

2. ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Introduction

2.1.1 Background of the Project

In July 1993, a heavy rain for two days between 19-20 July caused serious damages to lives, properties, farmland and infrastructures in the Central Development Region of Nepal. With the torrential rain, 1,500 people were killed in the region and the damaged infrastructures such as Hydro-power station on Kulekhani Dam and the road system were severely devastated.

The damages made to villages, farmlands, houses and families were very serious too. More than 500,000 people were suffered to loss of families, their houses and farms. As a result, many left their places for shelter, or job.

In view of rehabilitation and economical re-development of the region, Department of Soil Conservation, Ministry of Forestry and Soil Conservation of HMG of Nepal has initiated a project for prevention of water-induced disaster in the late 1993.

The JICA Study Team has undertaken a detailed study of the damaged areas in 1995, mainly in Makawanpur District including Kulekhani Watershed Area, and Mahadev Besi Bridge in Dhading District. As a result, the Study Team made a suggestion to conduct remedial measures to conduct in the areas severely damaged in Makawanpur District. The Study Team also made a recommendation to conduct remedial works for Kulekhani hydro-power station, sedimentation prevention works to Kulekhani Reservoir, disaster prevention measures to Mahadev Besi Bridge.

2.1.2 Proposed Disaster Prevention Plan

Within the frame work of the Study that the JICA Study Team conducted during the period from January 1996 to February 1997, the following measures have been suggested.

(1) Community Disaster Prevention Plan (CDPP)

Three most severely damaged villages have been selected for the Plan and a series of disaster prevention programme, economic development programme, and community organization programme are conducted as follows:

- i. Phedigaon/Phatbazar, Palung VDC;
 - A series of gabion structure on Gatte Khola
 - A series of gabion structures on Dungakhate Khola
 - Two concrete check dams on Dungakhate Khola
 - Bio-engineering works on the hillside
 - Concrete training dikes
 - Vegetated riprap channel
 - Land reclamation
 - Bank protection works
 - Gabion training dikes
 - Rural road on the dikes

- Community forestry
 - Agricultural development works including agro-forestry programme
 - Community organization including evacuation procedures
- ii. Namtar/Tilar, Namtar VDC;
- A multi-purpose check dam on Manahari Khola
 - A multi-purpose consolidation dam on Manahari Khola
 - A consolidation dam on Manhari Khola
 - A check dam on Syarse Khola
 - Land reclamation of the riverside area on Manahari Khola
 - Rehabilitation of irrigation canal
 - Slope protection works on Manahari Khola
 - Improvement of rural road
 - Agricultural development works including agro-forestry programme
 - Community organization including evacuation procedures
- iii. Chisapani, Agra VDC;
- Water supply system
 - Small scale sprinkler irrigation system
 - Community forestry programme including agro-forestry
 - A series of gabion structures on Chisapani Khola
 - A series of concrete check dams on Chisapani Khola
 - Community organization including evacuation procedures
- (2) Infrastructure Disaster Prevention Plan (IDPP) for Mahadev Besi Bridge
- A series of ground sills on Agra Khola
 - A series of gabion spur dikes with vegetation enhancement works
 - Stone pitching as embankment
- (3) Infrastructure Disaster Prevention Plan (IDPP) for Kulekhani Watershed Area
- A set of disaster prevention plan conducted in Phedigaon/Phatbazar
 - A set of recommendations on the prevention of sedimentation in Kulekhani Reservoir

2.1.3 Scope of Works for Environmental Impact Analysis

The following is a scope of works for the Environmental Impact Analysis of the "Study of Disaster Prevention Plan for Severely Affected Area by 1993 Disaster in the Central Development Region of Nepal":

- Conduct present natural and social environmental conditions of the VDCs in which the Project takes place;
- Identify environmental impact assessment on the natural and social environment in relation to the implementation of the Project; and
- Suggest environmental management programme and environmental monitoring

programme in order to maintain as much present conditions of the environment as possible.

2.1.4 Methodology of Environmental Impact Analysis

Methodology of the Environmental Impact Analysis is as follows:

(1) Primary Data Collection;

- Conduct field survey on the identification of wildlife distribution. A list of wildlife species made prior to field reconnaissance trip was used and interview survey was conducted on site with the local residents against the list ;
- Conduct field survey on the identification of plant species in the project area. Plant species are sampled on site for identification as well as the estimation of their dominance on site;
- Conduct field survey on the identification of fish species within the project area. A list of fish species made prior to field reconnaissance trip was use and interview survey was conducted on site with the local residents against the list;
- Conduct water quality test on the waters sampled on site. Fresh water was sampled on site and transported within the prescribed time and tested by the competitive laboratory according to the standard procedure of water quality test; and
- Conduct supplemental interview survey on the present conditions of social environment.

(2) Secondary Data Collection;

- Make use of the result of interview survey conducted on the present conditions of social environment within the framework of community organization plan for the Study. Available data are the Interim Report I and II of the "Study of Disaster Prevention Plan For Severely Affected Area by 1993 Disaster in the Central Development Region of Nepal";
- Make use of the design drawings and report conducted within the framework of the Study;
- Collect government report related to the Project;
- Make use of the published data on the natural and social environment; and
- Make use of the map in the scale of 1:25,000 published by the Survey Department of HMG of Nepal.

2.2 Environmental Impact Assessment for the Community Disaster Prevention Plan for Phedigaon / Phatbazar

2.2.1 Present Environmental Conditions

(1) Physico-chemical Environment

i. Topography

Palung VDC (Village Development Committee, a smallest political unit) is located in the north-western part of Makwanpur District. Palung VDC is accessible by the seasonal riverine trail from Thana bazar on Tribhuvan Highway at the point of 65 km from Kathmandu. It can also be reached by walking 20-25 minutes from Sikharkot, a market centre along the highway. The village lies across Palung river. Since the bridges on the river washed away during 1993 Disaster, foot path goes across the river bed. Phedigaon, Phatbazar and other areas become inaccessible during the monsoon season.

Palung VDC covers a total area of 18.7 sq. km spreading from 1780 m asl upto about 2500 m asl. It borders with Tistung Deurali and Agra VDC to the north, Daman VDC to the south and Daman and Bajrabarahi VDC to the east. Palung river forms the valley that function as border between Daman VDC and Palung VDC.

Settlement is found on the slopes of mountains. Palung Bazaar is a cluster of houses in the Ward No. 6 of Palung VDC and another cluster of houses are found in Podegaon, which is in the Ward No.3 as well as along the foot trails of Phedigaon to Deurali, a village on the way to Chisapani of Agra VDC.

The valley has been used extensively for agriculture and it is gradually increasing to grow more cash crops of vegetables. Palung was one of the village which started supplying vegetables to Kathmandu and now also supplies to Pokhara and some places in India, such as Siliguri, Calcutta, and Lucknow. Terraced farming areas dominate the landscape of the mountain slopes in Phedigaon and Phatbazar. Changes of mountain slope for the present terraced farming area have taken place during the past centuries and it has become almost a part of natural landscape.

The altitude of the upper most area of Kulekhani Khola, or Phedi Khola as is termed by the local residents, where Phedigaon and Phatbazar are located, is between 1,800 to 2,540m asl. Gradient of the slope at the head of the river is more than 40% while it is in the range of 15-25% in the area around Phedigaon and Phatbazar. The gradient of the river levels out toward the area near the confluence of Phedi Khola and Garti Khola.

Slope of the hills to the north of Phedigaon and Phatbazar is steeper comparing to the slope of the southern slope. The slope to the south is more fragile and there is a sign of a large block sliding from the slope to Phedi Khola area.

ii. Geology

Geology of the study area is mainly composed of schist, phyllites and metamorphic sandstone of Kulekhani formation, which is one of the Bhimpedi

group. Geology of the northern part of the area is composed of quartets and phyllites of Markhu formation. The land area upstream of the major river tributaries near landslide are steep, with 30-degree slope to the north composed of schist, phyllite and metamorphic sandstone. The land mass on the slope was saturated with rain and lost the strength thus collapsed in blocks. The debris clogged the course of stream which causes the river to take another course on agricultural land in places.

iii. River morphology

Palung VDC has a number of perennial and seasonal rivers. Phedi Khola is the major river which drains water from northwestern hills through the rivers of Dhungakate, Ghatte and Bhottekhoria Khola. The Phedi Khola is called as Palung Khola after the confluence of other rivers such as Soltu Khola, Mahadev Khola joining from north as well as Gharti Khola from south, in Daman VDC. Palung Khola is the major river draining water to Kulekhani Reservoir or Indrasarobar for producing hydro electricity.

Phedi Khola originating from the hills of south west part of Palung VDC forms the major river causing damages during 1993 disaster. It originates at the height of about 2510 m in Mahabharat range and travels about 5 km east to Palung where it becomes Sankhumul Khola or sometimes called Palung Khola. Due to the sharp decrease in height, the river flowing downwards forming deep gullies with different gradient. The riverbed gradient at the confluence of Dhungakate Khola and Ghatte Khola are 7.4 % and 6.7 % in average respectively. The riverbed gradient of Bhottekhoria Khola is 4.7 %, which is more gentle than the other two rivers. The gradient of Phedi Khola decreases as it flows downwards to Palung. Phedi Khola drains water from 5.6 km² of catchment area.

iv. Water Quality

The rivers and springs are the main sources of water for the use of the local residents. The use of water resources is not only determined by the availability of water but also by its quality. The quality is described through a set of variables relating to physico-chemical and biological properties of the water sources. However, the quality of water may be different for specific purposes and is dependent upon the geology, land use, human settlement and other activities.

Presently, water from most of the rivers are the sources of life as the local residents use it for irrigation, washing and drinking. Major Rivers in Palung Khola are Phedi Khola, Bhottekhoria Khola, Palung Khola, Mahadev Khola, Soltu Khola and other small streams. They all form Palung Khola near Palung Village. As is shown in the Table 2.1, some physico-chemical and biological parameters were analysed from the water of Phedi Khola sampled at the mouth of Phedi Khola near Palung village. Sampling point is shown in the Figure 2.11.

The tested results show that the water is within the WHO limits for drinking water as well as for all the other parameters. However, coliform is exceeding the recommended level. The high amount of coliform found in the water might be due to a number of houses and domestic animals in the upstream area. Very few households have installed the toilets thus river beds are used for toilet. Water from this river is not used for drinking but the small streams near the villages. There are also some water supply tanks located at the northern and western hills around Bhottekhoria and Pheidgaon. The water in the river is also suitable for

irrigation and aquaculture. The water in the river has been used by the local residents for washing and cleaning in Phedigaon.

v. Climate and Rainfall

Palung village experiences temperate climate with short summer days. The lower parts of the area are in the warm temperate while other areas on the mountain slope are in Temperate zone. Two distinct seasons exist, the summer monsoon season brings rains between April-May and September and the dry winter between October April-May. Climatic changes has been experienced in the area as there are more rain extending beyond the period of rainy season.

Winter season is comparatively long and more warm days with longer day time light and cool in the nights. Average temperatures in Palung are about 10 to 15°C. Mean maximum temperature during summer is 27°C and mean minimum temperature in winter is about 2°C. Sometimes in winter temperature reaches sub-zero temperatures of 2°C below zero. Occasionally, it snows during the winter season. Mean relative humidity is upto 60 % in winter and reaches as high as 91 % during the monsoon season in Palung.

As is shown in the Table 2.2, Data from Daman weather station shows the average rainfall for ten years (1981-1990) in the area was 1730 mm (millimeters) and its 73 % is recorded during the monsoon season. The result indicates that most of the rainfall occurred during the monsoon season between June to September while July is the peak of rainfall.

(2) Biological Environment

i. Fauna

Wildlife

Since almost entire area of Palung VDC are utilised for farming except in the steep slopes on the ridges of mountain, distribution of wildlife in Palung VDC is limited. There are some patches of forest area present in Palung VDC except for Ward No. 3 and 6. The area has been developed by the local residents long time ago and that they conducted intensive farming practices. Thus decrease of forest areas in Palung VDC was noticeable. Therefore the number of wildlife has decreased and that there is no endangered species observed nor recorded by the local residents.

At present, animals such as leopard is rare in Palung VDC while they are seen frequently before. This is due to the changes of habitat and loss of forested areas.

The animals which are common in Nepal are found also in Palung. The frequently seen animals are shown in the Table 2.3. Porcupine can be seen during the maize growing season as they come to eat them. The forest lie over the area between Palung and Agra VDC. Thus wild animals generally travel in both areas. There are only about 9 animal species recorded by the local residents as follows:

Hystrix sp. - Porcupine

This is a common animal found living near the trees. Appears during the night to eat maize, potato, beans in the months of March to April/May. They are regarded as wild pest by human as they damage crops.

Lepus sp. - Rabbit

Rabbits are found mostly at the bushy type of trees. Usually are nomadic type as they live towards higher hills during winter and towards lower hills during rainy season. Rabbits are also seen in the agriculture field looking for beans during April/May.

Canis aureus - Jackal

Found in abundant and all year round and in any environment. They prefer to kill chicken and small animals also feeds on maize, and dead animals. Few years ago they are found in plenty but now estimated to be little less. They often steal chicken during the daytime from village as there is less food found around forest.

Felis chaus - Wild Cat

Lives in the forest but steals chicken from the village during night. Seen in the village only during rainy season, not seen during winter. They are found in all the VDC area.

Herpestes edwardsi - Mongoose

Lives in the forest but feeds on small mouse around villages. Estimated to be decreasing may be because of killing of rats and mice with the use of poison.

Macaque mulata - Monkey

Monkeys are the most abundant animal in the forest and around villages. Damages the crop mainly maize. Many of them are found in Kuibhir forest. It was estimated that the monkey population is significantly increased that local residents thought some other local residents brought them from somewhere and released there.

Panthera sp. - Leopard

Very few are found these days and seen only few times. They feed on wild fruits such as *Prunus castanopsis*. They were common among the leopards but now can be considered as threatened.

Melursus ursinus - Small black bear

This species are also threatened as it is very rare to be seen. They were seen during rainy season Jun/Jul and come to consume wild fruits such as of *Quercus*, *Castanopsis*.

Funambulus sp. - Squirrel

The squirrels are a common visitor in the field however they live in the forest. They feed on the wild fruits and found in any environment and are resident.

Birds

Because of the development of agriculture in Palung VDC, very few bird species are found. Most of the birds found in the area are more or less common in any part of Nepal. Bird species commonly seen in the area are dove, cuckoo, wren, myna, sparrow, and crow. Some are rare such as egret and vulture. These

common birds feed on crops, seeds and insects while vulture feed on the dead bodies of animal. Woodpecker is also found in the area throughout the year. Table 2.3.b shows a list of birds commonly seen in the area.

Insects

Insects common to Palung VDC has been declined over the past years while some of them disappeared mainly due to the introduction of chemical fertilisers.

In the natural habitat, insects are abundant and attract birds as they feed on the insects. Insects such as dragon fly, spiders, grasshoppers, mantis, and a number of different kinds of butterflies are common in Palung VDC. Leech is also found abundantly during the rainy season along the hill trails and riversides. However, they are decreased due to the use of chemical fertilisers and insecticides.

Fish Species

Some freshwater fishes are found in the area. Presence of fishes in the rivers are largely depend upon the water temperatures and availability of feeding ground. Phedi and Palung Kholas are the major rivers where local residents catch fish. There is no fish culture in the area.

Most of the fish species found are stream fishes feeding on phytoplankton and zooplankton, while some fishes are surface feeder such as Asla and Buduna. Some are bottom feeder such as Carps. Fishing is done mainly for their own consumption. The types of fish found here in the Phedi Khola are very few and the number have been greatly decreased after the flood in 1993. The Fishes caught in the area are shown in the Table 2.3.c.

ii. Flora

General Conditions of Vegetation in Palung VDC

Palung VDC lies in the warm temperate zone of the Mahabharat region and its 40 percent of the total land area is occupied by forest. Forested area extends from 1800 m to 2500 m asl. It is mainly mixed hardwood and oniferous trees i.e. Rhododendron, Quercus, Schima, Castanopsis, Michelia, Lyonia mixed with Chir and Blue Pine. Deforestation of the forest in the areas around 1800 m asl took place as local residents conducted agricultural development, fuel and fodder collection including grazing animals.

Thus conditions of forest is very poor at present and that the dense forest is left on the top of mountain ranges. There are 12-15 species of trees in Palung VDC and this is considered as very low diversification of the forest species. In general, there are three types of forest, such as Alnus Forest, Mixed Hardwood Forest and Pine Forest.

Alnus Forest

This type of forest is common on the riversides, the area in the fresh landslide and degraded land lower than 2000 m asl. Alnus trees generally grow in large numbers as there is landslide. Young Alnus nepalensis are now commonly seen along Dhungakate Khola and Bhotekhoria Khola where landslide in the

upstream areas of these rivers took place due to the torrential rain in July 1993. *Alnus* trees are a good colonizer as it grows in the land having fresh disturbances of soil. This type of forest is found near the riverside of Palung village and has attained its maturity. Local residents keep the *Alnus* trees that grew on their agricultural land covered with debris after the 1993 Disaster. *Alnus* forest later gives way to other plant species such as *Schima castapensis* showing intermediate successional stage.

Rhododendron forest

Though there are little forested areas, *Rhododendron* forest is found in the upper most slope of Palung VDC. *Rhododendron arboreum* are found dominant in some patches with few oak trees or with some *Schima* trees and *Lyonia* as well as other shrubberies. The forest is categorised as 40 to 70 % of crown density area. Herbs and shrubs are also found in this type of forested area.

Pine forest

Pine forest dominates in the area towards the higher hills to the north of Phedigaon. The pine forest covers the crown density of 10 to 40 percent in lower altitude and from 40 to 70 percent in the higher altitude. The pine forest is mixed with oak trees of *Castanopsis indica*, *Lyonia* sp. And a few *Zanthoxylum armatum*.

The shrubs such as *Eupatorium adenophorum*, *Rubus ellipticus*, *Barberis aristata*, *Gaultheria fragrantissima*, *Pyreantha crenulata* and grass species such as *Erograstis tenella*, *Cyperus deformis*, and Khar ghans are found in the pine forest.

Herbaceous plants such as *Polygonum* sp., *Ageratum conyzoides*, *Drymeria cordata*, and some fern species are found as ground cover in the forest. In higher altitude some other plants such as *Potentilla nepalensis*, and *Vitex repens* are also found. *Gultheria* grows in the rocky terrain while *Potentilla* are seen in many places.

Lichen and moss as pioneer plants are also found around the rocks. It was noted that no such plant species has disappeared from the area.

As the height lowers, Banmara or the crofton weed becomes abundant in the moist area. Among the tree species, *Alnus* is abundant in the area. High altitude areas used for grazing are dominated mainly by the ground cover with grass, moss, and lichen. *Michelia* is now losing its habitat in this area. It is found in a very limited area. *Ageratum conyzoides*, a weed generally appears everywhere has been succeeded by *Drymeria cordata*.

A list of plants species from Dhungakatte Khola and upper Bhottekhoria Khola of Palung VDC are shown in the Table 2.4.

Uses of Plants Species

Forest is a source of various kinds of plants which are being used by local residents for various purposes. The plant species in use by local residents in Palung are mainly Pine and *Alnus* for building houses while other trees such as *Rhododendron* and *Lyonia* are used as firewood.

Besides the fuel and timber valued trees there are a number of shrub and herbs of medicinal value. Though the local residents use a few medicinal plants, they collect and export outside for cash income. *Zanthoxylum* sp. is also found in some places and local residents collect and use it for eating. The amount of plants collected in the area are not exactly known. Chiraito is the most costly one while Pakhanved is inexpensive as the cost varies from Rs.45 per kilogram of Chiraito to Rs. 1.5 per kilo of Pakhanved. Medicinal plants collected by the local residents are shown in the Table 2.4.b.

(3) Socio-cultural Environment

i. Demographic Characteristics

Population Distribution

Total population of Palung VDC is 6,454 as is shown in the Table 2.5 a. Ward No. 9, 7 & 2 is densely populated among others. Female population is slightly higher than male population. Its distribution is 50.3 % of female and 49.7 % in male.

Mixture of ethnicity is one of the major characteristics of the population in the area. Brahmin, Chhetri, Thakuri, Tamang, Magar, Gurung, Newar and Occupational caste (Kami, Damai & Sarki) are the main caste groups of Palung VDC. Brahmin/Chhetri/Thakuri can be categorized as one caste group and its rate of 38.8% is the highest among others followed by 26 % of Tamang 25.7 % of Newar.

Ethnicity

Majority ethnic group in Phedigaon is Tamang and it is roughly 75% of the total population of Phedigaon followed by Chhetri that occupies 16% of the total population of Phedigaon area. On the other hand, in Phantbazar, Chhetri and Tamang forms major caste group. Kami is about 3% in Phedigaon and Damai is about 6% in Phantbazar. Ethnicity of the population in the area is shown in the Table 2.5.c.

Migration

Migration from the villages in Palung VDC to urban areas is a general trend. Migration is mainly for better opportunities to work and generate income. Migration among the villages within Palung VDC is not common.

Migration can be classified into three types, Permanent, Temporary and Seasonal. Reports from the village indicate that 18 households have been out-migrated for better job opportunity. After the 1993 Disaster, migration for better job opportunity has not increased. The local residents who lost their families, houses and farmland are still living with their relatives if any, providing manual labour works for normal wages. Very few had a chance to migrate to Hetauda where the HMG/N and an INGO have offered houses for free.

It has been reported that about 268 individuals are temporarily out-migrated within Nepal and some went overseas for better job opportunity.

Occupational Distribution

As the Table 2.5.c. shows, nearly 90 % of the local residents of Palung VDC depend upon agriculture for living. Others are 5% of government services, 3% of wage work for agriculture, construction or as porter, and about 2% engage in business, mainly running village grocery stores.

Literacy

Palung VDC, being situated very near to Tribhuvan Highway, has a well developed education system. However, only 38 percent of the total population is literate. Among the women, only 16.5 percent are literate and those who complete secondary school are less than male population while among male population, 59 percent is literate. Thus those who continue higher education would have to go to Kathmandu or Hetauda.

ii. Land Use

Agricultural Land Use Patterns

As is shown in the Figure 2.11, forest area in Palung VDC is about 738 ha. This is nearly 40 percent of the total area of Palung VDC. The rest of area, approximately 1,142 ha, belongs to farmland, residential area, river and road. There are about 347 ha upland or slope terracing for cultivation where rice cultivation is not possible.

Average Land Holding

Land holding in Palung VDC is shown in the Table 2.6 and summarized as follows:

- 34.7 % are marginal farmers;
- 26.3 % is small landholders;
- 25.1 % is medium landholders; and
- 7.8 % is large landholders.

Further, 60 households became landless because of the 1993 Disaster.

Land Tenure System

Farming is conducted manually and individually. Thus share-cropping system does not function in the modern years. One of the reasons that the share-cropping system has decreased is due to the land reform system conducted in Nepal. The land reform system provided that the share-cropper has right to claim the land they used to cultivate and the ownership is thus transferred.

However, there has been another type of sharing land for agriculture, which is termed "Bandaki" in Nepal. The system functions as a person borrows money from another, and the lender holds rights to use the borrower's land until the money is returned.

The landless and marginal farmers depend their life on agricultural labour, or transporting agricultural commodities from other farmer.

Irrigation System

Many irrigation canals of traditionally managed irrigation system (FMIS) in Palung VDC have been damaged by the 1993 Disaster.

"Garigaon irrigation project" introduces water from Dhungakate Khola and supplied water for 100 ha of land on the right bank of Phedi Khola. Rehabilitation works has been mainly by beneficiary farmers under the technical assistance of IFAD and district engineers. In this FMIS, rehabilitation programme, materials have been fully provided after re-designing the irrigation system.

There were two irrigation intake, one on Dhungakate Khola and the other on Ghatte Khola In the area to the west of Phedigaon. It irrigated 30 ha. There was a 70 ha of irrigation system on the left bank of Palung Khola. The area is divided into two areas: a 20 ha unit in Phedigaon and a 50 ha unit in Soltu (Ward No. 7). These irrigation systems have also been damaged by the 1993 Disaster.

In Bhangkhorla, Karkigaon and Palung (Ward No. 4,5,6), several intakes formerly installed in Mahadev Khola were also washed away and the total area of 70 ha is under shortage of irrigation water.

Cultivation Patterns

Rice cultivation is the major crop in Phedigaon area. However, because of marketability there has been changes on the patterns of cultivation that they prefer vegetables to rice during the past few years. This change is also due to the damages made to the irrigation canals by the 1993 Disaster. Because of the quick return with high value, vegetable cultivation is changing the patterns of land use in the area. The local residents even start cultivating three crops almost at the same space as shown in the Table 2.7. Potatoes followed by sowing maize. Once potatoes are harvested, cauliflowers are transplanted within the field maize is grown. This practice is applied to a portion of land they own.

Potato, cauliflower, radish and cabbages are the main cash crops produced in Palung VDC. Carrot is also started by some pioneer farmers.

Because of different insects damage crops in the field and those on storage, insecticide is getting popular in the area. There has been a report that major insects damaging in the area are Field Crickets, Stem Borers, Hispa and Mealy Bugs.

Cut worms are found in the paddy field, Field crickets in the maize, Thrips and Aphids in wheat and Moths in potato. The farmers generally use the insecticides and pesticides for the treatment of vegetable farm when they start to damage vegetables before harvest.

Livestock Holding

The number and average livestock holding is moderate in the area because of small areas available for grazing in Palung VDC. There is a trend that the farming in this area has been modernised in recent years. It leads to make use of chemical fertiliser for quick result, compost made out of animal droppings is less

available. It is also the trend that growing three crops in one season requires lot of labour i.e. less time is spent for collecting fodder leaves.

Average cattle holding per household is 1.3 and buffalo is 0.6 per household. Goat is a source of income as it is sold for meat and 6.2 heads are maintained per house. Each household also keeps 6-7 chickens.

iii. Forest of Palung VDC

Existing Forest Condition in Palung VDC

Total land area of Palung VDC is approximately 1,880 ha and approximately 738 ha belongs to forest area. Except in Ward No.6, there are patches of forest in the Wards in VDC. Forests of Palung VDC is predominantly mixed broad leaves type of forest. The existing tree species in these forest are given in the Table 2.4.

As a result of the population growth, poverty, illiteracy, land slide and unsustainable use of forest resources, the forest cover of Palung VDC is shrinking. Before 1993, forests of the VDC was generally open to all the local residents and local residents used to extract forest resources from the nearby forests as and when they require them.

Following the great disaster of 1993, local residents of Palung VDC began to be more aware about the importance of the conservation of forest and its sustainable use. Since then, local local residents have been making efforts to form forest users' committee for community forestry programme. However, because of lack of efficient leadership, know-how and guidance, status of these forests have not been improved.

Conditions of the Forest in Phedigaon

The area and the conditions of the forested areas in Phedigaon has been severely degraded. All the existing forests are being managed, protected and utilized by the local residents themselves with their own rules and regulations. Though cutting of young trees said to have been banned for the last few years, the present situation of the forest shows that the cutting of trees are still continued.

All the wards in Palung VDC having forest area is administered by the local residents. This has created unequal resources distribution among the local residents from village that there is no forest or very small forest areas in their wards. However, this is a way to maintain depleting forest resources.

Because of the massive human encroachment and natural disasters such as landslide and severe soil erosion, forest degradation is rapidly taking place in the upstream area of Dhungakatte Khola, Ghatte Khola and Bhottekhorriya Khola. Remaining forest patches in these areas are still on the verge of rapid degradation.

There is in need of converting all the existing forest into community forest and massive planting of trees, bamboo, and grasses should immediately be started in order to maintain agriculture on the mountain slopes in the area.

Community Forestry Program

As it is mentioned above patches of forest areas existing in eight wards in Palung VDC are being utilized by the local residents of the respective wards without converting them into community forest. These forests are being managed, protected and utilized by the local residents of the respective wards with the informal regulations set out by their own initiative. However, as these regulations are not effective and sufficiently professional enough for proper management, protection and enhancement of its quality and capacity. As a result, the forest is ever shrinking and causing chronicle shortages of forest resources for the local residents based on the agriculture on the mountain village.

Having said that, introduction of community forest programme is essential. The programme should be based on the presend division of the use of forest. Local residents are not aware of what the community forestry program is about and rather they have misconception about it. During the study time, many forest users were asked what is their understanding about community forestry programme.

Majority of the users commented that they are against converting their forest into the community forest as, they think, the ownership will go to a group of local residents who are engaged in as the users' committee members. They presume, that once the forest is converted into community forest, its ownership and right to use will be limited to members of community forest users' committee only.

They also fear that the rules and regulations for community forestry programme will be much strict and they might have to face legal actions as they must go to the forest frequently for collecting necessary forest products. Managing forests by informal and unorganized users' groups cannot guarantee the preservation of forest products and the present system should stay vulnerable while it should be respected.

As a result of misconception prevailing on the lack of proper knowledge of the community forestry, local residents are reluctant to convert the existing forests into community forests. Although there are government offices such as District Soil and Watershed Conservation Office and Area Forest Office for informing local residents about community forestry program, and encouraging them towards community forestry, local residents remain conservative on the use of forest areas. It is therefore technical manpower is required in order to organize local community for the effective use of forest areas.

There is only one community forestry programme in the Ward No.7 as follows:

Name of Community Forest:	Kali Devi Community Forest Users Group
Area covered:	0.95 ha
Year of hand over:	1994
Total No.of Consumers:	21 Households
Ward No.:	7

Activities carried out by the forest users' committee following the hand over is as follows:

- Users' committee has engaged in the activities related to the protection of the forest;

- Following the hand over of forest, the committee carried out tree improvement program;
- Pruning branches and weeding wild plants by mobilizing the users became active; and
- The committee sold about 200 doko of green grass to the users last year.

The users committee intends to plant trees in the forest area as follows. However, there is not sufficient capacity for the government office or NGOs to provide proper seedlings during the planting season. Thus improvement of nursery should also be conducted.

The tree species intended to plant by the users' committee are Blue pine (*Pinus wallichiana*), Lapsi (*Choerospondias axillaris*), Bottle brush or Kalki (*Callistemon viminalis*), Silky oak or Kangiyo (*Grevillea robusta*), Painyun (*Prunus cerasoides*), Eucalyptus (*Eucalyptus camaldolensis*), and Kabro (*Ficus lacor*).

Leasehold Forestry Program

There is only one leasehold forestry programme existing in the Ward No.8 of Palung VDC. This leasehold forest programme takes place in the forest area of 7.5 ha. It was handed over in 1994 to a group of seven local residents of the Ward No.8. However, because of dispute between leaseholders and the local residents no significant activity has been conducted to date.

Shortly after the hand over of this forest, several disputes between leaseholders and the local residents emerged. First dispute occurred when the Survey Office confirmed the boundary of the leasehold forest and the local residents' land. Among the local residents one household raised an objection over the boundary clearance conducted after the survey. Because of the question was not solved, their dissatisfaction led to their violent action and the fencing of leasehold forest was destroyed and more than 15,000 saplings of newly planted trees were uprooted. The leaseholders took this dispute for legal actions. Now, this case is still under the consideration of the court.

This was a dispute between one of the local households and the leaseholders. But, after a year, majority of local residents stood against the leasehold forest as the leasehold forest area was leased for twenty five years, instead of originally known 5 years and if management was not satisfactory, accessibility of the leasehold forest area should be transferred to other local residents. The non-user group member of the local residents do not have right to obtain forest products except for a nominal charge to be paid. Thus, legality of leasehold is likely to create more problem than the technicality of leasehold forestry programme.

Existing Agro-forestry Practices in Palung VDC

There are a few trees in local residents' private land, for the last 8 to 10 years, there has not been any significant tree planting activity conducted by the local residents in their private land. Most of the forest and fodder trees planted in private land are more than 10 years old. In case of fruit trees, most of them are older than 6 to 10 years. Major fruit trees planted in private land are pear, peach, plum and lemon. Compared to the forest and fruit trees, fodder trees are very few in number.

Local residents are interested in planting trees of forest, fodder & fruit variety. As there is a good nursery nearby the VDC, they are willing to plant trees. They also demand technical assistance on the know-how of planting and growing trees, and the financial assistance.

Major forest, fodder and fruit species the local residents showed their interests and that these trees are found in the private land of farmers in Palung VDC are shown in the Table 2.8.

Use of Forest Product

In Palung VDC, 95 % of the local residents depend firewood for their cooking energy from community and government forests and the rest depend on the trees planted in their own farm land. However, 75 % of the local residents collect fodder from their own farm land while the rest collect from government and community forest.

Each household consumes 6,400 kg of firewood per year. Similarly, 8,000 kg of fodder is collected from their own land or public forest per household per year. Most of the households use fuelwood for cooking and heating except for local residents from Ward No.3 where there is no forest in the ward as they can not obtain wood for fuel. They are bound to change their fuel to kerosene in recent years.

Since Ward No. 9 has a large number of population, this ward require considerable quantity of firewood and fodder and that the ward is afflicted of deforestation. Fodder species collected by the local residents are *Artocarpus lakoocha*, *Litsea monopetala*, *Ficus* sp., *Garuga pinata*, *Quercus* sp., *Saurauia nepaulensis*, and *Bambusa* sp. and *Dendro Calamus* sp.

Rural electrification to Palung VDC has been well achieved as it is close to Tribhuvan Highway. The rate of electrification in Palung VDC is approximately 60%. Generally the local residents have used electricity for lighting. Those who are not benefited by electricity use kerosene for lighting. Small tea-shops and modernized families use electricity for cooking.

iv. Infrastructure of the VDC

Palung VDC is accessible via vehicular path from Tribhuvan highway. However, frequent flood-ing disturbs transportation during the monsoon season.

There is no health post except for the facility of Ilaka Health Post in the adjoining Sikharkot Bazaar of Daman VDC. The Ilaka health Post is providing mobile midwife and child health care, family planning and other basic health services in every Saturday to Palung VDC.

Drinking water supply has already facilitated to the local residents of Palung VDC. Main water source is located on the hill side to the west of Phedigaon between Dhungakate and Ghatte Khola. This source supplies water to west Phedigaon as well as to south Phedigaon, Phat Bazar, and to Deurali and Soltu. Bhotekhoria Khola supplies Panighat and also to Soltu. Water shortage is severe in the distant area from the source of water. This is further worsened as

the lack of management system. Some of the villagers have installed their private pipelines, while some fetch water from nearby streams.

Families do not use latrine even though Women Development Section had initiated the use of latrine and had trained local residents to built it. Most of the local residents use defecation nearby stream, or wooded area.

There are seven public and two private primary schools and one secondary school in Palung VDC. The secondary school is on the border between Palung and Daman VDC for the students of two VDCs. Very few Tamangs of Ward No.9 send their children to school mainly because of poverty. Recently, classes of intermediate level has started under the administrative management from Makwanpur Multiple Campus situated in Hetauda, some four hours to the south by road from Palung VDC.

There is one public telephone available at the Palung VDC office. There is a postal service available in Thanabazar of Daman VDC.

v. Commerce and Industry

There are 5-6 rice mills run by diesel which serve to the local residents of Palung VDC. There are also some water mills near the streams to serve for grinding maize and wheat.

A stone quarry has been established as an only industry in Palung at Ward No.9, near Phedigaun. This has been the source of debris on the Dunghakate Khola to some extent.

Most of the commercial services are located in Sikharkot and Thanabazar in Daman VDC. They also serve for the local residents of Palung VDC. These services are Nepal Bank Ltd., Ilaka Police Post, Agriculture Development Bank, Post office, Horticulture Centre, Vegetable Farming Development Branch, Agri Service Centre, Ilaka Health Post, Department of Forest, Women Development Section and Sahakari.

vi. NGO Activities

An NGO called Lhyama pucha based in Kathmandu has set up a branch in the Ward No.1. It is a group of local youths that volunteers to develop their own community such as organising relief programme during natural disasters, to minimize social evils, undertaking infrastructural building and other activities.

There have been a number of water supply system in Palung VDC and most of them have been destroyed by the 1993 Disaster. Some of them are under rehabilitation under the support of the Rehabilitation of Flood Damaged Rural Infrastructure and Agricultural Lands funded and implemented by the HMG, WFP and ILO.

vii. Religious/Cultural Activity

There are a number of Temples of God/Goddese in Palung VDC. The local

residents worship Pandukeshwor Temple and Mahadev Temple everyday. They are located in Palung Bazaar and Bhairav Temple in Phedigaon as is shown in the Table 2.9.

Pandukeshwor Temple lies at the side of Palung River, downstream of the confluence of Garti Khola and Phedi Khola. The area is filled up with sands and stones as a result of the 1993 flood.

There is Indrayani Festival celebrated once ever three years at Matsenarayan Temple in the Ward No.7 with the statues of Kumari, Ganesh and Bhairav. The 1993 flood has destroyed the place with cultural value.

viii. Area of Aesthetic/Scientific Value

The Palung VDC is situated at the foot of the Mahabharat range. The landscape is dominated by the terraced agriculture area and steep slopes. The area itself has no longer scenic beauty.

2.2.2 Environmental Impact Assessment

(1) Identification of the Environmental Impacts

The major project components proposed to be carried out in Phedigaon of Palung VDC under the Community Disaster Prevention Plan are as follows:

- Two check dams on Dunghakate Khola;
- River training works and the road on the dike;
- A series of gabion structures;
- Access road; and
- Community organization development activities including agricultural development, and afforestation programme.

The proposed afforestation and community forestry development programme is also intended to function as a part of the Infrastructure Disaster Prevention Plan for Kulekhani Watershed. Proposed site of the construction of check dams are shown in the Figure 2.6.

(2) Physico-chemical Environment

i. Topography

Structural works on the rivers around Phedigaon permanently change morphological process of the rivers in the area. Thus topography of the downstream area should be maintained essentially as it is now i.e. natural process does not take place, or limited upon completion of these structures.

Construction works also change topography of the construction areas to a very limited extent.

Construction aggregate is obtained from the present riverbed area. The present

river bed area is as a matter of fact the remnant of debris flow created by the 1993 Disaster. This causes a change to the "present" topography of the area. Itself is an acceptable changes to the natural environment of the area.

Land reclamation in Phedigaon will create farming area and intended to invite those who lost their houses and farming areas. Thus, the topography of the area changes from the present riverbed area to vegetated area. The change of topography in the area is accepted by the local community.

Construction of accessroad for construction works and the dike with the road on its crest should change the existing route of vehicular path along Palung Khola. With this road, topographic change on the riverside area should change. This change is acceptable by the local residents.

ii. River Morphology

There will be a number of significant changes on the river morphology of the area. Debris are checked with the structures constructed within the framework of the Project.

Debris accumulated behind the check dams and gabion structures should become part of the river in long term causing less debris flow while scouring action by the river water is enhanced to some extent.

Although the possibility is very small, the construction of concrete check dam at the bottom of the land mass that has developed cracks in the area above Loche Pakha might develop outlet of groundwater in the area. This may cause to trigger mass of land slide at this location depending on a number of conditions such as torrential rains, disturbance of the bottom of slope by the construction works, and seepage of groundwater at the location of construction works. Close monitoring and detailed geological investigation should make the construction works possible without causing any major disaster living on and around the slope.

iii. Water Quality

The quality of water depends upon not only the disturbances in river but also its surrounding environment. During construction of dams, and river bank protection works, turbidity of the water in the river should change as mud and debris are disposed. It is considered as temporary nature of impact on the water in the river. Since water from Phedi Khola in Palung Village has been tested and considered as normal for irrigation but not for drinking purpose, no impact to the drinking water supply is considered to occur.

(3) Biological Environment

i. Fauna

The construction works take place in the low altitude area while there is a few protected animals are possibly found in the forested areas in the high altitude

area. They will not adversely disturbed during the construction period.

Upon completion of the construction works, as the community forestry programme is implemented in the area, there will be abundant chances of increasing willife and birds. Depending on the species, some of them are harmful to the local agricultural activities. Thus changes in the distribution of wildlife and their impact to the agriculture in the area is subject to monitoring.

ii. Flora

Construction of check dams and hill side works do not impose any major adverse impact on the vegetation in the ara. Bio-engineering works should contribute to enhance vegetation in the area as it should help to regenerate plants along the river.

The upstream areas of Ghatte Khola, Dunghakate Khola and Bhottekhoria Khola are subject to community forestry programme. Thus vegetation in these areas are enhanced over time. This is to contribute to the local community for supplying fodder, fuel and fruits as well as to supply construction materials.

(4) Socio-economic Environment

i. Population

Implementation of the Project functions to cause positive psychology among the local residents as they feel that there will be an economic development project conducted in the area. This is probably the most positive impact among others.

The construction work will certainly raise an employment opportunity for the members of the local community. It will raise the income level of the local residents temporarily during the construction period. This in turn enable them to accumulate small capital to start their own conduct of business upon completion of the construction works.

The flux of labourer and other local residents will enter in this area and will certainly increase the demand of food and beverage during the construction period. The use of liquor will also increase and it will create localized social troubles if construction workers are dominated by the members of out-of-local community.

Prices of goods will be increased during the construction period to some extent and the local businessmen will get an opportunity to make money. The local residents of the area will directly hit by the increase of prices unless they increase their income by working for the Project.

Implemenation of the Project introduces advanced technology on the river training works. This will create more skilled labour than before. There is a possibility to cause emigration of skilled labour to large urban centers in the country. Alternatively, the traditional life style of the Newars and Tamangs and the families of other castes should also be affected with such opportunity.

The activities under the community development programme will benefit only some portion of the local residents in the community and not all the local residents in the area are directly benefitted. This result in the participation of those who will benefit from the activity.

Organization of the local community for evacuation system and installation of the monitoring device on the area where cracks are developed in the area above Loche Pakha should provide psychological settlement among the local residents.

The plan to organize local community encourages the local residents to participate to implement the Project. This will cause no side effect on the population and its economy while importing out-of-the-community members is not the case. Thus community participation for wage work or volunteer works is considered as positive impact causing to the local population.

ii. Land Use

The improvement of irrigation schemes, road and extension of cash crop production will cause to change land use patterns of the area. The irrigation facility will help to increase agricultural production and improves the local agricultural economy. This should improve the living standard of the farmers as a whole.

The improvement of road leading to Phedigaon will improve the accessibility to market places such as Kathmandu and Hetauda. Thus land use patterns of the area should change to a large extent as a result of the implementation of the Project.

The land use patterns in the area above Phedigaon will also change to some extent because of the enhancement of accessibility to the market places. These changes pose no adverse effect to the current patterns of land use.

iii. Infrastructure

Improvement of drinking water supply system will provide additional water to Phedigaon, Phatbazar and Soltu. This will decrease the workload of women and save time to join in agricultural works in one hand and leading to a more busy but convenient life style on the other.

Construction of dike and the road on its creast will facilitate a safe transportation system during the monsoon season. This should provide additional support to raise the level of economy of the local community.

iv. Religious/Cultural Activity

The access road for the construction works will positively affect the culturally important place of the Temple of Pandukeswore during the construction period as it is located on the right bank of Phadi Khola, where the road is planned to construct. Upon completion of the construction works, convenience of transportation to the temple should increase. No other adverse impact on the temple should occur.

v. Aesthetic/Scientific Value

There is no place of aesthetic or scientific value negatively or positively affected by the Project

2.2.3 Environmental Management Programme

(1) Physico-chemical Environment

i. Reinstatement of Riverbed Area

Construction aggregate are obtained from the riverbed in the area. These works will create un- even riverbed in place. Thus repairing works during and upon completion of the construction works should be conducted.

(2) Socio-economic Environment

i. Existing Conditions of the Road

Materials for construction works should be transported from outside through the feeder road off Tribhuvan Highway. Repairing works on the road during and after the construction works should be conducted both for the benefit of construction works as well as for the communities using the road.

ii. Community Forestry

The locally acceptable plant species can be produced with the help of expertise from the existing forest office as their nurseries area improved. Alternatively, NGOs specialised in the tree planting activities could support the community forestry programme. Without such support no community forestry programme or agro-forestry programme could not be successfully implemented. For this purpose, a package programme of community forestry including finance for the package itself, agro-forestry programme, establishment of nursery, a system of distribution and transportation of seedlings, community education programme on the tree planting, care of trees and environmental management as well as environmental conservation should be elaborated. Without such expertise and financial support, no community forestry programme nor agro-forestry programme functions in the area.

(3) Additional Project Component

i. Reintroduction of Fish Species

There has been abundant fish species caught in Palung Khola for home consumption before the 1993 Disaster. They all have been eradicated as a result of the flood in 1993.

After the construction of check dams and river training works, it would be

sensible to reintroduce fish species into the river. Since the same programme should be conducted for Namtar, the cosimplecation is nominal.

2.2.4 Environmental Monitoring Programme

(1) Physico-chemical Environment

The equipment monitoring the geological fault developing in the area above Loshe Pakha is a major monitoring programme necessary to conduct within the framework of the Project.

(2) Socio-economic Environment

Since the nature of project is a nunique among other development assistance project, monitoring programme should be launched to monitor the activities.

- If the goals and objectives of the plan is fulfilled;
- If the activities are implemented according to the project design;
- If the expected changes on the local community are observed;
- If any un-expected effects are observed;
- How the local community have developed the alternative measures when un-expected changes occurred; and
- If there is a need to change the design of the plan and its direction to the goal.

2.3 Environmental Impact Assessment for the Community Disaster Prevention Plan for Namtar VDC

2.3.1 Present Environmental Conditions

(1) Physico-chemical Environment

i. Topography

Namtar Village Development Committee (VDC) is one of the VDCs of Makwanpur District covering about 83.5 sq.km. It is in the western part of the District. The VDC is bordering with Daman, Gogane VDC to the north, Kalitar VDC to the west, Sarikhet, Basamadi, Bhainse to the south and Bhainse, Bhimpheedi to the east. The major villages of the VDC are Namtar, Manahari Khola, Ratmate, Ghairantar, Maryangkot, and Chhapdand. The village office, village sub-health post are situated in Namtar, the center of the VDC.

Northern part of the VDC is covered with forest and its altitude is extending upto about 2500 meters asl, while its southern part goes down to 800 m asl. The great difference of altitude of the VDC makes climatic conditions varying from temperate to sub-tropical.

Major river is Manahari Khola that flows generally from east to west separating the villages of VDC into northern and southern parts. The 1993 Disaster flood damaged the entire area of the Ward No.2. The riverbed rose its level more than 7 m. This village is accessible by vehicular path during the dry season from Chuniya, at the 104 km point from Kathmandu on the Tribhuvan highway.

ii. Geology

The geological condition of the project area consists of Nuwakot Complex (upper Paleozoic) and Bhimpheedi Group. The watershed area upstream of Namtar is composed of granites, amphiboles, marbles, quartzites, limestones, schists, conglomerates, sandstones and siltstones. The rocks generally dip towards the north-east with an angle ranging between 50 and 80 degrees.

The area between Simbhanjyang and upper basin of Manahari Khola is composed of intrusive igneous rock such as jointed granites, metamorphics and some sedimentary rocks.

iii. River Morphology

Manahari Khola is originated in the Mahabharat Range Draining through the Siwalik Range and enters the Chitwan valley. Its length is approximately 10 km from the origin to the lower side to Namtar village. Its catchment area is approximately 29 km². Major tributaries of Manahari Khola within Namtar VDC are Mahabir, Garduwa, Syarse and there are a number of small tributaries.

The gradient of Manahari Khola is 11 % in the upstream area and it goes down to about 3 % toward the downstream area. Among other tributaries Syarse Khola

and Gorduwa Khola are joining to Mahnari Khola at the same place across the village of Namtar. The head waters of Syarse Khola is only about 100 m upstream from the confluence with Manahari Khola. Gradient of these rivers are more than 30% and they can be devastating than others with excessive amount of rain.

The debris accumulated in Syarse Khola was brought down to Manahari Khola and deposited in the area in front of Namtar village. As a result, Manahari Khola expanded its width from about 50 m to about 200 m.

iv. Water Quality

The rivers and springs are the main source of water for the use of local residents in Namtar. The use of water resources is not only determined by the availability of water but also by its quality. Some physico-chemical and biological parameters were analysed. Sampling point is near Namtar village in Manahari Khola as is shown in the Figure 2.13 and its quality is shown in the Table 2.1.

The results of the water analysis are compared to the international standards for drinking, irrigation and fish culture. The pH, nitrogen, total phosphorus, biological oxygen are all well within the permissible level but due to the excess amount of coliform, it is not within the WHO standard for drinking purposes.

Local residents of Namtar do not use the water in Manahari Khola for drinking but use water from Syarse Khola as the water is found to be cool and tasty.

v. Climate and rainfall

Namtar VDC experiences Sub-tropical, warm temperate and cool temperate climate. Low altitude area is sub-tropical with warm temperatures. The area near Simbhnajyang in the north is cool climate zone and the temperatures reach 2° below zero during winter. It snows occasionally during the winter.

Relative humidity is recorded upto 60 % in winter and reaches as high as 91 % during the monsoon season. Monsoon season starts generally in June and ends in September. According to the record in Daman, almost all of the rainfall occurs during July as is shown in the Table 2.2.

(2) Biological Environment

i. Fauna

Wildlife

Because of the VDC's forest cover, which is about 70 % of the total land area, Namtar VDC is the place where wildlife is abundant. Leopard are found in Namtar is common in the area as they are frequently seen by the local resident.

Wildlife most frequently seen in the area is a black faced and ash colored monkey. Dumsi, or percupine, can be seen during the maize growing season as

they come to eat them.

Other wildlife commonly seen in the area are Jackal, Mongoose, Squirrel, Pheasant, and Monkeys. They all live near the farmland so as to be able to obtain food relatively easily. Jackals prey on chicken in the villages even during the daytime.

Bear is occasionally observed in the area but its number is considered very few. Bear is seen eating millet, buckwheat from the farmland. They also feed on the Castanopsis fruit etc. Wildlife seen in Namtar is listed in the Table 2.11.a.

Birds

There are not many wild birds despite the fact that there is a wide area of forest. Most of the birds found are more or less common in any parts of Nepal including the farmland or field.

Birds commonly seen in Namtar are Dove, Cuckoo, Wren, Myna, Sparrow, and Crow. Some are rare such as Egret and vulture. Wood Peckers are seen in the area. These birds feed on crops, fruits and insects while Vultures feed on the dead bodies of animals. Table 2.11 b. shows the bird species observed in Namtar.

Insects

Insects like dragon fly, spiders, grasshoppers, mantis, and a number of species of butterflies are common in Namtar. Leech is also found abundantly during the rainy season all along the hill trails and riversides. Decrease of insects due to the use of chemical fertilisers in the field as well as insecticides and pesticides is common in Namtar. Thus their population has declined comparing to a number of years ago in general.

Fish Species

Since Manahari Khola maintains water throughout the year, there are some fish species present in the river. Local residents use for their own consumption as well as to sell them at the village tea shops. Quantity of fish found in Manahari Khola became much less due to the 1993 Disaster. A catch of 2 kg in an hour before the 1993 Disaster was common while it takes several days to catch 1-2 kg of fish. Fish species observed in Namtar is shown in the Table 2.11.c.

ii. Flora

Characteristics of Forest in Namtar

There are about 70 percent forest land in Namtar. Forest area is thick in the north where accessibility is low due to high altitude and steep slopes. The forest are categorised into two major types of Pine Forest and Hardwood Deciduous Forest. There is also a few patches of forest mixed with coniferous and hardwood forest that Blue Pine is abundant. Species of the vegetation in Namtar VDC are shown in the Table 2.12.

Schima - Castanopsis forest

Schima-Castanopsis is the major forest type in Namtar VDC. In this forest type, *Castanopsis indica* and *Schima wallichii* are abundant. Some *Rhododendron arboreum* and *Rubus* species are found associated in this forest towards higher altitude above 1000 m. The crown density of the forest is estimated to be 40 to 70 percent. The forest situated near the villages could not attain maturity because of human interference. The forest is the main resources for collecting fuelwood, timber and fodder.

Pinus forest

The forests of altitude above 1000 m is dominated by Chir Pine. This type of forest is distributed in the southern and northern slopes. In this forest *Pinus roxbourghii* is found associated with *Rhododendron arboreum*, *Eugenia* sp., *Terminalia chebula* and *T. belerica*. The crown density of these forests is estimated at 40 to 70 percent. That they have not attained maturity.

Sal Forest

Around the lower parts of the hills near the settlement areas, Sal tree, or *Shorea robusta*, are found. However, Sal trees have been exploited heavily. Thus no mature Sal Forest is seen in Namtar. Other species found in the Sal Forest are *Ficus cunila* and *F. hispida*, and *Bauhinia*.

Tropical Mixed Forest

The area to the south of Manahari Khola is mainly Tropical Mixed Forest. In this type of forest, Sal trees are found associated with *Acacia catechu*, *Mallotus* sp., *Lyonia ovalifolia*, and *Bauhinia*.

Shrubs are common in this type of forest in this VDC. Major shrub species are found in this type of forest are *Mussaenda frondosa*, *Eupatorium adenophorum*, *Urtica dioica*, *Woodfordia fruticosa*, *Buddleia paniculata*, *Jatropha curcas*, and *Achyranthus bidentata*. Ground cover are *Cyperus deformis*, *Saccharum spontaneum*, *Eragrostis tenella*, and *Thysanolaena maxima*.

While *Pinus* and *Rhododendron* are found dominant in the high altitude area, and seen growing with *Shorea robusta*, which grows only in the tropical and sub-tropical zones. This makes the forest area unique comparing to other types of forest. Many orchid plants are found growing on *Schima wallichii* trees. Along the upper part of Gorduwa Khola, Amliso grass is dominant with other grass species such as Siru, Kharu, and Kharghans.

(3) Socio-cultural Environment

i. Demographic Characteristics

Population Distribution

The total population of Namtar is 7,999 and its 50.7 percent is male and 49.3 percent is female. The Ward No. 1, 2, 4, 7, & 9 are densely populated areas. The

total number of household is about 1252 (CBS, 1991).

Namtar VDC has been trying to update the information on population, although further compilation is required. The latest information shows that the population of VDC is about 8,294, increased by about 3.7 % over and above the 1991 census result. On the other hand, the number of households seems have decreased.

In the Ward No.2, there are 40 households decreased comparing to the census data of 1991. They are the flood victims and migrated to other Wards. Some of them moved out to Terai, in Makawanpur District. The average household size is found to be 6 in this VDC. The population of Namtar VDC in each wards is shown in the Table 2.13.

Ethnicity

The main ethnic/caste groups in namtar are Tamang, Brahmin, Chhetrie, Thakurie, Newar, Magar, Gurung, Chepang(Praja) and occupational castes groups such as Damais and Kamis. Amon all the ethnic/caste groups, Tamangs are the dominant group consisting of about 62% in the VDC followed by Brahmin/Chhetries/Thakuries of about 28%. The Brahmin, Chhetri and Thakuri are grouped in one category because of their similar traditional practices and religion, the Hinduism.

The dominant Tamang is comparatively primitive in their achievement on the level of agricultur- al technology. Similarly the occupational caste group of Chepang (Praja) is primitive in their achievement of the level of economy. Ethnic/caste group is shown in the Table 2.13.b.

Migration

Disaster was a major factor by which local residents were foreced to migrate out from the village. Some had to migrate because of the disaster and some migrate for the fear of disaster other than those who look for better job opportunities.

After the 1993 Disaster, about 60 household migrated outside the village. The food victims were provided free land for settlement at Banaspati with 2 katha of land. Among them are four Praja (Chepang), six Darji Nepali, two Tamang, and one Chhetri families.

Due to the close contact with Hetauda, more than hundred of local residents have migrated to Hetauda for job opportunity in the past.

It has been reported that more than 400 local residents migrate during off-farming season to get a seasonal jobs available in Hetauda. Destination of the seasonal migration are Kathmandu, Hetauda, and Narayangarth.

It has been reported that 10 households are in-migrated in the VDC after the disaster of 1993 from neighbouring VDC of the same District and neighbouring District of Dhading.

Occupational Distribution

Agriculture is the main occupation of local residents in Namtar. 90.7% of local

residents have engage in agriculture followed by construction worker/labourer of 6.1% and services of 2.5%. Only 0.7% of local residents engage in business. Table 2.13.c shows the distribution of occupation in Namtar.

Literacy Status

Literacy or VDC is in moderate state. The total literacy rate is about 46 % and 62.6 % of the total male population is literate while 28.7 % of the total female population is illiterate.

ii. Land Use

General Land Use Patterns

As is shown in the Figure 2.13, land use patterns in Namtar are dominated by forest followed by farming area. The total area of the VDC is about 9,642 ha. Total forest area in Namtar is approximately 8,351 ha and the farming area is about 1,291 ha. On the other hand, the record of land for taxation in Namtar VDC shows that the total area of cultivated land is only 676.2 ha. Up-land crop area is 492.3 ha and paddy is about 183.9 ha. The difference might be unused land, or grazing area.

Cropping Patterns

Rice is the main crop cultivated in Namtar VDC in the lowland while maize is main crop in the higher altitude area. Vegetables for sale are not popular in Namtar because of the transportation problem. Local residents grow vegetables mainly for their own consumption. The field where they grow rice was damaged by the 1993 Disaster. Cropping patterns in Namtar are shown in the Table 2.14.

Irrigation System

There are 2 irrigation canals from Manahari Khola and 3 canals from Gorduwa Khola that irrigate 102 ha of farming area in Namtar. Most of the canals have been damaged during the 1993 Disaster. Only small portions of the damaged canals have been repaired by the local effort to date.

Harmful Insects for Crops

As in other villages, different insects damages the crops in the farming areas. These insects are Field Crickets, Stem Borers, Hoppers, Beetles, Grasshoppers, Hispa, Army worm, Mealy Bugs in the Paddy Field. Cut Worms and Field Crickets are common in the maize field, Thrips and Aphids in wheat, Hoppers and Moths in potato fields. All these insects are also attracted to the vegetable farm. The farmers occasionally use insecticides and pesticides whenever available.

Use of Chemical Fertilizer

Namtar is accessible by vehicular path although the path is frequently damaged by the rain. In winter, when the chemical fertilizer could be found easily, local residents stock them transported from Hetauda as it is extremely difficult to obtain in monsoon, the growing season. It has been reported that the farmers use

the chemical fertilizer on winter crops such as wheat and vegetables.

Horticultural Development

Local residents of Namtar VDC grow different fruit trees. Fruits are alternative source of income for local residents living the higher altitude of Namtar. As geographical conditions and temperatures allow, citrus fruits such as Orange trees are planted among potato fields. Pear, Lemon, Mango, and Litchi are grown in the mid-range and low altitude area.

Bhadure Village of the Ward No.4 has a good potential for Orange, Lemon, Lime and Tangarine. Local residents of Bhadaure sell fruits of about Rs. 10,000 to Rs.30,000 to Hetauda in one season. Rest of the area in Namtar have a potential of Litchi, Jackfruit, Mango of better quality. However, there is a lack of nursery for fruits trees and the technical assistance for them.

Livestock Holding

The size of available grazing area is approximately eight times larger than the farming area. Therefore the size of livestock holding of the residents in Namtar is relatively larger than other VDCs of the District because of the availability of grazing areas or fodder species in the forest.

The average holding of cattle is 2.3 heads per household, 1.2 for buffalo and 4.0 of goat. In the lower part of the VDC, local residents practice stallfeeding for the cattle and buffalo while goats are left for grazing. At high altitude area, local residents practice relatively uncontrolled grazing for cattle and buffalo in the forest area.

Land Holding

Of the total households in Namtar, 37.6% are medium land holding farmers followed by 25.1 % of small land holders and 21.1 % of marginal land holders. Large land holders area about 12 %. Fifty six households, or 4.2% of the total households are landless. Most of these households became landless because of the 1993 Disaster. Table 2.13.d shows land holding in Namtar.

Land Tenure

Most of the farmers are owner-operator. A nominal number or approximately 2 % of the total number of farmers in Namtar are rent-in and rent-out farmers. They rent minimum 5 ropani to maximum 25 ropani of land for cultivation. The terms and conditions of rent are on 50/50 basis. If sharecropping was arranged, only one crop is selected.

iii. Forest of Namtar VDC

Forest Area

Total land area of Namtar VDC is approximately 9,642 ha and 5,785 ha, or 60 % of the total area is forest. There are forest in all nine Wards of the VDC. These forests are being utilized by the 1,256 households. Forest area in Namtar is mixed sub-tropical type, although pine trees are dominant tree species.

Community Forest Program

Local residents of Namtar are less aware about the community forestry program. Like local residents of Palung, they are reluctant to convert the forest into community forest. This has been so, because of lack of information. No government office or NGOs tried to inform local residents about the community forestry programme.

However, there has been an effort to preserve the forests with their own initiative. There are seven forest users' committees functioning informally for the preservation and utilization of forest resources of the VDC. Younger residents are more tactfully involved in such activities, and they seem serious about the preservation and sustainable utilization of the forest. One member from each forest users' committee will form VDC level's forest users' committee. There are seven informal forest users' groups in Namtar VDC.

Recently, one forest with an area of 560 ha which is situated over the area between Ward No.1 and 3 have been registered as community forest. This community forest has a total of 59 households as its users group. This is the only community forest so far registered from Namtar VDC.

Leasehold forestry program

There is no leasehold forest in Namtar VDC. It appears that local residents are not interested in leasehold forestry program.

Existing Agro-forestry Practices in Namtar VDC

There are a few trees in local residents' private land. However, for the last 8 to 10 years, there has not been any significant tree planting programme or individual effort to plant trees in their farming areas in Namtar VDC. In case of fruit trees, most of them are older than 6 years. Major fruit trees planted in private land are pear, peach, plum, lime and lemon.

Compared to the forest and fruit trees, effort to plant fodder trees in the private farming areas are very few.

Local residents are interested in planting trees of forest, fodder & fruit varieties. However, the following reasons hamper their desire:

- there is no good nursery nearby Namtar VDC from which they can obtain desired saplings;
- there is no expertise for agro-forestry; and
- financial problem is the most heavy burden.

Use of Forest Product

The total used forest product is about 165,175 kg of fodder and the 964,632 kg of fuelwood. Local residents of Namtar collect 70 % of the forest product from their own land while 30 % from the government forest.

The fodder collected by local residents are *Artocarpus lakoocha*, *Litsea monopetala*, *Ficus* sp., *Garuga pinata*, *Quercus* Sp., *Saurauia nepaulensis*, and *Bambusa* sp. Table 2.16 shows the annual consumption of fuelwood and fodder in Namtar.

As a mountain village community based on agriculture developed on the steep slopes, trees are essential for the mountain village agriculture and used for different purposes such as for housing, fuelwood, fodder, and to some extent, for medicinal values.

Sal(*Shorea robusta*), Sisoo(*Dalbergia sisoo*), and Salla(*Pinus sp.*) are the major trees used as timber. Sal trees are mainly found in the Jaleswore forest south of Manahari Khola while Sisoo are found around Syarse Khola Basin. Pine trees are found at the higher altitude area.

Lari Gurans(*Rhododendron arboruem*), Chilaune(*Schima wallichii*), and Katus(*Castanopsis indica*), from higher altitude, and species of Bajha(*Quercus sp.*) are used as firewood.

Some other plants like Tanki(*Bauhinia sp.*), Khanayo(*Ficus cunica*), and other species are used as fodder. These plants are also found planted in their own private lands.

Many plants of herb, shrub and trees have traditional value of medicine and they have been identified and utilised by local residents for years in many parts of Nepal. However, while there is a good scope of developing the way the medicinal plants are use, very few local residents in Namtar VDC realise the medicinal value.

The plants such as Pipla longum, Oscimum sanctum, Oscimum basilicum, Mucuna purita, and locally know by the names of Harro and Barro and other species are used as different medicines such as antidote for snake bite, stimulant, nerve tonic etc.

Local residents collect and sell medicinal plants such as Chiraito to the medicinal plant dealers for Rs. 40/kg, Bikh for Rs.25/kg, Kukur Tarul for Rs.6-7 /kg, Pakhanbed for Rs.6/kg and other plants. Asperagus have two rates as the male plants Rs. 20-12/kg while the female plants cost Rs.40-45/kg.

Use of Energy

Electrification in Namtar VDC has not been well developed except for one household near Simbhanjyang near Daman. Thus local residents have to use fuelwood for lighting as well as for cooking and heating. Kerosene is also used but for only lighting purposes.

It is estimated that fuelwood requirement is 10 kg per family per day and one litre of kerosene per family per month.

Before the 1993 Disaster, there are three biogas plant in use. However, two units are in use at the moment. Each one of them has been individually installed. Capacity of biogas plant is 6 cm³ and can operate one gas burner for cooking and two lamps for lighting.

iv. Infrastructures

Road

Namtar VDC is accessible by vehicular path but disconnected during the

monsoon season as the road is damaged by landslides. Shoulder of the road is weak and gullies develop further deterioration of dirt road. There are very few gabion or masonry works to protect the road linking from Chunya on the Tribhuvan Highway.

Health Facility

There is only one sub-health post in the Ward No. 2 in Namtar VDC. It is providing preventive, and curative health services to local residents of Namtar VDC.

Drinking Water and Sanitary System

The drinking water supply is rather poor, due to the lack of proper water supply system as well as the lack of organizing users' group. After the 1993 Disaster, some high density polyethylene pipes have been provided by Swiss donor for reconstruction of water supply system. However, the villagers have not used their resources effectively and pipes are still in stock. The water quality at some point is quite low.

Approximately 5 % of the total households have latrine installed temporarily or permanently. Most of local residents of Namtar VDC use open field, streams and forest for toilet.

Education

There are eleven primary schools, three lower secondary and one secondary schools in Namtar VDC. Literacy among the local resident is comparatively higher than the national average.

Communication Facility

There is only one post office which provides the postal service for local residents of Namtar VDC. No telephone has been installed to date.

v. Commerce and Industry

There are no other industries except rice mill. There are six diesel rice mills for husking paddy and grinding maize, millet, wheat and other grains. Further, there are 56 traditional water mills (Ghatta) for grinding various grains.

Veterinary Sub-post

There is one veterinary sub-post which provide animal health services in Namtar VDC.

Agricultural Development Bank

SFDP of Agricultural Development Bank is located at the Ward No.2 of Namtar VDC. It provides agricultural loan to raise the economic status of the farmers of the VDC.

Sajha Sanstha (Cooperative) is also providing services to farmers related to agricultural inputs.

vi. Religious/Cultural Activity

It has been reported that there are seven major Shrines/God & Goddesses in Namtar VDC. Among them popular is Kalikathan which is buried by debris deposited by the Manahari Khola during the 1993 Disaster. Local residents celebrate two times a year with sacrificing the young female goat on the full moon night of Mangsir and Jeshta.

vii. Area of Aesthetic/Scientific Value

The geography of Namtar can be divided into two region as high altitude hill and low altitude hill. The higher hills are covered by the forest. The lower hills are mainly cultivated and terraced agricultural area dominates the landscape.

2.3.2 Environmental Impact Assessment

(1) Project Components

As is shown in the Figure 2.8, major project components proposed under the Community Disaster Prevention Plan for Namtar are as follows:

- Multipurpose check dam in Manahari Khola to the north of Namtar;
- Two consolidation dams on manhari Khola;
- One check dam on Syarse Khola;
- Slope stabilization works on the embankment of Manhari Khola;
- Rural road improvement works;
- Reclamation of the riverside areas;
- Irrigation canal improvement; and
- Community organization programme.

Construction works of those structures are conducted based on the concept of community organization and the participation of local residents who are very much enthusiastic about the project to be implemented. Their participation is encouraged not only during the construction period but also in the future the repairing and maintenance works along with the disaster preventive measures.

(2) Physico-chemical Environment

i. River Morphology

Construction of check dams and river training works with bio-engineering activity change natural course of water permanently. Reclamation of the riverside with rivetment works should also contribute to change natural process of river morphology.

ii. Topography and Geology

There is no major change to the topography and geology as a result of the implementation of the Project.

iii. Water Quality

Construction works of the concrete structures should increase turbidity of the river during the construction period.

Multipurpose check dam impounds water in the river and the quality of water should change behind the dam over time. The extent and duration of the changes on water quality should be very limited as there is a constant supply of freshwater. Size of the reservoir created behind the dam is also limited.

(3) Biological Environment

i. Fauna

There will be no direct adverse impact on wildlife or bird species due to the construction of the structures for community disaster prevention plan.

The check dams are of the nature of gabion type and concrete consolidation dams are having openings for water to flow pass do not create still water. Thus, there is no possibility of fish culture except the naturally occurring hill river fish. The construction of check dams hope to be beneficial for resident fish species but will have negative impact for the migratory fishes.

The construction of check dams will prevent the migratory fishes from moving upstream or downstream of the river.

ii. Flora

Construction of check dams and hill side works do not impose any major adverse impact on vegetation.

Bio-engineering works on the embankment of Manhari Khola should help to regenerate plants along the river as the embankment is consolidated.

(4) Socio-cultural Environment

i. Population

Local residents of Namtar are employed for the construction works i.e. job opportunities are increased during the construction period. The employment opportunity during the construction period will prevent the migration trend of local residents of Namtar VDC.

Local residents should feel safer upon completion of the Project. Thus life style and the standard of life should be stabilized as a result of the implementation of the Project.

After the completion of the Disaster prevention plan the modern technologies will be introduced in the village which will affect the occupational caste groups in

their occupational profession. On the other hand, because of the introduction of modern equipment and technology, those who are willing to change their way of life should be stimulated by the Project.

ii. Land Use

With the construction of check dam on Manhari Khola, rehabilitation of irrigation system, upgrading the rural and reclamation of the riverside area will change land use patterns in the area.

Improvement of the rural road should affect present cropping patterns indirectly as transportation facility improves availability of chemical fertilizer, insecticides and pesticides in the area. Subsequent increased and uncontrolled use of chemical fertilizer, insecticides and pesticides should then lead deterioration of top soil.

iii. Infrastructure

Improvement of the rural road is the major positive impact to the infrastructure of the local community.

Rehabilitation of irrigation facility and the installation of micro-hydropower unit for electricity generation will provide better use of water resources in the area for raising the standard of living.

iv. Religious/Cultural Activity

No religious/cultural activities or its areas will be affected by the Project.

v. Area of Aesthetic/Scientific Value

No significant potential effect has been reported in the area of aesthetic values.

2.3.3 Environmental Management Programme

(1) Physico-chemical Environment

There is no environmental programme necessary to conduct to compensate the damages made to the physico-chemical environment.

(2) Biological Environment

i. Reintroduction of Fish Species

Because of the construction of multi-purpose check dam, the territory of fish species in Manhari Khola will be bisected and that the communities in the upstream area of the dam should deplete the fish species for animal protein within a few years. Thus, reintroduction of fish species to the upstream area and

the downstream area should be conducted once or twice a year. For this purpose, fish culture facility should be established in Namtar.

One expert on freshwater aquaculture and two assistants, one office building, approximately 0.5 ha of area for several fish ponds to be constructed in order to grow fishes should be a sufficient combination of the facility.

(3) Social Environment

There is no environmental management programme necessary to conduct as a compensation to the damages made by the implementation of the Project. Within the framework of the Project, community organization is conducted based on the concept of community participation and evacuation arrangement. Unless the organization arrangement infringe life style of the local residents, there will be no adverse effect of the organization to the social environment.

2.3.4 Environmental Monitoring Programme

The monitoring programme should be launched to monitor based on the following thinking:

- If the goals and objectives of the plan is fulfilled;
- If project components are implemented as designed;
- If the intended effects have taken place as designed;
- If the new effects have been observed and that it is necessary to developed alternative measures; and
- If there is a need to change the goal and the direction of the design of the Project.

Having said as above, monitoring on the reintroduction of fish species to the upstream area of the multi-purpose check dam as well as to the downstream area should be monitored once or twice a year. This monitoring work should be conducted by the organization conducting reintroduction of fish species to the area.

2.4 Environmental Impact Assessment for the Community Disaster Prevention Plan for Chisapani of Agra VDC.

2.4.1 Present Environmental Conditions

(1) Physico-chemical Environment

i. Topography

Agra VDC is located in the northwest corner of Makwanpur District and to the north of Agra VDC is Dhading District. Agra VDC covers 42.4 km² extending from 1,000 m asl to 2,500 m asl and the target area of the Project, Chisapani is approximately on the 2,200 m asl. The highest point is 2504 m that lies in the forest area to the south of VDC. The peak is the highest point of Palung VDC.

Agra VDC is on the steep slope of the mountain. Average gradient is 25-40 %. Gradient of the slope in the target area of Chisapani is more steep as it exceeds 40 % in places. The rivers originated in the mountain above Chisapani are the source of water supply for the village. Landslide has been observed in Agra VDC in 1954, 1970, and 1993. It implies that the area is prone to land slide. In Chisapani, the landslide occurred in 1970 caused the loss of 32 households approximately 49 ha of agricultural land was swept away. Further 25 ha of forest and shrub land was also damaged.

Agra VDC borders with Tasarpu, Thakre VDCs to the north, Tistung and Deurali to the east, Palung to the south and Gogane to the west. The major settlement areas are Chisapani, Chaubas, Dandabas, Mahadevkharka, Aiselukharka, Deukhel, Bahungaun, Chalti, and Agra. Figure 2.1 shows the location of Chisapani relative to other VDCs.

ii. Geology

Agra VDC including Chisapani lies on the Kulekhani formation with the alternating fine-grained biotite schist and strong micaceous impure quartzite of dark and light green-grey colour. The area around Chisapani, Chaubas, Dandabas of upper Agra Khola catchment is characterized by the formation of cuesta and the steep sloped terrace. All the damaged area or landslides of Agra Khola catchment occurred in the rocks of this formation. The dips are found to be 25° to 35° but there is a tendency of dips changing sharply from the upper slope to the lower slope.

iii. River Morphology

A number of streams originated from the hill top flow down mostly to north and northeast. The major rivers of this VDC are Agra, Chalti, Hakarti. They maintain water all year round although quantity of each river is not abundant to support large population. There are many other rivers which drain large quantity of water during the rainy season but most of the stream do not maintain water during the dry season.

Chalti Khola is one of the main tributary of Agra Khola originating from the hill of Chisapani approximately 2460 m asl. There are three streams of Chisapani, Majhuwa and Galchhi Khola. On the right bank of Majhuwa Khola, there is steep slope of 50° - 55° while gentle slopes facing north-east in left of Majhuwa Khola. The settlement are distributed in the gentle slopes. Chalti Khola is the main tributary of Agra Khola and it flows down from Chisapani all the way to Mahadevbesi.

iv. Water Quality

Water from the streams in Agra VDC are used for household as well as for farming purposes. The water in Chalti Khola, near the project site shows that the water quality is normal for irrigation but not recommended for drinking due to the excessive amount of coliform. The results of water quality analysis is shown in the Table 2.1.

v. Climate and rainfall

Agra VDC experiences a type of warm temperate zone of climate in the low altitude area and cool climate in the high altitude area. Both areas experience short summer. There are two distinct seasons of the summer monsoon period with abundant rainfall and the dry winter without rain. The winter is comparatively long with warm daytime temperatures and cool nights. The average temperature is approximately 10 to 15°C. The maximum temperature during summer is 27°C and minimum in winter is approximately 2°C. Sometimes in winter temperatures reach 2°C below zero. It snows occasionally. The average relative humidity is approximately 60 % in winter and it reaches as high as 91 % during the monsoon season. Monsoon season starts generally in June and ends in September. According to the record in Daman, almost all of the rainfall occurs during July as is shown in the Table 2.2.

(2) Biological Environment

i. Fauna

Wildlife

Since the area has been developed for agriculture during the past years, there are limited number of species of wildlife observed in Agra VDC. There are no endangered species observed or recorded by the local residents.

Wildlife is not abundant in Chisapani. Leopard found in Chisapani is not common although occasionally seen by the local resident.

Wildlife most frequently seen in the area is a black faced and ash colored monkey. Dumsi, or porcupine, can be seen during the maize growing season as they come to eat them.

Other wildlife commonly seen in the area are Jackal, Mongoose, Squirrel, Porcupine, and Monkeys. They all live near the farmland so as to be able to

obtain food relatively easily. Jackals prey on chicken in the villages even during the daytime.

Bear is occasionally observed in the area but its number is considered very few. Bear is seen eating millet, buckwheat from the farmland. They also feed on the Castanopsis fruit. Wildlife seen in Agra VDC is listed in the Table 2.3.a.

Birds

There are not many wild birds in Agra VDC. Most of the birds found are more or less common in any parts of Makawanpur.

Birds commonly seen in Agra VDC are Dove, Cuckoo, Wint, Myna, Sparrow, and Crow. Some are rare such as Egret and vulture. Wood Peckers are seen in the area. These birds feed on crops, fruits and insects while Vultures feed on the dead bodies of animals. The Table 2.3 b. shows the bird species observed in Agra VDC.

Insects

Insects like dragon fly, spiders, grasshoppers, mantis, and a number of species of butterflies are common in Chisapani. Leech is also found abundantly during the rainy season all along the hill trails and riversides. Decrease of insects due to the use of chemical fertilisers in the field as well as insecticides and pesticides is common in Chisapani. Thus their population has declined comparing to a number of years ago in general.

Fish Species

Due to the steep terrain of the area around Chalti Khola, hardly some species of fish are found. The Table 2.3 c. shows the fish species observed in Agra VDC.

ii. Flora

Vegetation

As there are a number of place names with "Kharka" in Agra VDC implies, which literally means that it is the place where buffaloes and goats were brought in during the summer for grazing. It indicates that there have been a lot of places for grazing. However, these places are no longer used for grazing.

The forest area in Agra VDC covers approximately 29 % of the entire area of VDC. Forested areas in Agra VDC can be classified approximately three different types as follows:

Alnus Forest

This type of forest is common on the riversides, the area in the fresh landslide and degraded land lower than 2000 m asl. Alnus trees generally grow in large numbers as there is landslide. Young *Alnus nepalensis* are now commonly seen along Chalti Khola where landslide in the upstream areas of the river took place due to the torrential rain in July 1993. Alnus trees are a good colonizer as it grows in the land having fresh disturbances of soil. This type of forest is found near the riverside of Palung village and has had attained its maturity. Local

residents keep the *Alnus* trees that grew on their agricultural land covered with debris after the 1993 Disaster. *Alnus* forest later gives way to other plant species like *Schima castapensis* showing intermediate successional stage.

Rhododendron Forest

Though there are little forested areas, *Rhododendron* forest is found in the upper most slope of Agra VDC. *Rhododendron arboreum* are found dominant in some patches with few oak trees or with some *Schima* trees and *Lyonia* as well as other shrubberies. The forest is categorised as 40 to 70 % of crown density area. Herbs and shrubs are also found in this type of forested area.

Pine Forest

Pine forest dominates in the area towards the higher hills to the east of Chisapani. The pine forest covers the crown density of 10 to 40 % in lower altitude and from 40 to 70 % in the higher altitude. The pine forest is mixed with oak trees of *Castanopsis indica*, *Lyonia* sp. And a few *Zanthoxylum armatum*.

The shrubs like *Eupatorium adenophorum*, *Rubus ellipticus*, *Barberis aristata*, *Gaultheria fragrantissima*, *Pyreantha crenulata* and grass species like *Eragrostis tenella*, *Cyperus deformis*, and *Khar ghans* are found in the pine forest.

Herbaceous plants like *Polygonum* sp., *Ageratum conyzoides*, *Drymeria cordata*, and some fern species are found as ground cover in the forest. In higher altitude some other plants like *Potentilla nepalensis*, and *Vitex repens* are also found. *Gultheria* grows in the rocky terrain while *Potentilla* are seen in many places.

Lichen and moss as pioneer plants are also found around the rocks. It was noted that no such plant species has disappeared from the area.

As the height lowers, *Banmara* or the crofton weed becomes abundant in the moist area. Among the tree species, *Alnus* is abundant in the area. High altitude areas used for grazing are dominated mainly by the ground cover with grass, moss, and lichen. *Michelia* is now losing its habitat in this area. It is found in a very limited area. *Ageratum conyzoides*, a weed generally appears everywhere has been succeeded by *Drymeria cordata*.

A list of plants species in Agra VDC are shown in the Table 2.4.

(3) Socio-economic Environment

i. Demographic Characteristics

Distribution of Population

The population census of 1991 in Agra VDC is shown in the Table 2.18.a. The total population of Agra VDC is 6,839 and its 50.1 % is male and 49.9 % is female. The Ward No. 1, 2, 3 and 5 are the areas with relatively dense population among others. The average family size in Agra VDC is 5.5 and the same in Chisapani is 5.8.

The area targetted for implementation of community disaster prevention plan is in Chisapani and its geographic location is approximately the southern half of the Ward No. 4. Population distribution of the Ward No.4 is 341 of male and 322 of female and 114 households.

Ethnicity

There are a number of the ethnic groups found in Chisapani such as Tamang, Brahmin/Chhetri, Magar, Gurung, Newar and occupational caste of Kami, Damai & Sarki. There are a few minority groups of those moved into the area from Terai.

As is shown in the Table 2.18.b, Tamang is dominant caste group followed by the Brahmin/Chhetri/Thakuri group. In Chisapani, Tamangs are more than 70 % followed by Gurung and Chhetri.

Migration Patterns

There is one family migrated to Phedigaon while they still maintain their land in Chisapani and conduct farming by commuting to their farming area. This is due to the landslide occurred in Chisapani. There are some families moved and resettled in Padam-pokhari VDC in Makawanpur District. Those are given land for farming and have already build their own houses. Some of them occasionally go back to Chisapani in the hope of reclaiming their land. Others are settled in Padam-pokhari and satisfied without the danger of disaster.

More than 500 individuals migrated temporarily to Kinshamdu, Hetauda or Narayanigharh for employment opportunity. On the other hand, there are more than 600 individuals who migrate seasonally to Kinshamdu, Hetauda and Mahadevbesi during the off-farm season. They work mainly as porter.

Distribution of Occupation

The Table 2.18.c shows distribution of occupation in Agra VDC. Agriculture is the main occupation. Those engaged in business are running village store while they run their own farming area.

Literacy

Since Agra VDC is in the mountainous area without major road, there are very few modern facilities including schools are available. Thus the level of literacy in Agra VDC is comparatively low. The rate of literacy in Agra VDC is 21.9 %.

There are primary schools in different parts of Agra VDC. These schools are capable of teaching upto the grade three. Attendance of female to school is extremely low. Only 3.2 % of the total female population ever attended school while 40.6 % male population experienced low level of education. Among the literate population, male literacy is 92.7% while female literacy is 7.3 %.

ii. Land Use

General Land Use Patterns

As is shown in the Figure 2.11, the land use patterns in Agra VDC is divided

into forest, pasture, and agricultural area. The agricultural area is further sub-divided into upland (Bari) crop area and lowland (Khet) crop area. The total area of Agra VDC is 2,140 ha and its 43.4 % is covered by forest while 40 % is under cultivation. Most of the land is non-irrigated upland (Bari) crop area. Table 2.24 shows land use patterns of Agra VDC.

Agricultural Land Use Patterns

As is shown in the Table 2.21, there is a variation between the cropping patterns of the higher altitude area and the lower altitude area. The cropping patterns are divided into two categories due to the characteristics of land as up land and low land crops. Rice can not be grown in the higher altitude but different kinds of vegetables are grown, like cauliflower, potato and others.

Average Land Holding

As subsistence agriculture is the main source of making their living, land holding of the local residents play an important role. As is shown in the Table 2.18.d, there is a high percentage of medium size land holders and a considerable number of families maintain large size holding. Marginal and small size land holders are the victims of the land slide occurred in the past years. It is remarkable that there is no landless families in Agra VDC.

Land Tenure System

All the farmers in Agra VDC are one way or other the land owner. A small portion of their land is rented out for share-cropping depending on the availability of farming labour, capital, and relationships among the local residents. The 1993 landslide also caused some to contract the share-cropping system. There is no rent-in as contract system of the agricultural land Agra VDC.

Harmful Insects to Agriculture

It has been reported that the insects as field-cricket, stem borers, grasshoppers, hispas, cut worms, aphids, moths, red ants, and weevils. They have been damaging their crops in the field and when stored in the house as well. Thus use of pesticide and insecticide is getting to be more common than before.

Livestock Holding

The presence of a number of the place names with "kharka" in Agra VDC shows that there have been a number of grazing areas available for raising animals.

However, as population increased in Agra VDC, deforestation took place and the modernization of farming system also took place during the recent years. Thus the number of livestock per family decreased sharply. One of the reasons that the number of livestock decreased in Agra VDC is that the children who used to keep livestock in the grazing area are now going to school. However, deforestation or clearing forest areas for converting them to farming areas are the major reasons that the livestock holding decreased.

The average number of livestock holding is now very small. A family holds 0.15 head of cattle and 2.6 heads of goat. Instead, rearing chicken is more common than before among the families.

iii. Forestry in Agra VDC

Forest Areas in Agra VDC

There are 1,224 ha of forest area in Agra VDC and the forest areas are distributed throughout the VDC. The Forest area in Agra is of mixed forest with Pine trees dominating the forest species of trees. Among the existing tree species, Khashru, Gurans, Angeri, and Kaphal are used as firewood.

There is only one community forest in Agra VDC situated in Ward No. 5. The community forest is known as Ghalepakha Community Forest which has an area of 84 ha. This community forest is registered under DFO Office and handed over to the user group in 1995. It is now being managed and utilized by a group of 65 local families. Very few no. of *Pinus wallichiana* and *Michelia champaka* are found in this community forest as it not an acceptable species for the local use.

There is a patch of forest in the area above Chisapani. The area is managed and utilized by the local residents with their own initiatives. Despite the management effort, the forest area and its quality are all declining as there are no effort to plant trees. The present users are interest area while there is a lack of tree planting expertise, financial arrangement and nursery. It appears that the users' committee has shown their interests to work with NGOs for the sustainable management of the forest.

There are a lot of fragile and eroded slopes within the forest area. Apart from tree planting activities, some sort of check dam or gabion structures are considered necessary.

Leasehold Forestry Program

There is no leasehold forestry programme in Chisapani area. However, there are nine leasehold forest areas in other wards of Agra VDC. Under leasehold forestry program, total area of 44.62 ha has been handed over to nine user groups. Average number of member per user group is five families.

Agriculture Development Bank has provided loan of Rs. 60,000 to carry out income-generating activities such as goat rearing. It is learned that progress of these leasehold forests are not satisfactory.

Existing Agro-forestry Practice in Chisapani

Very few trees are planted in private land in Chisapani. Most of them are 8 to 10 years old. Most of the forest and fodder trees planted in private land are of more than 10 years old. In case of fruit trees, most of them are planted 8 to 10 years ago. Major fruit trees planted in private land are pear, peach, plum and lemon and few apple trees.

People of Chisapani are interested in planting forest trees such as *Michelia champaka*, Bamboo and fruit trees such as apple, pear, plum, and apricot.

In considering the fragility of the steeply sloping landscape, bamboo and vetiver, nepier, broom grass are accepted in Chisapani.

Use of Forest Product

It has been reported that 60 % of fuelwood and fodder are collected from the

government forest and 40 % from the local residents' own land. A household consumes 1,474 kg and 23,579 kg of fodder a year.

The fodder species collected by the people are *Artocarpus lakoocha*, *Litsea monopetala*, *Ficus semicordina*, *Garuga pinina*, *Ficus auriculina*, *Quercus* sp., *Ficus neriifolia*, *Saurauia nepaulensis*, *Ficus lacor*, *Bambusa* sp. and *Dendrocalamus* sp. The Table 2.20 shows the annual use of forest products.

Use of Energy Sources

There is no electricity Agra VDC. Thus they use fuelwood for lighting purpose. The use of kerosene for cooking is nominal.

iv. Infrastructure

Road

Total lack of vehicular path in Agra VDC hampers economic development activity that should take place in the area. There is no vehicular path in Agra VDC. The nearest road is Shikharkot of Daman VDC approximately one and half hours on foot from Chidapani. The road leads to Mahadevbensi. Phedigoan, Thanabazar and Shikharkot are the major market centers for the local residents of Chisapani for buying and selling goods related to their economic activities and daily life.

Health Facility

There is only one sub-health post in the Ward No.1 for health service to the people of entire Agra VDC. Thus the local resident living in the upper Agra Khola area go to Thanabazar for a simple treatment. They go to Kathmandu and Hetauda for heavy injury or serious sickness.

Water Supply and Sanitary Conditions

There are relatively well developed drinking water supply system in all wards of VDC. However, there is a lot of room for improvement. Some people have to fetch water from springs and streams with their own effort.

There is no practice of using toilet except in the Ward No. 5. Approximately 60 % of the local resident use temporarily installed toilet. Rest of the total population use open field, stream or forest.

Education Facility

There are primary school of class three educational facility in Agra VDC. For further education, children in Agra VDC have to go to Palung VDC.

INGO of World Education is financing to run the classes for illiterates in Chisapani.

Communication Facility

There is no alternative communication facility except post office for the local

residents in Agra VDC. The post office is in the Ward No. 9. The service is not sufficient for all the wards in the VDC. Those living in Chisapani go to Palung for making telephone calls and postal service.

v. Commerce and Industry

It has been reported that there are three water mills located in Lamachaur, Moriya and Akase in Agra VDC. One Rice mill is located in Dandabas. There are 18 traditional grinding mills located in different areas of Agra VDC.

There is no banking services available in Agra VDC.

There is a programme financed by ADB for small farmers development in Chisapani. It covers a whole VDC that provides agricultural loans such as animal husbandry, crop loans, and small scale industrial loans. There is no other organization active in Agra VDC.

vi. Religious/Cultural Activity

Worshipping god and goddess whether daily or occasionally is a way of life of the local residents as other parts of the people in Nepal. Thus the local residents have created shrines for worship of their god/goddess. The people of Agra VDC worship and give sacrifices to them for the safety of life, family, crops, and the village.

vii. Area of Aesthetic/Scientific Value

The VDC is situated in the steep slopes of Mahabharat Range. The area of VDC has been heavily developed. Although the area is one of the best place to view Himalayan Range, the area itself has comparatively low aesthetic value except for the forest areas with old Rhododendro trees. The forest area above the slope of Chisapani is considered as one of the aesthetically valuable area.

2.4.2 Environmental Impact Assessment

(1) Project Components

The proposed project components for Chisapani village of Agra VDC are:

- A series of gabion structures across the rivers in Chisapani;
- Slope protection works with bio-engineering method;
- Water supply system ; and
- Community forestry programme along with rural development activities

The proposed site of the construction of the project components are shown in the Figure 2.8.

(2) Physico-chemical Environment

i. Topography and River Morphology

The landslide of Chisapani area occurs due to the geological structure as well as the steep slope in and around the Majhuwa Khola area. While the topographic changes have been taking place in the form of landslide, the natural process of land slide would be checked by a series of gabion structures and check dams. As a result accumulation of debris in the downstream area would be reduced.

These structures also maintains soil in the river over time i.e. scouring action similar to gully erosion is checked.

During construction period, some debris are inevitably disposed to the downstream area because of the construction works taking place on the steep slope. The amount disposed by the construction works should be nominal comparing to the amount of debris transported by the river during the rainy season.

These gabion structures and check dams are constructed to serve safety of the local community hence to maintain their agricultural land and their economic activities.

ii. Water Quality

During the construction period, water quality should change significantly in the downstream area. Since the construction works take place mainly during the dry season, very few amount of water is mixed up with construction debris.

The construction works take place in the area downstream of the water sources for Chisapani. Thus no water supply system is affected by the construction works. There is no water intake for drinking water supply in the downstream area of the river.

There is no fish species of any significance in the downstream area. Thus, changes of water quality during the construction period does not pose any impact to aquatic life in the river.

(3) Biological Environment

i. Wildlife

No part of the project components should pose any impact on the wildlife known to live in the area.

ii. Vegetation

Construction of check dams and hill side works do not pose any major adverse

impact on the vegetation in Chisapani area. Upon implementation of community forestry, the vegetation in Chisapani should be enhanced and it would serve as source of fuelwood and fodder supply. Agro-forestry programme should also enhance local conditions of vegetation. The bio-engineering works on the slope in Chisapani also contribute to enhance vegetation as well as to consolidate the top soil.

(4) Socio-cultural Environment

i. Population

There are approximately 0.6 % of the local residents who work as porter or agricultural labourer in Chisapani. Some of them will be involved in the construction work. These who migrate to urban areas for seasonal job will engage in the construction works. There is a programme to organize the local community for evacuation system as well as to encourage participation of the local residents to implement the project. These should provide positive image of the project.

ii Land Use

Land use of Chisapani area should be greatly changed. As is shown in the Figure 2.12, present land use of cultivation areas will be equipped with small scale irrigation system and the forest area above Chisapani should be designated as community forestry area. These changes will function toward raising their standard of living over time.

iii. Infrastructure

The present water supply system will be upgraded to serve as small scale irrigation and drinking water supply system. Access road for construction works should remain as a vehicular path linking Chisapani to Charikot. These changes should serve as the improvement of basic infrastructures for Chisapani.

iv. Religious/Cultural Activity

No part of the local cultural heritage should be affected by the implementation of the Project.

v. Area of Aesthetic/Scientific Value

No part of the local area with aesthetic or scientific value should be affected by the implementation of the Project.

2.4.3 Environmental Management Programme

Project itself functions as environmental management programme for the area devastated

by the 1993 Disaster. No part of the Project planned to implement in Chisapani significantly and adversely affect biological or social environment.

2.4.4 Environmental Monitoring Programme

There is no environmental monitoring programme that require to obtain data for further study or to monitor the achievement of the Project.

2.5 Environmental Impact Assessment for the Infrastructural Disaster Prevention Plan for Mahadev Besi Bridge

2.5.1 Present Environmental Conditions

(1) Physico-chemical Environment

i. Topography

The bridge is located at the confluence of Agra Khola joining to Mahesh Khola, which is a perennial tributary of Trishuli River. Mahadev Besi is located at the altitude of 600 m asl and about 35 km to the west from Kathmandu.

There are a number of tributaries of Agra Khola. Chalti Khola is one of the main tributaries originated at the altitude of about 2,400 m near Chisapani in Agra VDC. As the river travels, it passes through different types of terrain forming gulleys and valleys. The Agra Khola Drainage Basin is located in Mahbharat Range and its total drainage area is 112 km².

ii. Geology

The upper Agra Khola basin is formed by Kulekhani formation while the lower parts by Bhimphedi group. There are many large landslides in the Kulekhani formation. The landslides in this part have four main types; plane rock slide, wedge failure, debris slide and deep-seated rotational slide. Plane rock slide is especially common on the dip slope, whereas wedge failure observed mostly on the counter dip slope.

The lower Agra Khola basin is formed by quartzites, schists, phyllites, limestones and marbles of the Bhimphedi group. Granites are also exposed in the part of western basin. Rocks are intensely faulted, folded and jointed which is the cause of easy collapse of land.

iii. River Morphology

Agra Khola is formed by six small streams flowing from south to north. The major tributaries are Chalti and Mel or Liti Khola with the catchment of 12.9 km² and 32.8 km² respectively. The total drainages of Agra Khola is 112 km².

The ridges of the catchment areas are steep and the river gradient is 25 % towards the origin of all those streams but gradually decreases in the middle portion with the slope of about 4 %. The gradient near the confluence of Agra to Mahesh is only about 0.15 %. When the slope is high, river flow with great speed washing away the top soil and materials on the way. This type of river is more damaging as it cause landslides. The river in this case traveled the distance of about 20.5 km.

iv. Water Quality

Water from Agra Khola is being used for various purposes by the people living

around the river. This water however, is not used for drinking, but a wild estimate that it might also be used for drinking as there are a number of Danuwar Rai people who have temporary working site in crushing the stones. The water seems polluted with human activities such as washing, cleaning. A sample of water from Agra Khola is tested to find out the quality.

The Tested result show that, the water is normal for irrigation purpose but not recommended for drinking. It has excessive amount of Iron content than WHO's limit. In comparison to the water test result from Chalti Khola, the upstream of Agra, all the figures show higher numbers than Chisapani area. Result of the water quality test is shown in the Table 2.1.

v. Climate and rainfall

Mahadev Besi area lie at the sub-tropical climatic zone being located at the altitude of about 600 m. It experiences hot summer with warm and humid monsoon. There is no weather station in Mahadev Besi but the nearest station at Dhunibesi of Dhading district can be considered for this Place. Rainfall occurs mostly during the monsoon season which is from June to September. The rainfall records for the past 10 years from the station shows the average annual rainfall is 1490 mm of which about 79 percent rainfall occurs during the period of June to September. There occurs some down pours during winter due to the western winds.

The data shows that maximum rainfall found to be mainly during the monsoon season with an exception of 212 mm in day during May 1983. It can be generalised that July - Aug. is the month when maximum rainfall occurs. Table 2.30 shows the rainfall patterns in the area.

(2) Biological Environment

i. Fauna

Wildlife

An investigation of the available wildlife in the area surrounding the Agra river has been carried out by visiting the places and inquiries with the village people. The areas have been heavily developed for the agricultural practices. Only few patches of forest are left in the upper most slopes of the river. There are also some patches of unencroached land seen at the river sides which are much steeper for people to exploit.

The most common animals are squirrel, jungle cat, jackal, monkey while tiger, leopard are only occasional visitors. Rats are also found in wild but can also be infested in the agricultural land and even at households.

Bird Species

In the bird species the most common in around forest are Dhukur, Jureli, Sarukh (Dagre), Cheebe, Malewa, Huttityang, Parrots, Woodpeckers, Pheasants, Patriges, and Eagles. Some are common around the settlement and feeds on the crops such as sparrow, swallow, pigeon, crows

Fish Species

Some common stream fishes were found in Agra Khola. However, they have been greatly decreased as the local residents heavily fished in the area. Table 2.3 shows wildlife, bird species and fish species commonly found in the Mahadev Besi Bridge area.

ii. Flora

Vegetation

The climate varies from sub-tropical at Mahadev Besi to warm temperate at the mid hills of Mahabharat region and cool temperate at Chisapani of Agra region. Similarly, the vegetation also differs in different climatic regions. The area can be broadly divided into coniferous and broad leafed mixed forest type of vegetation.

Protection Forest

Only one forest area has been categorised into Protection forest lies in Thakre VDC, at the other side of Agra Khola. Though that is protection forest the trees are not so much as the crown density is only from 10 to 40 percent according to Land use map. This protection forest is dominated with hardwood mixed forest of trees like *Schima wallichii*, *Eugenia jambolana*, *Salmalia malabarica*, and *Melia azadirach*.

Deciduous Mixed Forest

There are only little parts of deciduous hardwood forest in Tasarpu and Bhumisthan VDCs. The forest is also of immature type due to the encroachment by people for fuel and fodder collection. Most of the common trees and ground cover are the same in other forested areas.

Another parts of the area these VDCs are covered by grazing and shrub land. Most of the shrub species are *Phyllanthus emblica*, *Woodfordia fruticosa*, *Berberis aristata*, *Zizyphus mauritina*, *Asperagus* sp., and some ferns. These shrubby area located at some of the exposed parts are somewhat dry.

The forest can be categorised as the mixed forest of *Schima wallichii*, *Lagestroemia parviflora*, forest where some other trees are found scattered. As the place is steep sloping and can not be easily encroached, there are trees like *Eugenia jombolana*, *E. operculata* also found which are having medicinal value. In some heights, *Bassia butiracea* growing and *Woodfordia fruticosa* found frequently at the sides of trails.

The herb species are like *Eupatorium* in shady places, *Osbekia* in the rocky hill sides and some *Vitex repens*, *Discorea deltoides*, *Colocasia* sp. *Smilax* are found as ground cover as well as around the trees. *Melia azadirach*, *Cedrella tooni*, *Gravelia robusta*, *Pinus roxbourghii*, and *Salmalia malabarica* are also seen in small numbers.

In Thakre, Tasarpu and Bhumisthan VDCs, a large area compared to forest area are remained as grazing area. The major plant species are *Eupatorium*

adenofolium, Adhatoda vesica, Cassia mimosoides, Caesalpinea decapetala, Achyranthes bidentata, Jatropha curcas, Ageratum conyzoides. Grasses like Cyanodon dactylon, Cyperus erithrorhizos, and Eragrostis tenella.

(3) Social Environment

i. Demographic Characteristics

Population Distribution

Mahadev Besi bridge lies in between Bhumisthan and Thakre VDCs but the Agra Khola flows from the sides of Bhumisthan, Tasarpu and Thakre VDCs. So these three VDCs are affected by the Agra Khola. The total population of these areas surrounding Agra Khola are about 19141 (CBS, 1991) of which the population of Bhumisthan is about 41.7% followed by Thakre VDC about 35.7% and Tasarpu is about 22.6%. The average family size is about 5.6 which exceed the National figure. The male-female ratio is about 51.1 : 48.9. About one third of total population of these 3 VDCs are affected by the disaster as they live in the Agra Khola watershed area.

Ethnicity

The main ethnic/caste groups are Tamangs, Brahmins, Chhetries, Newars, Magars, Chepangs (Praj) and occupational castes groups as Damais, Kamis and Sarkis. The up-dated census data is not available in the VDCs so the CBS (1991) data is taken as the basis. According to the CBS the watershed area is dominated by Brahmin/Chhetri caste group (45.3%) followed by a tribal group Tamang (37.1%). The other mongoloid groups such as Magar, Gurung and Newar found in minimal numbers, 3.4 and 1.5 percent respectively. The Chepangs generally known as cave dwellers are found very low only 1.1%.

Migration

About 120 households were reported to be in-migrated from either same or neighbouring district for better economic opportunity. Some migrated there because they had owned some land from before. Some migrated to open up shops on the highway.

Out migration from the area is found to be less than in-migration as there are only about 45 households out-migrated from the district. Generally those who migrated out had gone towards Terai region. The trend of in-migration is higher because of higher opportunity to earn money due to the Prithivi high way.

The seasonal migration in the area is also higher than seasonal out migration, because of the stone crushers that people from other areas come for stone collection and transportation. The opportunity of this concrete collection become higher after flood disaster of 1993 in Agra Khola, due to stone accumulation.

The out migration is more from towards the remote inaccessible by vehicle area like the villages of Tasarpu, because people from Tasarpu have less opportunity for income generation works besides their own agricultural activities.

Occupation Distribution

The main occupation of the people residing around the Mahadev Besi Bridge is agriculture (77.8%) followed by construction/labourer whether it will be the agri-labour or service/job. The professional businessmen are minimal.

It was noted that nearly all the people from the village Sangramtar of Bhumisthan were affected by the flood disaster. Many trucks come there for stone collection even before flood disaster which has caused the Sangramtar Rai's fishing collapsed. Then about 30 households of these Danuwar Rai have to change their activity to stone crushing as fishes are on the extinction.

Literacy

The literacy status of Mahadev Besi & surrounding area is about 43.1% lower than the national average 48%. Among the male population of these 3 VDCs, 43.8% are literate while only 29.1% female are literate. Literacy among the women is considerably higher may be because of the literacy classes run by government and non-government (NGOs). However those who had completed high school level is only 1.6 percent.

Demographic characteristics of the Mahadev Besi Bridge area is shown in the Table 2.31.

ii. Land Use

General Land Use Patterns

The total area of Mahadev Besi and surrounding area is about 6316 ha. It has been calculated from the LRMP land use map of 1994 but not exactly similar with the record of land tax office. Due to the variation of figure it is not mentioned by farm category. However, the size of farming area is about 53.4 % of the total land area, or 3374.2 ha and it is larger than the size of forest area, which is 46.6% of the total land area, or 2941.8 ha.

Agriculture Land Use Patterns

Rice is the main crop cultivated in the lowland while maize is main crop in the higher altitude area. Vegetables for sale are also popular in the area because of the transportation available to Kathmandu.

Livestock Holding

The average livestock holding per household is 3.9 heads of Goats, 1.5 heads of cattle and 0.8 heads of buffalo. The local residents of the area practice to raise pigs particularly in Bhumisthan VDC because of the demand created by the Danuwar Rai, one of the lower castes in the country. The total number of pigs in the area is about 315. Most of the people practice stall feeding for cattle and buffalo. The goats are usually left for grazing.

Average Land Holding

As is shown in the Table 2.31.d, 31.8 % of the total household of 3,437 in the

area are large farmers followed by the medium land holders of 29.3 %, the small holders of 23.2 % and the marginal holders of 13.2 %, and the landless of 2.5 %.

Land Tenure System

In the Agra River Basin, a minimal number of sharecropping and fixed rental system of tenure is practiced. Only 1% farmers practice sharecropping on the 50/50 basis and 1% of them practice fixed rental basis of land tenure arrangement.

iii. Forest Area Administration

Community Forest Area

Dandagaon community forestry of Bhumisthan is a mixed forest managed by the local people. The lower parts have the trees like *Shorea robusta* and *Alnus nepalensis* on the upper slope of the area. *Schima castanopsis* forest is a successional plant to *Alnus nepalensis*. The pioneering species of *Alnus nepalensis* grow on the disturbed area and it gives a way to *Schima castanopsis*.

The upper parts of the hill have coniferous forest of *Pinus roxbourghii* mixed with *Cinnamomum tamala*, *Myrica esculanta*, *Betula alnoides* along with wild fruits of *Pyrus pashia* and *Prunus* species.

Use of Forest Product

Approximately 66 % of the local residents of the Mahadev Besi Bridge area collect fuelwood mostly from their own land. The rest is collected from community or government forest. Similarly, about 61 % of fodder was collected from their own land and the rest collected from the community or government forest. *Artocarpus lakoocha*, *Litsea monopetala*, *Ficus* sp., *Garuga pinata*, *Quercus* sp., *Sauroria nepaulensis*, and *Bambusa* sp. are the fodder plants planted on the private lands.

Use of Energy Sources

There is no electricity facility in the area though it is on the Prithvi Highway. The local residents have to depend upon the use of firewood for cooking. Kerosene is used for lighting. The yearly consumption of fuelwood is estimated to be about 4600 kg per household.

iv. Infrastructure

Road

By the 1993 Disaster, Prithvi Highway was disconnected for three weeks mainly because three bridges had been washed away. The urgent rehabilitation measures are being undertaken by the US & the UK assistance and the road was temporarily restored to connect Kathmandu. The new bridge is under construction at the side of the old damage bridge.

Health Facility

Among the three VDCs there are two sub-health posts in Thakre & Tasarpu VDC. It has been reported that in Bhumisthan there are three places of health service facility either for Primary Health Center or Ilaka Health Post. These health posts are providing health services however it is not sufficient for the people of this area.

Drinking Water and Sanitary System

Piped water supply system has been developed in the area. The drinking water supply facility has been reported in all wards of these VDC except for the Ward No. 5 of Bhumisthan. However, 15 % of the total population has not been equipped with the facility.

There is no practice of using latrine except the small town & along the highway. Most of the local residents use the river bank, forests, and the open field for toilet.

Education Facility

There are 21 primary schools, 2 lower secondary and 1 secondary school.

Communication Facility

There are 2 public call offices in the western boarder along the Tribhuvan Highway of Thakre VDC and 1 in Simle along the Highway of Bhumisthan VDC. Three post offices are providing postal service for the people of that area.

v. Commerce and Industry

There are no large scale industries in this area except poultry farm and small scale mills of diesel plant and water turbine.

There are a number of service institutions located in Simle Bazaar of Bhumisthan VDC. These are two SFDPs of Agricultural Bank in Simle and Thakre, Veterinary Sub-Post in Thakre, Himalaya Hatching and Telecommunication Tower in Thakre VDC.

There is a NGO called NRMP (Natural Resources Management Project) which is actively implementing drinking water supply and sanitation programme, literacy program and income generation programme in Tasarpu VDC.

vi. Religious/Cultural Activity

It has been reported that there are more than hundreds of temples of gods & goddesses which are worshipped by the local people.

vii. Area of Aesthetic/Scientific Value

There is no area of aesthetic or scientific value in the area around Mahadev Besi Bridge.

2.5.2 Environmental Impact Assessment

(1) Project Components

The Project is to control debris of Agra Khola in order to safeguard Mahadev Besi Bridge. The river improvement program is also a part of the Project. To control the debris, the following is planned to conduct.

- Two ground sills;
- A series of gabion structures with bio-engineering treatment; and
- An access road of about 1 km.

Two ground sills will be constructed at 300 m and 700 m upstream of Mahadev Besi Bridge. Gabion spur dikes and stone pitching works are conducted at the mouth of Agra Khola mainly in order to guide the water flow of the river on the fixed path and go through the piers of the bridge.

An access road of about 800 m will also be constructed along the river from the confluence mainly to transport required construction materials to the construction site. There already is a temporary access road in the river which has been in use by the trucks transporting stone and sand from the confluence of Agra Khola and Liti Khola.

The Figure 2.5 shows the project components and their locations for protection of Mahadev Besi Bridge.

(2) Environmental Impact Assessment

i. Physico-chemical Environment

Construction aggregate for the construction of ground sills and gabion structures will be available in the river. Excavation of construction aggregate will change the natural process of the changes of river morphology. However, the amount of construction works as well as the construction of ground sills will pose very limited impact to the river morphology of the mouth of Agra Khola.

Water quality of the river will be changed during the construction period. It is a temporary change of the quality of water in the river. The construction works should take place during the dry season when the quantity of water in the river is very small.

ii. Biological Environment

Fish Species

Fish species are already disappeared in Agra Khola because of heavy exploitation of them. So there is no chances of damaging the habitat of fish in the Mahadev Besi Bridge area.

Bird Species

The area along the river is the habitat for some bird species whose population

has already decreased. During the construction period, their habitat should be affected to some extent.

Vegetation

The construction of ground sills will take place in the riverbed. Vegetation in the river is already sparse around the area. At the sides of the river also most of the land is agricultural land and estimated that no damage will take place in vegetation.

Bio-engineering works planned to conduct along the river will employ plant species such as *Salix* sp. in order to protect the embankment. This is in line with the environmental management techniques. There will be a measures to regenerate further plant species, as well as to enhance some wildlife and bird species.

iii. Social Environment

Population

The construction of the ground sills, access road, and spur dike construction works should create employment opportunities during the construction period. The access road constructed for the Project should remain in the river bed that it will not be much of help to the local community.

The Danuwar Rais involved in the construction aggregate producing works have started collecting small sized stones from around the river for selling to the dealers. Thus, when construction works begin, sales of construction aggregate will increase to some extent.

Land Use

The construction works will pose very limited impact on the changes in land use patterns in the area around Mahadev Besi Bridge.

Infrastructure

There will be no major impact on the infrastructures in the area around Mahadev Besi Bridge.

Religious/Cultural Activity

The construction works will pose no impact on the cultural/religious heritage in the area around Mahadev Besi Bridge.

Area of Aesthetic/Scientific Value

There is no area of aesthetic or scientific value affected by the Project.

Effect on the National Economy

After the completion of the construction works, mahadev Besi Bridge will serve its own purpose with a system to safeguard its piers. Thus long term stability of the bridge will play an important role on national and regional economy.

2.5.3 Environmental Management Programme

No environmental management programme induced by the Project is required.

2.5.4 Environmental Monitoring Programme

No environmental monitoring programme induced by the Project is required.