CHAPTER 4

HARZARD MAP IN KABILASH VILLAGE

4.1. Method of Hazard Mapping

The hazard map, in a word, is a map expressed the forecasting dangerous district (hazardous zone) to reduce the damage by natural disaster. An effective hazard map cannot be easily made for the disaster mitigation. However, the effort to make this kind of map in many parts of the world has been performed for a long time. As a result, the hazard map of various types exists recently.

The purpose of hazard mapping is as follows;

1) **The disaster recognition**: To recognize the risk of the disaster, it is necessary to grasp the place characteristics at past and present. It is possible that new place of potential disaster is appeared in the future even if it is not recognized now, because place characteristic changes according to social circumstances.
2) **The disaster prediction**: If we could grasp the basic factor, occasions and mechanism of disaster, the range where danger reaches would be forecast.
3) **The disaster risk evaluation**: By utilizing only disaster prediction, it is not enough to judge the degree of danger. Then, if the overall judgment of risk by the specialist is shown, a relative dangerous level of an objective place is clarified, and it becomes easy to take the judgment and the action.
4) **Countermeasures against natural disasters**: If a dangerous place is clarified beforehand, countermeasures against it can be taken in advance. If danger actually is approaching, it will evacuate to the safety place.

Hazard map is not only made by professional persons, but inhabitants can also make it. Hazard map made by inhabitants might not be sufficient correct scientifically, but, from viewpoints of togetherness and self-effort of inhabitant, it is more important and valuable. According to these, I will explain the hazard map by inhabitants.

Hazard map has much information at past, so it is important/valuable thing. If it is heavy rain, hazardous area and risky buildings are shown in Hazard Map. The historical disaster records are also shown. And, if inhabitants feel danger and/or if caution/warning notice is recommended, the escape routes and sites are also shown.

For hazard mapping, it is important that the information of past disaster and past/recent land use. And, it is also important to find out recent hazardous place; the place where tree tilts to, the place where soil encroaches, the place where rock falls and so on.

4.1.1. Base Map

As hazard information is described on a certain map generally, it is necessary to use the base map. There are several base maps usually, for hazard map, the topographic map is utilized. And the satellite/aerial photographs (images) are also used for base map, because the photographs/images can be easily grasped disaster risk situation of objective area by inhabitants.

In this section, topographic map and satellite image are explained, on base map of hazard map.

(1) Topographic Map

A Topographic Map includes contour lines drawn to represent changes in elevation. *A topographic map is a detailed and accurate graphic representation of cultural and natural features on the ground. Or, Traditionally, the main division of maps is into topographic and thematic maps. Topographic maps supply a general image of the earth's surface: roads, rivers, buildings, often the nature of the vegetation, the relief and the names of the various mapped objects.*

Topographic maps are also commonly called ***contour maps*** or ***topo maps***. In the United States, where the primary national series is organized by a strict 7.5 minute grid, they are often called ***topo quads*** or quadrangles.

Topographic maps conventionally show topography, or land contours, by means of contour lines. Contour lines are curves that connect contiguous points of the same altitude (isohypse). In other words, every point on the marked line of 100 m elevation is 100 m above mean sea level.

Topographic maps have multiple uses in the present day: any type of geographic planning or large-scale architecture; earth sciences and many other geographic disciplines; mining and other earth-based endeavours; and recreational uses such as hiking or, in particular, orienteering, which uses highly detailed maps in its standard requirements.

When reading a topographic map, you need to visualize in your mind's eye a 3-dimensional view of what the symbols and contour lines are representing. Topographic map is the representation on a flat surface of part of the Earth's surface drawn to scale. Most topographic

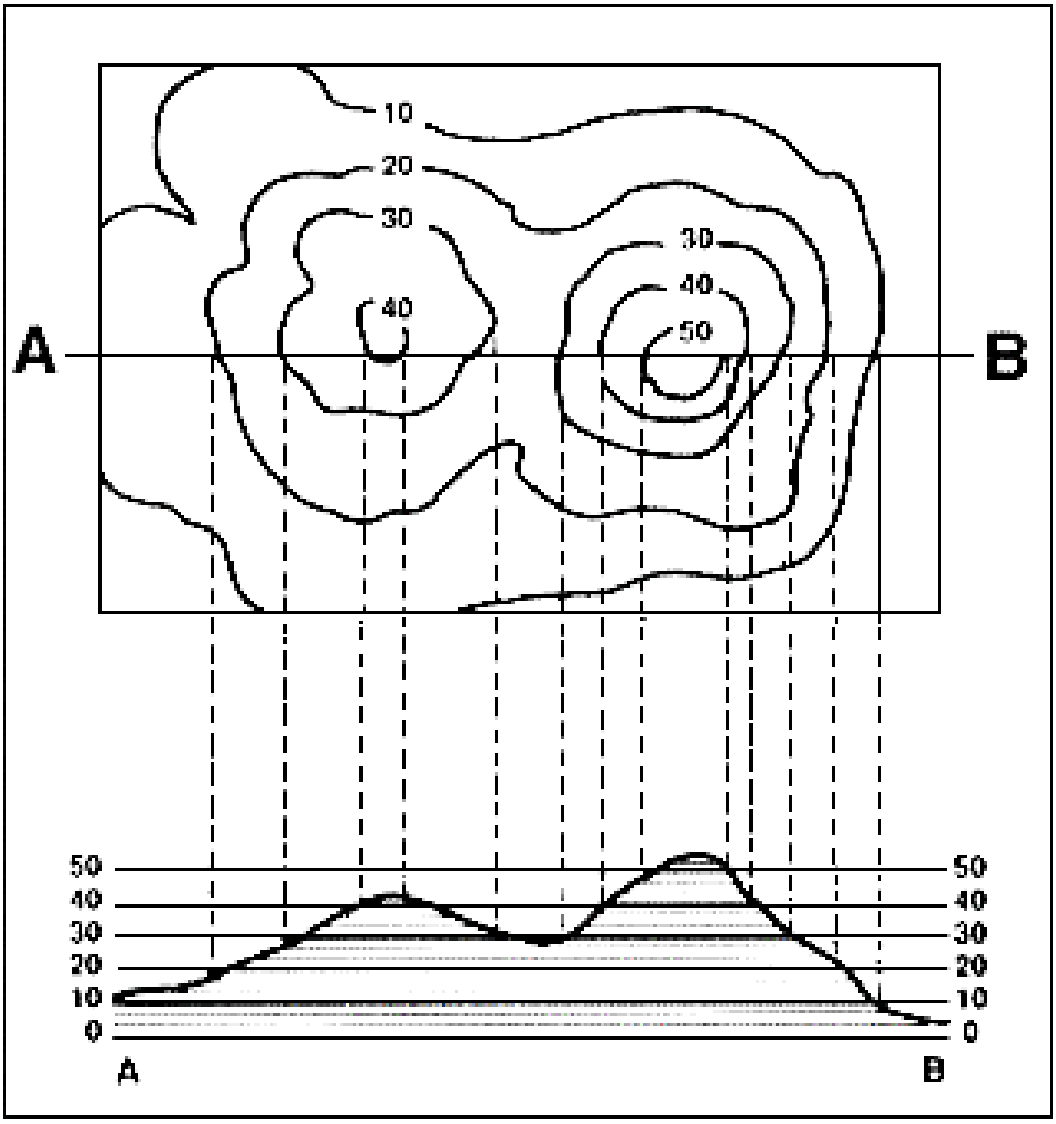


Figure 4.1.1 Topographic Map and Cross Section

maps also show land boundaries and other man-made features. Figure 4.1.1 shows an example of topographic map.

Generally, topographic map is drawn as follows;

contour interval: the difference in elevation between adjacent contour lines on a map.

contour line: an imaginary line on the Earth's surface connecting points of the same elevation.

index contour: on a topographic map, a contour that is printed heavier than others and is usually labeled with the elevation it represents. Index contours occur at regular intervals, often every fifth or every fourth contour line (depending on the contour interval).

Relief: the difference in elevation between any two points.

scale: expresses the relationship between distance on the map and the true distance on the

Earth's surface.

spot elevations: elevations of road intersections, summits of hills, lake shorelines, etc. These are accurate to within the nearest foot or meter.

One of the easiest landscapes to visualize on a topographic map is an isolated hill. If this hill is more or less circular the map will show it as a series of more or less concentric circles.

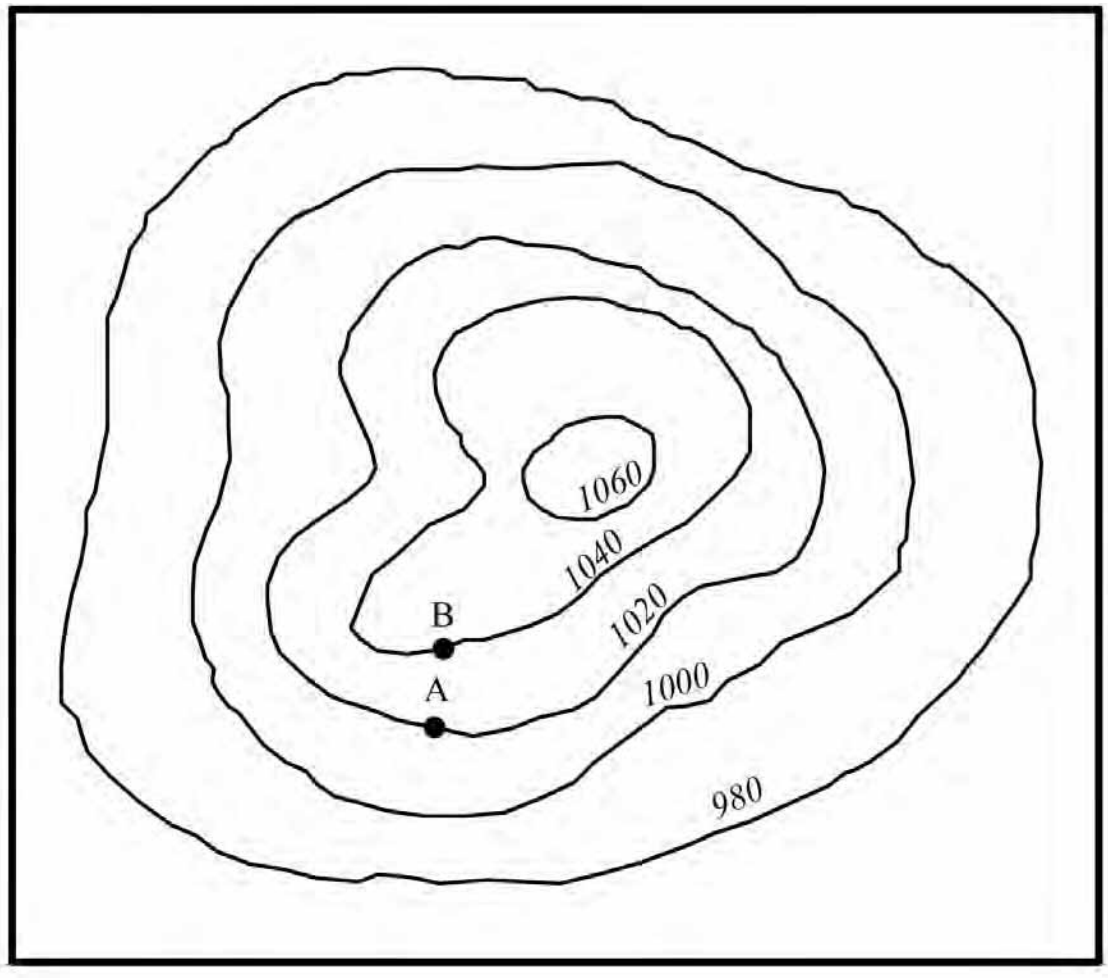


Figure 4.1.2 Example of Isolated Hill on Topographic Map

Imagine that a surveyor actually marks these contour lines onto the ground. If two people start walking in opposite directions on the same contour line, beginning at point A, they will eventually meet face to face. If these same two people start out in opposite directions on different contours, beginning at points A and B respectively, they will pass each other

somewhere on the hill and their vertical distance apart would remain 20 meters. Their horizontal distance apart could be great or small depending on the steepness of the hillside where they pass.

A rather more complicated situation is where two hills are connected by a saddle. Here each hill is circled by contours but at some point toward the base of the hills, contours begin to circle both hills.

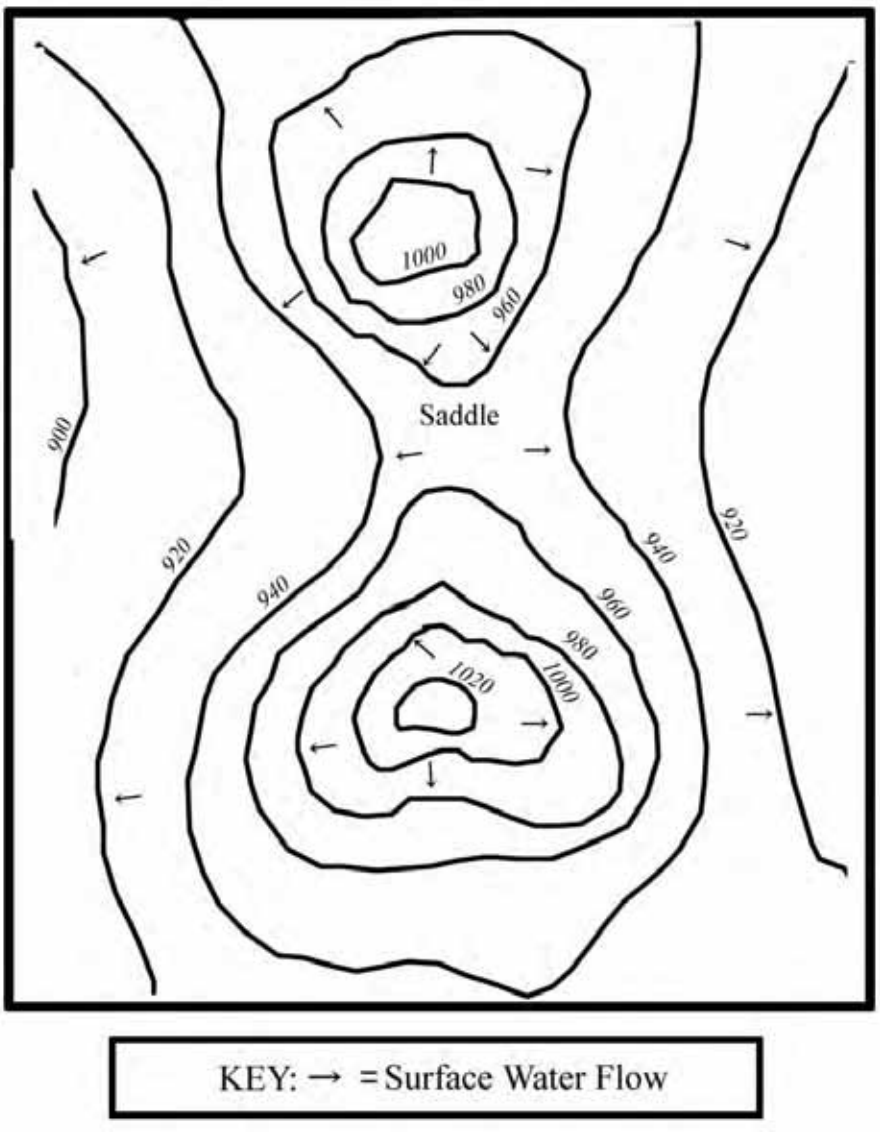


Figure 4.1.3 Example of Saddle on Topographic Map

How do contours relate to water flow? A general rule of thumb is that water flow is perpendicular to contour lines. In the case of the isolated hill, water flows down on all sides of the hill. Water flows from the top of the saddle or ridge, down each side in the same way water flows down each side of a garden wall

As the water continues downhill it flows into progressively larger watercourses and ultimately into the ocean. Any point on a watercourse can be used to define a watershed. That is, the entire drainage area of a major river like the Merrimack can be considered a watershed, but the drainage areas of each of its tributaries are also watersheds.

Each tributary in turn has tributaries, and each one of these tributaries has a watershed. This process of subdivision can continue until very small, local watersheds are defined which might only drain a few acres, and might not contain a defined watercourse.

Figure 4.1.4 shows an idealized watershed of a small stream. Water always flows downhill perpendicular to the contour lines. As one proceeds upstream, successively higher and higher

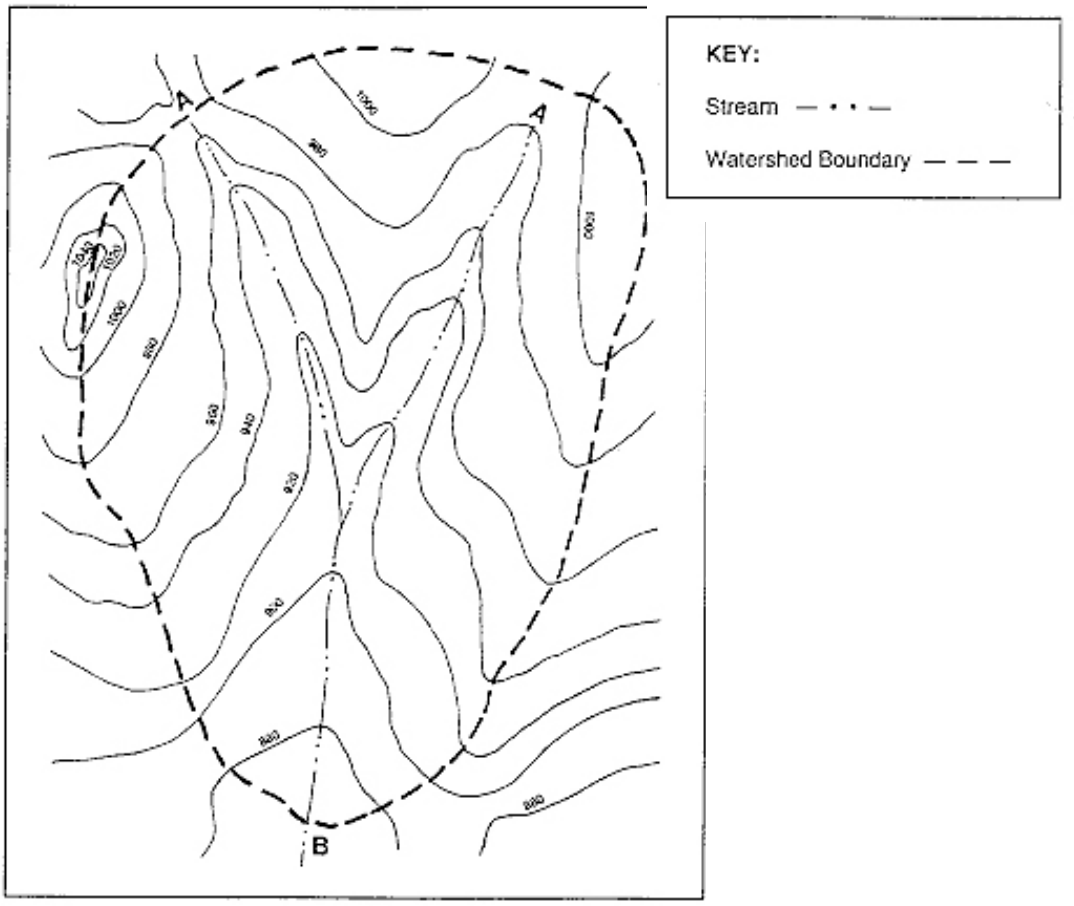


Figure 4.1.4 Example of Idealized Watershed Boundary on Topographic Map

contour lines first parallel then cross the stream. This is because the floor of a river valley rises as you go upstream. Like-wise the valley slopes upward on each side of the stream. A general rule of thumb is that topographic lines always point upstream. With that in mind, it is not difficult to make out drainage patterns and the direction of flow on the landscape even when there is no stream depicted on the map. In Figure 4.1.4, for example, the direction of streamflow is from point A to point B.

Ultimately, you must reach the highest point upstream. This is the head of the watershed, beyond which the land slopes away into another watershed. At each point on the stream the land slopes up on each side to some high point then down into another watershed. If you were to join all of these high points around the stream you would have the watershed boundary. (High points are generally hill tops, ridge lines, or saddles).

(2) Satellite Image

There are lots of satellites surrounding earth. Earth-orbiting satellites are divided into three categories in accordance with their missions.

- Transferring information: Communication technology --> Communication satellites, Broadcasting satellites
- Defining positions: Navigation technology --> Global positioning satellites
- Measuring objects: Remote sensing technology --> Earth observation satellites

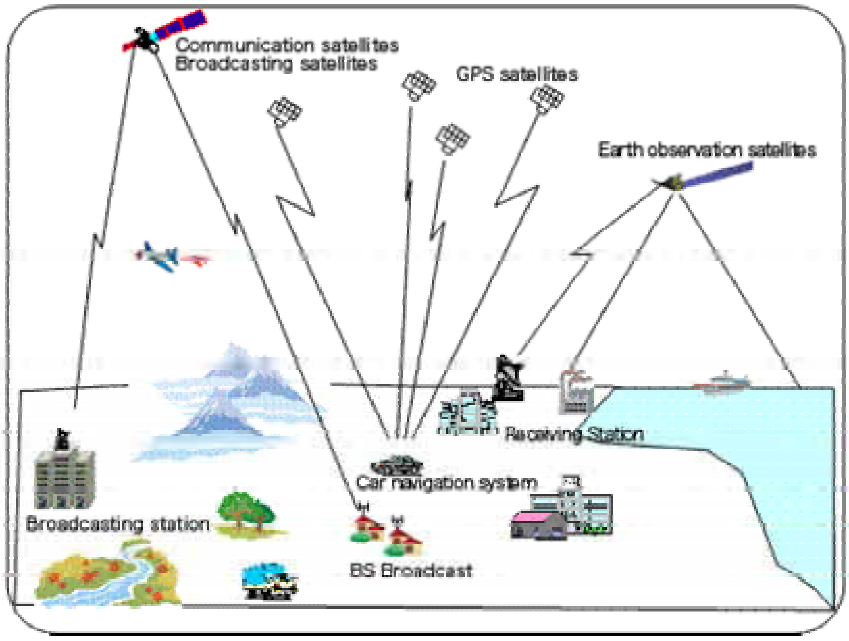


Figure 4.1.5 Satellite Operation
(http://www.restec.or.jp/search/beginner/eng/beginner_2a.html)

There are various satellite images by satellites for measuring objects. Radiometers and photometers are the most common instrument in use, collecting reflected and emitted radiation in a wide range of frequencies. The most common are visible and infrared sensors, followed by microwave, gamma ray and rarely, ultraviolet. They may also be used to detect the emission spectra of various chemicals, providing data on chemical concentrations in the atmosphere. And, Stereographic pairs of aerial photographs have often been used to make Topographic maps by Imagery Analysts, Terrain Analysts in trafficability and highway departments for potential routes. Moreover, simultaneous multi-spectral platforms such as Landsat have been in use since the 70's. These thematic mappers take images in multiple wavelengths of electro-magnetic radiation (multi-spectral) and are usually found on earth observation satellites, including (for

example) the Landsat program or the IKONOS satellite. Maps of land cover and land use from thematic mapping can be used to prospect for minerals, detect or monitor land usage, deforestation, and examine the health of indigenous plants and crops, including entire farming regions or forests.

Figure 4.1.6 Image of LANDSAT Satellite (http://en.wikipedia.org/wiki/Landsat_5)

In the broadest sense, remote sensing is the small or large-scale acquisition of information of an object or phenomenon, by the use of either recording or real-time sensing device(s) that is not in physical or intimate contact with the object (such as by way of aircraft, spacecraft, satellite, buoy, or ship). In practice, remote sensing is the stand-off collection through the use of a variety of devices for gathering information on a given object or area.

Figure 4.1.7 shows a satellite image at Kabilash village by IKONOS satellite. We can recognize various objects such as each house, road and forest, on satellite image. Thus, satellite image is used at first time (Gathering information form inhabitants) on base map.

Figure 4.1.7 Example of Satellite Image by IKONOS

4.1.2. Method of Hazard Mapping

If hazard map is made by inhabitants, they should carry out as follows;

1) Collection of disaster information from inhabitants of object area.
2) Confirmation in site of the collected information
3) Completion of hazard map

In this section, each step of hazard mapping is explained.

Figure 4.1.8 shows an example of hazard map. Dangerous place, evacuation route (rescue path), evacuation site and previous disaster information (landslide, debris flow and so on) are drawn on the hazard map. All inhabitants can understand the legend such as evacuation site and route.

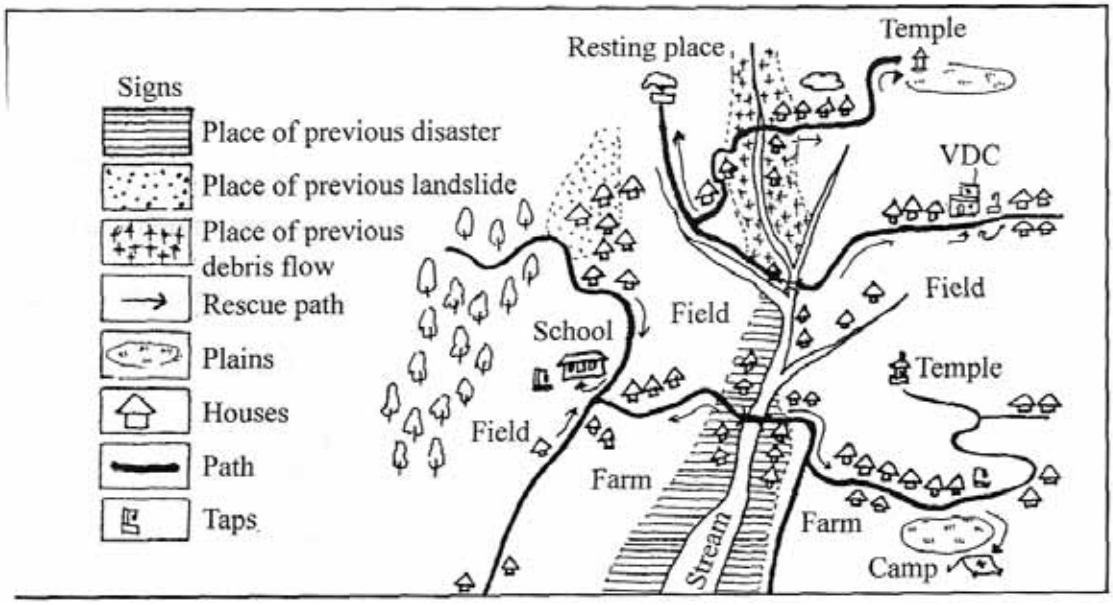


Figure 4.1.8 Example of Hazard Map

STEP1: Collection of disaster information

You have to collect disaster information from inhabitants. If you prepare the hearing sheet as shown at Table 4.1.1, necessary disaster information would be grasped easily.

At hearing, acquiring disaster information should be written on satellite image/topographic map. Procedure of hearing is shown for example, thus this procedure should be modified according to condition at objective area,

When we collect disaster information from inhabitants at objective area, we have to prepare as follows;

1) Several questionnaire/hearing sheets; we have to prepare the sheets of the number

of hearing inhabitants.

2) Sheet of participants list (or White paper); we have to memorize name and phone number/address of participants/inhabitants.
3) Satellite image at the scale of one per several thousand (or Topographic map at the same scale)
4) Several color pens (Black pen, Red pen, Blue pen and so on)
5) Notebook for memorizing

Photo 4.1.1 shows situation of step 1. Using questionnaire/hearing sheet, we have to grasp the past disaster records, dangerous area information, inappropriate land/water use and structural measures at hazardous area.

For hazard mapping, past disaster records have to be collected as follows;

- Previous/recent disaster locations
- Previous/recent disaster information;
  - ✧ Disaster type: Rock fall, Landslide, Slope failure, Road foundation failure, Debris flow as shown at Section 3.1
  - ✧ Date/time: Date and time that disaster occurred.
  - ✧ Casualty: Number of died/injured persons
  - ✧ Damage occurred: Life damage (house lost, shed lost, livestock loss etc), Infrastructure damage, Environmental damage
  - ✧ Main cause: Heavy rainfall, Earthquake, Explosion of glacier lake, etc.

And, information of hazardous area must be collected and confirmed, too. At slope area such as Kabilash village, hazardous area is;

- Buildings under risk because to heavy rain
  - ✧ Doweling house
  - ✧ Tool shed
  - ✧ Animal shed
- Area which inhabitants feel danger
  - ✧ Soil erosion
  - ✧ Tilted trees area
- Area which inhabitants have any recognition
  - ✧ Seepage zone
  - ✧ Toe cutting

Inappropriate land/water use is problem because of occurring disaster at place overused land/water. For example, deforestation causes surface soil to be more prone to erosion. Due to heavy rain, erosion proceeds and forms gullies, which in turn acts as catalyst for landslide disaster. Thus, on hazard mapping, it is important to grasp inappropriate land/water use as

follows;

- Previous/recent slash and burn field
- Previous/recent deforestation area
- Previous/recent irrigation system

Whereas, many structural measures at hazardous area are made by government etc. Structural measures are useful to protect/mitigate disaster. Thus, we should also hear about structural measure as follows;

- Gabion wall
- Drainage structure measure
- Wicker work
- Revetment
- Sabo/Check dam
- Bio-engineering work
- Other structural measure

STEP2: Confirmation in site

You should confirm in site collected information. Disaster information of inhabitants might be mistake sometimes because of memory errancy. And hearing inhabitant might not grasp new disaster information. Thus, you should survey in site for confirmation of disaster situation. Especially, you have to confirm;

1) Point of recent water-induced disaster
2) Point and size/type of recent structural measure work
3) Recent situation surrounding safety place/evacuation site
4) Recent situation of route from house to safety place

Moreover, if you are able to employ professionals, site survey should be carried out or professionals should check your made hazard map. Figure 4.1.9(a) shows the disaster information on satellite image.

STEP3: Completion of hazard map

According to step 1 & 2, you should complete hazard map. When disaster information is collected, satellite image on base map is used because of easily understanding by inhabitants. But, there is much disaster information on satellite image, on such hazard map, disaster information could be grasped difficultly. Thus, in this step, we should use topographic map on base map. Legend of hazard map is shown clearly. Example of completed hazard map is shown

as Figure 4.1.9(b).

Table 4.1.2 shows the legend of hazard map. Risky building, evacuation site and disaster (Debris flow and Probable landslide) is important information. Thus, this important information has to been drawn by appropriate symbol, on hazard map. All ward hazard maps is shown at Appendix.

Table 4.1.1 Example of Hearing Sheet

Questionnaire

1. Do you know anything about previous/recent disaster that occurs in your locations?

2. What type, where and when it was occurred?
   Disaster type: Location: Date/time:
   Casualty: Damage occurred: Main cause:

3. Can you locate the previous/recent deforestation areas in your locality, if yes, where?

4. Do you know the area where slash and burn farming is going on and any knowledge of previous such works, if yes, where?

5. Do you know the area where mostly soil erosion took place in this locality, if yes, where?

6. Any idea about previous and new landslide that are in your locality, where they are?

7. Have you ever seen the tilted trees area in your locality, if yes, where they are?

8. How is the slope condition in the locality and what types of cultivation are done in these area?

9. Is there any seepage zone in locality, if yes, where?

10. Have you seen any debris flow in your area, if yes, where?

11. Do you have any information where toe cutting is undergoing, if yes, where?

12. What type of land use is there mainly on those slide area?

13. Did you saw any structural measure installed on above areas, can you name it, what and where?

14. Is there any building (doweling house, tool shed, animal shed) under risk because to heavy rain, if yes, where?

15. How is the condition of School and Health post, can you used them in the case of emergency period?

16. Do you know where the safest place is by running during disaster?

17. Do you ever talk with your families or community members regarding to Natural disaster, how they happen and what are the process to mitigate them?

Introduction of hearing

Hearing from inhabitant

Photo 4.1.1(a) Situation of Step 1

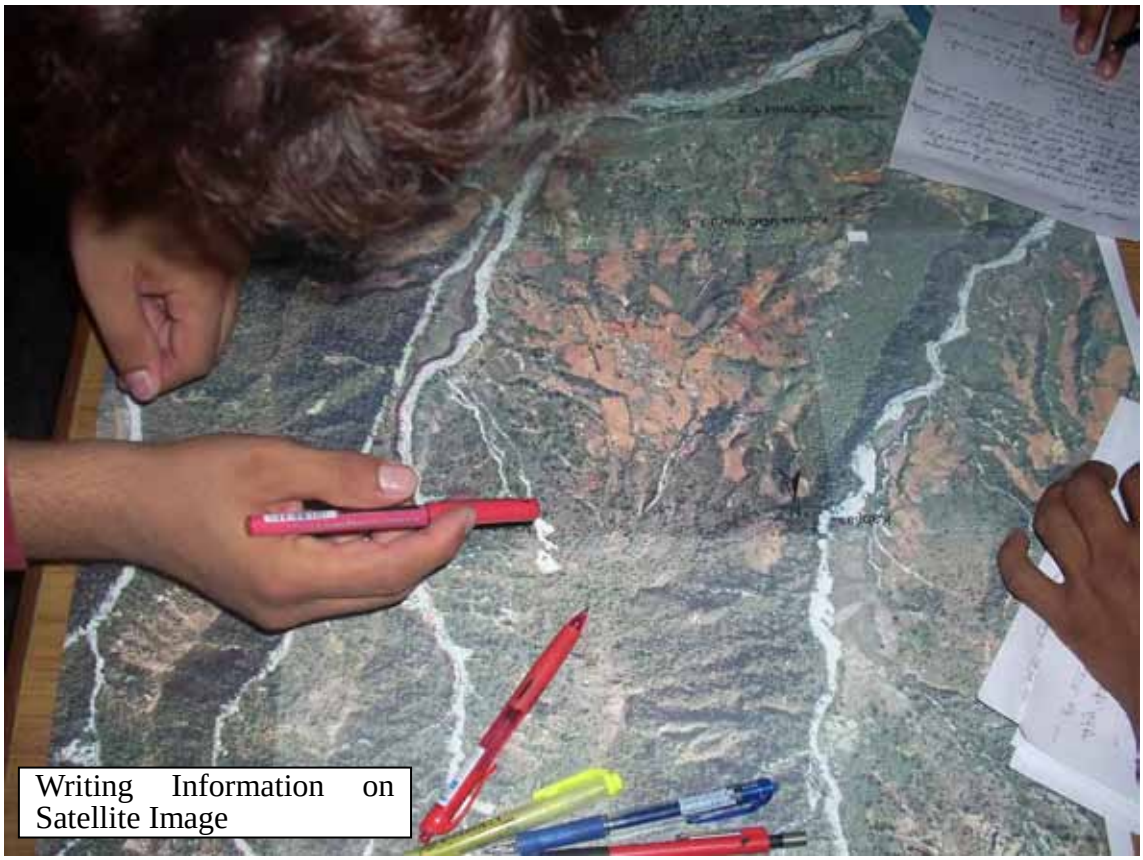


Figure 4.1.9(a) Disaster Information on Satellite Image at Step 1 of Hazard Mapping

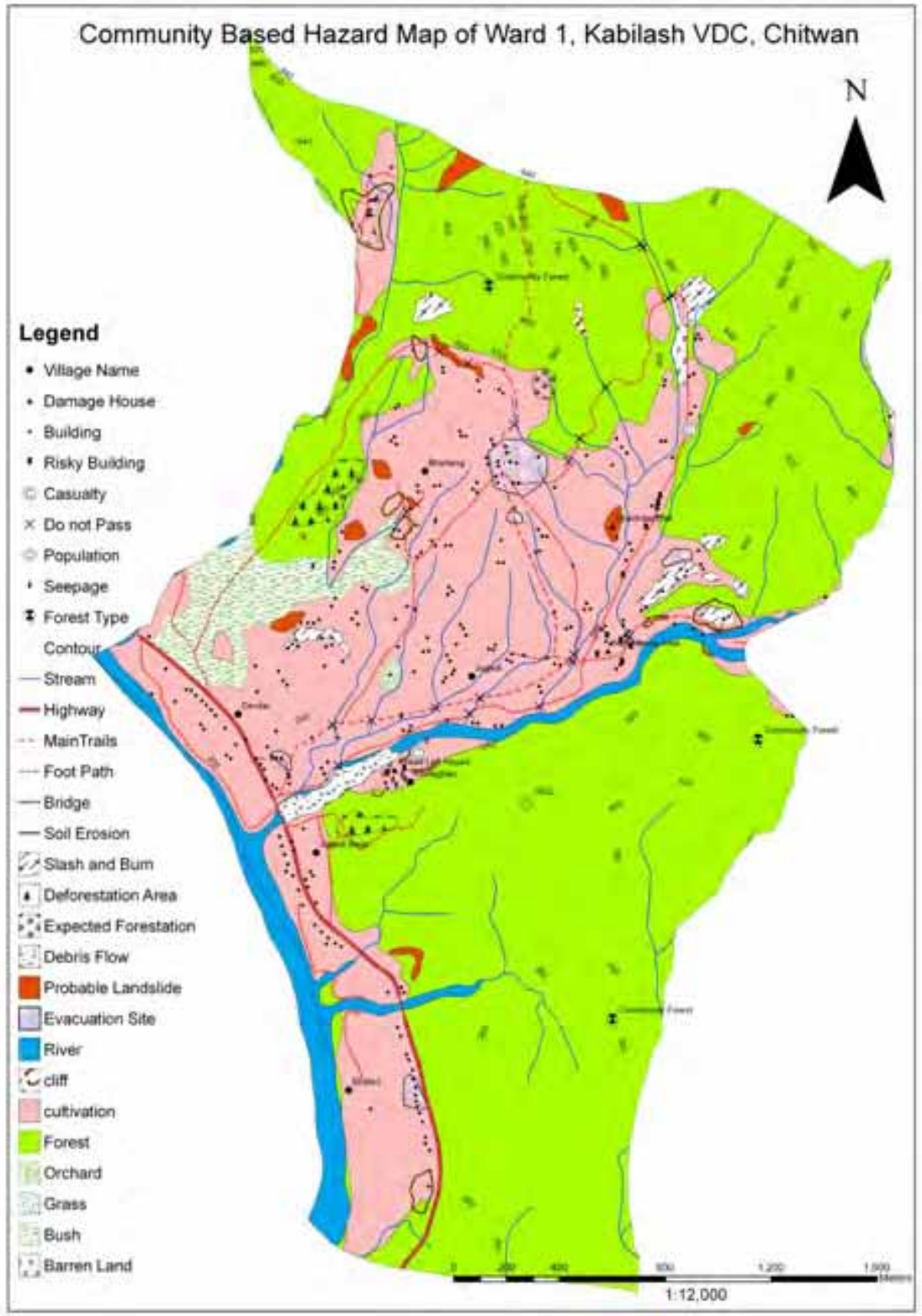


Figure 4.1.9(b) Example of Hazard map final version (Ward No.1）

Table. 4.1.2 Legend of Hazard Map

Item	Sign (Simbol)	Remarks
Village Name		
Damage House		
Building		
Risky Building		
Casualty		

4.1.3. Dangerous Disaster Type in Kabilash Village

Sediment-related disasters are shown at Figure 4.1.10. But it is low risk on large-scale slide type, inhabitants in Kabilash village should pay attention to rock (mass) fall, slope failure, road foundation failure and debris flow.

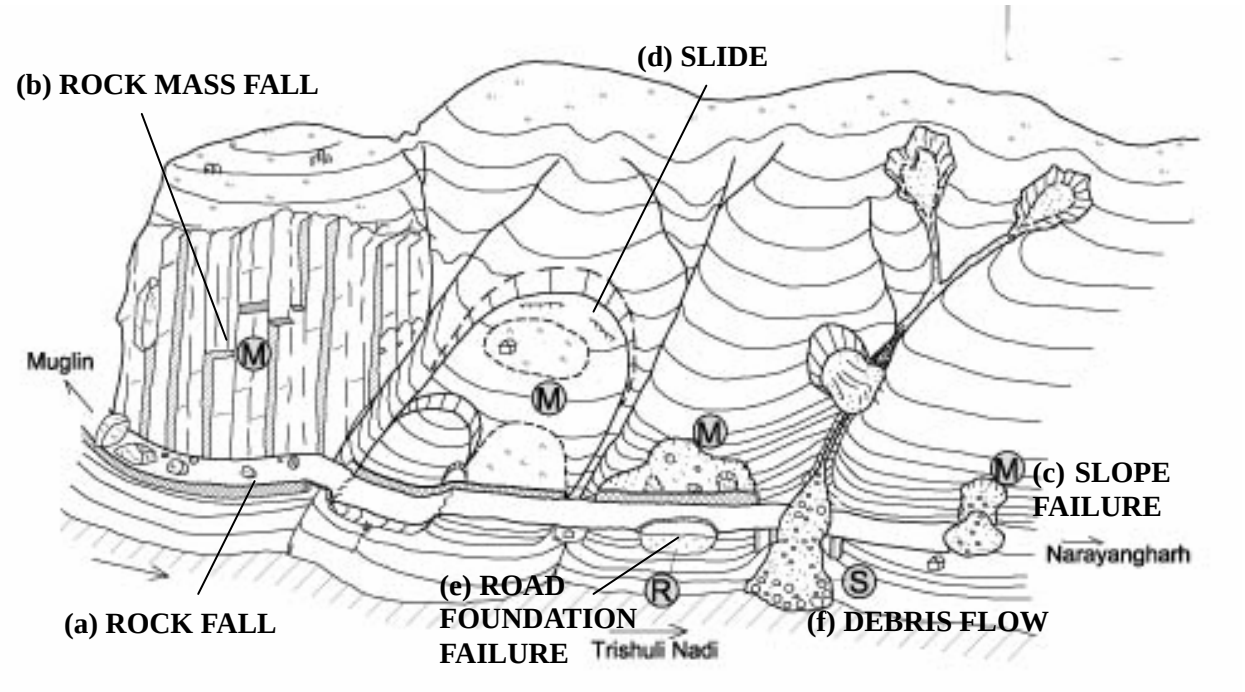


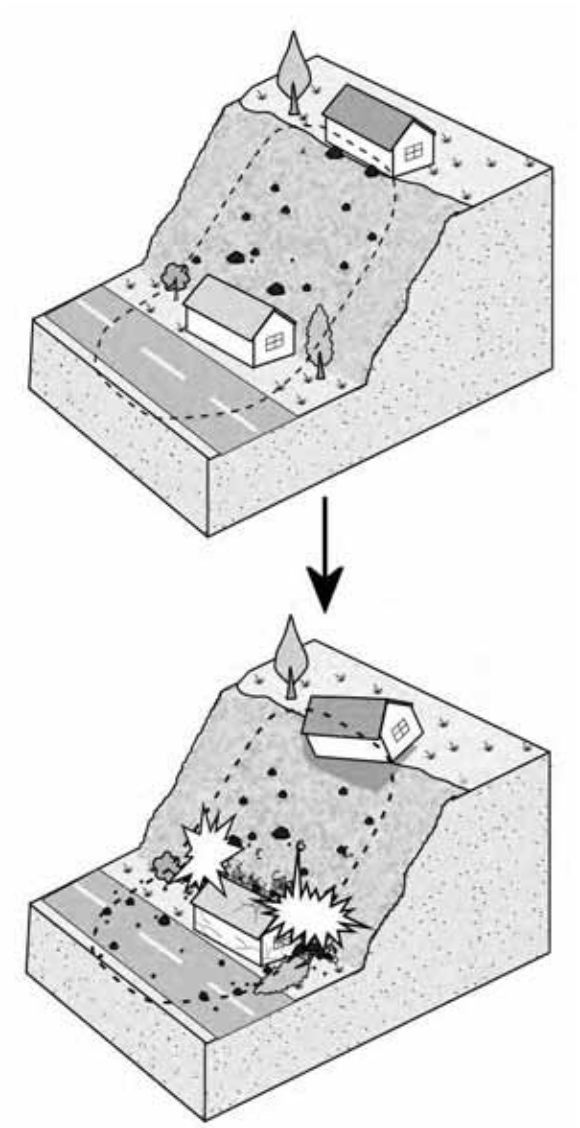
Figure 4.1.10 Schematic Picture of Sediment-related Disaster Type

By such disaster type, where is dangerous place? That is important problem. We have to evacuate from hazardous area at heavy rain. It is important information what place the personally lives in

As shown at figure 4.1.11, buildings at top/bottom edge of steep slope are much danger at heavy rain.

At place on deposits of previous debris flow, new debris flow would occur at heavy rain again. It is high possibility that houses on deposits are destroyed by new debris flow. Thus, inhabitants should not be stay in such house, they have to escape to safety place at heavy rain.

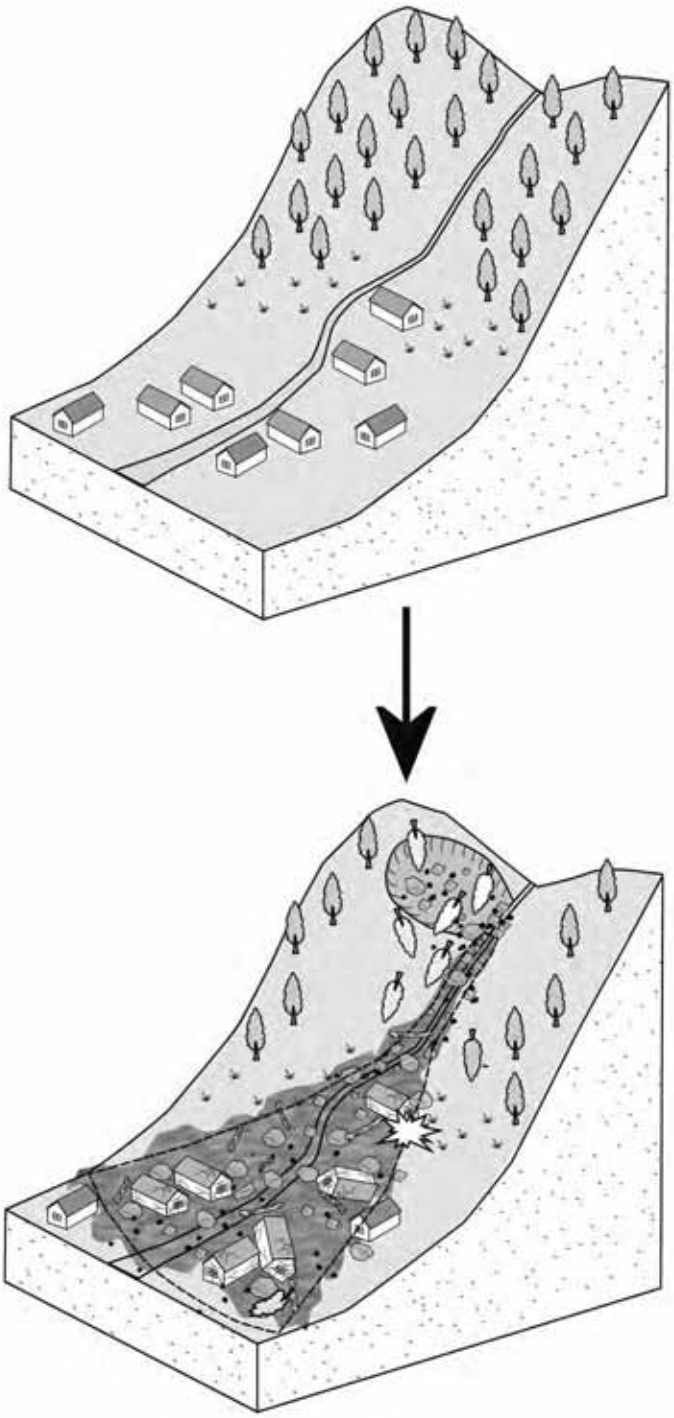
On the other hand, houses at bottom edge of potential landslide have also high risk. At heavy rain, such houses are destroyed by soil mass of landslide as shown at Figure 4.1.13. Thus, inhabitants at bottom edge of potential landslide should also escape to evacuation site at heavy rain.



Dangerous houses at top/bottom edge of steep slope

House at top edge of steep slope would be fallen/tilted by slope failure at heavy rain, and houses at bottom edge of steep slope would be destroyed by rock (mass) fall. Its phenomena often occur after heavy rain.

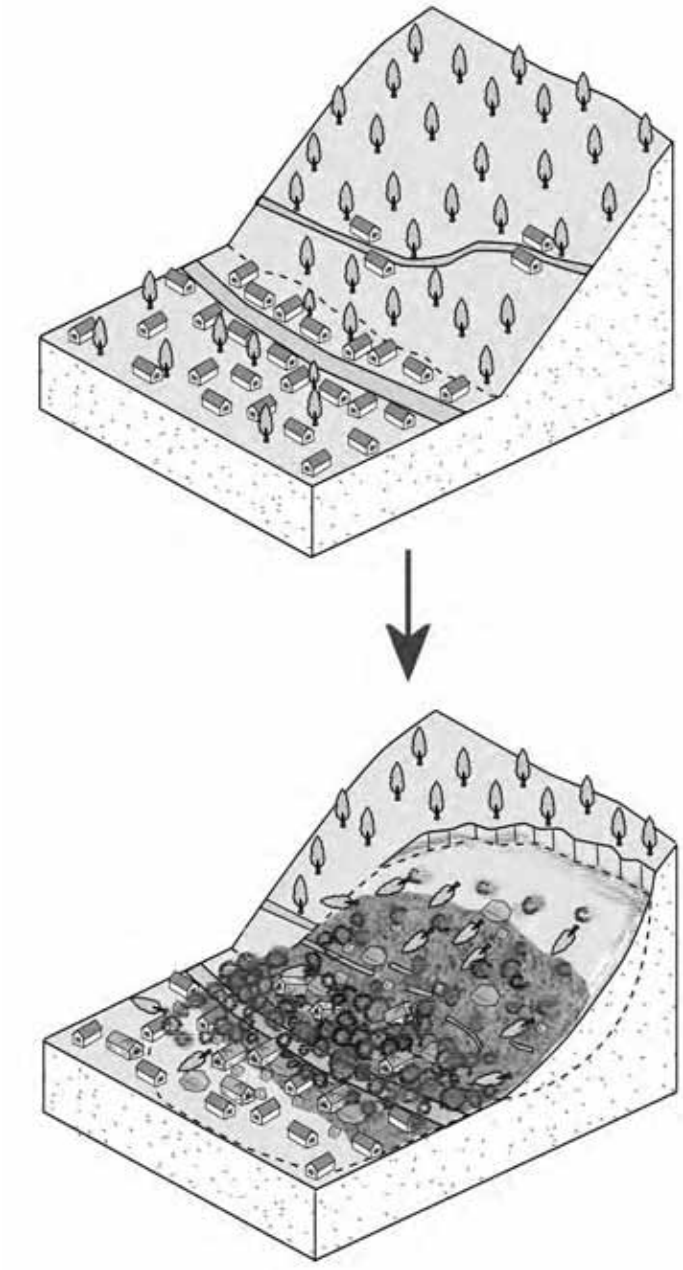
Figure 4.1.11 Schematic picture of risky place (Top/bottom edge of steep slope)



Place on deposits of previous debris flow, in another ward, place near river/stream

Houses on deposits of previous debris flow would be destroyed at heavy rain.

Figure 4.1.12 Schematic picture of risky place (Place on deposits of previous debris flow)



Bottom edge of potential landslide or place on potential landslide

Houses at bottom edge/ on potential landslide would be destroyed at /after heavy rain.
But, many landslides comparatively slowly slide at long time, so houses at bottom edge/ on potential landslide are not always risky buildings by heavy rain.

Figure 4.1.11 Schematic picture of risky place (Place bottom edge /on potential landslide)

4.2. Past Disaster Record and Hazardous Area in Kabilash Village

There were 248 road closer disasters in the Narayangha-Mugling Highway in 10 years 1997 to 2006 (by the road slope/stream inventory survey).

And in 2003, the slides and debris took lives of 4 people in Jalbire, 1 person at 5Km, 2 persons in Simaltar, 5 persons in Jugedi and 6 persons in Chandibhanjyang due to a house washed out by the debris. A truck was also buried in the debris at Kahale Khola (21Km) fortunately, driver could escape and there was no casualty. It is also in record that two persons (husband and wife) had lost their lives when a house was washed out by Chuni River during the heavy rain falls in 1999. Similarly, three people (2 children and one woman) lost their lives in Bangesal during the rainy season in 2006. Thus, the human deaths by the disaster around N-M highway is 23 persons.

In 2003 a truck was buried in the debris at 21Km fortunately, driver could escape and there was no casualty. But, this driver might die a little more. Thus, it is thought that the human death by the disaster on N-M highway is one person.

4.3. Safety Place and Evacuation Route

Inhabitants where live/stay at hazardous area should escape to safety place as soon as possible at heavy rain. If it is heavy rain which is larger than a certain threshold of rainfall amount, it is high possible that disaster occurs at dangerous area such as top/bottom edge of steep slope. Thus, it is important to escape to evacuation site through safety route.

Where is safety site, how is appropriate evacuation route?

In the case of water-induced/sediment-related disaster, the area that water/debris is not arrived is safety place. As shown at Figure 4.3.1, it is danger near/along river (or stream (Khola)). At steep slope such as cliff and potential landslide, it is also danger. The place which is higher than surroundings, and a wide place in view, is more suitable as the evacuation site (See Figure 4.3.2).

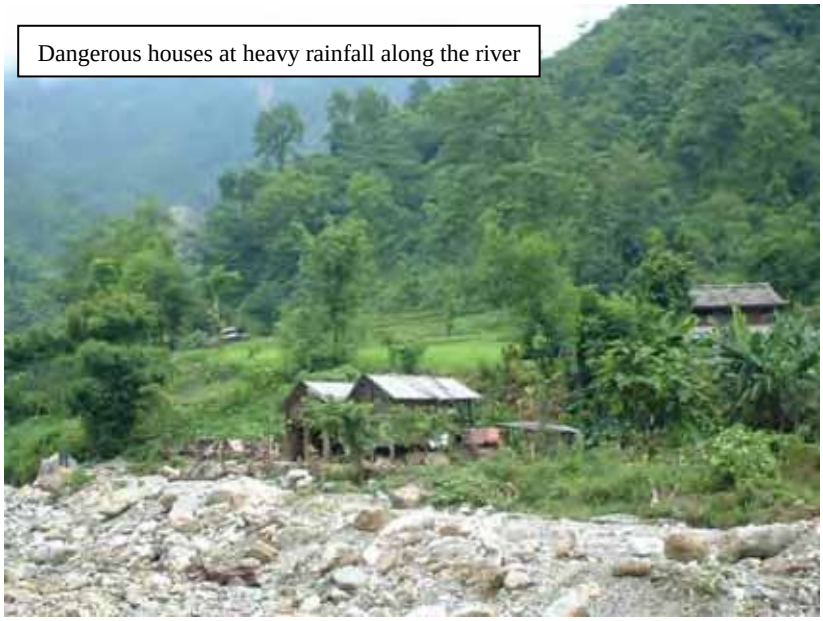


Figure 4.3.1 Dangerous area (along river/stream)

Figure 4.3.2 Appropriate Safety place/Evacuation Site
(This figure is modified http://www.pref.kochi.jp/~bousai/kikenkuiki/index.html)

For safety place, most typical sites are school and health post. But, in the case that these typical evacuation sites can not be escaped, other safety places need to be found out. On other safety places we have to be selected to the place where disaster has not occurred, the high place which dose not be damaged by sediment-related disaster such as debris flow, and so on. Figure 4.3.3 shows example of evacuation site in Kabilash village.

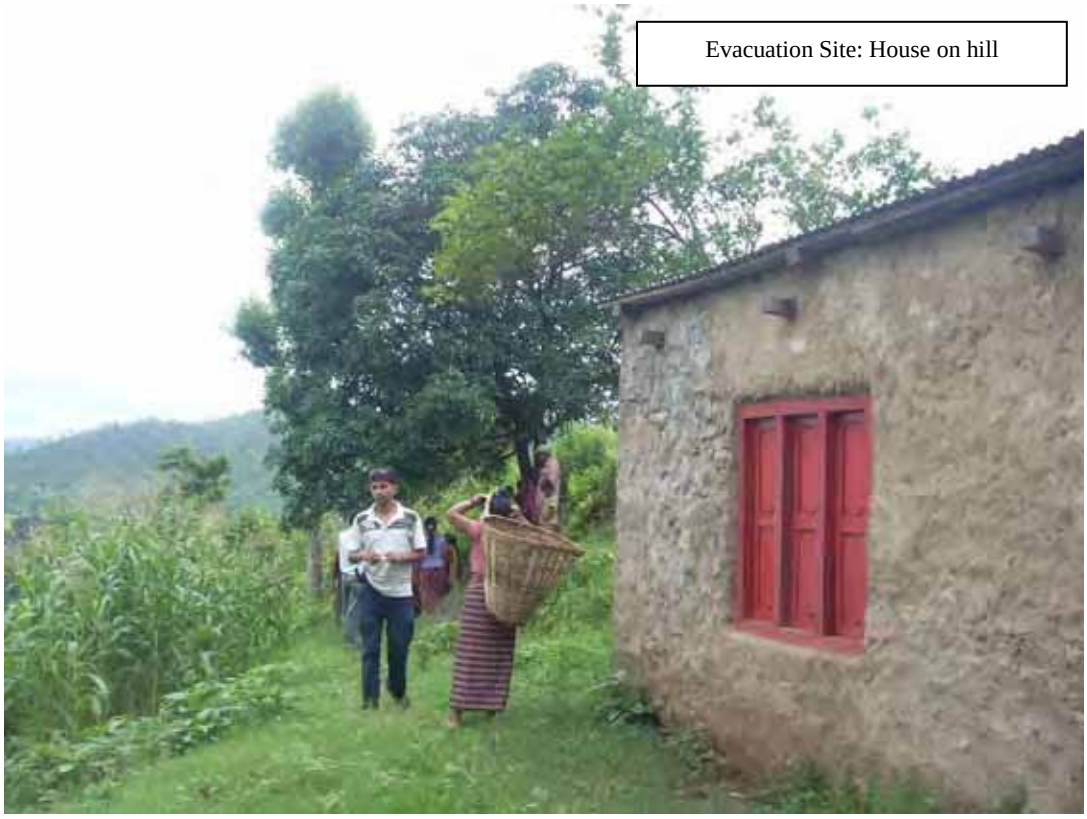


Figure 4.3.3 Evacuation Site (Gathering situation during drill)

We should escape safety place/evacuation site if we grasp symptom of disaster. Thus, safety of evacuation sites such as school, health post and other safety place has to be evaluated, and evacuation routes should be examined, on hazard mapping.

To examine evacuation route, much information for evacuation needs to be shown on hazard map. Evacuation route is;

- route which inhabitants have not cross river/stream
- route where is not along cliff/steep slope
- route where is not seepage zone or soil erosion zone

As shown in Figure 4.3.3, if your house is near a landslide zone, you should evacuate at warning notice. In this time, you would have another risk if you select evacuation route 1, because you must pass to the bridge of stream (Khola) which intersects to evacuation route 1. Debris flow and rapid high-level water often occur at Khola, so it is dangerous. Then, you should not persist in evacuating to the safety place 1, and you have to select safety place 2. Thus, you must transfer to safety place 2 through the evacuation route 2.

From the above mentioned if there is risky/hazardous zone surrounding evacuation route, we should avoid the risky/hazardous zone and select other evacuation route/site.

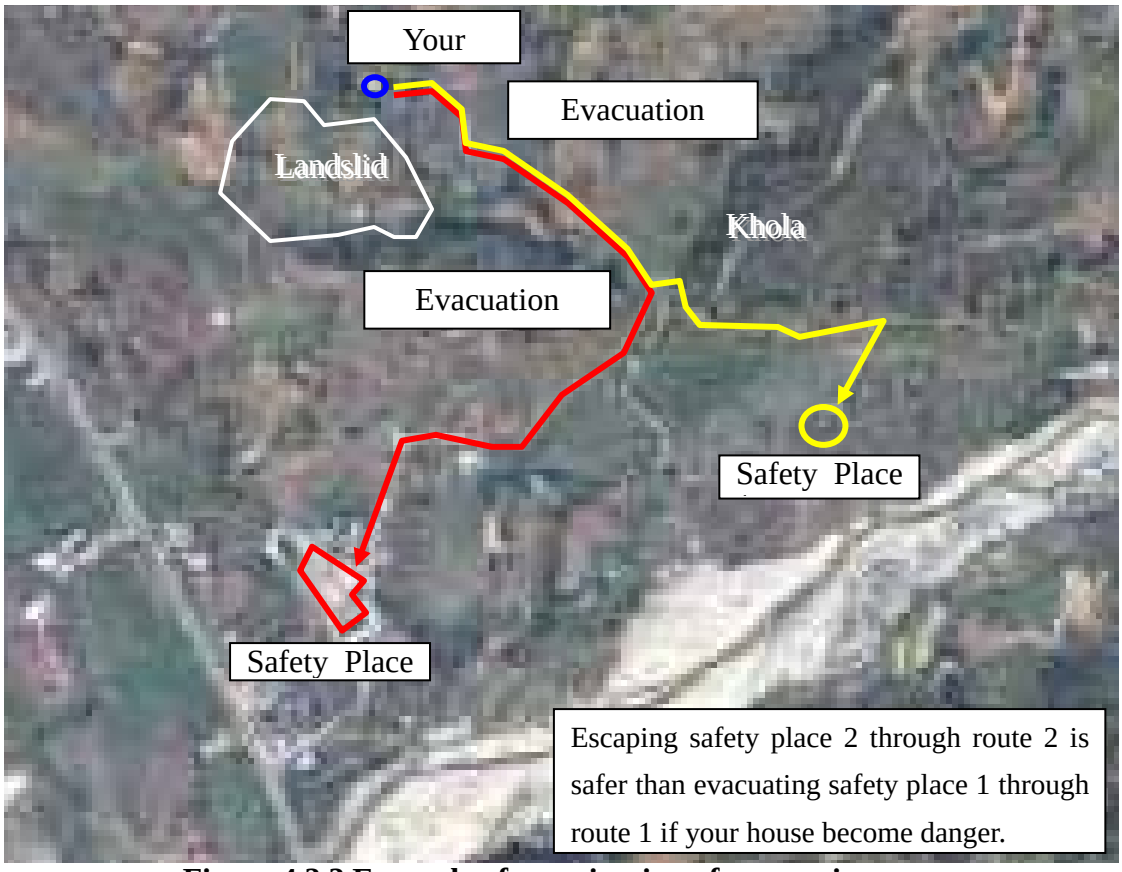


Figure 4.3.3 Example of examination of evacuation route

If there is warning notice, persons surrounding objective area have to carry out evacuation as soon as possible. Whereas, if an inhabitant finds out warning sign from nature, the inhabitant should inform to other people surrounding point of warning sing. Then, according to inhabitants' judgment, they should evacuate to safety place.

At warning notice, persons in objective area should escape to safety place/evacuation site near their points. During transfer to safety place/evacuation site, escaping persons pay attention to as follows;

- Do not be nervous

Inhabitants gathered at evacuation site do not be nervous

- Take the bag containing minimum means of livelihood already prepared.

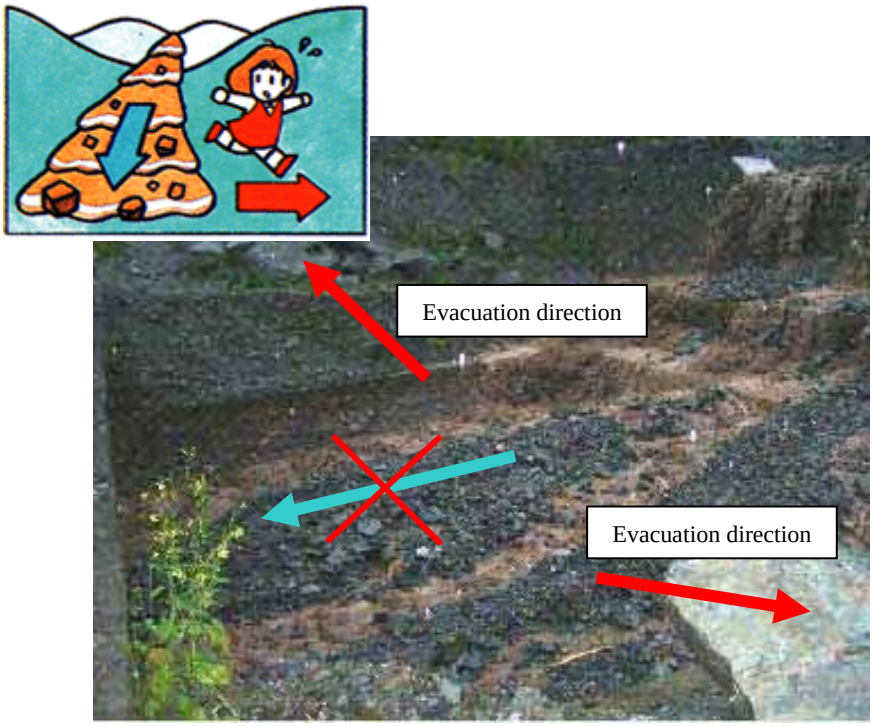
Escape bag of containing minimum means of livelihood such as water

- Primarily evacuate weakness persons such as women with baby, children and old persons.

- Do not cross stream, river and bridge, and do not swim

- Do not return abandon home soon

- If you see the landslide/debris flow suddenly, escape right or left. Never descend downward.



- Inform leaders if you see someone in trouble during disaster

Should rescue someone in trouble during disaster

(http://www.nikkei.co.jp/topic/photo5/20080614a5b6e012_14.html)

After disaster, there is a case that inhabitants must have been staying in safety place/evacuation site. Including this case, evacuated inhabitants have to pay attention to the following.

- Do not be nervous

- Provide first aid treatment to injured persons, and cooperate to take serious persons to health post/hospital.

(http://www.nikkei.co.jp/topic/photo5/20080614a5b6e018_14.html)

- Make partition/screen at evacuation site for tentative lavatory and nursing to baby, as much as possible.

Making partition for tentative lavatory

(http://www.bousai.city.chiyoda.lg.jp/disaster/info_020960.html)

(http://www.bousai.city.chiyoda.lg.jp/disaster/info_020960.html)

- Burn/Bury the dead livestock and rotten things.

CHAPTER 5

EARLY WARNING AND EVACUATION

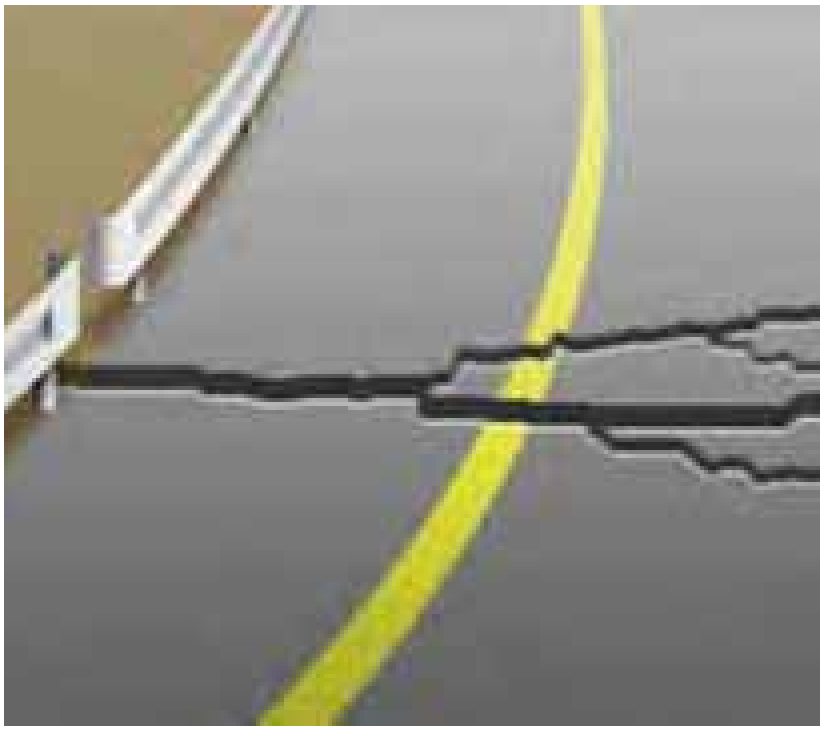
5.1.Warning Sign from Nature

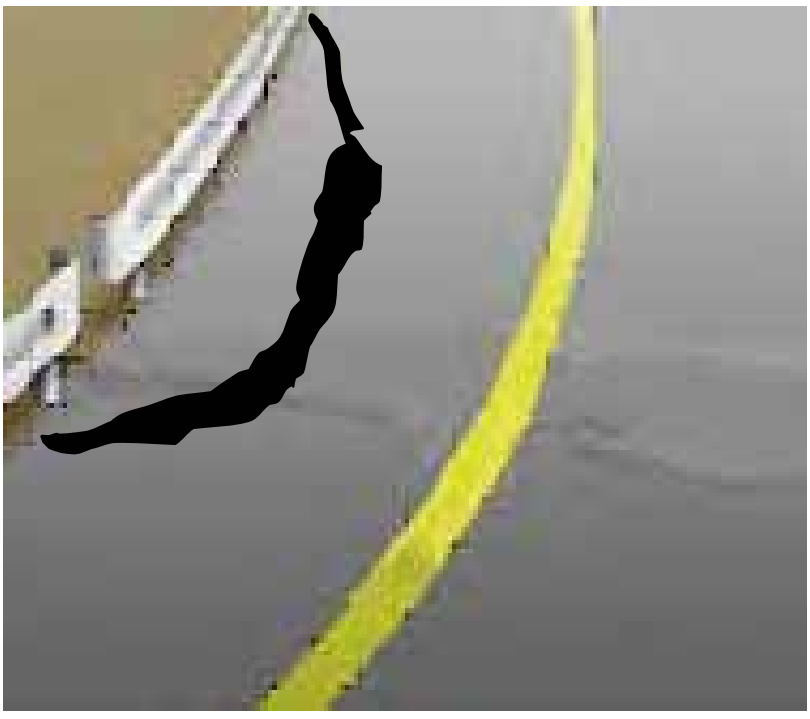
If sediment-related disaster might occur during/after heavy rain, inhabitants in objective area should escape from disaster. Then, it is important that we can grasp the warning sign from nature. Thus, in this section, warning sign of landslide, slope failure and debris flow are mentioned.

If there is warning sign from nature, inhabitants at hazardous area should prepare the escape and discovered person has to announce to other people surrounding point of warning sing. But, even if warning sign from nature is discovered, all inhabitants do not have to escape to safety place. And, there is also warning sign which doesn't always have to evacuate soon. Warning sign from nature is the one which should evacuate directly and one which disaster dose not occur rapidly. Landslide often slides slowly, so inhabitants at dangerous area do not have to escape directly in the case of a certain warning sign of landslide. But, there is similar case of warning sign at landslide, slope failure and debris flow. Thus, the inhabitants should escape to safety place according to judgment of themselves. Warning signs from nature are shown as follows;

- Warning sign of landslide/slope failure from nature;
  a) Land seen cracked, sinking or rising unevenly
  (http://www.pref.tochigi.jp/town/kasen/sabou/dosya_zencho.html)
  This warning sign is not dangerous at once, and it shows that the slope failure and so on may occur in the near future.

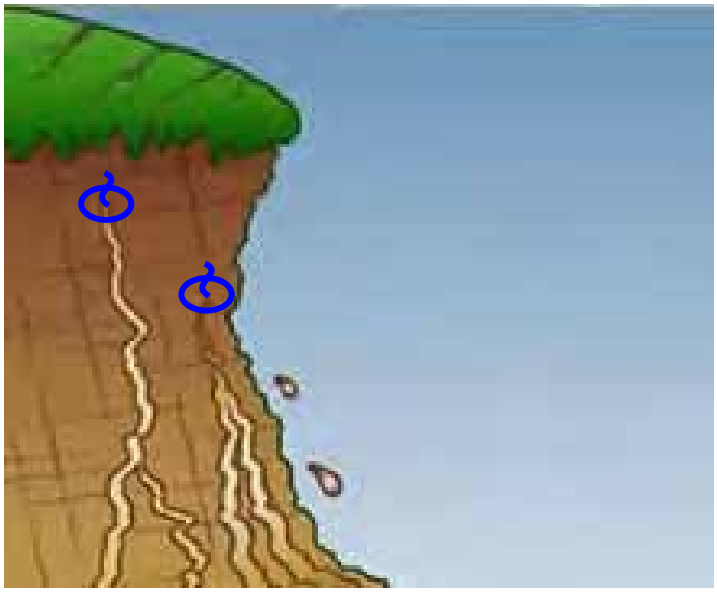
b） Crack seen in road, wall of the house
(http://dim2web03.wni.co.jp/saboyogo/standard/subegake.html)
Crack type of upper picture may be large landslide type, and it would not be dangerous at once. But, lower crack is dangerous situation.





c） Seepage water from steep slope increases or becomes more muddy water (http://dim2web03.wni.co.jp/saboyogo/standard/subegake.html)

In this case of muddy water, inhabitants should escape to safety place as soon as possible, because slope failure would occur.

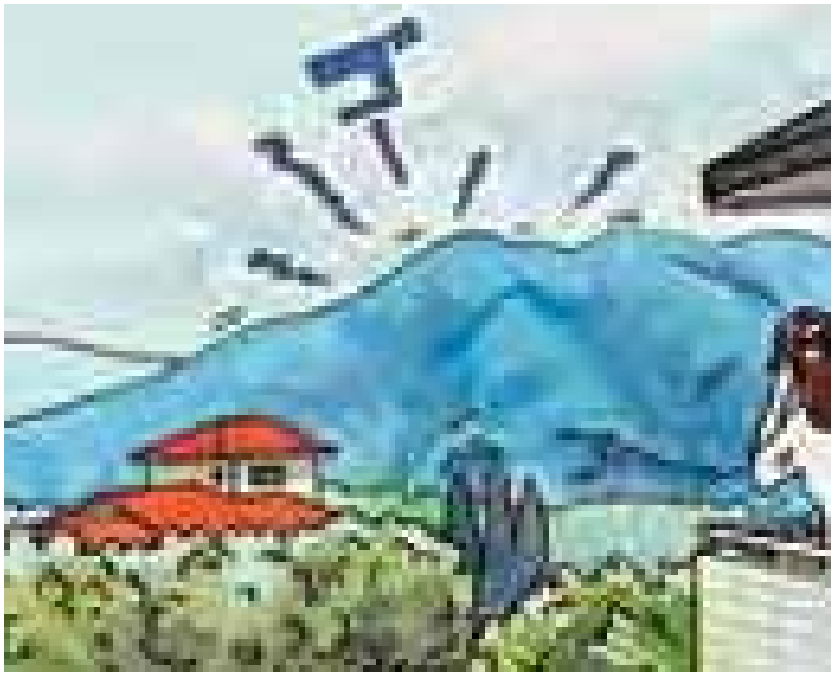


d） Small stones seen falling lightly

(http://www.pref.nagasaki.jp/sabo/webpages/zentyou.html)

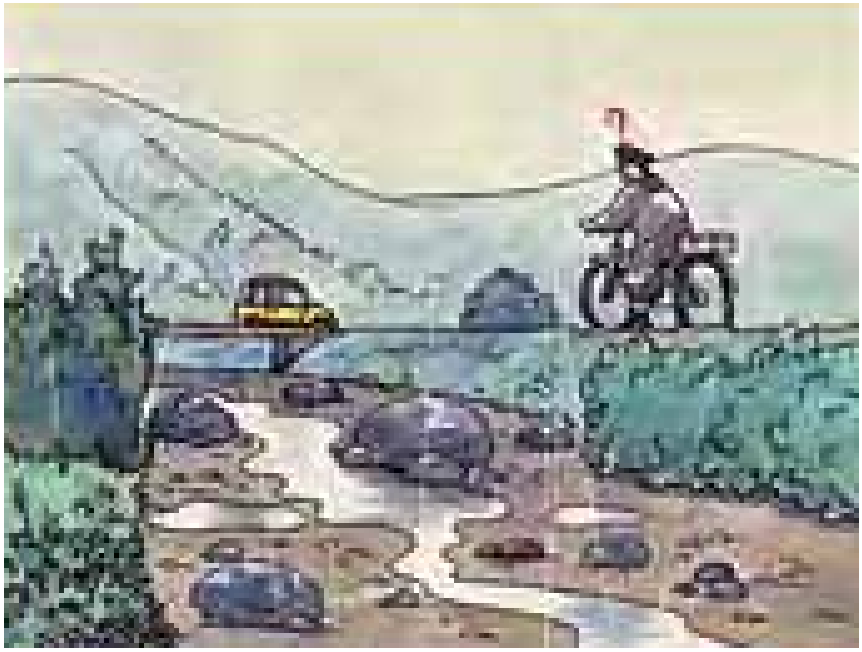
If small stones are fallen, it is dangerous near fallen stone area.

e） Unnatural sound to be heard from sloppy land and cliff
(http://www.pref.nagasaki.jp/sabo/webpages/zentyou.html)



- Warning sign of debris flow from nature;

a） Drying of streamlet suddenly even if it is rain
(http://www.pref.nagasaki.jp/sabo/webpages/zentyou.html)



b） Flow of other things along with muddy water suddenly
(http://www.pref.tochigi.jp/town/kasen/sabou/dosya_zencho.html)

c） Unnatural sound of the trembling of mountain
(http://www.pref.tochigi.jp/town/kasen/sabou/dosya_zencho.html)
It is often warning sign of Debris Flow. There are several cases of landslide

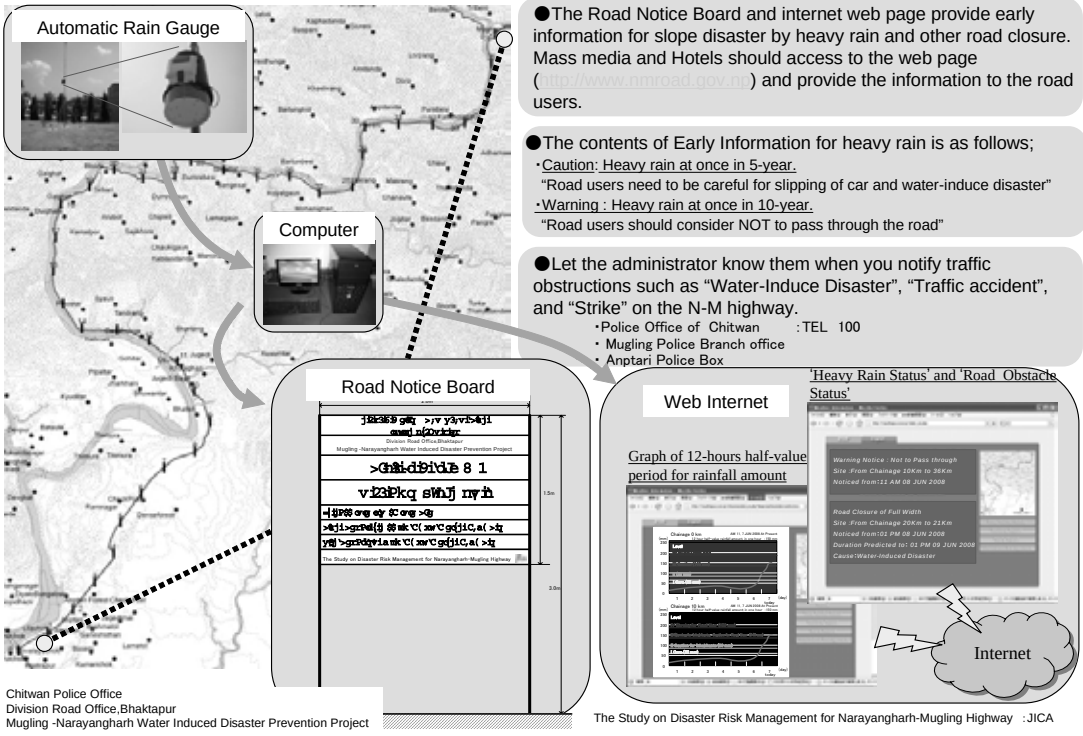
5.2.Early Warning and Evacuation System in Kabilash Village

There are disasters which have not warning sign from nature, too. In these cases, we need to grasp the other phenomena, and we should evacuate to safety place before disaster. Many sediment-related disasters occur at heavy rain usually. Thus, if we would measure the rainfall amount, we would grasp the possibility of disaster (See Figure 5.2.1). If the rainfall is over a certain threshold value, inhabitants should escape to safety place. Generally, the threshold of rainfall amount is decided, it carry out note and recommendation to villager according to threshold. It is called early warning/information system.

Figure 5.2.1 Attention to rainfall amount for the escape from disaster
(http://www.pref.kochi.jp/~bousai/kikenkuiki/index.html)

For Narayangharh-Mugling highway and Kabilash village, the early information/warning system has been installed since 2008. Traffic and disaster information system will be formulated as shown in the Figure 5.2.2. Above picture in Figure 5.2.2 is early information system for Narayangharh- Mugling highway. The rainfall amounts are measured by several rain gauges, these rain data are analyzed on computer. Using the analyzed data, judged result is shown at web internet and Road Notice Board. On the other hand, lower picture in Figure 5.2.2 is early warning/evacuation system for Kabilash village. Monitoring of rainfall as same as Narayangharh-Mugling highway is also carried out. If it is heavy rain, several warning information is communicated to each ward of village and Kalika FM. Figure 5.2.3 shows general flow of this system. And, the other aim of this system is judging of the road closure of highway and the evacuation of villager.

Narayangharh- Mugling (N-M) Highway Early Information System



●The Road Notice Board and internet web page provide early information for slope disaster by heavy rain and other road closure. Mass media and Hotels should access to the web page (http://www.nmroad.gov.np) and provide the information to the road users.

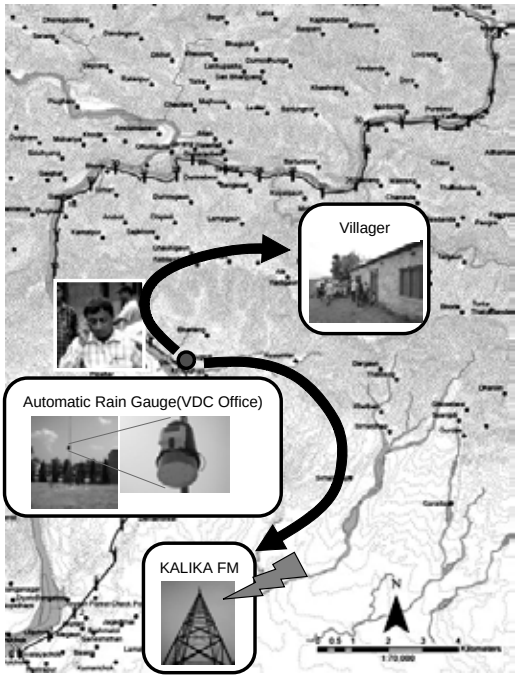
●The contents of Early Information for heavy rain is as follows;
・Caution: Heavy rain at once in 5-year.
"Road users need to be careful for slipping of car and water-induce disaster"
・Warning : Heavy rain at once in 10-year.
"Road users should consider NOT to pass through the road"

●Let the administrator know them when you notify traffic obstructions such as "Water-Induce Disaster", "Traffic accident", and "Strike" on the N-M highway.
・Police Office of Chitwan : TEL 100
・ Mugling Police Branch office
・ Anptari Police Box

Chitwan Police Office
Division Road Office,Bhaktapur
Mugling -Narayangharh Water Induced Disaster Prevention Project

The Study on Disaster Risk Management for Narayangharh-Mugling Highway :JICA

Kabilash Village Early Warning/Evacuation System



●Early information under heavy rain will be provided by Kabilash VDC and KALIKA FM.

●The contents of Early Information for heavy rain are as follows;

RECOMMENDATION of PREPARATION for EVACUATION
(Heavy rain of once every 2-year probability precipitation)

- Avoid the movement in the village as much as possible.
- The student must stay in my house or school.
- The villager who lives around the dangerous area* must prepare to evacuate in preparation for the RECOMMENDATION of EVACUATION.
- Evacuate promptly to avoid the movement at nighttime even before the RECOMMENDATION of EVACUATION after 5:00PM.

RECOMMENDATION of EVACUATION
(Heavy rain of once every 5-year probability precipitation)

- The villager who lives around the dangerous area* is strongly recommended to evacuate to the evacuation site promptly.
- When you evacuate, call neighborhood while noting peripheral safety enough each other.
- When you evacuate, take care one's feet and the sediment disaster.

*The dangerous area: A place where the disaster occurred in the village in the past and a dangerous place, etc. have been described to the hazard map newly made this time.

●When rain that the water of 5mm or more is collected to the glass in an hour continues, there is a possibility that the RECOMMENDATION of PREPARATION for EVACUATION is announced officially. Take care about warning by the rain hearing broadcasting KALIKA FM.

Kabilash Village Development Committee (VDC)
KALIKA FM

The Study on Disaster Risk Management for Narayangharh-Mugling Highway :JICA

Figure 5.2.2 Early Information/Warning System in N-M highway & Kabilash Village

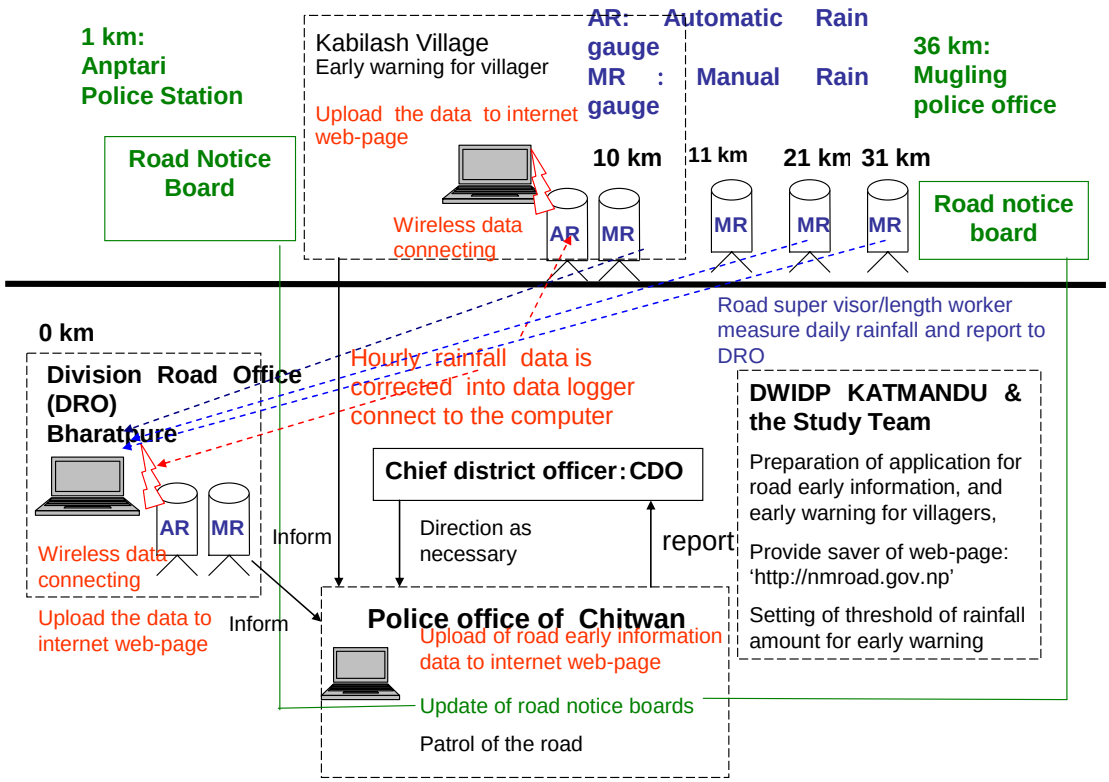


Figure 5.2.3 General flow of early information system

Early warning/evacuation system for villager is made for reducing disaster. Figure 5.2.4 shows the system of information transmission under heavy rainfall in Kabilash village. Using automatic recording rain gauge, the rainfall amount is grasped. If the rainfall amount is larger than a certain value, Kabilash village VDC must note/recommend to villager. And VDC will announce to Kalika FM. Ward leader in village would lead his ward members for warning/evacuation. It is called the early warning/evacuation system.

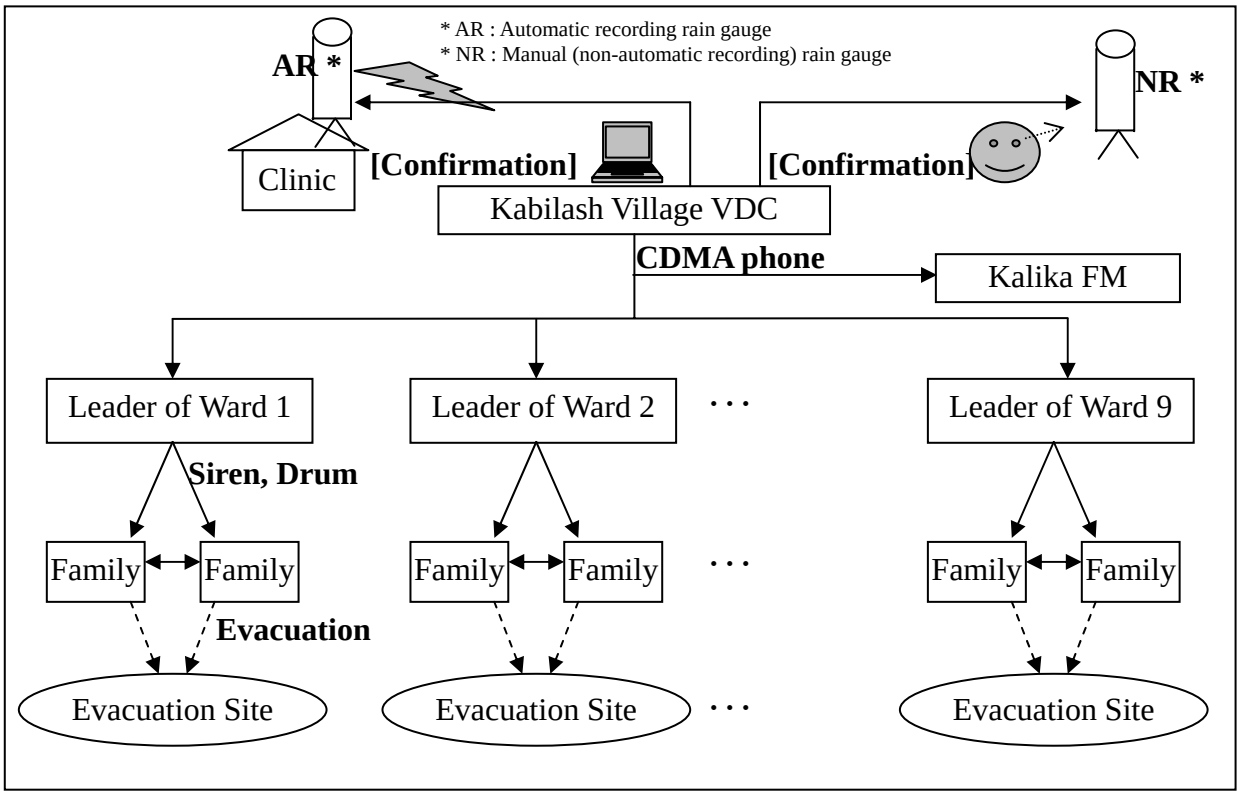


Figure 5.2.4 System of Information Transmission under Heavy Rainfall in Kabilash Village

Key of early information/warning/evacuation system is the measurement of rainfall amount. Thus, the measurement of rainfall and its method are explained as followings.

Amount of rainfall is measured by rain gauge, typically. Basic concept of rain gauge is shown as Figure 5.2.5. Rain water is gathering to upper rain cup, then gathering water shoots lower basket and shooting water swings this basket up-and-down. And, this swing number is modified at rainfall amount. Generally, automatic recording rain gauge as shown Figure 5.2.6 is made by this method. But, automatic recording rain gauge is expensive and has to be connected to computer. Thus manual rain gauge (i.e. non-automatic recording rain gauge) is used generally as shown Figure 5.2.7.

Rainfall monitoring is measured by several kinds of rain gauge at several times intervals. For example, rainfall amount is measured at one day interval so it is daily rainfall amount.

The traffic control criteria should be determined based on the historical records of traffic and highway conditions on heavy rainfall days in the past several years, as same as warning/evacuation. For example, the traffic and highway conditions on heavy rainfall days of

2003 and 2006 and conditions on recent heavy rainfall day (17 August 2007) were taken as references for traffic control criteria development. Therefore it is important to monitor the rainfall amount.

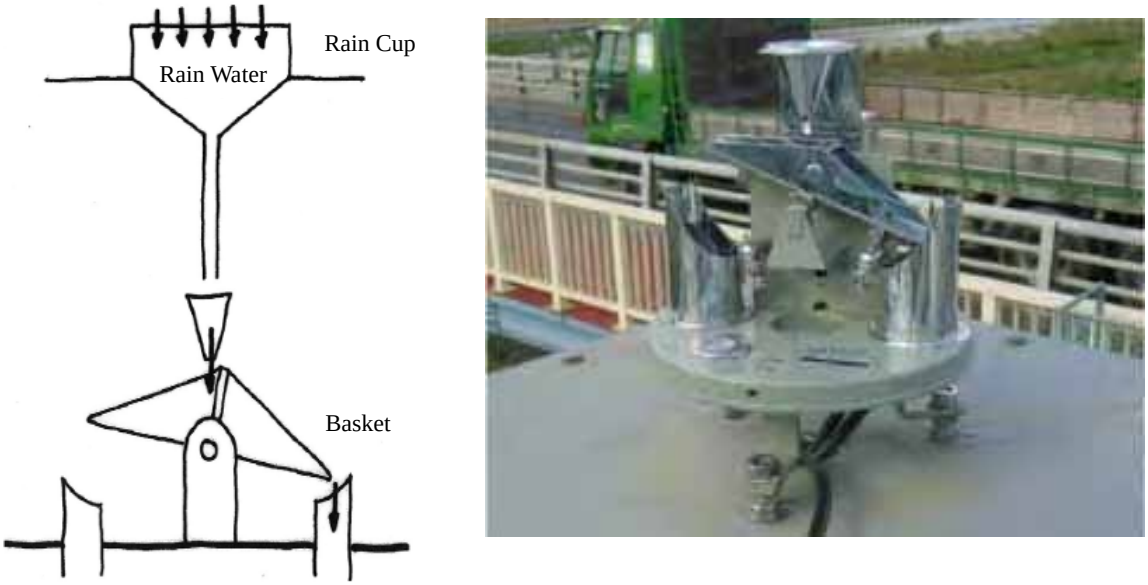


Figure 5.2.5 Schematic picture of rain gage

Figure 5.2.6 Automatic recording rain gage in Kabilash village

Figure 5.2.7 Manual recording rain gage in Kabilash village

Based upon these rainfall monitoring, member of early warning/evacuation system have to carry out to announce the notice and recommendation about sediment-related disaster. The role of each member of early warning/evacuation system in Kabilash village is shown as Table 5.2.1.

Automatic recording rain gauge (AR) is checked at everyday 8:00 AM by a team of Kabilash VDC (the name is Kabilash VDC Early Warning / Evacuation Team), in sunny/cloudy day. Whereas, in rainy day, the team checks automatic recording rain gauge at 4 times/day (8:00 / 12:00 / 16:00 / 20:00) and Manual rain gauge at once /day (8:00). Because rain condition changes time by time, rainfall amount should be monitored at several times per day.

If it is heavy rain which 12 hour half-value rainfall amount is more than 60 mm (i.e. early warning level 1), Kavilash VDC sets into care stance. In this time, VDC staffs gather at VDC office, staffs announce to ward representatives, and check / upload to web-page of modified rainfall amount every one hour.

If it is heavy rain which 12 hour half-value rainfall amount is more than 80 mm (i.e. early warning level 2), Kavilash VDC pay attention to disaster occurrence, it becomes set up the Caution Notice . In this time, VDC Secretary declares recommendation of preparation for evacuation, and VDC staffs inform Caution Notice to each Ward Representatives, Police Office (PO) and Division Road Office (DRO)

Whereas, if it is heavy rain which 12 hour half-value rainfall amount is more than 140 mm (i.e. early warning level 3), Kavilash VDC Secretary declares recommendation of evacuation, VDC staffs informs Warning Notice to each Ward Representatives, PO and DRO, as quickly as possible. In this time, Ward Representatives inform Warning Notice to inhabitants by siren, drum and so on. Then inhabitants transmit warning information to neighborhood by walking, and they should escape to safety place (i.e. evacuation site) as soon as possible.

Above explained threshold of early warning by modified rainfall amount is summarized at Table 5.2.2. And, action flow at each early warning level shows Table 5.2.3.

For above mentioned, it is an example of Kabilash village, according to the condition of objective area, early warning/evacuation system should be modified. If there is not automatic recording rain gauge at objective area, system with other rainfall monitoring needs to be set up. And, since the early warning/evacuation system is carried out appropriately, it is necessary to train. Figure 5.2.8 shows the situation of evacuation drill.

Moreover, rainfall amount is different of each point, so warning by this rainfall amount is a certain standard one. At a certain point of ward, if it is much heavy rain, villagers near/on dangerous place should escape to safety place according to themselves judgment. Thus, it is important that villagers understand the dangerous place, ward leader should inform to such villager.

Table 5.2.1 Role of Each Member of System in Kabilash Village

Players	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 ✓ Rescue injured persons and aid treatment them
(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
(6) Villagers	✓ Inform Caution Notice / Warning Notice to neighborhood ✓ Grasp the situation of evacuation

Table 5.2.2 Threshold of early warning by modified rainfall amount

Early warning level	Threshold of rainfall	Action
Level 1	12 hour half-value rainfall amount = 60mm (1 year return period)	Set into care stance - 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 of evacuation
Level 3	12 hour half-value rainfall amount = 140mm (5 year return period)	Warning Notice - Recommendation of evacuation

Table 5.2.3 Action flow at each early warning level

Early warning level	Action of each players
Before Level1	■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)
Level1 Set into care stance	■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 (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
Level2 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

Level3 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)

Figure 5.2.8 Situation of drill about early warning/evacuation
(Up: Explaining of drill, Low: Informing of notice by CDMA Phone)

XIII

DRILL MATERIALS

Plan of Joint Training Exercise

on

Early Information and Warning System

in N-M Highway, Kabilash Village and its Vicinity Area

26th June 2008

JICA Study Team/Counterpart Team (DWIDP &DOR)

Chitwan Disaster Management Partnership Committee

Workshop and Joint Training Exercise on Early Information and Warning System in N-M Highway, Kabilash Village and its Vicinity Area

For

The Pilot Projects ;

N-M Highway Early Information System

And

Early Warning and Evacuation System of Kabilash Village

Agenda

1. **Date/Time: 26th June, 2008 From AM 8:00 – 16:00**
2. **Place: The Royal Century Hotel 4th Floor Seminar Room;**
   Bharatpur Heigt, Chitwan, Tel: 56-525865
3. **Registration 8:00- 8:30**

(Facilitator; Dr. R Tuladhar; Superintending Hydro-Geologist, DWIDP)

4. **Agenda:**

4.1 Seminar/Workshop

(1) Opening Address by Mr. Ratna Raj Pandy; CDO, Chitwan District 8:30- 8:35

(2) Pilot Project on Early Information/Evacuation System and Significance of Joint Training; by Mr.masatoshi Eto; Team Leader, JICA Study Team 8:35-8:40

(3) Outline of Early Road Information System and Disaster Management of Kabilash Village By Mr. M. Mori, JICA Study Team 8:40- 8:50

(4) Plan of Operation of Each Implementing Unit 8:50- 9:05

A) Road Office Unit by Mr.Bijaya Chapagain, Engineer, Road Office Bharatpur
B) Kabilash Village Unit by Ms. Saraswoti Adhikari; Coordinator, Kabilash VDC
C) Police Office Unit by Mr.Prakash Malla

(5) Method and Schedule of Joint Training Exercise

By Mr. M. Mori, JICA Study Team 9:05-9:15

(6) Directive Address on Exercise

By Mr.Ghyan Bikram Shah; SP, District Police Office 9:15-9:20

- Coffee Break; 9:20-10:30/Preparation of exercise -

-

4.1 Joint Training Exercise

(1) Joint Training Exercise 10:30-14:30

-Come back to the hotel 15:30-

(2) Review and Evaluation for the Exercise 15:30- 16:00

a) Road Office Unit by Mr.H.Bhurtel Engineer, Road Office Bharatpur
b) Kabilash Village Unit by Ms. Saraswoti Adhikari; Coordinator, Kabilash VDC
c) Police Office Unit by Mr.Prakash Malla

(3) Discussion on Early Information and Warning System 16:00- 16:30

(4) General review and evaluation by Mr. Rashi Ram Dhakal

(4) Closing Remark: by Mr. Ratna Raj Pandey; CDO, Chitwan District 16:30-16:45

- Fellowship Banquet 17:00-18:30-

Participants List of Workshop and Joint Training Exercise on Early Information and Warning System in N-M Highway, Kabilash Village and its Vicinity Area for The Pilot Projects: N-M Highway Early Information System and Early Warning and Evacuation System of Kabilash Village

Date: 26th June, 2008 from 8:00 AM – 16 PM
Place: The Royal Century Hotel Meeting Room; Bharatpur Height, Chitwan

S. No.	Name	Designation	Organization	Remarks
1	Mr. Ratna Raj Pandey	CDO	Chitwan District	
2	Mr. Gyan Bikram Shah	SP	District Police Office	
3	Mr. Prakash Mall	Inspector	District Police Office	
4	Mr. Depandra Shah	In-charge	District Traffic Police Office	
5	Mr. Madan K.C.	S.I.	District Traffic Police Office	
6	Mr. Krishna Bd. Chhetri	A.S.I.	District Traffic Police Office	
7	Mr. Rajendra Sharma	Division Chief	DOR, Chitwan	
8	Mr. Bijaya Chapagain	SDE	DOR, Chitwan	
9	Mr. Humakanta Bhurtel	Engineer	DOR, Chitwan	
10	Mr. Pradhubna K. Khadka	Secretary	Kabilash VDC	
11	Mr. Ajaya Paudel	Staff	Kabilash VDC	
12	Ms. Saraswoti Adhikari	Staff	Kabilash VDC	
13	Mr. Bhakta Bd. Gurung	Staff	Kabilash VDC	
14	Mr. Suk Man Tamang	VDC Staff	Kabilash Ward 9	
15	Mr. Lok Nath Bhandari	Secretary	Chandibhanjyang	
16	Mr. Nilkantha Lamichane	Secretary	Darechowk	
17	Mr. Hira Bd. Gurung	Disaster Member	Ward 4	
18	Mr. Bhowa Bd. Gurung	Teacher	Kabilash Ward 1	
19	Mr. Sher Bahadur	Disaster Member	Kabilash Ward 9	
20	Mr. Khadga Bd. Lama	Disaster Member	Kabilash Ward 9	
21	Mr. Santosh K. Shrestha	Disaster Member	Kabilash Ward 1	
22	Mr. Tanka Gurung		Kabilash VDC	
23	Mr. Soroj Pandit	Project Manager	NMWIDPP	
24	Mr. Pathak	Engineer	NMWIDPP	
25	Mr. Misra	Engineer	NMWIDPP	
26	Mr. Ramesh Tuladhar	Team Leader/Nepali	DWIDP	
27	Mr. Rajendra Sharma	Hydrologist	DWIDP	
28	Mr. Tanka Upreti	Coordinator	RRN, Chitwan	
29	Mr. Anjit Gurung	Staff	RRN, Chitwan	
30	Mr. Suresh Chaudhari	Staff	RRN, Chitwan	
31	Mr. Prabin Kharel	Student		
32	Ms. Sharada Kharel	Student		
33	Ms. Sarita G.C.	Student		
34	Mr. Madhav Sigdel	Student		
35	Mr. Suresh Rajbhandri	Technician	Preesu Electronic	
36	Mr. Roshan Shrestha	Technician	Preesu Electronic	
37	Ratna Pd. Sapkota	Board Member	Sahamati	
38	Kabiraj Gurung	Coordinator	Mother Society, Ward 4	
39	Mr. Jeevan K.C.	Project Manager	Practical Action	
40	Mr. Tritha Pd. Sharma	Journalist	Local Newspaper	
41	Mr. Narayan Dhungana	Reporter	Kalika FM	

42	Mr. Manoj Panta	Program Report	Kalika FM	
43	Mr. M. Eto	Team Leader	JICA Study Team	
44	Mr. M. Mori	Team Member	JICA Study Team	
45	Mr. H. Ohno	Team Member	JICA Study Team	
46	Mr. Y. Numata	Team Member	JICA Study Team	
47	Mr. T. Matsuo	Team Member	JICA Study Team	
48	Mr. J. Kitagawa	Team Member	JICA Study Team	
49	Mr. Sujan Raj Adhikari	Geologist	JICA Study Team	
50	Mr. Amar Shah	Staff	JICA Study Team	

1. Purpose

Purposes of the training exercise for N-M Highway Early Information System and Early Warning and Evacuation System are as below.

a) Certification of Operability of Early Information System Devices

b) Trial application of planned information network

c) Training of operating computers in each implementing unit; DPO, RDO, Kabilash Village

d) Response of Drivers

e)Response and behavior of Villagers warning information

2. Outline of Information System

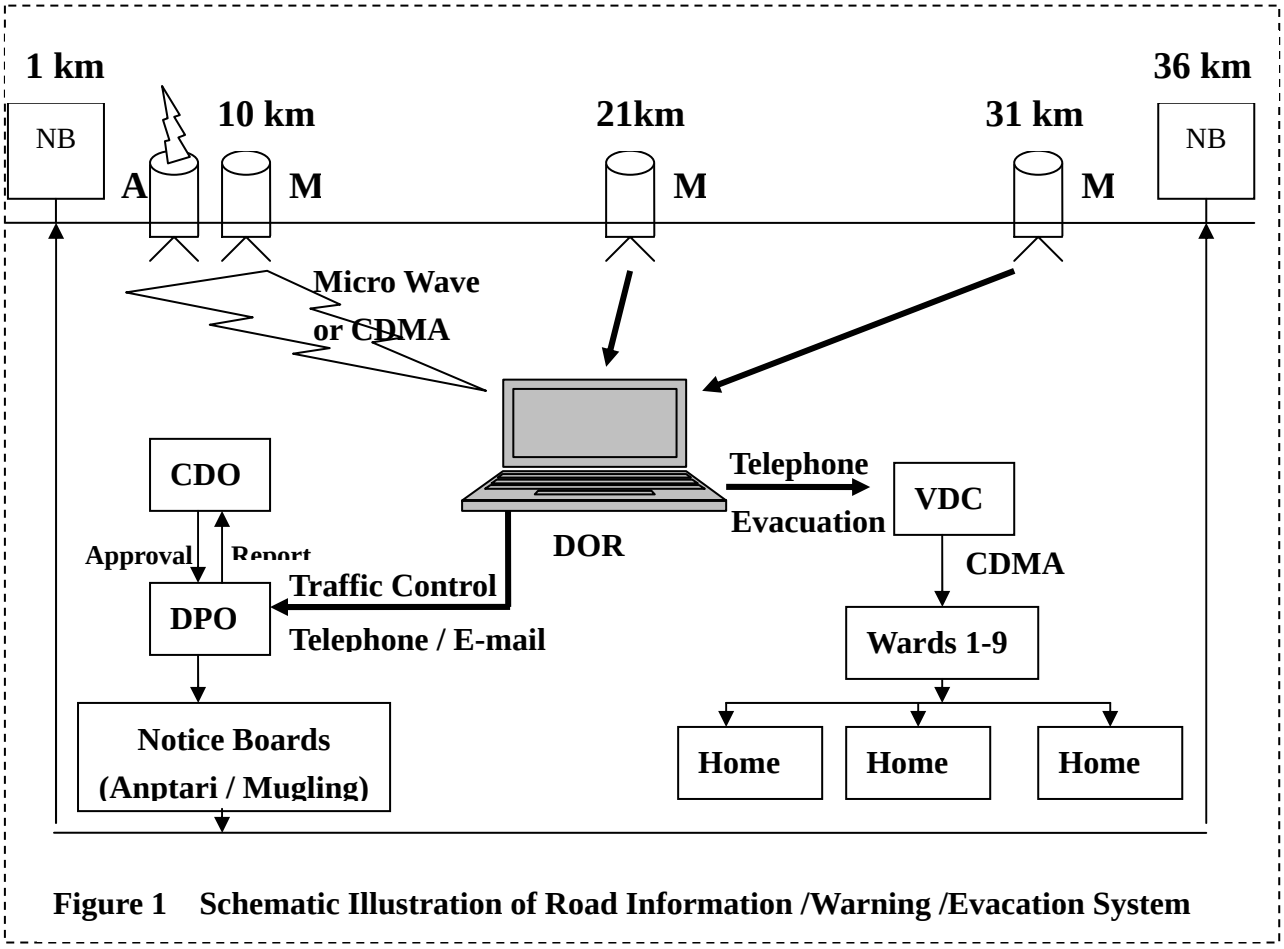


Figure 1 Schematic Illustration of Road Information /Warning /Evacation System

2.1 Methods of Information Collection

- Automatic rain gauge: dangerous rainfall intensity and pattern /Report by drivers and passer-by/Patrol of ROD/DPO

2.2 Method of Information Notice

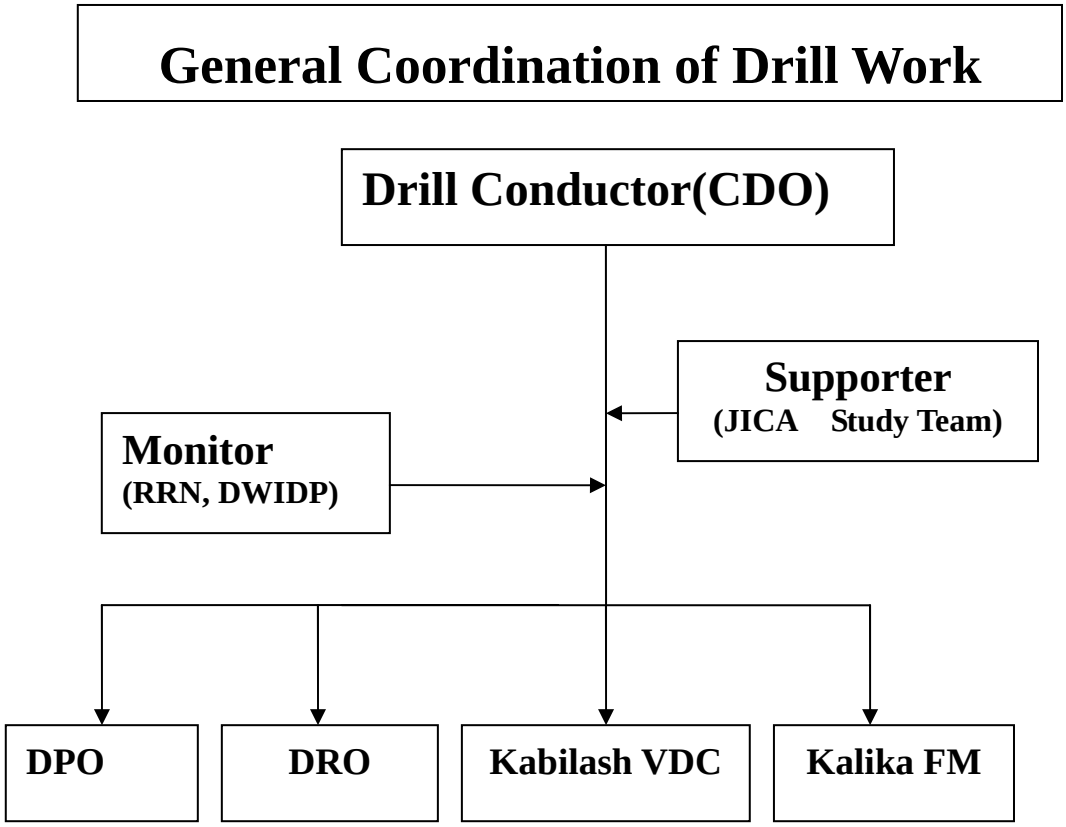
- Notice board/Web page (http://nmroad.gov.np)/CDMA phone

  Radio broadcast(kalila FM; 95.2 and 91Mhz

2.3 Operation Organization

- Dictrict Police Office, Chitwan
- Division Road Office, bharatpur
- Kabilash VDC and Disaster Management Group

3. Organization of Drill

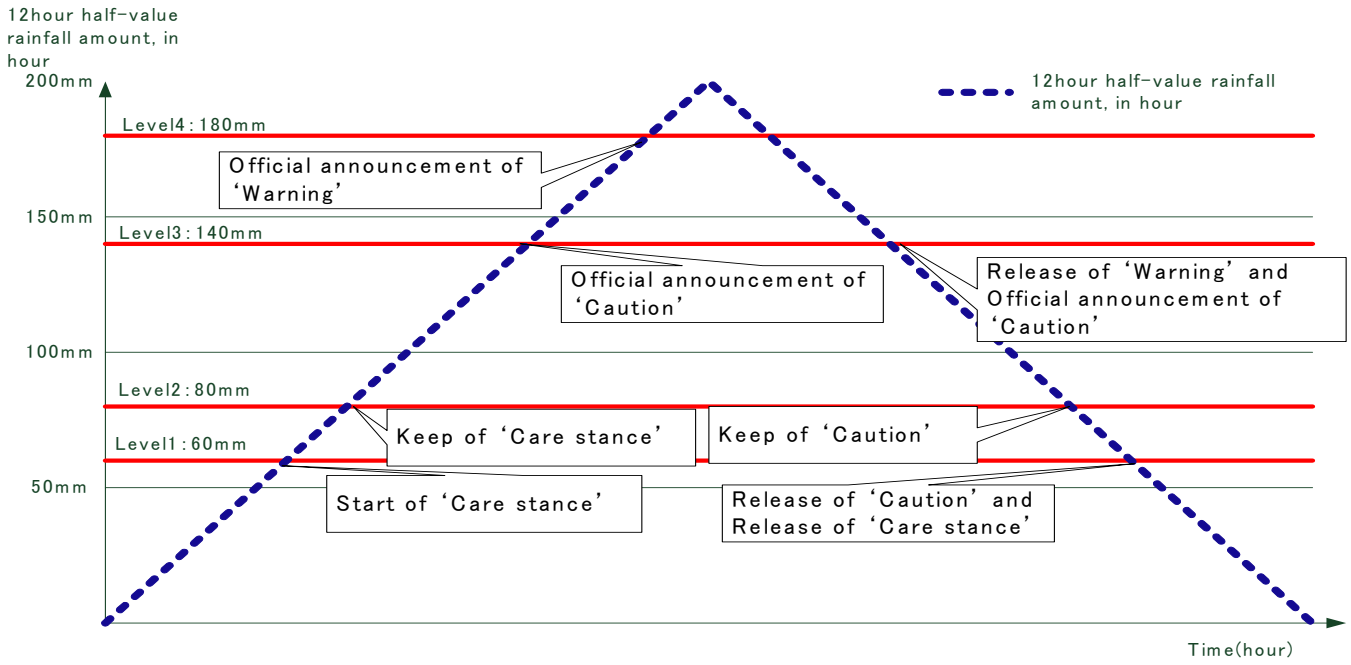


4. Role of Organzation

The role for each organization on Drill on June 26th

Organization	Role	Implementation Group	Supporter
District Police office(DPO)	1. Collect urgent information for road traffic obstacles 2. Patrol/Inspection/judgment about road traffic obstacles. 3. Update information for notice boards. 4. Disseminate information by internet web-page 5. Urgent response to road traffic obstacles.	- Information Receiver - Decision maker - Computer operator - Board updater - Patrol	JICA study team (Computer operator) RRN (Hearing for road user)
Divisional Road office (DRO)	1. Monitor automatic rain gauge and manual rain gauge at DRO office. 2. Report road traffic obstacles to police office/station. 3. Patrol/Inspection/judgment about road traffic obstacles for road user. 4. Urgent response to the road disaster.	- Computer operator - Decision maker - liaison - Patrol - Data collecter	JICA study team (Computer operator)
Kabilash VDC	1. Monitoring of automatic rain gauge and manual rain gauge at Kabilash VDC. 2. Report road traffic obstacles to police office/station. 3. Patrol/Inspection/judgment about road traffic obstacles for inhabitants. 4. Urgent response to the road disaster.	- Disaster education/Hazard map Team	**MNDWIDPP (Information provider)** JICA study team (Computer operator) RRN (Hearing for inhabitants)
Supervisor / Length worker	1. Report road traffic obstacles to police office/station	- Finder	
Inhabitants / Road user	1. Report road traffic obstacles to police office/station	- Finder	
Media Association (Kalika FM)	1. Broadcast information of traffic obstacles/early warming under heavy rain by radio.	- confirmer for Web site	

5. Time Schedule



Time		District Police Office (DPO)	Division Road office (DRO)	Kabilash VDC	Kalika FM	Inhabitants A
11:00	Rainfall warning Level II		Upload rainfall graph Inform to police	Upload rainfall graph Inform to police/Kalika FM		
11:20					Caution notice for Kabilash VDC	
12:00	Rainfall warning Level III	Caution notice for driver	Upload rainfall graph Inform to police	Upload rainfall graph Inform to police/Kalika FM		
12:20		Caution notice for driver by notice boards and web-pages			Warning notice for Kabilash Villager	
13:00	Road closure of partial width due to water-induced disaster at Ch 21km+200					Inform to Police TulBahadur Gurung

13:05		Dispatch Patroller, Inform division DRO				
13:10			Dispatch argent action staff			
13:20		Road traffic obstacle notice by notice board and web-page				
13:30	Reopen on Ch 21km+200		Inform to police			
13:35		Dispatch patroller				
14:00	Rainfall warning level 0	Revise road traffic obstacle notice for driver	Upload rainfall graph Inform to police	Upload rainfall graph Inform to police/Kalika FM		
14:20		Remove warning notice for driver			Announce warning notice for Kabilash VDC is removed	

Workshop and Joint Training Exercise on Early information and warning system in NM Highway, Kabilash Village and its vicinity area for the Pilot Projects: Early Road Information System and Disaster Management for Kabilash Village

Date / Time: 26th June, 2008 From AM 08:00 – 17:30
Place: The Royal Century Hotel Meeting Room, Bharatpur Height, Chitwan

Dr. R. Tuladhar, Superintending Hydro-Geologist, DWIDP
He firstly welcomed all the participants. And he detail talked about the purpose of meting and gave the introduction to the Agenda.

Mr. Ratna Raj Panday; CDO, Chitwan Distict
In his opening address, he welcomed all the participant and requested to help as much as they can on today drill to support the system.

Mr. M. Eto,Team Leader JICA Study Team
He had highlighted what's the main purpose this joint training work and request the entire participant to support on this work

Mr. M. Mori, JICA Study Team
He mainly focused on road early information system and Disaster management system of Kabilash VDC and its major significance during the time of disaster.

Mr. Bijaya Chapagain, Engineer, Divisional Road Office, Bharatpur
He talked about the plan of operation of divisional road office during and after disaster and also highlighted how they are using the system

Ms. Saraswoti Adhikari, Staff, Kabilash Village development committee.
She talked about the previous disaster that has occurred in the village and also talked about the plan of operation of Kabilash Village development committee during and after disaster and also highlighted how they are using the there system.

Mr. Prakash Malla, Inspector Distict Police office Bharatpur
He talked about the plan of operation of District Police office during and after disaster and also highlighted how they are using the system.

Mr. M. Mori, JICA Study Team
At this point he talked about the method to carry out today joint exercise and the time table of each assignment.

Mr Ghyan Bikram Shah, SP, District Police office, Bharatpur
He emphasized that this type of system is useful for mitigation of disaster. He personally request each and every member in the system to conduct there role as much as they can.

Joint Training Exercise: 10:30- 14:30

Mr H Bhurtel, Engineer, Divisional Road Office, Bharatpur
He told that in the beginning there was some confusion in the work but finally they run the system smoothly and the entire staff member who participate in this work conduct their duty well.

Ms. Saraswoti Adhikari, Staff, Kabilash Village development committee.

She told that there was no problem in the work, from the being the system work perfectly and they conducted all thing which is written in the schedule with out any hassle.
Not only had this she also emphasize Villager of Ward 1, Ward 5 and Ward 6 participates well in the evacuation system. And FM Media had done very good job, without there support this evacuation was not successful in those area which do not have telephone facility. She also requested to the main authority to speak with Nepal Telecommutation, to increase there service in these area. She also told that as this program have to be run from VDC and as they have small budget in VDC they required some JICA Fund to run this system smoothly.

Mr. Prakash Malla, Inspector Distict Police office Bharatpur
He told that in the beginning there was some confusion in the work but finally they run the system smoothly and the entire staff member who participate in this work conduct their duty well.
He wants to shear major problems that had been observed during today exercise.
1. The time was too short.
2. understanding and communication problem with Mugling traffic police
3. No action from DRO side, even when police patrol was in main side of disaster
4. Problem in Notice board. Lots of nuts and bolts, better to have sliding one for changing notice quickly
5. No light in notice boards so how people see what is there in night time
6. There should be fixed person in this network from, Kabilash VDC, DRO, DPO and Kalika FM, so that there is smoothness in the system or there should be fixed telephone number only for this case.
7. Communication Frequency problem in the road corridor from DPO

He praised the Kabilash VDC that they run the system smoothly. And also told that DRO and DPO have to improve their work to manage the system well.

Question and Answer, Discussion:

Mr. Bhob Bahadur Gurung Teacher Kabilash VDC
He and his follow villagers are happy with the system, the main problem of this system is shearing the information, as many wards don't have communication facility so only FM is the main source now but every time people are not tuning the radio so he suggested to have CDMA facility in every ward in VDC so that any one can have the information in easy way. He also said that there are now three management committees in this system from VDC, early information and evacuation system, disaster education and hazard map, and simple countermeasure and plantation but to run this committee for long lasting they required some fund.

Mr. Pradhun Kumar Khadka, VDC Secretary, Kabilash VDC
The major issue to run this system is the fund so if any parties help then in generating fund then they can run this system for long-lasting period.

Mr. Pandit, Project Manager MNDWIDP, Bharatpur
He admire the whole network system and information release of today drill. So for the long lasting case all the organization in this network must be work jointly and there should be good collaboration between DRO, DPO, Kabilash VD and Media.

Mr Ghyan Bikram Shah, SP, District Police office, Bharatpur

As today is the first time this network is running in the context of Nepal so there are lots of high and lows. But we have to learn form all mistake and there should be good teamwork between DRO, DPO, Kabilash VD and Media to run the system smoothly. He also highlighted that some intensive should be there so that all the staff member in this system work better and they can run this program for long lasting period. He also highlights that is only before the disaster period but for the case of main disaster, evacuation and relief should also added in this system.

Mr. Bhupal B. Niraula, LDO
He thanks the study members for the implementation of disaster mitigation project in both Naraynghar-Mugling Highway and Kabilash Village development Committee. He also thanked the participants that they conduct their duty very well in today's drill. And also suggested them to do more than this in the real time and long lasting of this system. As this is the new technology in the context of Nepal so everybody should understand what there main role is. District development committee will also help as much as they can to run this system smoothly. This system is for only early warning.

Mr. M. Eto,Team Leader JICA Study Team
He wants to say four things, Thanks to all the participants without there support this drill was not successful. He say Sorry to every one that only 90% work is successful the rest 10% have problem. He also promised that when he will be back in Mid November 2008, during this period he will talked with Japanese government and Nepal government to reduced those incompleted demand and finally suggest all to help this system run smoothly as much as they can from their side**.**

Dr. Ramesh Tuladhar Team Leader counter part Team, DWIDP
He gives the vote of thanks to the entire participant and suggests every one who is in the system to work properly and perfectly.

Mr. Ratna Raj Panday; CDO, Chitwan Distict
In his closing address, he thanks the entire participant that they conduct their duty well in this drill. But he wants to see more action in the real situation. He recommends that every person have to know there own responsibility towards the society.

XIV

LANDSLIDE AND RAINFALL MONITORING

XIV. LANDSLIDE AND RAINFALL MONITORING

In this chapter, landslide movement is evaluated with result of the rainfall amount and pipe strain gauge measurement along Narayangharh-Mugling Highway.

The rainfall monitoring in 2008 was started. Study team has monitored the amount of the rainfall with automatic raingauges and manual raingauges in rainy season. The landslide potential is considered with the rainfall.

During rainy season in 2008, maximum modified rainfall amount is 52 mm in Kabilash Village and 36mm in Division Road Office, Bharatpur as shown in Table 14.1. These data are smaller than the value expected as one hour return period (60 mm). Moreover, the date of Kabilash village is generally bigger than division road office Bharatpur.

Table 14.1 Amount of rainfall in rainy season in 2008

Rainfall monitoring site	Start from	Maximum modified rainfall amount	Monthly Rainfall (mm)				
			JUN	JUL	AUG	SEP	OCT
Division Road Office, Bharatpur	30 MAY 2008, 3:00 PM	36 mm 29 AUG 2008, 1:00 AM	151 mm	340 mm	286 mm	100 mm	36 mm
Kabilash Village 11km from Bharatpur	14 JUNE 2008, 4:00 PM	52 mm 2 AUG 2008, 9:00 AM	-	399 mm	421 mm	161 mm	38 mm

Figure 14.1 and Figure 14.2 shows modified rainfall amount of 12 hour-half value of DOR and Kabilash Village in June to October, 2008 respectively.

To monitor the movement of landslide, pipe strain gauges have been put into the ground. Figure 14.3, 14.4 and 14.5 shows the relationship between the daily rainfall amount in Kabilash Village and the results of pipe strain measurement records of Landslide-1 (SL-1), Landslide-3 (SL-3) and Landslide-4 (SL-4) on N-M Highway respectively. Judging from the results of the pipe strain gauge, it has not shown any kinds of hazardous movement. The hazardous movement was evaluated by Table 14.2 which is the criteria for evaluation of the landslide potential in general.

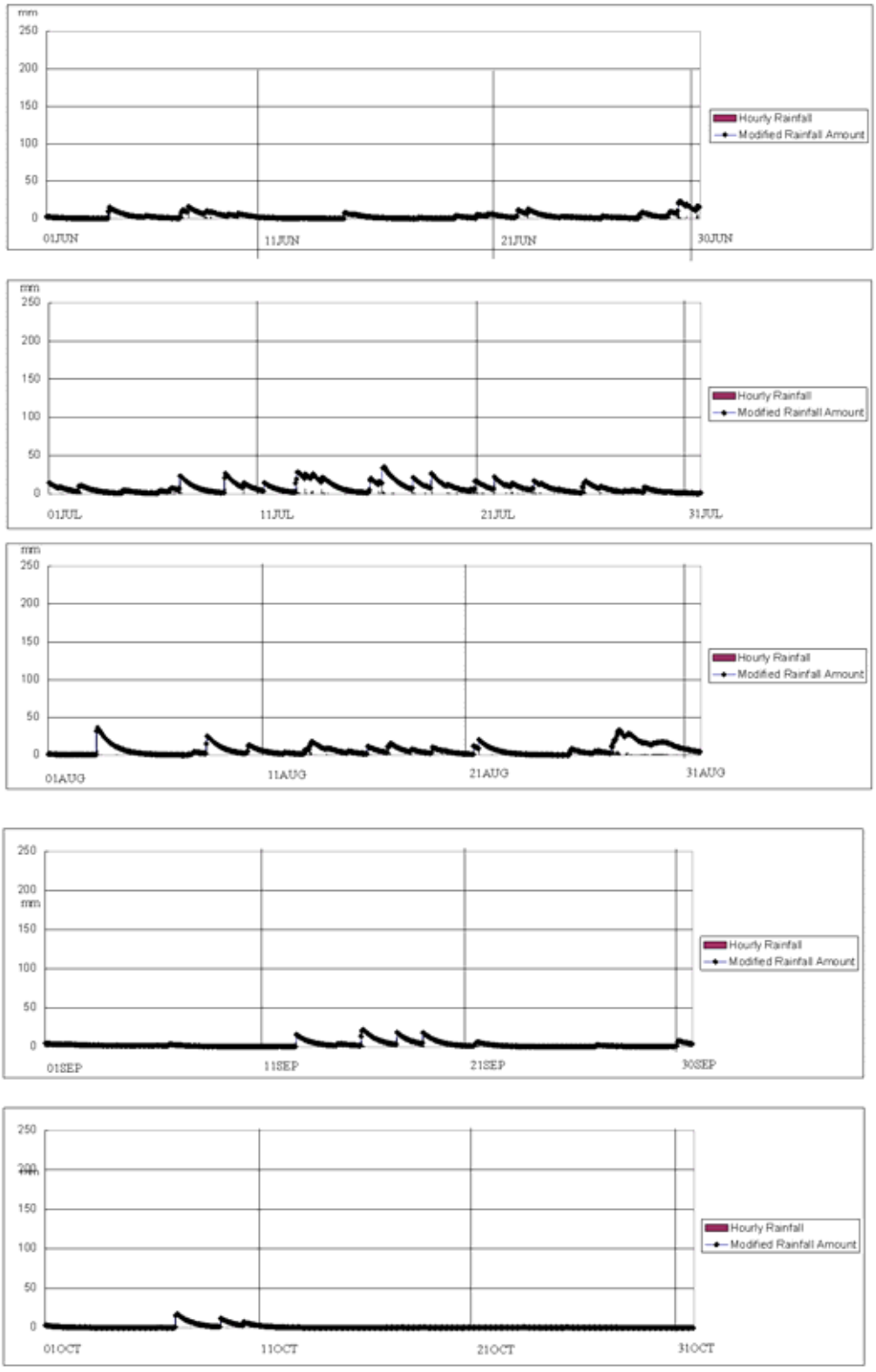


Figure 14.1 Modified Rainfall Amount of 12 hour-half Value of DOR (JUN-OCT 2008)

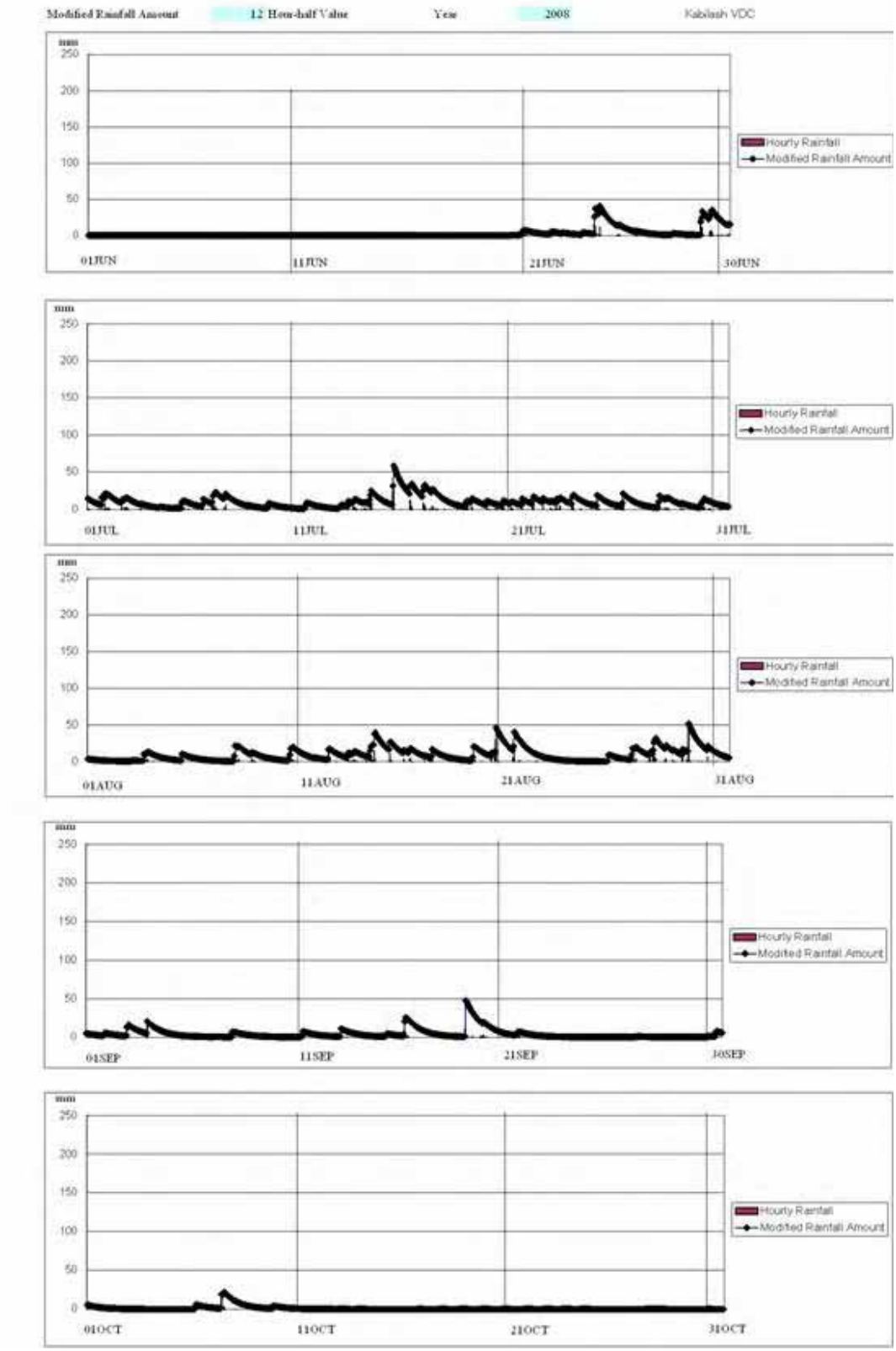


Figure 14.2 Modified Rainfall Amount of 12 hour-half Value of Kabilash Village (JUN-OCT 2008)

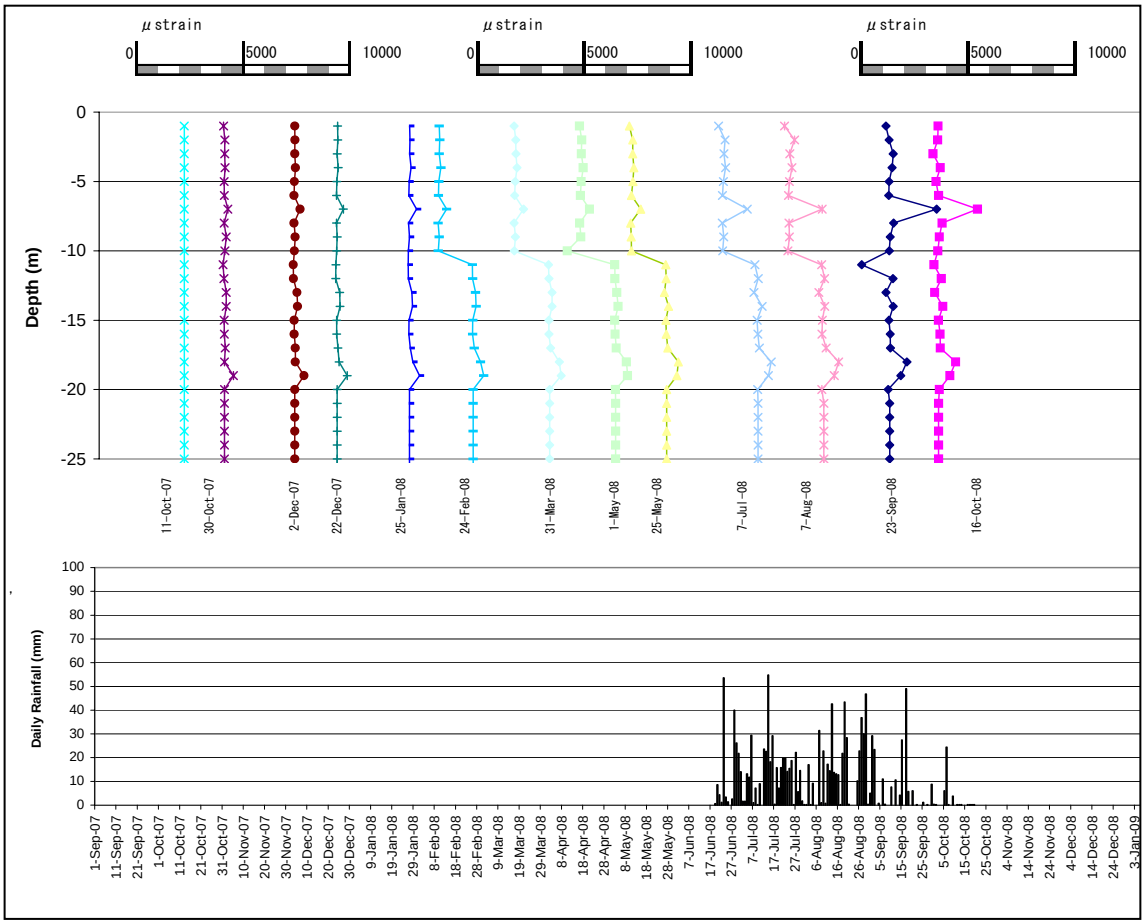


Figure 14.3 Pipe Strain Measurement Records of SL -1 and daily rainfall amount in Kabilash Village

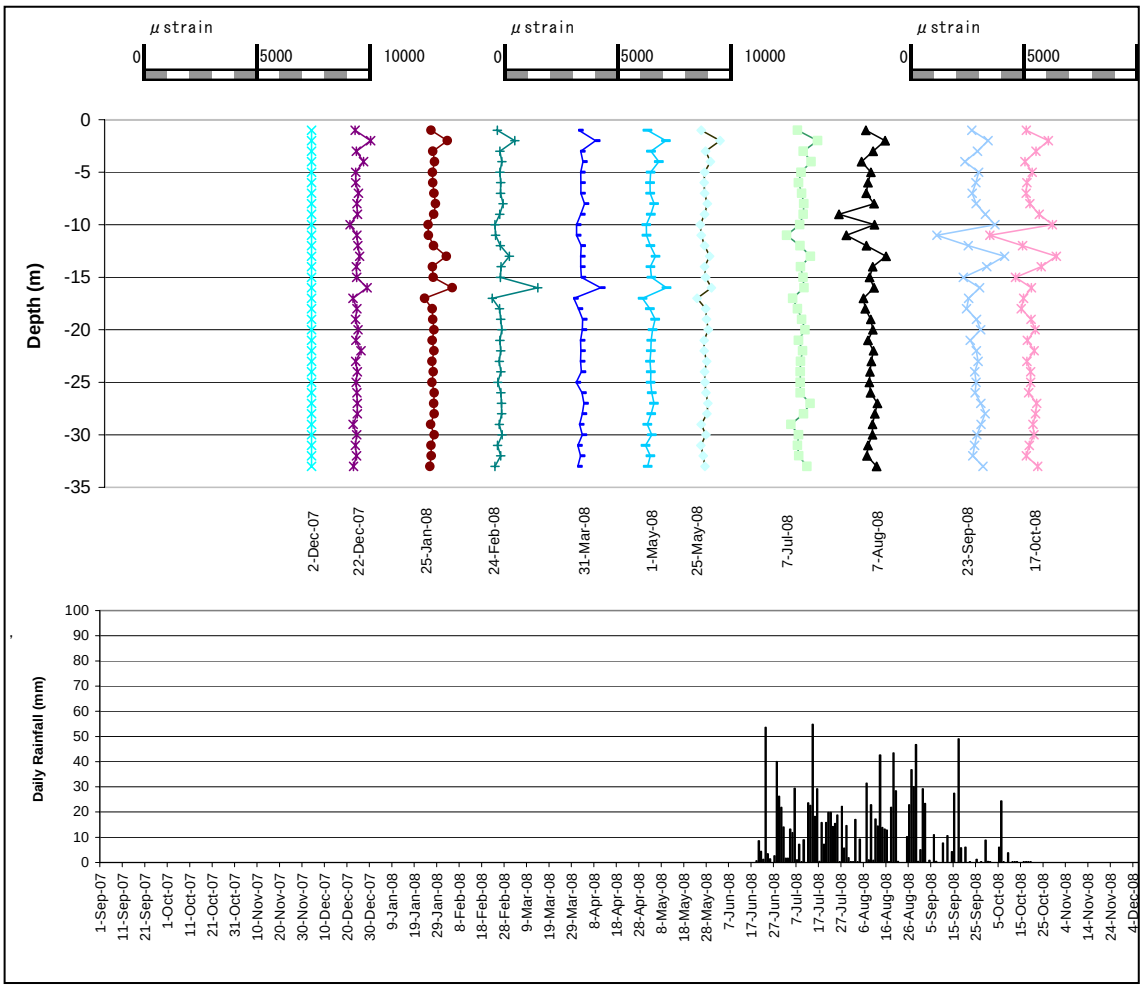


Figure 14.4 Pipe Strain Measurement Records of SL -3 and daily rainfall amount in Kabilash Village

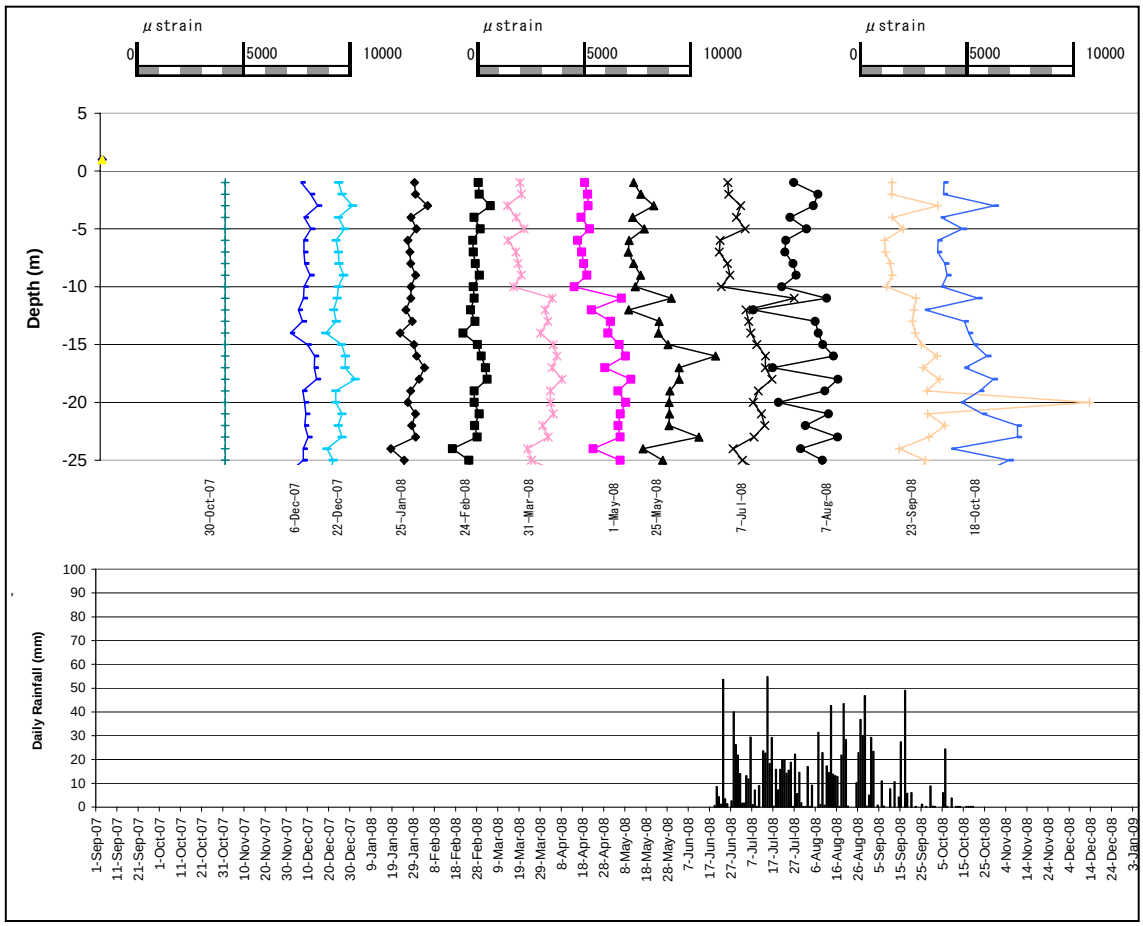


Figure 14.5 Pipe Strain Measurement Records of SL -4 and daily rainfall amount in Kabilash Village

Table 14.2 Evaluation of Observational Result

Classification of Movement	Value of accumulation (μ/month)	Variability Characteristics		Topographic and geological possibility of existence of slip surface	Overall judgments	
		Tendency of accumulation	Status of moving		Classification of slip surface	Activity and Type of landslide
A	Over 5,000	Very High	Accumulative	Possible	Determined	Active Rock Landslide－Debris Landslide
B	Over 1,000	High	Accumulative	Possible	Quasi-determined	Slowly moving creep
C	Over 100	Low	Accumulative /Intermissive /Destabilizing /Regressive	Possible	Potential	Impossible to conclude existence of slip surface. Need to continue observation.
D	Over 1,000 (Short term)	Nothing	Intermissive/ Destabilizing/ Regressive	None	Abnormal	Slip surface is not existent. Caused by except landslide.

Source: Landslide Japan

XV

RELATED LAW AND REGULATION

XV. LIST OF RELATED LAW AND REGULATION

Year	Name	Road/Disaster Management sections
1971, 1989 (1st revision)	Nepal Road Standard 2027 1st revision 2045	- Nepal Road Standard (2027) shall apply to all roads constructed with in Kingdom of Nepal. - The roads should be designed for the stage construction and that the standards should be framed on the same principle. - It is not feasible to improve the standard of a road by very small increments and it is normal practice to design and construct new roads and improvements works to withstand the estimated traffic at some future date. In Nepal, this forward period shall be 10 years.
1999	Environmental Management Guidelines, Department of Roads, Geo-Environmental Unit, July 1999	- A properly formulated and well coordinate public participant program communicates to local resident the adverse impact as well as the benefits resulting from road construction, maintenance, and rehabilitation. - Involvement of local people is likely to result in more sustainable projects with the people feeling a sense of local ownership, social acceptability and commitment to maintaining the road.
1999	Local Self Governance Act, 2055	Section 28: Functions, Duties and Powers of Village Development Committee: <u>Relating to Irrigation and Soil-erosion and River Control:</u> - To prepare programs on soil-erosion and river control that affects the village development area and to implement or cause to be implemented the same. <u>Relating to Forests and Environment:</u> - To afforest or have afforestation in barren land, hills, steppe and steep land and in public land. - To prepare programs in respect of forests, vegetation, biological diversity and soil conservation and to carry out or cause to be carried out the same. - To make various programs on environment protection and to carry out or cause to be carried out the same.
2002	National Transport Policy 2058	**<u>Strategy</u>** - The government shall clearly indicate the limit and scope of work to be done from the central level and take responsibility of transport structure to be constructed from the central level. - Making the decentralization governance system more strengthened and by maximum utilizing the source and means of local level, the development and promotion of transport system shall be done from the local level itself. **<u>Policy</u>** - To manage the organizational structure as to develop the capacity self reliance for arrangement of source of investment in the construction, repairing maintenance and strengthening of the transport infrastructures and operate the same by providing required services. - High priority shall be given to completing construction of the road connection all 75 district headquarters of the country to the main road network. - Special attention shall be given to the maintenance and repair the existing transport infrastructure to ensure that appropriate service levels are sustained. - Priority shall be given to maintain and upgrade of transport

Year	Name	Road/Disaster Management sections
		infrastructure of the central level on the basis of traffic density and economic consideration. **Action Plan** - All transport services shall be considered as an essential service. - A Road Transport Authority, by merging the Department of Roads and Department of Transport Management, shall be established in order to make the road transportation and transport management self-governing and self-reliance.
2003	Reference Manual for Environmental and Social Aspects of Integrated Road Development	**Stakeholder Role and Responsibility** - All stakeholders should work together in coordinate fashion, as a term, to assure integrated and environmentally and socially sound development. - Local stakeholder group need to be familiar with all relevant E&S (Environmental and Social) aspects and activities before, during and after construction so that they will involved and well prepared for the opportunities and benefits, as well as disturbance, change and other adverse impact that new roads and road upgrading activities may cause. - One or more district or municipality representative shall participate as an active project implementation team member along with road agency staff, consultants, contractors and NGOs. **Environment Management Action Plan and Monitoring** - Environment Management Action Plan with specific mitigation plan is best prepared during detailed design phase. EMAP mainly focuses on mitigation. Special consideration must be given to the protection of community resource where adverse impacts are avoidable, or there mitigation where adverse impact are unavoidable, as well as to group that relay on them for their livelihoods, or who use them on ritual or social occasion. **Social Action Plan** - Many new road projects as well as project for road improvement, watershed protections have adverse impacts on certain population groups. The impacts may lead to involuntary resettlement, loss of livelihood, increase in the cost of living, significant alternation in the social and physical environments, and some time all these, so it is necessary to clearly identify the affected groups and formulate measure to avoid adverse impacts. **Resettlement Action Plan** - Compensation is provided to property owners for the loss or degradation of there property.
2007/08 -2009/10	Three Year Interim Plan	- It is adopted the planned road asset management system for sustainable, reliable and safe road transport operations by preserving the existing road asset through prioritized implementation of repair, maintenance, rehabilitation and reconstruction of roads and bridges.