ANNEX - 5

COMMUNITY DISASTER EVACUATION SYSTEM

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

FINAL REPORT

Supporting Report

Annex-5 : Community Disaster Evacuation System

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1. BASIC CONCEPT OF EVACUATION SYSTEM IN THE CDPP AREAS

1.1 Basic Concept

As mentioned in Chapter 1 of Annex-2, the main objective for community disaster evacuation system is to minimise the human damages due to mountainous disasters such as landslides, debris flows, slope failures and floods. The concept of evacuation system is that the people shall escape from the energy of disasters with less structure measures. In the engineering viewpoint, the disaster prevention measures were usually taken to assume the design force of the disasters and to design the countermeasures which is more stronger than the design force. However, the design force of disasters in the Study Area would be quite big, and the massive structures will be required to meet the design force if such structural engineering approach is taken. It will be resulted too expensive to be viable in the rural economical viewpoint.

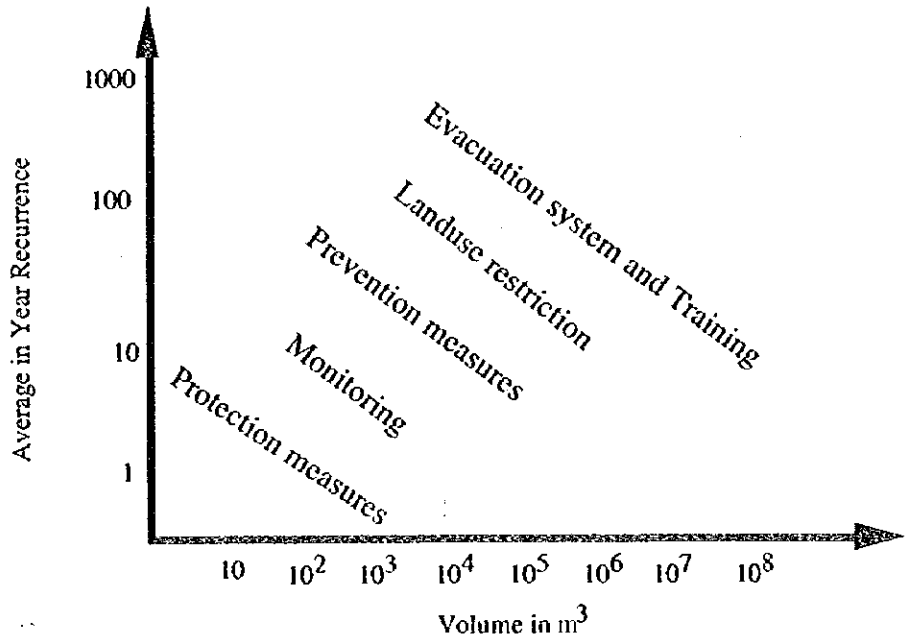
Considering the above, it was proposed to be taken the three different approaches in the Community Disaster Prevention Plans, which are consisted of :

1) Disaster prevention approach,
2) Disaster mitigation approach, and
3) Disaster evacuation approach.

The prevention approach is according to the structural engineering viewpoint, and the design of the disaster prevention structures will be determined in the minimum required design force. It will be expected to be effective immediately but only within the range of the design disaster scale. The mitigation approach is aiming at reduction of disaster potential in the area, which means that the occurrence of disaster would be smaller by the mitigation measures such as gabion works, hillside works as well as bioengineering works. In such approach, there will be no design calculation. And it will not be clear the effects in quantity in a short time, but it must be highly effective to reduce the disaster potential in the long term viewpoints. Combining with the mitigation approach, the prevention measures would be more effective in the long term viewpoint.

Under such conditions, the evacuation approach will be in the very important roles. The main objective is to minimise the human damages under the less reliability in the prevention as well as the mitigation measures.

The following figure shows the role of the prevention measures (structural measures), the mitigation measures (bioengineering and forest management measures) and the evacuation measures:



Schematic Concept of Disaster Prevention Measures

As shown in the figure above, the evacuation system will cover the larger scale of disasters which cannot managed by the protection measures as well as the mitigation measures although the physical facilities such as farm land, rural infrastructures cannot save by the evacuation measures.

1.2 Importance of Evacuation System in Nepal

The community disaster evacuation system will be played quite important role of disaster management activities in Nepal. The whole country of Nepal has generally high potential of mountain disasters such as debris flows, landslides, slope failures as well as the floods. On the other hand, the structural countermeasures against the disaster potential are almost noting in the mountain and river sides. There are some disaster mitigation measures such as gabion protection works, bioengineering works and hillside tree plantation works and so on. However, such disaster mitigation measures would effect in the long term viewpoints, and there is less reliability in the engineering viewpoints. Moreover, there are millions of such high hazardous areas in Nepal in the view of topography and geology. And it is not possible to provide structural countermeasures for all the dangerous areas in a short time.

On the other hand, the disaster evacuation approach is sometimes quite effective without any preventive structures. In the previous experiences, the timely evacuation activities made no human damages although the physical disaster damages were quite big.

In the case of July 1993 disaster, there are no human damages at Bhainse villages in Makwanpur district, which is located along the Tribhuvan highway, around 17 km north

from Hetauda. The Hetauda bridge crossing over the upper Rapti river along the Tribhuvan highway was completely washed out, and also Kulekhani No.2 hydropower plants were severely damaged in Bhainse village. However, there were no human damages at the community. The debris flow which made damages to the bridge, hydropower stations as well as the residential areas, attacked the community at 9 o'clock p.m. on July 19, 1993, but all the villagers have already evacuated to the bank office which is located on the higher portion of the community. There is an army camp located in the community to guard the hydropower station. The army instructed to the villagers to evacuate the bank at 8 o'clock, one hour before the occurrence of the disaster.

In the case of Bhainse village, the army's knowledge of the disaster potential made possible to realise the effective evacuation activities. On the other hand, most of the villages have no such opportunities to be supported by the army, police or other educated people. The importance for evacuation system is therefore that the people in the area shall fully understand the hazard potential of their village, and they shall notice that where is the safer zone in their village, and when and how to evacuate at the emergency case. For getting such knowledge, effective awareness and education system will be required. The government is highly expected to have such roles to minimise the human damages by the disasters. In the people's side also, it is highly required to form the community disaster evacuation committee to assess the evacuation system under the technical support from the government. The human damages by the disaster shall be minimised by the disaster evacuation measures.

1.3 Procedures of System Design

Figure 1.3.1 shows the procedures of system design for community disaster evacuation system. Prior to proceeding the system design, the hearing survey for respective community is carried out. The survey aims to investigate the actual evacuation activities and patterns which were done at the 1993 disaster by the people. Based on the survey results, the judgement of existing evacuation will be made in the technical viewpoints. Then, the problems in the existing evacuation activities are listed up, and to assess the solutions.

In parallel to the hearing survey at site, the advanced evacuation system in Japan will be investigated. Based on the investigation results, the aspects which can be applied in the system design in Nepal shall be found for improvement of the existing evacuation activities in the Study area.

Based on the both investigation results, the optimum solutions for the major issues in the existing evacuation activities in the communities are proposed and the community disaster evacuation system planning will be carried out. In the planning stage, it is considered that the application of appropriate technologies with adequate reliability in the proposed system taking into account the various successful and unsuccessful experiences in the evacuation system of Japan.

2. INVESTIGATION OF EVACUATION SYSTEM

2.1 Hearing Survey for Existing Evacuation Activities

2.1.1 Survey Method

Hearing survey is carried out in October 1996 for grasping the detail of evacuation activities in the three communities, Phedigaon, Namtar and Chisapani at the time of July 1993 disaster. Each 50 households scattered in the community are selected in the three communities for collecting information according to the questionnaire as shown in Table 2.1.1, which is consisted of 15 questions. The detail of the results are in Attachment A5-1. The location of sampled houses are shown in Figure 2.1.1 for Phedigaon and Chisapani, and Figure 2.1.2 for Namtar respectively.

There are two main objectives of the hearing survey as shown below:

1) To find out the existing evacuation pattern of the people,
2) To find out the destination and procedures of evacuation activities.

2.1.2 Results of Hearing Survey

Tables 2.1.2 through 2.1.4 summarise the results of the hearing survey for three communities of Phedigaon, Namtar and Chisapani respectively. The results of the hearing survey is presented below for the major questions:

In Question 2 of the questionnaire, the caste of samples are shown. According to the survey, it was found that the destination of evacuation doesn't depend on the caste, and there will be no problems to stay in the same evacuation shelter in different caste in the case of emergency. The local people clearly answered that there will be no difficulties to stay the same place in the different caste at the emergency case.

In Question 6, whether the evacuation activities have made or not is asked. According to the survey, 56% of Phedigaon, 62% of Namtar and 100% of Chisapani made actions for evacuation. It is remarkable that all the sampled household in Chisapani evacuated to somewhere, which indicates that the effective evacuation system would be highly respected as the countermeasures against disasters in Chisapani.

In Question 7, the timing of evacuation activities is asked. According to the survey, many people in Phedigaon and Namtar have evacuated in the evening or the night. On the other hand, about 90% of the samples in Chisapani have evacuated in the evening or the next morning, and nobody made actions in the night. The heaviest rainstorm occurred at 4 o'clock in the evening at Tistung as shown in Figure 2.1.3, and it seems that the evacuation at the next morning is not timely for effective evacuation activities. On the other hand, topography in Chisapani is so steep and it is completely dark at night due to no electricity. Considering the above, it is assumed that people in Chisapani could not make actions at night due to difficulties in physical conditions, and they have to wait until next morning for commencing evacuation activities.

In Question 8, the reasons for making evacuation activities are asked. The survey results indicate that the most of them decided to evacuate because of observing abnormal disaster phenomena such as heavy rain, occurrence of landslides or slope failures, and flush floods in the stream nearby the residences. Based on the above results, it was understood

that the many of villagers can identify the abnormal natural phenomena in the village, and that triggered to determine to evacuate by themselves.

In Question 9, the destination of evacuation place was asked. Figures 2.1.4 and 2.1.5 describe the survey results of the origin and destination of the evacuation activities in Phedigaon/ Chisapani and Namtar respectively. The results indicate that many villagers decided the evacuation destination prior to the evacuation actions, and they have their own safety zones in their viewpoints. The safety zones as well as the dangerous zones listed up by the villagers are shown in Figures 2.1.4 and 2.1.5. The distance of the evacuation route is generally within 150 m for Namtar, within 400 m for Phedigaon and within 200 m in Chisapani. However, some villagers in the eastern part of Chisapani have evacuated about 1 km away crossing over the mountain ridge due to flooding in the stream to the western safety area. In Namtar, those who live on the river terrace evacuated from the edge to the centre of river terrace with the distance about 300 m to 600 m. In the mountain area such as Phedigaon and Chisapani, it tends to evacuate from the lower area to the upper area of the slope. In the river terrace such as Namtar, they are generally evacuating from the edge to the centre of the river terrace. Such tendencies are reasonable in the view of disaster mechanism.

In Question 10, the unit of evacuation activities is asked. According to the survey, most of the villagers made evacuation actions by family, except Chisapani. In the case of Chisapani, some groups consisted of the neighbours are tentatively formed and made evacuation actions by the group.

In Question 11, the location of dangerous areas to the disasters are asked. The raised dangerous areas by the villagers are shown in Figures 2.1.4 and 2.1.5, and which are almost covered with the high hazard areas defined in the Hazard Maps which are shown in Annex-1.

In Question 12, the reasons not to evacuate are asked. According to the survey, there are two major reasons for not to evacuate as below:

1) Because, they don't know where to evacuate,
2) Because, they feel that staying is much safer than evacuating somewhere.

Based on the above results, to show the safer zones in the community against disasters from the technical viewpoints would be effective for the villagers to identify the proper destination for evacuation. In addition, it was seen that some villagers didn't evacuate for saving elders or livestock which cannot evacuate by themselves.

In Question 13, the necessity of evacuation system is asked. According to the survey, all the samples insisted on the necessity of the evacuation system.

In Question 14, the location of the safety zones in the community are asked. Figures 2.1.4 and 2.1.5 show the locations of safety zones identified by the villagers. They have clear reasons why the identified places are safer than others in the viewpoints of topography and landuse conditions. The selected safety areas by the villagers are almost within the non-hazard areas defined in Hazard Map in Annex-1. However, the detail assessment of the safety of the evacuated places should be done and some alternative evacuation places may be required.

In Question 15, the ownership of facilities such as TV, radio and watch are asked. According to the survey, about 60% of samples own the radio and watch. It seems that

weather forecasting information through radio broadcast would be effective for some disaster preparedness activities.

2.1.3 Assessment of Current Evacuation Activities in the Communities

Based on the results of hearing survey, the current evacuation activities in the Study area are assessed. The following issues were revealed in the engineering viewpoints by respective process of evacuation activities:

(1) Disaster Forecasting or Assuming Process

a) Villagers can identify the abnormal phenomena of natural conditions prior to the occurrence of disasters.

b) Disaster forecast by measurement of rainstorm would be quite useful, but it will take time to accumulate the data and to analyse the correlation between rainfall pattern and the occurrence of disasters.

c) The appropriate measures for assuming disasters in prior shall be found based on the observed abnormal natural phenomena by the villagers.

(2) Criteria for Evacuation Activities and Timing of Evacuation

a) Finding the abnormal phenomena of natural conditions, such as heavy rainstorm, landslides and flooding are the criteria for activating evacuation.

b) Many villagers in Phedigaon and Namtar have made evacuation activities prior to the occurrence of disasters.

c) Many villagers in Chisapani have evacuated in the next morning. It was not timely evacuation activities, and it would be required to provide the alternative criteria for evacuation activities to make the earlier evacuation activities.

d) Reason for delay of evacuation in Chisapani is due to the occurrence of landslide in midnight.

e) Some villagers have decided to evacuate by seeing the collapse of the house nearby. This is too late to commence the action of evacuation. Some other criteria would be required for timely evacuation activities.

(3) Evacuation Route and Destination

a) About 70% of villagers recognised the appropriate evacuation destinations prior to the disaster occurrence, and those who live in the safer area recognised well that the evacuation activities are not required for them.

b) To aware the results of hazard mapping would be quite effective for functioning the proper evacuation activities.

c) Evacuation activities are mainly done by family or neighbouring families. Under such condition, planning unit for system design would be preferable by family or neighbouring families.

d) The routes from the origin to the destination for evacuation are not proper in many cases. The safer route should be introduced in the view of disaster mechanism.

e) The destination of evacuation are mainly private houses or schools in the safer areas, and it was observed that some villagers were force to go out from the destination and to look for another place due to insufficient capacity of the destination.

(4) Other Issues

a) The weak for evacuation activities such as old people and babies exist in some families. In that case, it would be quite difficult to have evacuation actions. Some co-operation system among neighbours will be necessary to provide effective evacuation system.

b) Some people didn't evacuate to save the properties such as livestock. Assessment for saving properties would be important for the villagers, however, the human lives should be saved prior to that. The main objective and policy of evacuation system should be aware and the people should understand that to save human lives is the most important.

c) Almost all villagers recognise the necessity of evacuation system, which is more reliable than the existing evacuation activities.

2.1.4 Major Issues of Current Evacuation Activities in the Community

The issues of current evacuation activities are found based on the assessment of survey results mentioned above, which will be major points for the system design for improved evacuation system in respective community:

(1) Disaster forecasting or assuming process

- The villagers are generally sensitive to the abnormal phenomena of natural conditions, and the criteria for commencing evacuation activities mainly depend on the villagers sensitivities. As the results, many people recognised the dangerous prior to the occurrence of disasters.

(2) Transmission of information process within the community

- There are active team works among the neighbours in the community, and it seems that there are high possibilities to form the disaster evacuation committee in the community.

(3) Evacuation timing

- The evacuation timing are generally not appropriate considering the occurrence of the disasters. It was too late to commence the evacuation actions though they could assume the disaster potential by abnormal phenomena timely. Alternative criteria for commencing evacuation activities would be required to improve the current evacuation activities.

(4) Evacuation route

- They have taken the existing trail from their houses to the destinations for evacuation. Along the trails, however, there are usually high possibility to occur landslides, collapses or debris flows according to the long term experiences in Japan. The evacuation routes which they have taken should be carefully reviewed and alternative route shall be found if necessary.

(5) Evacuation places

- It was found that some people could not evacuate due to no safer areas nearby. The scattered evacuation places in the safer areas will be required to provide the appropriate destinations for all the villagers.

- In some destinations, no buildings or insufficient capacity of buildings are observed and some villagers were force to go out from the destinations and to look for another destination under the storm rainfall condition. Multipurpose shelters would be effective to solve the matters constructing at the scattered locations in the community.

(6) Awareness

- Some people could not identify the proper destination for evacuation. Also some people have evacuated even then the location of their houses are within non-hazardous areas. Awareness of the results of hazard assessment would be effective for the villagers to recognise the hazard level of their residence, as well as to find out the appropriate destination from their houses.

- Some people didn't evacuate to save properties such as livestock. It is recommend to evacuate without such properties to save the human lives. Education for disaster evacuation would be required to minimise the human damages.

(7) The weak against disasters

- In some families, there are the weak against disasters such as old people or babies. Some special criteria for earlier commencing evacuation activities or co-operation system among the neighbouring families would be required.

2.2 Disaster Warning and Evacuation System in Japan

2.2.1 Exiting Disaster Warning and Evacuation System in Japan

Figure 2.2.1 shows the frame of existing disaster warning and evacuation system in Japan. The system is generally consisted of the following 5 sub-systems:

1) Data collection sub-system,
2) Data processing and warning decision sub-system,
3) Warning transmission sub-system,
4) Aerial warning and evacuation sub-system.

The detail of each component is explained as follows:

(1) Data Collection

Data collection for disaster forecasting, warning and evacuation system is generally carried out by the central or local government. Most of the data collected by the government are meteo-hydrological data such as real time rainfall and water level at the various points.

One of main government agency for collecting data is Meteorological Agency which utilise the Automated Meteorological Data Acquisition System (AMeDAS), meteorological radar as well as meteorological satellite called "Himawari". AMeDAS is the nation-wide network of automatic raingauge stations which is collected the real time of the precipitation and automatically transmitted to the regional office through the radio wave transmission. The meteorological radar observe the aerial rainfall distribution by radar. The meteorological satellite observe the cloud distribution, thickness and the movement. Based on the three different data and information, weather forecasting is made by the Meteorological Agency and report to public through mass media.

Another major government agency for data collection for disaster management is Ministry of Construction. It is responsible for river management, and it developed basin-wide meteo-hydrological observation network for the major river basins in Japan. In addition to the meteo-hydrological gauge networks, it owns meteorological radar to grasp the aerial rainfall distribution, which is also useful to forecast the further river phenomena.

Besides, Ministry of Construction is responsible for observing the debris flow and volcano mudflow at the major high hazardous areas. The observation system is composed of debris flow sensors, raingauge stations, warning loud speakers, video monitors and so on.

At local government including cities, towns and villages, they mainly receives such meteo-hydrological information from the government, however, some local information such as various alarming phenomena and damages information are collected by the local government, and transmitting to the central government. Besides them, the meteo-hydrological data for the minor river basins are collected and managed by the local government themselves.

(2) Data Processing and Warning Criteria

In Japan, most of the collected data at site are transmitted through radio wave and automatically input the computer data base, and there is no manual process from observation to data processing.

Based on the processed data, various forecasting analysis are executed by computer simulation model for flood, debris flow and so on. Based on the current conditions and further forecasting conditions of natural hazard, alarming and warning information are issued. The criteria for alarming and warning have been determined based on the accumulated observation data for long term, and the criteria are reviewed periodically.

The alarming and warning information issued by the central government are timely transmitted to the local government by the various measures. The local government and municipalities assessed the information from the government as well as their own data collected by the observation networks and information from the regional offices, and the warning order is issued based on the assessment results by the responsible government agencies.

(3) Warning Transmission System

There are three major routes of disaster information transmission from the government to the people: government routes, mass media route and self dissemination route.

Government route are mainly provided by the central or local government through radio wave. People can receive the alarming and warning information directly through the loud speakers, patrol cars and so on. However, there are some difficulties to receive the information due to limitation of loud speaker stations and patrol cars. In addition, it is reported that such information sometimes could not be caught by the people due to heavy sound of rainstorm or flood.

Mass media route is played the major roles for the warning transmission to the people. At the time of high hazardous natural events, the special broadcast programs are provided and the latest information is transmitted to the people thorough television and radio. The information through mass media is timely and quite useful for the people to grasp the real situation of the natural hazard.

Self dissemination route is provided by the regional disaster evacuation committee, which is generally formed by the people's group. It usually have information relay system from neighbour to neighbour. The system is quite simple and effective without any instruments, however, it is not always functional in case that the group is too big and the network is to wide by spreading the residents.

In the case of Nepal, the self dissemination route would be applicable for improving the current warning transmission activities. In addition, it is recommendable to develop the nation-wide weather observation system as well as the development of the timely weather report through mass media.

(4) Evacuation system

Evacuation system is usually formulated by the local government such as cities, towns and villages. The administrative area is generally divided into many units for independent evacuation activities. The government advises and supports their evacuation activities such as provision of evacuation shelters instruction of evacuation route and so on.

For example, the construction of evacuation shelters and destination of respective evacuation unit group are planned and developed by the local government. In many cases, the public facilities such as school, community hall, temples is generally appointed as the evacuation shelters. The respective evacuation unit group is informed their destination and route by the government through public information. At the emergency case, the unit evacuation group will evacuate to the destination by themselves, and the government would provide the various services such as medical service, food supply and so on.

Beside them, the local government would have intensive dissemination and education activities to the people to instruct alarming phenomena of disasters, preparedness of instruments such as torch light, drinking water, dried food, radio equipment and so on.

2.2.2 Collected Alarming Phenomena for Mountain Disasters in Japan

(1) Observed Alarming Phenomena for Mountain Disasters

In the hearing survey to the villagers, the Study Team asked whether the remarkable or abnormal phenomena are observed or not prior to the disaster in July 1993. However, no specific replies were given by the villagers and no concrete alarming phenomena were collected by the filed investigation.

On the other hand, various alarming phenomena for disasters are accumulated by the experience of disasters in Japan, and the some of collected information in Japan would be applicable to identify the alarming phenomena in Nepal so that there are many similarities between Japan and Nepal in terms of geology, topography as well as the natural mechanism of disasters.

The followings are the various alarming phenomena collected in Japan for respective type of natural hazard:

1) Alarming phenomena for debris flow

   a) Abnormal heavy vibrating sound are occurred in the mountain.
   b) The stream flow suddenly changes such as being muddy or mixing the wooden chips.
   c) Flood discharge decreases suddenly in spite that heavy rain is observed continuously,
   d) Big sound of rolling stones or bursting trees are heard,
   e) The slope failures are observed near by,
   f) Abnormal smells are felt.

2) Alarming Phenomena for Landslide

   a) Cracks are observed on the ground,
   b) Downlift or uplift of the lands are observed,
   c) The water level of pond or lake is suddenly changed,
   d) Water in the well is suddenly becoming muddy,
   e) Pressure water comes out from the slope,
   f) Trees on the slope are heavily swinging or falling down,
   g) Many underground insects such as earthworms are observed on the ground,
   h) Abnormal sells are felt.

3) Alarming Phenomena for slope failure

   a) Small pieces of stones fall down from the cliff,
   b) Cracks are observed on the slope or cliff,
   c) Ground water comes out from the hillslope or cliff,
   d) The spring water suddenly increases or decreases,
   e) The spring water becomes muddy,
   f) Sound is observed prior to big slope failure,
   g) Trees on the cliff are heavily swinging or falling down,
   h) Abnormal smells are felt.

(2) Warning Criteria for Storm Rainfall in Mountainous Area in Japan

In addition to such alarming phenomena for respective mountain disaster, the phenomena of storm rainfall is also useful to assume the disaster in near future so that the alarming phenomena listed above are occurred due to heavy rainstorm. Regarding the relationship

between storm rainfall and the mountain disasters, the following phenomena are revealed in Japan:

a) <u>There is a still high possibility to occur mountain disasters even after the heavy rainstorm</u>
The large scale of mountain disasters such as debris flow, landslide and slope failure occur mainly after cumulative rainfall with a few hundred millimetres. This is because, such earth moving phenomena are generally required to infiltrate the mountain completely and high groundwater pressure is observed. To rising up the ground water level, it is usually required large amount of rainfall continuously. In some cases, the mountain disasters in large scale occurred at the small rainfall after the heavy storm passed. Considering the above experiences, it is required to make attention even the heavy rainstorm is phased out and careful patrol shall be continued.

b) <u>Attentions shall be paid once heavy rainstorm are observed</u>
According to the watchers of large scale mountain disasters in Japan, the rainstorm intensity at the disaster is remarkably high such as:

- Just like a upside down of the bucket with full of water,
- Just like immediately filled with the rainfall when they open the mouth toward the sky,
- cannot hear anything due to the sound of rainstorm.

The high rainfall intensity as the above condition would trigger the mountainous disasters such as debris flow, landslides and slope failure.

c) <u>There is a strong relationship between storm rainfall pattern and the occurrence of mountain disasters</u>
Generally, the slope failures and landslides will occur about 3 to 4 hours after the heaviest rainstorm are observed. The tendencies of local storm in the mountain region are to change the rainfall intensity for every 2 or 3 hours, then the mountain disasters occurs generally after the second cycle of the heavy rainstorm. Considering the above phenomena, the observation of rainfall pattern would be effective to forecast the mountainous disasters, particularly to catch the first cycle of the high intensity of rainstorm.

Beside, it is a tendency that the local rainstorm occurs at midnight or early morning. Accordingly, it would be required to pay due attention for 24 hours during the rainstorm.

In many cases, large scale of mountainous disasters will occur after observed a few hundred millimetre of cumulative precipitation.,

Reflecting such strong relationship of storm rainfall pattern and the occurrence of mountain disasters, the warning criteria for heavy rainstorm are established in Japan, particularly in the mountainous areas as follows:

Warning criteria for storm rainfall in mountainous area in Japan

a) Cumulative precipitation : more than 100 or 120 mm,
b) Hourly rainfall : more than 50 or 60 mm,

c) 3 hours rainfall : more than 100 or 120 mm,
d) 24 hours rainfall : more than 250 mm.

(3) Mechanism of Alarming Phenomena

As for the observed alarming phenomena for mountain disasters listed above, there are some scientific reasons of occurrence such as the phenomena prior to the disasters. The mechanism of the alarming phenomena are explained in the followings:

1) For debris flow

a) Abnormal heavy vibrating sound are occurred in the mountain
It is the sound of debris flow from the mountain. Therefore, the debris flow may flow down to the downstream plateau with amplifying by eroding river bed and river banks from the upstream.

b) The stream flow suddenly changes such as being muddy or mixing the wooden chips, twigs or planks.
It means that soil erosion or slope failures becomes active in the upstream basins in the mountain.

c) Flood discharge decreases suddenly in spite that heavy rain is observed continuously
It is the symptom that some abnormal phenomena occur along the river on upstream, such as dam up by the debris material or slope failures along the river bank, or dam break of such trapped material on the river and the stored water flush flowing to the downstream.

d) Big sound of rolling stones or bursting trees are heard
It is the sound of debris flow occurred in the mountain.

e) The slope failures are observed near by
In that case, there is a possibility of the occurrence of slope failures in upstream and become debris flow to the downstream.

f) Abnormal smells are felt
The source of such smell is unknown. But there are many cases that such smell are felt together with debris flow, landslides and slope failures.

2) For Landslide

All the listed alarming phenomena for landslides are mainly due to change of water pressure in the ground as well as the affect to the flow condition of permeable layer of ground water. Due to such change of ground water conditions, the insects live in underground came out to the surface.

3) For slope failures

a) Small pieces of stones fall down from the cliff
The small pieces of stone were removed from the cliff due to remarkable shearing activities of the cliff prior to the collapse. In case that there is no rock fall from the cliff, or there are many stone falling down or many small failures on the gentle slopes less than 40 degree, there is a high possibility to occur big slope failure in future.

b) Cracks are observed on the slope or cliff
In many cases for slope failures, the remarkable cracks of the upper part of the slope are observed from 2 or 3 days before the occurrence of the collapse. In such cases, the heavy rainfall would be trigger the big slope failures.

c) Ground water comes out from the hillslope or cliff
The same mechanism as explained for debris flow

d) The spring water is suddenly increased or decreased
The same mechanism as explained for debris flow

e) The spring water become muddy
There are some possibilities to occur such phenomena as the spring water becoming muddy:

1) Due to increase of spring water and the flow changes from laminar flow to turbulent flow,
2) The water vein in the underground is changed due to deformation of ground condition. In that case, there are two cases , one is to increase the spring water due to accumulating water veins under the ground, and another is to decrease by clogging of water veins.

f) Sound is observed priori to big slope failure
It is said that such phenomena as bursting bounders, cutting the wood roots will occur with the bid noise just before the slope failures. The same phenomena are also observed in case of the occurrence of landslides. According to the watchers in Japan, the creak sound of rock collapse are at first felt, then the sound of wood roots cutting comes, and the mixtures noise with vibration sound are coming.

2.2.3 Major Issues of Evacuation System in Japan

Major issues of existing disaster warning and evacuation system in Japan is assessed through the hearing survey to local government.

The hearing survey was carried out in 1993 after the severe disasters in many places in Japan. In 1993, there were many disasters which were occurred mainly by typhoons, and strong low pressure belts. The remarkable heavy rainstorm triggered landslides, debris flows as well as flood in many places, which were reported at 1,785 locations of severely damaged areas. After such severe event, the Japanese government monitored the disaster warning and evacuation activities lead by the local government as shown in Figure 2.2.2.

The figure shows the reasons of warning order which was issued by the local government. According to the results, 41% of the samples issued the disaster warning based on the meteorological forecasting information. Also, the information from the residents regarding the landslides or debris flows are the main reasons for ordering the disaster warning, which shares 27% of the sampled reasons.

Figure 2.2.2 shows that the time lag from evacuation order to the occurrence of disasters. According to the results, the time lag with more than 1 hours shared 40% of the samples,

which is within allowable time for preparation and evacuation activities. On the other hand, about 9% of evacuation orders are within one hour before the occurrence of disasters, and about 40% of evacuation orders are declared after the occurrence of disasters. Those timing of issuance of evacuation orders were not appropriate.

Even, facilitating such advanced equipment as telemetering system, national weather forecast, mass media and so on, about 50% of evacuation orders were not in time and it will be serious affects to the evacuation activities by the people.

Figure 2.2.2 shows the evacuation conditions at the issuance of evacuation orders. When the evacuation order are declared by the local government, many people have already evacuated to the shelters. According to the hearing survey, about 70% of the sampled cities, towns or villages, self evacuation by the people prior to issuance of evacuation order are observed.

On the other hand, the reason of self evacuation activities are asked to the people, and the major answers are as follows:

1) Alarming information by the patrol cars of local government,
2) Self decision due to a menace against the heavy rain,
3) Suggestions by the neighbours.

For the transmission of warning information, the loud speaker announcement from patrol cars, wireless disaster prevention network system as well as the individual information transmission system by house to house are generally applied in the municipalities in Japan.

Figure 2.2.2 shows the reasons that the evacuation orders are not issued by the local government. According to the survey, about 42% of the sampled local government , of which the evacuation orders are not declared, are because of no previous experiences the occurrence of disaster under the observed rainfall intensity. Also 25 % of them had no time to issue the evacuation orders. On the other hand, about 5% of them could not declare the order due to midnight .

2.2.4 Assessment of Availability of Evacuation System in Japan for Nepal

Considering the reliability and effect of the current disaster warning and evacuation system in Japan, it can be said that the advanced data collection, processing and disaster forecasting assessment will not be clearly resulted to provide effective evacuation activities. For example, about 40% of the evacuation orders were not timely declared and it was too late to declare even using various advanced technologies for data collection, processing and disaster forecasting are applied. On the other hand, the self evacuation looks quite effective based on the supporting information provided by the local government, mass media and neighbours. About 70% of the people have evacuated prior to declare of the evacuation orders.

Considering the above, to formulate the effective community disaster evacuation system in Nepal , it is recommended to consider the following issues:

1) To improve self evacuation activities,
2) To provide supporting information for self evacuation activities, such as hazard map, list of alarming phenomena, and so on,

4) To strengthen the user's committee for effective awareness and education for community disaster evacuation system.

3. COMMUNITY DISASTER EVACUATION SYSTEM

3.1 Framework of the Proposed Community Disaster Evacuation System

Frameworks of community disaster evacuation system will be assessed based on the results of hearing survey in the community as well as the results of the assessment of current evacuation system in Japan.

According to the hearing survey results, it can be concluded that the needs of community disaster prevention system is quite high and which is expected to be well functioning if the proper information are given to the people in time. Most of the villagers will be self evacuating if they feel dangerous, but the problems are the timing to commence the evacuation actions. The provision of supporting information for determining the evacuation activities would be quite effective. In addition, since it was found that some villagers didn't know the appropriate destination for evacuation, they couldn't activate for evacuation. It was also seen in some cases that the evacuation areas are full of people and some of them were forced to go out and to look for the another destinations.

On the other hand, it was learned that the advanced data collection, processing system and disaster forecasting system would not be so effective for timely evacuation activities if it is too complicate. Even in Japan, the disaster evacuation system mainly depends on the self evacuation by the people prior to the evacuation orders by the government.

Considering the above observation results, the framework for community disaster evacuation system is proposed as shown in Figure 3.1.1 and the major concepts are as follows:

1) Self evacuation policy,
2) Vital awareness and education activities by forming community disaster evacuation committee,
3) Introduction and development of supporting information for better decision making for evacuation activities,
4) Identification, selection, improvement and construction of optimum evacuation route and destination for effective evacuation activities.

3.2 Formation of Disaster Evacuation Committee

Formation of disaster evacuation committee is essentially required and important to establish, operate and manage the community disaster evacuation system. Since the basic policy of the system is self evacuation, the key issue for effective system establishment is to assess and activate under the people's initiatives. The villagers should be well aware the frame of the system and their responsibility under the policy to save their life by themselves. For the successful system implementation, well awareness and education activities would be also important and that shall be also done by the initiative of the committee under the technical support from the specialists as well as the government.

The procedures of formation of the committee will be the same as formation of user's committee as explained in Annex-6.

The major activities of the committee will be as follows:

(1) Establishment, operation and maintenance of the System

It is proposed that the establishment, operation and maintenance of the community disaster evacuation system shall be managed by the committee. The basic policy of the system is to be self evacuation. It means that people in the community should decide when, where and how to evacuate at the time of emergency. Respective family should clearly understand the policy and they should be conscious the responsibility to participate the committee.

(2) Formation of unit evacuation groups

In the committee, it is proposed to form many unit groups which are divided the community in the view of topographic conditions. The determination of evacuation will be done by the individual people, but the information shall own and transfer each other in the unit group. People in the same unit evacuation group will have the same evacuation shelter, which shall be constructed and maintained by the unit evacuation group. The co-operation system to help the weak persons such as elders, babies and injured people shall be also established in the group. The dense and frequent information exchange will be highly effective for community disaster evacuation activities.

(3) Awareness of the System

The awareness of the disaster evacuation system shall be carried out by the committee to all the people in the area through the unit evacuation groups. At least, people should know that when, where and how to evacuate at the time of emergency. The basic rule and process of the system which would be established by the committee for the evacuation activities, will be aware to all the people and they should be fully agreed to the decisions made by the committee.

(4) Education to the People

Education material for disaster evacuation will be highly expected to realise effective evacuation system for whole Nepal. It is proposed that the government shall be responsible for procurement of the manual for community evacuation system, which will be contained the procedures for establishing the system, and many useful information to improve the decision making for evacuation individually.

3.3 Development of Supporting Information for Self Evacuation Determination

Development of supporting information is essential to find out the alarming phenomena of disasters timely. The results of hearing survey at respective community indicate that the many villagers are quite sensitive to find out the change of natural conditions but the determination of evacuation actions are generally delayed. The time lag between the observation of hazard condition and the determination of evacuation actions will be the key issues and the system shall aim at shortening the time lag with appropriate measures.

In this study, the following five measures are proposed for development of supporting information for community disaster evacuation activities:

1) Hazard mapping,
2) Preparation of list of alarming phenomena,
3) Simple monitoring measures for finding out the alarming phenomena,
4) Improvement of nation-wide mete-hydrological observation network.
5) Improvement of national weather forecasting program,

The detailed improvement plans are as follows:

(1) Hazard Mapping

Preparation of hazard map is essential for community disaster evacuation system. The detailed hazard assessment by the specialists in the field of topography, geology, and river engineering are required to prepare the community level of hazard map on the scale of 1:5,000 or 1:10,000 topographical map. The measurement of alarming phenomena as well as the evacuation destination and routes will be assessed based on the hazard map.

In the three priority communities in the Study, hazard map of 1:5,000 were prepared as shown in Annex-1. The detailed procedures to develop the hazard map is mentioned in Annex-1.

(2) List of Alarming Phenomena

Preparation of list of alarming phenomena of the disasters in mountainous areas will be effective for the people to find out the change of natural conditions prior to the occurrence of disasters. The results of hearing survey indicate that the people are rather sensitive to find out the change of natural conditions but they are difficult to assume the disaster occurrence by such changes. Such conditions made delay of the decision and action of evacuation activities.

Considering the above, collecting the various alarming phenomena of mountain disasters and dissemination to the people would be effective for the people assuming the occurrence of the disasters in prior. It would make possible for the people to determine the evacuation actions earlier as they can find the change of natural conditions and look for the list whether such changes are the alarming phenomena of disasters or not.

The various alarming phenomena against the mountain disasters are introduced in Sub-section 2.2.2 in this report, which are collected based on the various experiences in Japanese mountain disasters. The list would be quite useful for self evacuation system by the people, and they are widespread applied by the Japanese government for awareness of disaster prevention activities.

(3) Simple Monitoring Measures for Grasping Warning Phenomena

By the observation of natural conditions, it would be possible to assume the occurrence of the disasters. In this case, the transmission of information would be very important from the observer to the residents. In the case of the three communities in the Study, however, it would be rather difficult for timely measurement and transmission the information due to less communication measures.

On the other hand, local level of monitoring system would be rather useful for assuming the disasters by the community disaster evacuation committee themselves. In this Study, the following three monitoring measures would be proposed, which shall be installed, operated and maintained by the committee under the technical support from the government:

a) Landslide measurement,
b) Flood water level measurement,
c) Rainfall measurement.

The detail of the procedures are as follows:

a) Landslide measurement

The location of landslide measurement sites are selected at high hazardous areas against landslide according to the hazard map. The measuring equipment is quite simple as shown in Figure 3.3.1. The surface crack shall be found out on the high hazardous areas and the wooden sticks shall be put on the both sides of the crack. The bridge across on the crack shall be put on the top of the sticks. The centre of bridge wood shall be cut, and the distances of cutting pieces shall be measured periodically.

When landslide activates, the gap between bridge wood will be widening and the measurement of the gap would be effective to assume the future big landslides.

b) Flood measurement

Flood measurement shall be carried out by the simple procedures. The measurement will be useful to assume the flooding as well as the river bank erosion. The staff gauge shall be installed along the river and the marks shall be put according to the geological formation of the bank. For example, the bank consisted of the rock will be generally strong against the flood, however, the sand and grave bank and the weathered rock bank would be rather weak against the flood , erosion and scouring. When the flood level reach to such weak layers, it would be quite dangerous and immediate evacuation activities would be required. Figure 3.3.2 shows that the general trend of hazardous of the bank erosion and scouring. Particularly, the flood measurement in such a way would be effective in Chisapani, upstream area of Namtar as well as Namtar along the Manhari Khola in the Study Area.

c) Rainfall measurement

The observation of rainfall duration and intensity is widely applied for disaster forecasting in many countries. In the Study area, it is proposed to introduce the simple measurement activities utilised existing available tools in household. The criteria for evacuation actions will be necessary but it will be needed to accumulate the long term record and to find out the correlation between rainfall parterre and the occurrence of disasters. On the other hand, there is a warning criteria of rainfall pattern in the mountainous area of Japan as mentioned in sub-section 2.2.2. If the criteria is applied for the Study area at the July 1993 disasters, they could evacuate at 4 o'clock by exceeding 100 mm of cumulative rainfall, which is about 5 hours prior to the occurrence of the disaster. (Refer to Figure 2.1.3)

The measurement can be done in each household by utilising cooking tools such and pan, pot, cup or bucket. The rainfall criteria shall be marked on the tools and put on the outside. The villagers can observed easily and to find out the timing of evacuation in timely.

(4) Improvement of Meteo-hydrological Observation System

There are many unknown factors in meteo-hydrological viewpoints regarding the hazard assessment so that the meteo-hydrological observation network is not well developed. Improvement of the observation network will be effective not only for disaster prevention issues but also various water resources development activities. According to "The Study on Nation-wide Hydro-Meteorological Data Management Project", which is carried out

by the JICA in 1993, the higher economic return is expected by improvement of meteo-hydrological observation networks with about 30% of economic internal rate of return (EIRR). To accumulate the storm rainfall record and to find out the correlation between the rainfall pattern and disaster occurrence would be effective for accurate forecasting and is expected to provide more reliable criteria for evacuation and reduce the human damages by the mountain disasters.

In the Study area, it is recommended to install one meteorological station at school respectively. The installation, data collection and processing shall be responsible for the government, but for the observation and maintenance shall be carried out by the school, which will be useful for education purpose also. The meteorological stations shall be included in temperature, relative humidity, daily and hourly rainfall. The hourly rainfall will be quite important to develop the accurate criteria for disaster warning.

(5) Weather Forecast and Weather Report Program through Radio Broadcast

The results of hearing survey revealed that about 60% of people in the villages own the radio equipment. The weather report through the radio broadcast would be rather useful for villagers to grasp general trend of storm and monsoon. The weather forecast would not be useful to determine the evacuation timing, but they can assume the coming thick cloud by monsoon or low pressure belts in a few days before. It means that the villagers can make some preparedness activities such as food stock, confirmation of evacuation shelters, and some other things as required.

The accurate weather report however depends on the dense of meteorological observation network. The information collection from India and other neighbouring countries would be also effective. Considering the above, some improvement of weather report and frequent dissemination through the radio broadcast shall be carried out under the responsibility of the government.

3.4 Improvement of Evacuation Activities

3.4.1 Selection of optimum destination and route for respective household

Selection of optimum destination and route are assessed based on the hearing survey at the community, in which the actual origin and destination for the evacuation activities are asked and the results are shown in Figures 2.1.1 and 2.1.2.

The every destination areas are assessed by the hazard map and it was found the most of evacuation destination selected by the villagers are within the safety areas and they are generally right in selecting the destination.

Those who stay within the safety areas, are recommended to stay, and they should know that their places are safer than other areas. However, those who stay outside of the safety areas, they should knows the proper destinations for evacuation actions. The route to the destination would not be shown in detail, but the following issues should be in mind for evacuation activities:

1) It shall avoid to pass the dangerous zone such as landslides, slope failures and debris flow indicated in the hazard map to evacuate to the destinations.
2) It shall avoid to pass the gullies for evacuation so that the gullies in the mountainous region will be suddenly occurred the flood.

3) It shall avoid to be on the direction of the flood since the debris flow tend to go straight even the river course are not in straight.

General procedures to design the evacuation route and destination for mountainous area and river terrace are shown in Figures 3.3.3 and 3.3.4 respectively.

Taken into consideration the above conditions, the route and destination shall be selected. In this Study, the optimum route and destination to the safer zone are shown in the community evacuation system plan for respective community for those who are not in the safer zones. The details are explained in the later section 3.5.

3.4.2 Improvement or construction of evacuation shelters in multipurpose use

The evacuation shelter shall be provided in each safety zone selected in the above sub-section. In case that there are some public facilities such as school and health post in the evacuation zone, the public facilities shall be used as the evacuation shelters. In that case, the target number of people shall be checked and the capacity of existing facilities shall be confirmed. In case that there is not enough capacity of public facilities or no public facilities in the evacuation zone, the possibilities of utilisation of private house shall be assessed. Even then, in case that there is no capacity to stay the target number, the multipurpose shelters are recommended to construct.

In the Study area, the cold storage for vegetable storing or potato seed storage are highly required in the agriculture marketing viewpoint. The multipurpose shelters for the use of cold storage and potato seed storage shall be constructed as required.

3.5 Proposed Evacuation System

3.5.1 Chisapani Community Disaster Evacuation System

Chisapani area is generally described as high hazardous area on the slope which is gradually eroded by landslide or gully erosion. On the other hand, the residential area is mainly located on the eastern ridge and about 80% of the population is concentrated along the ridge.

According to the hazard assessment in Annex-1, the ridge area is classified as rather safe areas than the other areas on the slope. The villagers know well about the hazard situation in the village, and most of the villagers have evacuated at this ridge except those who could not pass the Chisapani Khola from the eastern part. The evacuation planning is therefore basically followed to the existing evacuation pattern which was observed at the 1993 disaster.

Figure 3.5.1 shows the evacuation system plan for Chisapani. Four evacuation units are proposed in the area as shown in the figure. The details of respective evacuation unit is described below:

(1) Unit A : Gothdanda

Unit A is planned at the northern part of the ridge, which is called as "Gothdanda" by villagers. There are about 10 households belong to the unit and most of the houses are within the safer area according to the hazard assessment. The families which is required to evacuate would be 1 or 2, located on the

northern part of the unit. Considering the less families to be required for evacuation activities, the shelter will not be required in the Unit, and the evacuation destination shall be defined at some of the houses within the safety area.

On the eastern edge of the ridge in Unit A, it is recommended to provide the monitor of landslide, for assuming landslide during the rainstorm. The simple gauges proposed in Section 3.3 would be available for the landslide monitoring.

(2) Unit B : Thindanda

Unit B is planned at the south of Gothdanda, in where the Begesori Primary School exists. About 20 families are belong to the unit and many of them are outside of the safer zone. The villager calls the area as " Thindanda", which is defined as one of the safest area in Chisapani by the villagers. The safety zone on the ridge is however rather narrow. The Begesori Primary school is located within the safer zone and the villagers can utilise it as the evacuation shelter.

As the most of families stay on the slope and they are required to climb up the slope to the evacuation shelter, and the distance is rather far with about 500 m at most. Since the distance is far and the evacuation route is steep, the earlier evacuation activities would be required.

Landslide monitoring activities would be recommended at the two locations, on the both, eastern and western edges of the ridge. Simple gauges shall be installed and observed by the villager during the rainstorm to commence the evacuation activities earlier.

(3) Unit C : Kailashdanda

Unit C is planned at the main part of the village, in where the canteen, bank and many houses are located. There are about 30 families in the unit. At the 1993 disaster, most of the villagers in this area as well as those in Thindanda have evacuated to the same places on the top of the hill. No building exist on the hill but the villagers believes that the hill is the safest area in the village.

Based on the hazard assessment in the Study, the hill is quite safe and wide enough for the evacuation destination. Considering above, it is recommended to construct multipurpose shelter on the hill of Kailashdanda.

According to the agricultural research in the Study, installation of cold storage of potato seed would be quite feasible in agro-economical aspect. All the villagers so far buy the potato seed every year, but if they have the storage, their expense would be much less and net income is much improved.

Taking into account the above agriculture needs, the shelter is recommended to construct as the multipurpose use as evacuation shelter and potato seed storage. The capacity of the multipurpose shelter would be enough for 30 families.

(4) Unit D : On Slope farmland

Unit D is planned on the slope between Majuwa Khola and Chisapani Khola. About 20 households are scattered on the slope. At the 1993 disaster, most of the residents have evacuated to Deurali or Dhulo Nang Chuli, which are located

on the Phedigaon site. It is more than 1 km away from the unit and the evacuation route was not safe enough so that there are many landslides or slope failures observed along the route.

The Study team judged that the previous evacuation activities at the area were not recommendable considering the distance and the hazardous on the route, and it is recommended to have alternative evacuation destination in the unit. There is no safer zone defined in the unit, but the proposed evacuation zone is defined as the low hazard area against the landslide. Since the unit is surrounded by the gullies, it is better not to cross the gully but to stay within the unit. The proposed location of evacuation shelter is at the centre of farm land which is away from the gullies. Since there is no buildings at the place, it is recommended to construct multipurpose shelter which shall be utilised for shelter as well as potato seed storage. The capacity of shelter shall be enough for 20 families.

A few families stay just along the Chisapani Khola in the western part of the unit. Since the houses are in high hazard area against bank erosion, the simple monitoring to the flooding shall be considered.

On the upper part of the unit at rather far from the unit, there are many small cracks due to surface landslide. Installation of landslide monitoring gauges are recommended to observe the surface movement although it is difficult to monitor during the rainstorm. This monitor would be also effective to maintain the trail which passes through the lower part of the slope.

3.5.2 Phedigaon Community Disaster Evacuation System

The many deep gullies exist in Phedigaon area, which indicate that severe gully erosion were repeated by the flood and debris flow. In the case of Phedigaon, it is quite dangerous to cross such gullies during the rainstorm. Moreover it would not be physically possible to cross such deep gullies. Considering the above, Phedigaon area is divided into 11 units by the gully network to avoid crossing gullies for selecting the evacuation route.

Figure 3.5.1 shows the proposed evacuation system plan together with Chisapani community. The 11 units for Phedigaon Community are from Unit E to Unit O. The details are explained as follows:

(1) Unit E : Bandelidanda

Unit E is planned on the left bank of Phedigaon Khola at the downstream part. The villagers call the area as "Bandelidanda". Palung bazaar, the VDC office and telephone office of Palung VDC is included in the Unit. The number of household in Unit E is counted at about 150 based on the topographic map of 1 : 5,000. Major part of Unit E is defined as the safer zone against the disasters. On the other hand, Palung bazaar which is consisted of about 30 households are defined as high hazardous area against the flooding. At the 1993 disaster, most of the villagers in Palung bazaar have made evacuation actions to the Bandelidanda. That activities would be right in the viewpoint of hazard assessment.

Accordingly, most of residents would not be required to make evacuation actions in the Unit E except about 30 families in Palung bazaar. Those who are required to evacuate in Palung bazaar shall find the destinations to somewhere in the higher area in Bandelidanda. Evacuation shelter will not be required as there are many private housed in the safety area, and each family in the safety zone shall receive a few families from Palung bazaar during the rainstorm.

(2) Unit F : Soltgaon

Unit F is planned on the left bank of Bhotekoria Khola just west of Bandelidanda. About 40 families are belong to the unit. The safety zone is found along the ridge which is about 1 km long and rather narrow with more or less 50 m width. About one third of the families are in the safety zone and it is not necessary to make evacuation actions. On the other hand, those who stay in the lower area along the river would be required to evacuate to the higher place. Also the three families who stay in the northern edge of the unit are in the critical condition so that many cracks are observed on the slope nearby.

The landslide monitoring is recommended for the area which is on the slope of left bank of Bhotekoria Khola for earlier evacuation actions of the three families.

Shelter would not be required in the unit and the every household in the safety zone shall receive a few families from the non-safety zone at the emergency case.

(3) Unit G : Cautara

Unit G is planned at Phedigaon bazaar which is at the lower area between Ghatte Khola and Bhotekoria Khola. There are about 40 families in the unit. The trail to Chisapani passes in the unit and the bazaar along the trail would be safe in terms of geological structures. The people who stayed in the lower area as well as the isolated area beyond the Ghatte Khola stay in the high hazardous area against the flood and debris flow. Particularly, those who are in the isolated area should evacuate in the earlier stage of the rainstorm. Due attention should be paid to assume the debris flow or flood in the isolated area so that they have to cross Gatte Khola for evacuation.

Considering the above, it is proposed to install the raingauge stations at the school in the isolated school which can assume the further debris flow by measuring accumulative precipitation during the rainstorm.

As there are many shops and no space in the safety zone, it is not recommended to construct the evacuation shelter and those who are in safety zone shall receive a few families from non-safety zone at the time of emergency.

(4) Unit H : Ponmalidanda

Unit H is planed on the upstream area of Bhotekoria Khola on the right bank. All the area in Unit H is defined as low hazard area or safety area in the Hazard map in Annex-1, and it is generally not required to make evacuation activities. There are about 60 families belong to the unit.

The safety zone is located on the centre of the unit, in which about one-fourth of the people in the unit stay. In case of emergency such as the 1993 disaster, the evacuation from outside of safety zone shall be carried out.

The evacuation shelter will not required in the unit. The families who are in safety zone shall receive a few families respectively at the time of emergency.

(5) Unit I : Deolari

Unit I is planned on the upper part of Ghatte Khola on the left bank just next to Unit I, Ponmelidanda. There is no high hazardous area in Unit I also and no evacuation activities would be required. In case of Unit I, most of families are in safety zone.

At the 1993 disasters, many people have evacuated from Chisapani to the area.

(6) Unit J : Dhulo Nange Chuli

Unit J is planned on the most upper area of Ghatte Khola. There are only 6 families in the unit. The safety zone exist on the ridge between Phedigaon and Chisapani. Two families of them are in safety zone, however, the remaining four families are in very dangerous against the gully erosion. The four families would be forced to cross the gullies if they take the shortest route. It is strongly required to select the evacuation route to reach the safety zone which should not cross the river but to go toward the ridges and to reach to the safety zone.

The evacuation shelter would not be required in the unit. The families in the safety zone shall receive a few families at the emergency case.

(7) Unit K : Ghatte Khola

Unit K is planned at the south of Unit J, in which 10 families stay. The area surrounded by the tributaries of Ghatte Khola both of which are severely eroded by the repeated flush flood as well as debris flow. The safety zone is located on the central ridge between two gullies and 7 families of them are in the safety zone.

However, the remaining three families on the eastern part of the unit are in the critical conditions against the bank erosion. Due attention should be paid at the time of rainstorm. It is strongly recommended to install simple monitoring gauges against the flood by staff gauge, and the three families should observe carefully the flood level for earlier evacuation actions. It is also recommended to observe the rainstorm by utilising the cooking tools such as pan or bucket for the three families.

(8) Unit L : Between Dhungakate and Ghatte Khola

Unit L is planned between the Ghatte Khola and Dhungakate Khola on the gentle slope. According to the hazard assessment, the area is formed by the landslide though it is currently stable. Most area of the unit is therefore defined as the safety zone. There are about 35 households belong to the unit and most of the people are in the safety zone. However, five families stay along the northern gully on the right bank are in critical conditions against the bank erosion. They

are requested to observe the flood of the gully as well as the rainfall observation as the three families in Unit K for the earlier evacuation activities.

Since there are many houses in the safety zone, no evacuation shelter would be required.

(9) Unit M : Upper Dhungakate Khola

Unit M is planned on the upstream of Dhungakate Khola. There are only two families in the unit. The safety zone spread widely on the centre of unit. One house is not in the safety zone but it would easily reach to another house and no evacuation shelter would be required.

(10) Unit N : Loshe Pakha

Unit N is planned on the right bank of Dhungakate Khola. Severe bank erosion along the Dhungakate Khola and active landslide on the southern ridge are observed in the unit. the safety zone are very limited on the centre of the unit and no housed are found in the safety zone.

There are about 15 families in the unit. Since no buildings exist in the safety zone, it is recommended to construct multipurpose shelter in Unit N, which shall be enough space for 15 families.

In addition to construction of the multipurpose shelter, it is recommended to monitor the landslide activation by simple gauge at two locations, one is along the ridge on the south, and another is middle part of the slope for taking earlier evacuation actions. Due attention should be paid for the various alarming phenomena during the rainstorm.

(11) Unit O: Gairigaon

Unit O is planned on the left bank of the Phedigaon Khola on the opposite site of Area E. There are about 120 families in the unit. Most of the area are defined as the safety zone except Bista tole and Phatbazaar.

Three families stay in Bista tole which is located on the upper edge of the unit. The active cracks are observed on behind of the area, and they are requested to observe the landslide activation during the rainstorm for effective evacuation.

There are about 30 families at Phatbazar, which is high hazardous area against the flooding. All the families in Phatbazar have evacuated to Gailigaon at the 1993 disaster. The Study team judged the evacuation actions are right in the view of hazard conditions.

As many households exist in the safety zone of Gairigaon, the construction of evacuation shelter may not be required.

3.5.3 Namtar Community Disaster Evacuation System

Figure 3.5.2 shows the evacuation system plan for Namtar. As shown in the figure, most of the residential area in the community are within the safety zone, there would not

be required to make actions for evacuation. In other word, it is recommended to stay home at the time of heavy rainstorm.

The important thing is that those who stay in the safety zone should understand the safety of their area and not to approach the high hazardous area at the time of rainstorm or flooding.

There are some areas which is defined as high hazardous zone in Namtar as described below:

(1) Along the river bank

Along the river bank of Manhari and Syarse Khola of which no rock foundation is seen or the foundation is weathered, it would be defined as high hazardous zone against bank erosion at the flood. Such areas are described as shown in Figure 3.5.2.

(2) Confluence of Manhari Khola and the tributaries

At the confluence of Manhari Khola and the tributaries, particularly those from the left bank, would be rather dangerous against the debris flow. It should not approach such areas at the time of rainstorm or flooding.

(3) The areas which is exposed big boulders on the slope of terrace

Since the Namtar Community located on the several stages of river terrace, big boulders are seen on the slope of terrace in some locations. In such area it is feared that the boulders are suddenly fallen down. It should not approach to such areas at the time of heavy rainstorm.

(4) On the river channel

Since Manhari Khola was became much wider by the severe bank erosion of 1993 disaster, some activities such as water mills are seen on the flood river channel. The watermills on the flood channel is quite dangerous at the time of flood and it should not approach at the rainy season.

Table 2.1.1 Questionnaires for Evacuation System Plan Formulation

Hearing Survey for Evacuation System Planning
JICA Disaster Prevention Study Team

QUESTIONNAIRE
Sample No.

Q1. Name
Q2. Caste
Q3. Occupation
Q4. Family No.
Q5. Location of Residence (Mark sample No. on the Map)
Q6. Whether you and your family have evacuated or not at 1993 disaster?
1) Yes
2) No

If yes, please answer Q7-Q11&Q13-Q15. If no, please answer Q11-Q15.

Q7. When you have evacuated ?
1) Morning
2) Daytime
3) Evening
4) Night before dinner
5) Night after dinner
6) Midnight after sleeping
Time :
Exact Answer:

Q8. Why you have decided to evacuate?
1) Because, I observed abnormal natural phenomena, such as
a) Heavy rain
b) Occurrence of landslide or slope failure
c) Flush flood in the stream
d) Big sound by rolling stones
e) Bank erosion by the flood
f) Others
2) Because I found that neighbours are evacuating.
3) Because My family / neighbours suggested me to evacuate.
4) Because I found that my house is nearly collapsed by
a) Heavy rain
b) Landslide or slope failure
c) Debris flow
d) Bank erosion
e) Flush flood
f) Others ( )
5) Others
Exact Answer:

Q9. Where did you evacuate? (to show the route and destination on the Map)
Exact answer:

Q10. With whom you have evacuated?
Exact answer:

Q11. What was the most terrible things for you at the 1993 disasters?
1) Heavy rainstorm,
2) Flush flood or debris flow at the stream (to show the map, which river?)
3) Slope failure or landslide on the slope (to show the map, which slope?)
4) Others,
Exact Answer:

Q12. Why you have not evacuated?
1) I wanted to evacuate, but I was too fear to go.
2) I wanted to evacuate, but I didn't know where to go.
3) Because, I felt that staying is much safer than going out.
4) Because, My family suggested not to go.
5) Because, I didn't feel that it is serious disaster.
6) Others
Exact Answer:

Q13. Do you think evacuation system is necessary in your community or not?
1) Yes
2) No

Q14. Are there any places which are thought to be safe against disasters by the villagers?
1) Yes
2) No
If Yes, where is it?
(To show the Map)

Q15. Do you have the following equipment?
1) Watch : Yes or No
2) Radio : Yes or No
3) TV : Yes or No

Table 2.1.2 Results of Hearing Survey for Evacuation System Planning (Phedigaon/Phatbazar Area)

No.	Q1.	Q2.	Q3.	Q4.	Q5.	Q6.	Q7.	Q8.	Q9.	Q10.	Q11.	Q12.	Q13	Q14	Q15		
															(1)	(2)	(3)
1	Dadri Bahadur K.C	Chettri	Agriculture	5		Yes	3	1e,4e		All Family Members	2	-	Yes	Yes	No	No	No
2	Bir Bahadur Lama	Tamang	Shopkeeper	5		No	-	-	-	-	3	3	Yes	Yes	No	No	No
3	Hari Basnet	Chettri	Agriculture	7		Yes	5	1c,4e		All Family Members	1	-	Yes	Yes	Yes	Yes	No
4	Kedar Tamang	Tamang	Agriculture	5		Yes	3	1c		All Family Members	3	-	Yes	Yes	No	No	No
5	Laxman Biswekarma	Kami	Blacksmith	7 (3)		No	-	-	-	-	2	2	Yes	Yes	Yes	No	No
6	Bhupal Tamang	Tamang	Agriculture	6		No	-	-	-	-	2	3	Yes	Yes	No	No	No
7	Sher Bahadur K.C.	Chettri	Agriculture	4		Yes	5	1c,1e		All Family Members	2	-	Yes	Yes	No	Yes	No
8	Sher Bahadur Lama	Tamang	Agriculture	11		Yes	3	1a,1c		All Family Members	2	1	Yes	Yes	Yes	No	No
9	Narayan Ale Magar	Magar	Agriculture	6		Yes	3	1a,1c		All Family Members	2	-	Yes	Yes	Yes	Yes	No
10	Kanchhi Ale Magarni	Magar	Agriculture	7		Yes	3	1c,1e		All Family Members	2	-	Yes	No	No	Yes	No
11	Saraswati Karki	Chettri	Agriculture	6		No	-	-	-	-	2	3	Yes	No	Yes	Yes	No
12	Dhuli Maiya Karki	Chettri	Agriculture	9		No	-	-	-	-	3	1	Yes	Yes	No	Yes	No
13	Ganga Devi Karki	Chettri	Agriculture	6		No	-	-	-	-	3	1	Yes	Yes	Yes	Yes	No
14	Chini Naya Busnet	Chettri	Agriculture	2		Yes	3	1b,1e	-	All Family Members and Two Guests	3	-	Yes	No	No	No	No
15	Sabitra Karki	Chettri	Agriculture	2		No	-	-	-	-	3	2	Yes	No	Yes	Yes	No
16	Maya Karki	Chettri	Agriculture	1		No	-	-	-	-	2	6	Yes	No	No	Yes	No
17	Chandra Bahedur Ale Magar	Magar	Agriculture	6		No	-	-	-	-	4	3	No	Yes	Yes	Yes	No
18	Sushila Ale Magar	Magar	Agriculture	7		No	-	-	-	-	3	1,2,4	Yes	No	Yes	Yes	No
19	Rajendra Thapa Magar	Magar	Agriculture	4		Yes	5	1a,1b		All Family Members	3	-	Yes	No	Yes	No	No
20	Sabitri Karki	Chettri	Agriculture	5		No	-	-	-	-	3	2	Yes	Yes	Yes	Yes	No
21	Dil Maya Tamang	Tamang	Agriculture	7 (11)		Yes	5	1e		All Family Members	2	-	Yes	No	No	No	No
22	Kanchhi Tamang	Tamang	Housewife	2 (3)		Yes	5	1f,2		All Family Members	2	-	Yes	No	No	No	No
23	Yek Bahadur Lama	Tamang	Agriculture	5 (6)		Yes	2	1b,1c		All Family Members	3	-	Yes	Yes	No	No	No
24	Jhamak Bahadur Tamang	Tamang	Agriculture	14 (16)		Yes	5	1b		All Family Members except Old Father and Mother	1	-	Yes	Yes	Yes	Yes	No
25	Rup Bahadur Tamang	Tamang	Agriculture	9 (11)		Yes	5	1b		All Family Members	2	-	Yes	Yes	Yes	No	No
26	Dhuli Maya Lama	Tamang	Agriculture	9 (7)		Yes	1	1a,1b,1e		All Family Members	2	-	Yes	Yes	Yes	No	No
27	Bhadra Bahadur Tamang	Tamang	Agriculture	13		No	-	-	-	-	2	1,2	Yes	Yes	No	No	No
28	Urmila Tamang	Tamang	Agriculture	6		Yes	1	2		All Family Members	3	-	Yes	No	Yes	Yes	No
29	Anak Moutan	Tamang	Agriculture	12		No	-	-	-	-	2	2	Yes	No	No	No	No
30	Chin Maya Tamang	Tamang	Agriculture	10		No	-	-	-	-	2	2	Yes	No	No	Yes	No
31	Beu Kumari Bista	Chettri	Agriculture	10		No	-	-	-	-	3	2,3	Yes	No	Yes	Yes	Yes
32	Nani Maiya Basnet	Chettri	Agriculture	2		No	-	-	-	-	3	2	Yes	Yes	No	Yes	No
33	Bachhu Ram K.C.	Chettri	Agriculture	13		Yes	6	1c		All Family Members	2	-	Yes	Yes	Yes	Yes	No
34	Kanchhi Bista	Chettri	Agriculture	8		No	-	-	-	-	2	3	Yes	Yes	Yes	Yes	Yes
35	Sher Bahadur Tamang	Tamang	Agriculture	7		No	-	-	-	-	1	1	Yes	Yes	No	Yes	No
36	Kaila Tamang	Tamang	Agriculture	2		Yes	4	4e		All Family Members	2	-	Yes	Yes	Yes	Yes	No
37	Shakta Bahadus Tamang	Tamang	Agriculture	4		No	-	-	-	-	1	2	Yes	Yes	Yes	Yes	No
38	Kanchhi Tamang	Tamang	Agriculture	9		No	-	-	-	-	1	2	Yes	Yes	No	No	No
39	Maili Tamang	Tamang	Agriculture	7		No	-	-	-	-	3	2	Yes	No	No	No	No
40	Chandra Maya Tamang	Tamang	Agriculture	5		Yes	1	1e		All Family Members	2	-	Yes	Yes	Yes	Yes	No
41	Narayan Karki	Chettri	Agriculture	11		Yes	5	1c,3,4e		All Family Members	2	-	Yes	Yes	No	No	No
42	Bimira Karki	Chettri	Shopkeeper	7		Yes	3	1c,3,4e		All Family Members	2	-	Yes	Yes	Yes	Yes	Yes
43	Bishnu Bhakta Shresta	Chettri	Shopkeeper	10		Yes	5	1c,3,4e		All Family Members	2	-	Yes	Yes	Yes	Yes	Yes
44	Keshab Bhujel	Gharti	Agriculture	4		Yes	3	1b,1c,3,4e		All Family Members	2	-	Yes	Yes	Yes	No	No
45	Bishnu Maya Karki	Chettri	Agriculture	7		Yes	6	1c,4e		All Family Members	2	-	Yes	Yes	No	No	No
46	Ram Lal Shrestha	Newar	Shopkeeper	7		Yes	3	4e		All Family Members	2	-	Yes	Yes	Yes	Yes	Yes
47	Shyan Prasad Paudel	Bhramin	Agriculture	8		Yes	4	1a,1c		All Family Members	2	-	Yes	Yes	Yes	Yes	No
48	Shree Prasad Paudel	Bhramin	Agriculture	7		Yes	3	1a,1c		All Family Members	2	-	Yes	Yes	Yes	Yes	Yes
49	Nema Man Pradhan	Newar	Agriculture	6		No	-	-	-	-	2	3	Yes	Yes	Yes	Yes	Yes
50	Rukmini Napit	Newar	Agriculture	6		Yes	3	1a,1c,2,3		All Family Members	2	-	Yes	Yes	Yes	Yes	No

Note: (1) Hearing survey was carried out on October 7 to 8, 1996.
(2) The results of Q4 denote the number of family at the time of 1993 desaster. The figures in () denote the number of family at the time of hearing survey.

Table 2.1.3 Results of Hearing Survey for Evacuation System Planning (Namtar/Tilar Area)

No.	Q1.	Q2.	Q3.	Q4.	Q5.	Q6.	Q7.	Q8.	Q9.	Q10.	Q11.	Q12.	Q13	Q14	Q15		
															(1)	(2)	(3)
1	Hari Prasad Burtaula	Bhramin	Shopkeeper	7		Yes	3	1a,1c,4e		All Family Members	2	-	Yes	Yes	Yes	Yes	No
2	Sita Ram Lataula	Chettri	Shopkeeper	2		Yes	5	1a,1c		All Family Members	2	-	Yes	Yes	Yes	Yes	No
3	Lila Bahadur Nepali	Low Caste	Tailor	6		Yes	3	1a,1c,4e		All Family Members	2	-	Yes	Yes	No	Yes	No
4	Laxman Burtaula	Bhramin	Teacher	9		Yes	3	4e		My Father, My wife, My Younger Brother	2	-	Yes	Yes	Yes	Yes	No
5	Badri Bahadur Gautam	Chettri	Agriculture	5		No	-	-	-	-	2	3	Yes	Yes	Yes	Yes	No
6	Gaeiri Shankar Lataula	Bhramin	Agriculture	5		Yes	6	1c,3		All Family Members and Neighbours	2	-	Yes	Yes	No	No	No
7	Ganesh Bahadur Kanchan	Chettri	Agriculture	2		Yes	5	1c,3,4e		All Family Members and Neighbours	2	-	Yes	Yes	Yes	Yes	No
8	Radha Krishna upreti	Bhramin	Shopkeeper	9		Yes	3	1c,3,4e		All Family Members and Neighbours	3	-	Yes	Yes	Yes	Yes	No
9	Ram Prasad Kanel	Bhramin	Agriculture	7		Yes	3	1b,3		All Family Members	3	-	Yes	Yes	Yes	Yes	No
10	Hari Krishna Sibakoti	Bhramin	Politician / Agriculture	7		No	-	-	-	-	4	3	Yes	No	Yes	Yes	Yes
11	Sita Upreti	Bhramin	Agriculture	9		Yes	3	1a,1b		All Family Members	1	-	Yes	Yes	Yes	Yes	No
12	Suntali Rumka Lama	Tamang	Agriculture	8		Yes	6	4b		All Family Members	3	-	Yes	Yes	Yes	No	No
13	Jagat Bahadur Praja	Chepang	Agriculture	6		Yes	6	1a,1b		All Family Members	3	-	Yes	No	Yes	No	No
14	Gobinda Praja	Chepang	Agriculture	5		Yes	4	1a,1b		All Family Members	3	-	Yes	Yes	No	No	No
15	Bishnu Bahadur Ghising	Tamang	Student	9		No	-	-	-	-	2	3	Yes	Yes	Yes	No	No
16	Ash Man Ghising	Tamang	Agriculture	5		Yes	3	1a,1e		All Family Members	2	-	Yes	No	No	No	No
17	Purna Bahadur Ghising	Tamang	Agriculture	5		Yes	3	1a		All Family Members	3	-	Yes	Yes	No	No	No
18	Gopini Gautam	Chettri	Agriculture	6		Yes	4	1a,2		All Family Members	2	-	Yes	Yes	No	Yes	No
19	Krishna Prasad Kalakheti	Bhramin	Agriculture	7		Yes	5	1d		All Family Members	2	-	Yes	Yes	Yes	Yes	No
20	Nakarai Satyal	Chettri	Agriculture	5		Yes	4	1a		All Family Members and One Guest	1	-	Yes	Yes	Yes	Yes	No
21	Tej Prasad Gartaula	Bhramin	Agriculture	5		Yes	3	1b,1c,3,4a		All Family Members	2	-	Yes	Yes	No	Yes	No
22	Susila Bartaula	Bhramin	Agriculture	5		No	-	-	-	-	2	3	Yes	No	Yes	No	No
23	Ganga Maya Bartaula	Bhramin	Agriculture	20		No	-	-	-	-	1	3	Yes	No	Yes	Yes	No
24	Bhagawan Gautam	Chettri	Agriculture	4		Yes	3	1a,1b,3		All Family Members	3	-	Yes	Yes	Yes	No	No
25	Kedar Prasad Bartaula	Bhramin	Agriculture	10		Yes	4	1b,1c,4e		Three Brothers	2	-	Yes	Yes	Yes	Yes	No
26	Thuli Maya Runba	Tamang	Agriculture	6		No	-	-	-	-	2	2	Yes	No	No	No	No
27	Budhi Man Runba	Tamang	Agriculture	6		No	-	-	-	-	2	2	Yes	No	No	No	No
28	Dip Bahadur Parja	Chepang	Agriculture	3		Yes	5	1b,3		All Family Members	3	-	Yes	Yes	No	Yes	No
29	Eka Bahadur Tirung	Tamang	Agriculture	3		No	3	1a		All Family Members	2	-	Yes	Yes	Yes	No	No
30	Taya Bahadur Runba	Tamang	Agriculture	6		Yes	3	1b		All Family Members	3	-	Yes	Yes	No	No	No
31	Kali Bahadur Satyal	Chettri	Agriculture	9		No	-	-	-	-	3	5	Yes	Yes	No	No	No
32	Ram Sharan B. K.	Low Caste	Agriculture	6		Yes	1	1a,1b,3		All Family Members	1	-	Yes	Yes	Yes	No	No
33	Dhar Kumari Satyal	Chettri	Agriculture	5		No	-	-	-	-	2	3	Yes	No	Yes	Yes	No
34	Ramji Baniya	Chettri	Agriculture	6		Yes	1	1a		All Family Members	1	-	Yes	No	Yes	Yes	No
35	Ambika Thapa	Chettri	Agriculture	3 (5)		Yes	6	1a		All Family Members	2	-	Yes	Yes	No	Yes	No
36	Nama Raj Parajuli	Bhramin	Agriculture	4		No	-	-	-	-	3	5	Yes	No	No	Yes	No
37	Suntari Bishwokarma	Kami	Agriculture	11		No	-	-	-	-	4	5	Yes	No	No	Yes	No
38	Bishwo Nath Upreti	Bhramin	Agriculture	7		No	-	-	-	-	2	5	Yes	No	Yes	Yes	No
39	Bhimsen Bishwokarma	Kami	Agriculture	5		Yes	3	1b,2,4a,4b		All Family Members	3	-	Yes	Yes	No	No	No
40	Nani Maya Shatyal	Bhramin	Welfare	5		Yes	6	1a,1b,1c,4e		All Family Members	2	-	Yes	Yes	Yes	Yes	No
41	Parbati Bartaula	Bhramin	Agriculture	6		No	-	-	-	-	2	5	Yes	No	Yes	Yes	No
42	Shiva Maya Bartaula	Bhramin	Agriculture	5		No	-	-	-	-	4	3	Yes	Yes	No	No	No
43	Kalpana Bartaula	Bhramin	Agriculture	9		No	-	-	-	-	2	5	Yes	No	No	Yes	No
44	Bhagabati Bartaula	Bhramin	Agriculture	5		No	-	-	-	-	4	2	Yes	No	Yes	Yes	No
45	Kedar Nath Bartaula	Bhramin	Agriculture	8		No	-	-	-	-	2	3	Yes	Yes	Yes	Yes	No
46	Parmila Bartaula	Bhramin	Agriculture	8		Yes	3	1a,1b,1c,3,4e		All Family Members	2	-	Yes	Yes	No	No	No
47	Sonamshing Runba	Tamang	Agriculture	8		Yes	3	1b,1c,3,4b		All Family Members	3	-	Yes	No	No	No	No
48	Parbate Runba	Tamang	Agriculture	6		Yes	3	1a,3		All Family Members	3	-	Yes	No	Yes	Yes	No
49	Kul Pasad Bartaula	Bhramin	Agriculture	7		No	-	-	-	-	3	3	Yes	No	No	No	No
50	Dura Bahadur Bulun	Tamang	Agriculture	7		Yes	3	1a,1b,3,4b		All Family Members and Neighbours	3	-	Yes	Yes	Yes	No	No

Note: (1) Hearing survey was carried out on October 10 to 12, 1996.
(2) The results of Q4 denote the number of family at the time of 1993 desaster. The figures in () denote the number of family at the time of hearing survey.

Table 2.1.4 Results of Hearing Survey for Evacuation System Planning (Chisapani Area)

No.	Q1.	Q2.	Q3.	Q4.	Q5.	Q6.	Q7.	Q8.	Q9.	Q10.	Q11.	Q12.	Q13	Q14	Q15		
															(1)	(2)	(3)
1	Ram Kumari Gurung	Gurung	Agriculture	5		Yes	1	1a,1c,3,4a		All Family Members	3	-	Yes	No	No	No	No
2	Dil Bahadur Syagntan	Tamang	Agriculture	3		Yes	3	1a,3,4a		All Family Members	3	-	Yes	Yes	Yes	Yes	No
3	Imah Syangtan	Tamang	Agriculture	8		Yes	1	1b,3,4a		All Family Members	1	-	Yes	No	No	Yes	No
4	Muno Syangtan	Tamang	Agriculture	8		Yes	3	1b,1c,2,3,4b		All Family Members	2	-	Yes	Yes	No	No	No
5	Sita Lama	Tamang	Agriculture	5		Yes	1	1a,1b,1c,2,3		All Family Members	3	-	Yes	Yes	Yes	Yes	No
6	Ram Kumar Syangtan	Tamang	Agriculture	2		Yes	1	1a,1b,1c,3		All Family Members and Neighbours	3	-	Yes	Yes	No	No	No
7	Chandra Bahadur Gurung	Gurung	Day Laborer	4		Yes	3	1b,1c,4b		All Family Members and Neighbours	3	-	Yes	Yes	Yes	Yes	No
8	Harka Bahadur Syangtan	Tamang	Agriculture	5		Yes	3	4a,4b		All Family Members	3	-	Yes	No	No	Yes	No
9	Krishna Bahadur Syangtan	Tamang	Agriculture	4		Yes	3	1a,4a		All Family Members and Neighbours	3	-	Yes	Yes	Yes	Yes	No
10	Ganesh Bahadur Thing	Tamang	Shopkeeper	4		Yes	3	4a		All Family Members	3	-	Yes	Yes	Yes	Yes	No
11	Potekaila Syangtan	Tamang	Agriculture	6		Yes	1	4a		All Family Members	3	-	Yes	Yes	No	No	No
12	Thulimaya Syangtan	Tamang	Agriculture	5		Yes	1	1a,1b,2		All Family Members	3	-	Yes	Yes	Yes	No	No
13	Tek Bahadur Syangtan	Tamang	Agriculture	8		Yes	1	1a,1b		All Family Members	3	-	Yes	Yes	No	No	No
14	Ram Bahadur Syangtan	Tamang	Agriculture	5		Yes	6	1a,3,4a		All Family Members and Neighbours	2	-	Yes	Yes	Yes	Yes	No
15	Pratashing Lama	Tamang	VDC Assistant technician	4		Yes	1	1a,3,4a		All Family Members	1	-	Yes	Yes	Yes	Yes	No
16	Ram Bahadur Bulun	Tamang	Agriculture	8		Yes	1	1a,1b,1c,3		All Family Members and Neighbours	2	-	Yes	Yes	Yes	Yes	No
17	Sunmaya Ghale	Tamang	Agriculture	5		Yes	1	1a,4a		All Family Members and Neighbours	3	-	Yes	Yes	No	Yes	No
18	Sunmaya Ghale	Tamang	Agriculture	3		Yes	1	1a,3,4a		All Family Members and Neighbours	3	-	Yes	Yes	Yes	Yes	No
19	Thulo Chandra Bahadur Syangtan	Tamang	Agriculture	5		Yes	1	1a,1b		All Family Members	3	-	Yes	Yes	No	No	No
20	Shyam Kumar Syangtan	Tamang	Agriculture	8		Yes	5	1a,1b		All Family Members	3	-	Yes	Yes	Yes	Yes	No
21	Chandra Bahadur Tamang	Tamang	Agriculture	10		Yes	1	1a,1b		All Family Members	3	-	Yes	No	Yes	Yes	No
22	Chandra Bahadur Khatri	Chettri	Agriculture	7		Yes	1	1b		All Family Members	3	-	Yes	No	Yes	Yes	No
23	Dal Bahadur Bulun	Tamang	Agriculture	6		Yes	1	1a,1b		All Family Members and Two Guests	3	-	Yes	Yes	No	Yes	No
24	Krishuna Bahadur Khatry	Chettri	Agriculture	1		Yes	1	1b,2		All Family Members	4	-	Yes	Yes	No	No	No
25	Shiva Bahadur Chettri	Chettri	Agriculture	5		Yes	1	1a,1b		All Family Members	3	-	Yes	No	No	Yes	No
26	Kanchhi Syangtan	Tamang	Agriculture	7	(8)	Yes	1	1b		All Family Members	3	-	Yes	No	Yes	Yes	No
27	Chandra Bahadur Syangtan	Tamang	Agriculture	9	(7)	Yes	1	1a,1b		All Family Members	3	-	Yes	Yes	Yes	Yes	No
28	Bir Bahadur Syangtan	Tamang	Agriculture	6		Yes	1	1a,1b		All Family Members	3	-	Yes	Yes	No	Yes	No
29	Sher Bahadur Syangtan	Tamang	Agriculture	6		Yes	5	1a,1b,2		All Family Members	3	-	Yes	Yes	No	No	No
30	Ram Bahadur Syangtan	Tamang	Agriculture	3		Yes	1	1a,1b		All Family Members	3	-	Yes	Yes	Yes	No	No
31	Lar Bahadur Syangtan	Tamang	Agriculture	4		Yes	1	1b,1c,2		All Family Members	3	-	Yes	Yes	No	Yes	No
32	Ram Bahadur Gurung	Gurung	Agriculture	5		Yes	3	1b,1c,3		All Family Members	3	-	Yes	Yes	Yes	Yes	No
33	Kanchhi Maya Syangtan	Magar	Agriculture	4		Yes	5	1a,1b,1c,3		All Family Members	2	-	Yes	Yes	Yes	Yes	No
34	Ram Sharan Syangtan	Magar	Agriculture	7		Yes	4	1a,1b,1c,3		All Family Members and Neighbours	2	-	Yes	Yes	No	Yes	No
35	Ram Bahadur Gurung	Gurung	Agriculture	8		Yes	1	1b,1c,4b		All Family Members	2	-	Yes	Yes	Yes	No	No
36	Bishnu Maya Syangtan	Tamang	Agriculture	3		Yes	1	1a,1b,1c,2,3,4a		All Family Members	2	-	Yes	Yes	Yes	No	No
37	Dilkeemari Gurung	Gurung	Agriculture	4		Yes	1	1b,1c,4b		All Family Members	3	-	Yes	Yes	No	No	No
38	Indra Lal Syangtan	Tamang	Agriculture	8		Yes	5	1abc,3,4b		All Family Members	3	-	Yes	Yes	Yes	Yes	No
39	Karshing Syangtan	Tamang	Agriculture	6		Yes	2	1a,1b,1c,3,4b		All Family Members	2	-	Yes	Yes	Yes	Yes	No
40	Sete Syangtan	Tamang	Agriculture	9		Yes	1	1a,1c,3		All Family Members and Neighbours	3	-	Yes	Yes	No	Yes	No
41	Arjun Bahadur Tamang	Tamang	Agriculture	5		Yes	3	1b		All Family Members	3	-	Yes	Yes	Yes	Yes	No
42	Ganesh Bahadur Tamang	Tamang	Agriculture	7		Yes	2	1b		All Family Members	3	-	Yes	Yes	No	No	No
43	Kanchhi Tamang	Tamang	Agriculture	6	(7)	Yes	4	1b		All Family Members	3	-	Yes	Yes	Yes	Yes	No
44	Bishnu Maya Gurung	Gurung	Agriculture	7		Yes	1	4b		All Family Members and Neighbours	3	-	Yes	No	No	No	No
45	Sano Kancha Gurung	Gurung	Agriculture	9		Yes	1	4b		All Family Members	3	-	Yes	No	Yes	No	No
46	Jhamak Bahadur Gurung	Gurung	Shopkeeper	3	(7)	Yes	2	1a,1b		All Family Members and Brother's Family	3	-	Yes	Yes	Yes	No	No
47	Surya Bahadur Tamang	Tamang	Agriculture	10	(11)	Yes	3	1b		All Family Members	3	-	Yes	No	Yes	No	No
48	Kanchhi Gurung	Gurung	Agriculture	5	(7)	Yes	2	1a,1b		All Family Members	3	-	Yes	Yes	No	No	No
49	Sharan Gurung	Gurung	Agriculture	13	(9)	Yes	1	4b		All Family Members	3	-	Yes	Yes	No	Yes	No
50	Harka Bahadur Tamang	Tamang	Agriculture	8	(7)	Yes	1	1b		All Family Members	3	-	Yes	Yes	Yes	Yes	No

Note: (1) Hearing survey was carried out on October 9, 1996.
(2) The results of Q4 denote the number of family at the time of 1993 desaster. The figures in () denote the number of family at the time of hearing survey.

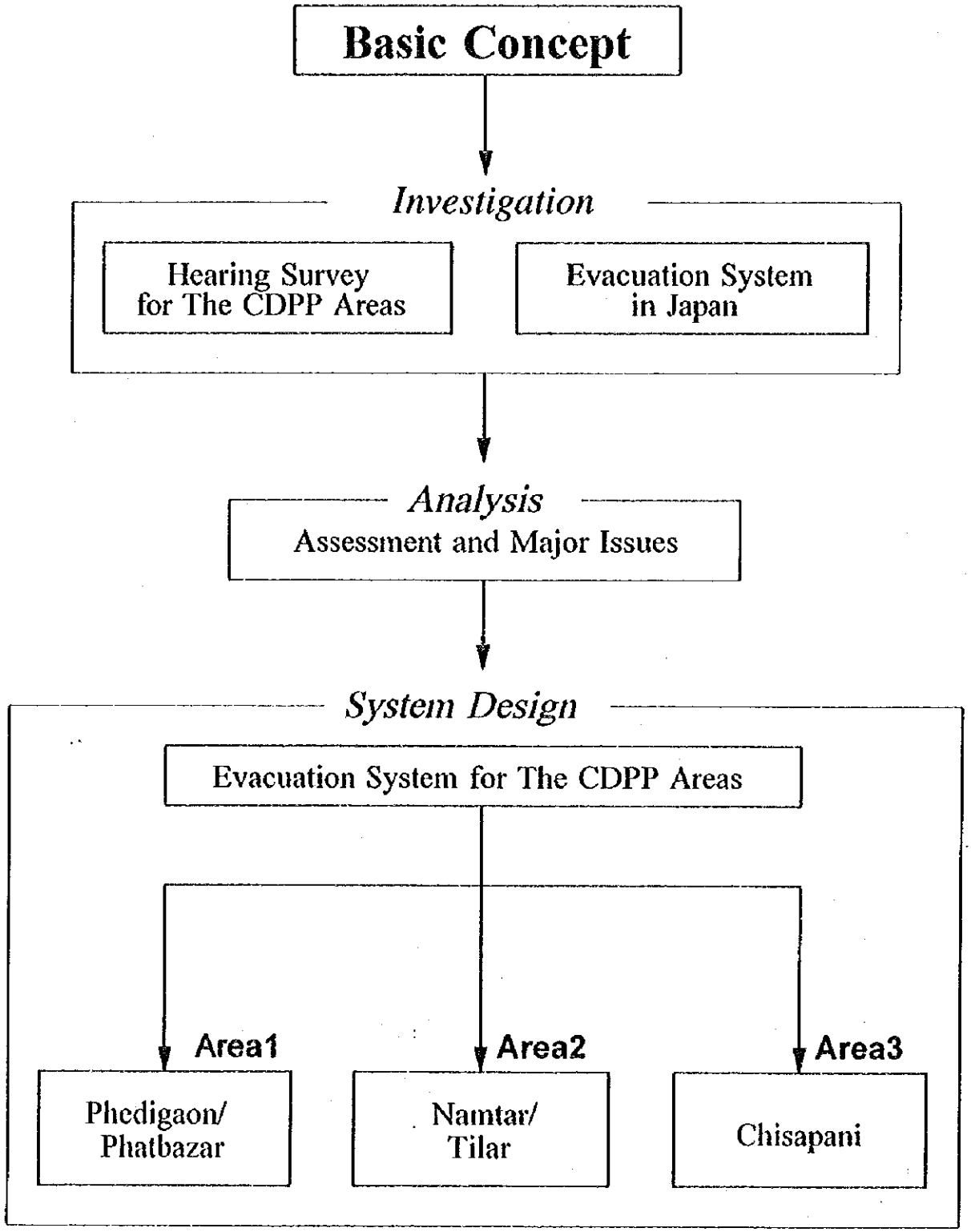


Fig. 1.3.1
Precedures To Disaster Evacuation System Plan Formulation

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