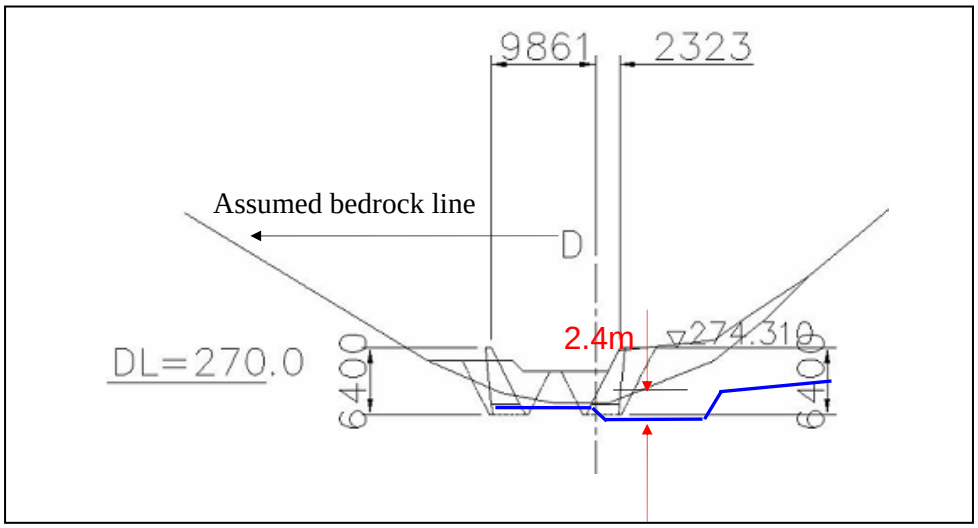


Figure 7.1.2 Standard Section of Debris Flow Guide Concrete Wall

(3) Construction Quantity

On the above structural calculation, the layout of the debris flow guide concrete wall work is given in detail in Data & Drawing 9, while the total quantity of the related works at site is summarized in the table below.

Table 7.1.5 Total Quantity of the Work

Work	Description	Quantity
Excavation of common	Soil + Soft rock	7,747.0 m^3
Backfill		5,554.0 m^3
Concrete		2,606.4 m^3
Form work	Wooden	3,204.9 m^2

7.1.3 Construction Plan

(1) Organization for Implementation

The Marsyangdi Hydropower Plant has been managed by Nepal Electric Authority (NEA). However, according to discussions with counterpart organizations and related agencies, it is finally proposed that the DWIDP will take all responsibilities as the implementing agency for the proposed works.

In addition, the proposed concrete revetment work, basically similar to concrete wall in terms of construction procedure, can be carried out by local contractors in terms of available technology and equipment and recent experience. It is thus proposed that the proposed works at the Ruwa Khola site are includes in the Package I, as described in Section 4.2 , and carried out by local contractors under the management of the DWIDP.

(2) Preparatory Works

(a) Temporary yard

The access road as well as space between the access road and the hillslope just upstream of the power house is suitable for the temporary yard. The temporary yard area is used for the concrete plant, construction equipment, material stack, etc.

(b) Construction materials

Cement , sands and gravels required materials for construction shall be purchased.

(c) Construction equipment

Foundation excavation is proposed to be implemented by manpower. Jack hammer or backhoe may be required when larger boulders are encountered.

(3) Construction Procedure for Concrete Wall

The construction procedure is shown in Figure 7.1.3. During the foundation excavation and concrete placing, river flow must be guided by the excavated lines. Because the width of the river and discharge are large, and the existing concrete sabo dams will be an obstruction in excavating a deeper diversion channel for the present riverbed, piling of soil bags is recommended to form a diversion channel.

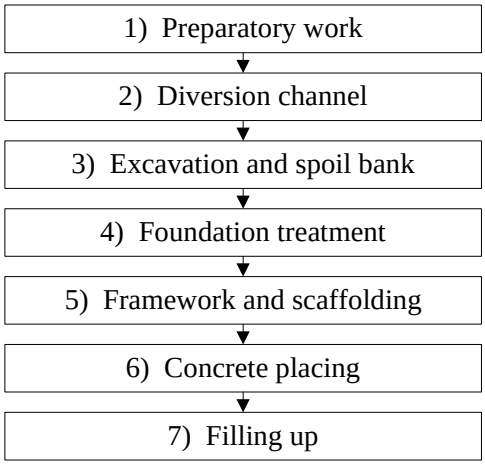


Figure 7.1.3 Construction of Guide Concrete Wall

However, prior to construction, the capacity of diversion channel should be carefully examined in view of the possible frequency and volume of flood that may occur during foundation work.

If the bedrock below the foundation ground deeper than 3.0 m below the present ground

surface after borehole investigation, the concrete wall is proposed to rest directly on the gravel layer with a footing spread. Uniformed concrete treatment must be done.

(3) Construction Schedule

The following figure shows the construction schedule for guide concrete wall works.

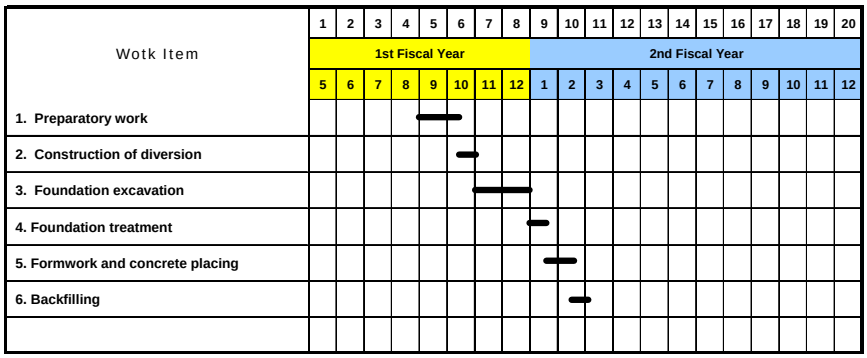


Figure 7.1.4 Construction Schedule for Guide Concrete Wall

The construction period is roughly estimated to be about 6.0 months, including preparatory work of about 2.0 months. Foundation excavation, because of manpower, needs about 2.0 months at rate of 200 m^3/day (20 work days per month).

Rainfall and flood will largely influence construction time, quality and safety. It is thus proposed that foundation excavation commence after the rainy season and backfill to be completed before subsequent rainy season.

7.1.4 Project Cost Estimation and Cost-Benefit Analysis

(1) Total Cost Estimation

The work quantities for the designed revetment-type guide concrete wall were calculated on the basis of the layout of the structures. The construction cost was estimated to be 18,363,663. Rs, which include 13% VAT.

(2) Cost-Benefit Analysis

The method of cost-benefit analysis is discussed in detail in Chapter 4. The result of said analysis for the structural measures at the Marsyasngdi Power Plant site is summarized in the following table.

Table 7.1.6 Results of Cost Benefit Analysis

ALp (mil.Rs/Year)	Construction Cost (mil.Rs)	RRR (Risk Reduction Ratio)	BCR	ENPV (mil.Rs)
4.858	18.364	0.90	1.99	12.759

7.2 Project Evaluation

7.2.1 Social and Environment

(1) Social Evaluation

Social impact will be minimum limited only during implementation term of the construction of guide walls which will cause some traffic disturbance in the vicinity area. After construction of guide walls, the function of the facilities of Marsyangdi Hydropower Plant and the highway bridge will be possibly protected from debris flow.

- Marsyangdi Hydropower Plant

  By implementing the guide concrete walls, it will be possible to control debris flows similar to the 2003 disaster level. Moreover functions of the power plant will be kept safe.

- Highway bridge and securing the traffic

  As the guide concrete walls can smoothly flow out the flood of the debris flow to the main stream, bridge will be safe from influence of scouring and over topping.

(2) Environment Evaluation

The guide walls are not constructed in the river bed but implemented along both banks of the valley. Thus, impact for natural condition will be very low and river bed will be stabilized by the smooth river/debris flow.

7.2.2 Comprehensive Evaluation

This project is feasible and can be implemented with minimum impacts. Consequently, after completion it will generate favorable effect to the social and natural environment.

CHAPTER 8

TECHNICAL TRANSFER

8.1 Technical Advice on Structural Measures

8.1.1 Background

After the 2003 water-induced disasters in the NM Highway, various countermeasures were implemented in 2004 and 2006, mainly as rehabilitation works for road slope disasters which had been carried out by DOR. And, preventive works for debris flow is being implemented by DWIDP.

These implemented countermeasures have effectively insured the safe passage of vehicle along the highway and is keeping traffic function even during a rainy season.

However, as visibly observed along the highway, some implemented structures were damaged either partially or completely. It is considered that these damaged structures must have some engineering deficiencies in terms of planning/designing/ construction which should be improved in the future. Therefore, a technical reference related to the design and construction of the structural measures, especially focusing on those damaged structures, is deemed necessary.

In the aspect of technical transfer, a technical reference document entitled “Technical Guide on Sabo and Road Slope Protection Works” was prepared as a separate volume of this Study (refer to Volume IV: Technical Guide on Sabo and Road Slope Protection Works).

8.1.2 Purposes

This technical guide is intended to provide some technical reference or guidelines for DWIDP and DOR engineers. Its main objective is to assist DWIDP and DOR engineers or also other technical staff that are concerned on planning, design, construction and supervision of road slope disaster mitigation measures.

The policies for preparing the technical guidelines are as follows:

a) To collect samples of preventive structural measures applied in Nepal, which require improvement regarding their planning, design and construction;

b) To record and analyze these examples with respect to their problems and relevant causes;

c) To suggest the improvement methods and design procedures in response to the recorded problems;

d) To introduce new and practical slope protection and prevention methods for the mitigation of road slope disasters.

e) To formulate reasonable standard procedure and plan for slope disaster prevention

f) To suggest regular maintenance works to keep the slope and other road structures in good condition.

8.1.3 Outline of Technical Guide

The guide provides technical guidance on the design and construction of structural measures. It comprises three parts which consists 8 chapters. Preface gives the background, purpose, and preparation policy for the Guide.

Part I contains Sabo Work, which including Chapter 1 and 2 that mainly deals with mitigation of debris flow disasters.

Part II contains Road Slope work which includes four chapters from Chapter 3 through Chapter 7, and mainly discusses the requirements of structural measures related to road slope disasters.

Part III contains Maintenance Work, consisting only Chapter 8, which briefly describes the maintenance practices.

A discussion on this Guide was carried out among the Team, senior engineers of DWIDP and DOR on 12th June and many comments and requirements from engineers of MNWIDPP have been given to the Team. This Guide was revised considering the discussion, comments and requirement mentioned above.

In addition, this guide will be finalized considering the discussion, comments and requirement mentioned above. This is a very preliminary technical material and hopefully can be updated by DWIDP and DOR technical staff with enhancement of future engineering practices.

8.2 Technical Transfer on Disaster Information System and Disaster Education

8.2.1 Disaster Information System

Technical transfer on disaster information systems (Road Early Information System and Early Warning/ Evacuation System) for staffs of Bharatpur Road Office, Chitwan Police Office and Kabilash VDC had been carried out during the following seminar/workshop with operation training, which is described in Chapter 5.

- 18th June for DRO and DPO
- 19th June for Kabilash VDC
- 26th June Joint Seminar/ Workshop with Operation Training

Through these instructions of technical transfer on the disaster information system, staffs in charge of the system have obtained related operational skills.

8.2.2 Disaster Education

As described in Section 6.5, the technical transfer for the education on disaster is composed of the following three points.

(1) Educational materials for the education on disasters

(2) Implementation of the education on disasters for the community

(3) Formulation and implementation of Early Warning/ Evacuation System

(1) Educational materials for disaster education

The educational materials for the residents and the students in the village are as follows. The education using these materials is based on community-based disaster preparedness. Leaflet for the education written in Nepalese is handed down to all residents of the village.

a) Textbook for the disaster education

b) Hazard Maps for the disaster education

The Team was carried out disaster education for leaders, students, villagers as reported in Chapter 6.

(2) Implementation of the disaster education for for the community

The Team conducted training to the Disaster Education/ Hazard Map Team in VDC organization

at the end of August 2008. The Disaster Education/ Hazard Map Team obtained sustainable programs related to education on disasters during this training.

- The procedure and the education for making hazard maps form white maps

The Team was carried out two disaster education for the students and the villagers in VDC (Phase I: late-September 2008, Phase II: late-October 2008).

(3) Formulation and implementation of Early Warning/ Evacuation System

The Team conducted training to the Early Warning/Evacuation Team and Disaster Education/Hazard Map Team formulated in VDC organization as follows.

- How to use the automatic rain gauge and the manual rain gauge.
- How to measure precipitation
- How to use the computer and its system
- The operation for the Early Warning/ Evacuation System

Kabilash VDC learned methodology on community based disaster management by training and exercise mentioned above. And, they showed their ability on disaster management in executing the pilot project.

CHAPTER 9

CONCLUSION AND RECOMMENDATION

The purpose of the study is to formulate the basic strategy on disaster risk management for N-M Highway which is the key section to connect Katmandu and India, and planning countermeasures to prevent debris flow of Ruwa Khola posing a threat to the Marsyangdi hydro power plant.

The study had been implemented since the end of July 2007 to February 2009, and the expected purpose has been successfully accomplished. The result of the study is summarized and some recommendations on disaster risk management for self-supported sustainability are stated in this Chapter.

9.1 Conclusion

9.1.1 Risk Level of Narayangharh-Mugling Highway

Risk evaluation has been carried out from view points of geo-topographical and economic loss induced by sediment related disasters.

(1) Hazard Condition from View Points of Topo-Geological Aspect

Hazard condition of the target area was assessed by interpreting the aerial photo, satellite image and field geological survey including boring and electric investigation.

a) It is suspected by interpreting aerial photo and satellite images that around 30 slopes were deformed by landslides or rock creep. However, it was found during the geological survey that these are not currently active as catastrophic landslides
b) Lower parts of the slopes facing the road are prone to collapse under heavy rain,
c) Landslides and slope collapses are occurring in tributary valleys crossing the highway which are potential source of debris flow.

(2) Risk Assessment by Economic Loss of Slope Disasters

The risk before 2003 disasters and current total risk has been estimated to be 194 ALp (million Rs) and 106 ALp (million Rs) respectively, based on a statistical analysis between the factors and FRCDp for the road disasters.

Drastic improvement of risk level of current situation from 2003 has been generated by the rehabilitation work named Road Maintenance and Development Project, Road Rehabilitation

Component for N-M Highway which had been done from 2004 to 2006 by DOR, and preventive work named Mugling-Narayangharh Water Induced Prevention Project (MNWIDPP) which is being implemented from 2004 by DWIDP.

The effectiveness of above mentioned countermeasures are realized in 2006 when no serious road blockade happened during heavy rain falls in which was of same magnitude as the 2003 rainfall that induced considerable disaster.

9.1.2 Basic Strategy Disaster Risk Management

Considering current risk level mentioned above, following five programs have been proposed as the basic strategy for disaster risk management for N-M Highway.

I. Additional Structural Measures

II. Regular Maintenance and Quick Response

III. Maintenance of Sabo Facilities

IV. Road Early Information System

V. Disaster Mitigation Activities in Communities

I. Additional Structural Measures

Implementing additional countermeasure

Nine (9) sites which were estimated to have potential economic risk over one million Rs/year was selected to be implemented additional countermeasures. By implementing these countermeasures, potential economic loss induced by sediment-related disasters would reduce 36 million rupees and total potential economic loss would be 70 million rupees from current risk of 106 millions rupees.

The total construction cost for the additional countermeasures is estimated around 200 million rupees.

II. Regular Maintenance and Quick Response

Regular road maintenance is already systemized DOR and executing steadily according to Annual Road Maintenance Plan. Cleaning of drainages and slope protections are effective to reduce collapses of river side slopes under heavy rain and protection for pavement. Existing quick response and reopening system is being executed according to yearly plan of operation made by DOR.

III. Maintenance of Sabo Facilities

Formulation of maintenance of sabo facilities was newly proposed in the study. Inventory survey of sabo facilities to formulate the system is being implemented by DWIDP and the system has been finalized.

IV. Road Early Information System

Road Early Information System has been formulated which provides early warning of disaster occurrence and traffic congestion. This system has been operated since July, 2008 through pilot project to verify effectiveness of the system. It is expected that reduction of fatal traffic accident induced by disasters and useless traffic congestion.

V. Disaster Mitigation Activities in Communities

Disaster mitigation activity in Kabilash Village was formulated and implemented in the pilot project.

1) Hazard mapping
2) Disaster education
3) Early Warning/ Evacuation System
4) Simple structural measures
5) Forestation planning and countermeasure planning

Activities listed above were prepared and being carried out in the pilot project. This system contributes not only to reduce casualties induced by road slope disasters but also improve village life and safety.

9.1.3 Implementation Cost for Basic Strategy

Initial investment for implementing the basic strategy is around two hundred million rupees which is mostly allotted for the additional countermeasures that will be implemented by DWIDP and DOR.

Through Road Early Information System and disaster mitigation activities in communities of the pilot projects, an organization which is composed of DOR that is mainly charged of road disaster management, DWIDP that is mainly charged of water induced disaster management, Chitwan DPO, Kabilash VDC, NGO and inhabitants, has been formulated and will be functioned.

9.1.4 Sabo Planning for Ruwa Khola

(1) Risk Condition of Ruwa Khola

Existing sabo dams which were constructed by DWIDP are effective to prevent small amount of debris flows. But, collapse of unstable slopes of upper stream under heavy rains will generate big amount debris flows which can not be controlled by the preventive function of the existing sabo dams. Hence, when the same level of heavy rainfall would induce such debris flow disasters, Marsyangdi Power Plant economic loss would be estimated to be around 5 million rupees per year.

(2) Countermeasure Planning

Considering the hazard condition and risk level of Marsyangdi Power Plant, countermeasures for protecting the power plant has been planned as below:

a) Removal of soils in the sabo dams; 8,500 m^3

b) Concrete walls to protect the power plant; right bank: 207 m; left bank: 57 m; total: 267 m

Concrete wall has been planned to be able to treat debris flow induced by 95mm/hour rainfall which is intensity of 2003 rainfall. Concrete walls at right bank are aligned along the existing low retaining wall without alteration of exiting facilities of the power plant

Construction cost for the countermeasures is around 18 million rupees which will be implemented by DWIDP.

9.1.5 Formulation of Implementation Organization

(1) Implementing Organization for Structural Measures

After the disaster, the DOR executed rehabilitation works for mainly river side slopes, and DWIDP implemented preventive sabo dams for debris flows which were very effective for the heavy rainfall in 2006. This shows that it similar cooperation between DOR and DWIDP for road disaster management in the future is necessary.

(2) Implementing Organization for Maintenance

Chitwan DRO had carried out road disaster management according to the yearly maintenance plan until 2003 disasters and will manage the maintenance in the future. DWIDP will organize and implement the maintenance for the sabo facilities.

(3) Implementing Organization for Road Early Information System and Disaster Mitigation Activities in Kabilash Village

“Planning and Review Committee (district level)” and “Advisory Committee (central level)” on

Chitwan District Disaster Management Partnership have been formulated with concerned organizations and key personals; DOR/MOPP, DWIDP/NOWR, PSSD/MOHA, DoLIDAR/MOLD as Advisory Committee and CDO, SP of Police Office, Division Chief/Road Office, PM/MNWIDPP etc.

This committee managed and operated the Road Early Information System and disaster mitigation activities in Kabilash Village.

9.2 Recommendation for Self-Supported Sustainability

9.2.1 Continuous Implementation of Basic Strategy

Five programs with the basic strategy on disaster risk management for N-M Highway were formulated considering the actual risk level and economic feasibility of the target area. These programs shall be implemented continuously to maintain credible traffic function and road safety.

9.2.2 Application of Basic Strategy for National Road Section

The basic strategy on road risk management was formulated by focusing on the 36 km of the N-M Highway. But, methodology in the basic strategy can be applied for road sections which have similar issues on road disaster management.

It is recommended to apply of the basic strategy for 5,000 km of the strategic road net work in Nepal and formulate reasonable road disaster information system.

9.2.3 Development of Disaster Information System

The disaster information system (Road Early Information System and Early Warning/ Evacuation System) was formulated and operated. Considering evaluation of the pilot project, following 12 matters are suggested and recommended to make self-supporting, sustainable systems.

(1) System operation as a session in the "Chitwan District Disaster Management Partnership Committee"

It is recommended that this committee on road early information system and early warning/ evacuation system shall be operated as part of the session of abovementioned "Chitwan District Disaster Management Preparedness Committee" chaired by CDO, since the said committee is being operated by all concerned official organizations, NGOs and villagers. This disaster information system shall be informed district wide. It is expected that this system would be supported and advised by the members of the preparedness committee.

(2) Opening the committee twice a year

- Review Committee after rainy season
- Planning Committee before rainy season (May)

Operation of the system shall be reviewed every year just after rainy season to discuss lessons learned of the preceding year. Moreover, before rainy season, result of review committees operation plans shall be discussed by implementing organizations to build-up practical

operation system of the year.

(3) Execution of drill

Drill of the system operation shall be carried out after the planning committee confirm the plan of operation for the year and strengthen information network among concerned organizations.

(4) Training for computer operation

Each organization assigns staffs for the total implementation of the system at present. However, persons who possess adequate ability in operatin computers are very limited in the organization. Moreover, the staffs are too busy with other ordinary tasks to be able to concentrate on operating of the system, especially during rainy season. Therefore some persons should be trained to operate the computers in the future.

(5) Brush up of operation plans of next year

Operation plans for the next stages was made up by the DPO, DRO and Kabilash Village as reported in the former session. However, the plans can be further refined for its actual operation, which do not seem to involve considerable work.

(6) Operation on Kabilash Village

The Team understands that human resource and budget is limited to operate the early warning and evacuation system. However, it is expected that the system shall be operated considering the condition of the village, i.e., a real “community based disaster management”.

(7) Role of Advisory Committee (central level) in the future

Advisory committee is composed of MOHA, DoLIDAR, DOR and DWIDP. The advisory committee provides input on the technical advice to the implementing organization of road early information system and early warning/ evacuation system for Kabilash Village. The system operation shall be supported by following the action that was conducted by the advisory committee;

- Checking the system and request holding Planning Committee before rainy season
- Request for holding Review Committee after rainy season
- Presentation and discussion on the system in “Chitwan District Disaster Management Partnership Committee”
- Advice on reviews and plan of operations

Through the activities mentioned above, the committee grasps the know-how of these new system and understanding of financial support requirement on central level.

(8) Role of DWIDP

DWIDP shall call the advisory committee. It shall coordinate the review of the systems after rainy season, and the planning of the systems before rainy season. DWIDP also shall make presentation about the reviews and the planning of the systems on Chitwan Disaster Management Preparedness Committee (CDMPC).

DWIDP also provides advises on water-induced disaster management policy and methodology/ equipment maintenance.

(9) Early warning for serious disturbance

NMHEIS started the early warning for heavy rain and traffic obstacle (road closure and traffic jam) information. However it can be modified in case of treating early warning for serious disturbance such as rock slope failure at km 29+800 on 14th August 2008. DPO should issue early warning when danger situation for traffic is recognized.

(10) Improvement of notice board

There are some drivers who can not read Nepalese alphabet. Hence, illustrations can be one of the means of notifying motorists. However, this should be subject to further discussion by CDMPC.

(11) Public awareness

It may be effective for DPO to conduct seminars on the Road Early Information System and traffic manners to enhance the awareness and the effectiveness for drivers and road users.

(12) Financial plan for the systems operation

As a plan to secure the finances, imposing fee for advertising could sustain implementation of the systems. This is subject to discussion by CDMPC regarding practical collection method and corresponding expenditure.

These systems can be applied for district wide disaster management to reduce casualties of water induced disasters.

9.2.4 Technical Advice on Countermeasure Works

Generally, countermeasure works for debris flow and slope protection are being implemented suitably. However, some existing preventive structures were damaged with preventive functions degraded. It is considered that the cause of some of the poor countermeasure works are due to unsuitable application of planning/designing and inadequate construction works. It is important that basic technical procedures should be reaffirmed and instructed to engineers in charge of planning/designing/construction in “Technical Guide of Sabo and Road Slope Protection”.