

2.6 Environmental Impact Assessment for the Infrastructure Disaster Prevention Plan for Kulekhani Watershed Area

2.6.1 Present Environmental Conditions

(1) Physico-chemical Environment

i. Topography

Kulekhani Watershed region lies in the north-eastern part of Makwanpur District, south-west of Kathmandu valley in the Central Development Region of Nepal. The watershed is situated in the Mahabharat range and is surrounded by mountains and hills. The watershed has an area of 126 km² lying in eight Village Development Committees (VDCs) namely Palung, Daman, Bajrabarahi, Chitlang, Markhu, Phakhel, Sisneri, Kulekhani and a part of Tistung VDCs.

The reservoir occupies about 1.7 percent of the watershed area while forest occupies 44 percent. The agricultural land of both level and sloping terraces are 41.6 percent of the total watershed area. Looking at the land use percentage, forest occupies nearly half, but most of the area is in the steep slope area unsuitable for agriculture.

Kulekhani Reservoir area can be reached by an access road from Tribhuvan Highway which pass from the upper part of the watershed area via Tistung, Kunchhal. The damsite in Kulekhani is accessible all the year by the dirt road unless the road is damaged or blocked by landslides.

Altitude of the watershed area varies from about 1,100 m in the south-east corner to 2,600 m in the south-west, and again from 1,535 m at the dam site upto 2,621 m at the peak of Simbhanjyang. In general Mahabharat range forms a large syncline, which stretches over nearly the whole length of Nepal.

The topography of the area is rugged terrain and has steep slopes. The study on the Sediment Control of Kulekhani Watershed by NEA has categorized the slope as is shown in the Table 2.23.

There are wide flat land around Palung, Bajrabarahi, Chitlang in the middle of the watershed area which are heavily cultivated. Such areas contribute to trap sediment which is otherwise flow into the Kulekhani Reservoir.

ii. Geology

Kulekhani Watershed Area is geologically divided into two major groups, Phulchowki group and Bhimphedi group. Phulchowki group consists of Kulekhani formation, Palung granite and Markhu formation while Bhimphedi group consists of Tistung, Sopyang, Chandragiri and Chitlang formation.

Kulekhani formation is a well-bedded alternation of fine grained biotic schist and micaceous quartzite. Rock slides observed around Phedigaon were located in the schist of Kulekhani.

Markhu formation consists of phyllites and marble. Phulchowki group begins with Tistung formation and is composed of slate, quartzite, and phyllite. Sopyang formation is composed of soft-weathered phyllitic slate and limestones.

Chandragiri limestone contains some phyllite and quartzite. Limestone is generally weathered on the surface. Chitlang formation mainly consists of phyllitic slate and the intercalation of quartzite and calcareous bands.

Granite of Palung is the only igneous rock which is deeply weathered and permeable. It contains sand, gravel, cobble and boulders.

The study area can be divided geologically into two broad zones, granite zone and non-granite zone or the schist zone.

The granite zone which occupies the left bank of the Palung mainstream has a steep gradient of mountain slope. On the July 1993 disaster, debris flows occurred in many tributaries originating from the granite zone. The debris of boulders of all dimensions are accumulated at the confluences of mainstream of Kitini Khola and Chalkhu Khola.

On the other hand, comparing with the granite zone, the schist zone has a gentle mountain slope and a smaller relative displacement to ridge from piedmont. The debris flows occurred in the Phedigaon during the July 1993 disaster. Apparently changing of landforms have not been recognised in other schist zone. It is assumed that in order to be deep weathering layer in schist zone, many a fine materials have been transported to the downstream and deposited in the reservoir.

iii. River Morphology

Palung Khola originating from Phedigaon of Palung VDC has been taken as a major river for bringing debris, sedimentation in Kulekhani Reservoir. The Palung Khola is also called as Sankhamul Khola after the confluence of Gharti Khola from Daman VDC. As it pass through Tasar village, the name also changed to the village name as Tasar Khola and so on. Finally, it drains in to the reservoir. There are a number of tributaries of this Khola, such as, Gharti Khola from Daman, Bisingkhel, Chitlang, Tistung kholas.

The Palung Khola is drained by three major streams; Dhungakate Khola, Ghatte Khola and Bhottekhoriya Khola. These streams have the gradient of about 25 degrees in the upper reaches due to the presence of rock exposure. Towards the lower part, the gradient is reduced to about 5 degrees as there is colluvial/alluvial fans near Phedigaon village. These streams join with the Palung Khola where the gradient is only about 1 degree.

Within the Kulekhani Watershed Area of 126 km², about 66 km² belongs to the catchment of Palung Khola only, all of which provides water to the reservoir.

iv. Water Quality

The rivers and springs are the main source of water for the use by people in the watershed area. The use of water resources is not only determined by the

availability of water but also by its quality. The quality is generally 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.

Some physico-chemical and biological parameters were analysed from the water of Palung river upstream Phedi Khola, near the reservoir and water from the reservoir itself. The water was collected for the testing purposes during rainy season.

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 bacteria, it is not within the WHO standard for drinking purposes. The other parameters are normal for irrigation and fishery.

As is shown in the Table 2.1, the results of the test show that the water is normal for irrigation and fishery purposes but not recommended for drinking. Actually the water directly from these river and reservoir are not used for drinking. The Presence of coliform in all the rivers are much more higher but in the reservoir is less. The Figure 2.15 shows sampling points for water quality test.

v. Climate and Rainfall

The watershed area lies in the Warm Temperate climatic zone towards the lower areas and cool temperate zone at higher altitudes. There exists two clear seasons, rainy season and dry winter. In some places, there occurs snow in the winter but summer days are hot and humid.

The summer season is followed by rainy season which usually starts from June to September. The weather station at the Department of Soil Conservation (DOSC) district office situated at Markhu, Simlang, shows the data of rainfall mostly occurs during the period of June to September. However, the monsoon can not be predicted by its nature. Sometimes there is not much rain during the said period of June to Sept. but there will be much rainfall in October.

As is shown in the Table 2.30, the records from Markhu Weather Sstation shows that the annual rainfall during 10 years from 1981 to 1990 is 1423.5 mm of which 72.6 percent rain falls only during the period from June to September.

Maximum rainfall occur in this area is July or August in 1993, the disaster occurred during July with heavy rainfall on 20th that maximum rainfall recorded on that day was 385 mm. The rainfall of one day earlier was only 4.5mm while the following day recorded up to 21 mm only. Due to this maximum rainfall on one day, made the saturated land mass at different places slide down, sedimenting in the reservoir.

(2) Biological Environment

i. Fauna

Wildlife

An investigation of available wildlife in the area around Palung Khola in Palung VDC, Bajrabarahi VDC and Markhu was carried out by visiting the places and inquiries with the village people. The areas has been developed for agricultural practices with some forest areas. Few patches of forest are found at different places. In Markhu, there are some area around the reservoir developed as forest and some natural vegetation remained where the forest are unreachable.

Since Kulekahni Watershed Area covers parts of Daman, Palung, Markhu, Chitlang, Bajrabarahi VDCs of Makwanpur district, these VDCs were visited for observation and identification of wildlife. It was a difficult task to find the animals during the study period so the information about the wildlife is according to the local residents. Most of the animals present are common to Palung, Daman VDC. Wild animals like, Jackal, wild cats, Squirrel, Percupine in forest and around the farmland. The leopards are seen but rare now. Deer was only reported in Markhu VDC. About bird species, they were also the similar species as recorded. Some of the bird species are observed and found out information with the help of book. There are two distinct types of animals one group seen in the forest while the other group in the settlement area.

The most common animals are squirrel, jungal cat, jackal, monkey while tiger, leopard are only occasional visitors. It was difficult to say that these animals reside in the forest or come from somewhere at times. Table 2.3.a., which shows a list of wildlife found in Palung and Agra VDCs, generally reporesent the distribution of wildlife in the Kulekhani Watershed Area.

Bird

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, like sparrow, swallow, pigeon, crows. It was also difficult that what birds are seasonal as they have not been observed in that way. The Table 2.3.b., which shows a list of bird species found in Palung and Agra VDCs, generally reporesent the distribution of bird species in the Kulekhani Watershed Area.

Fish species

Kulekhani Reservoir occupies the area of about 216 ha. along the Palung Khola in Markhu VDC. This man made lake become a suitable habitat of for fish species. The river was also a good habitat for the stream fishes. The stream fishes found before the creation of Kulekhani Reservoir is shown in the Table 2.25.a.

After the formation of lake for generating electricity by the construction of rockfill dam, some improved varieties of fishes have been introduced. These fishes are shown in the Table 2.25.b.

ii. Flora

General Conditions of Vegetation

The damages of Kulekhani Watershed Area was due to the deforestation and also due to the excavation of rock, soil for the construction of rockfill dam from around the area. An attempt was carried out to find out the vegetation of a number of places in around the Palung Khola flowing from Palung Daman VDCs to Markhu.

The climate varies from warm temperate to cool temperate in the mid hills of Mahabharat region. Similarly, vegetation also differs in different climatic regions.

The area can be broadly divided into Coniferous forest and mixed deciduous hardwood forest. Compared to other study areas, some parts of the watershed area having protection forest such as in Bajarabarahi, Daman, Chitlang, Palung, Markhu VDCs.

Protection Forest

Parts of the coniferous forest are categorised as protection forest after the plantation programme from the government or from the dam construction project. It can be noted that the areas seems heavily degraded due to the encroachment of human population. Due to the exploitation of the forest, bare soil surface has been exposed. Thus, in the newly plantation programme area assisted by FINNIDA to plant Pine trees mainly for soil conservation has been developed. Since the exposed land area shows dry sandy type of soil where broad leaved plants have difficult to survive, Pine trees are forming the forest. In such protection forests, *Pinus wallichii* is the dominant species.

Deciduous Hardwood Forest

Kulekhani Watershed Area has been dominated by *Rhododendron* trees which has now been heavily exploited. Most of the forest areas are very sparse with trees as they are continuously exploited for fuel, fodder. *Rhododendron* wood is the best type of charcoal to be sold to Jewelry makers in Kathmandu. In such forest areas, *Rhododendron* is found growing along with *Lyonia ovalifolia*, *Pyrus pashia*, *Schima wallichii*, and *Ficus nemoralis*. Most of the area are already without the *Rhododendron* trees.

The sampling area of the forest species are as follows:

The area around the Gharti Khola and Bayu Khola in Daman VDC;

The forest is of coniferous trees like *Pinus wallichii* and other broad leaved trees in mixed forest. Around Bayu Khola, *Pinus wallichii* is dominant. Other species along with Pine are like *Pyrus pashia*, *Rhododendron arboreum*, *Lyonia ovalifolia* towards the upper part with the ground cover of some shrubs like *Achyranthes bidentata*, *Rubus cordifolia*, *Potentilla fulgens*, and *Arisaema tortuosa*.

Gharti Khola Area;

There are more of shrubs than trees. Shrubs like *Gaultheria fragrantissima*,

Rubus ellipticus, and grasses of *Imperata cylindrica*, and *Erograstis tenella* are found. Towards more shady areas, *Eupatorium adenophorum*, and *Berberis aristata* are found.

Basantagaun of Bajrabarahi VDC;

Pine trees are dominant in the upper region while *Alnus* is dominant in the lower areas. The upper part is mostly covered with *Pinus walichii* where some ground cover of shrubs and herbs are found. While in the lower part, the mixed forest type is having *Alnus nepalensis*, *Quercus lanata*, *Q. incana*, *Rhododendron arboreum*, *Lyonia ovalifolia* are major species. At some parts *Juglans regia*, *Albizia* sp. are also found. The shrub species are similar to other places dominated by *Pyreantha crenulata*, *Berberis aristata*, *Gaultheria fragrantissima*.

It was found that some of the tree plantation area, *Banmara* or *Eupatorium* species became dominant as it grows on the open areas.

People from Basantagaun are more conscious about conservation of land that they had left cultivation and allowed plants to grow in some of the steep slopes. They also had made the foot trail lined with stone.

In Chitlang as well as in Markhu, most of the areas are covered with grass and shrubs which are more similar to other parts. The areas are having some natural vegetation with some areas of community forestry.

A list of plant species found in the Kulekhani Watershed Area is shown in the Table 2.4, which shows a list of vegetation found in Palung and Agra VDCs, generally represent the distribution of plant species in the Kulekhani Watershed Area.

(3) Social Environment

i. Demographic Characteristics

Distribution of Population

The watershed area is considered for the five VDCs namely, Palung, Daman, Bajrabarahi, Chitlang and Markhu. The information from those VDCs show that the total population is about 29,732. Of the watershed area, the middle part of watershed is densely populated such as in Bajrabarahi VDC have about 23.1% population followed by Daman VDC (23.0%) and least among the five VDC is Markhu having only 10.5% population. The average family size is 5.6. The male-female ratio is about 50.2 : 49.8.

Ethnicity

The main ethnic/caste groups are Newars, Brahmin, Chhetri, Thakuri, Tamang and Magar. The up-dated data is not available in the Kulekhani Watershed Area because the VDC did not have the up-dated census data. So the data from CBS (1991) & VDC office 1996 available are presented. However, the Kulekhani Watershed Area is dominated by Newar (32.2%) followed by Brahmin/Chhetri/Thakuri group (31.5%), Tamang (26.9%) and so on.

Migration

Migration is a common phenomenon among the local residents. People migrate from one place to other looking for better life. There are different types of people who migrate for different purposes. Some migrate to other place for good but some only for certain period as long as have the work to do. Again some leave the village looking for work only during the off-farm period to utilise the extra time and also to generate some income.

It is normal for people to migrate from village to urban areas where there is opportunity to do work and earn for living. So migration in the village backward is almost nil. Of course some migrate from one remote village to more accessible village.

Those who are the victims of environmental degradation are more likely to migrate than those who do not yet have to suffer from that cause. About 115 households are already migrated outside the village or watershed area. Most of them are displaced due to the construction of Kulekhani Reservoir for electricity generation.

The out-migration trend is higher than in-migration due to lack of its economic opportunity and forth coming natural disaster as before 1993. The temporary in-migration are generally the school teachers, different government officials and NGO officials only. The number is about 250. But the out-migration is very high as about 2502 individuals. The trend is higher in Chilang VDC among the watershed area because it has less developed infrastructure. It was observed that the young people specially boys go out from the village looking for work. As they had very less education they self-employ in daily labourer.

People living in around Thado Khola, a tributary drianing into the reservoir expect that they will be removed to somewhere else when the construction of check dams begins. They thought that the check dam is like the one of Kulekhani which collect water and flood their area.

Seasonal migration also take place in the Watershed area which comes to about 1500 person in a year. This seasonal migration trend indicate that the economic opportunity is not sufficient in the watershed area.

Occupational Distribution

The main occupation of people residing in the Kulekhani Watershed is agriculture, followed by construction worker or laborer whether agricultural labour or other. A small percent of the local residents serve as school teacher, government or private services. The Table 2.26.c. shows the occupational distribution of the Kulekhani Watershed Area.

Literacy

The literacy status of the Kulekhani Watershed Area is 55.4% which is higher than the national average. It was due to the higher literacy percentage of Daman VDC situated on the Tribhuvan highway. The female literacy is lower to that of the male literacy similar to other area. Only 33 percent of the female are literate among the female population and about 74.7 percent of male among male population are literate in the watershed area. Among the five VDCs, Chilang and

Markhu have least percentage of literate people.

ii. Land Use

General Land Use Patterns

The total area of watershed has been reported to 12500 ha. (sediment survey of Kulekhani Reservoir, Dec. 1993, DOSC). According to the local residents living there, the total area of the study site is about 9792.6 ha. only. The exact figure is yet to find out. Of the total area about 50.7% falls on the forest category and 44.1% on farming category. And the rest falls on pasture, streams, rock and cliff, and reservoir area. The Table 2.27 shows the general land use patterns of the Kulekhani Watershed Area.

Average Land Holding

Of the total households about 35.7% are small farmers followed by marginal farmers of 25.2%, medium farmers of 23.0 % and large farmers of 13.1 %. It has been reported that about 152 households are landless, the cause of being landless was not known. The detail breakdown of the average land holding is given in the Table 2.26.d.

Land Tenure System

It has been reported that most of the farmers are owner-operator. Some of the farmer practice share-cropping on 50/50 basis. It is executed only for cash crops. The landless and marginal farmers depend on manual work such as working in the farm for others, portering vegetables from the farm to the road head.

Irrigation System

Intensive economic activities tend to degrade the environmental conditions: the forest is degraded, terrace farming expands to steep slopes, irrigation canal network extend to the slopes in the watershed and so on. Such activities will cause soil erosion, land slides, and slope failures. The eroded soil in the watershed flows into the streams and reach to the reservoir. The phenomenon threatens power generation of the Kulekhani Reservoir.

Many FMIS schemes in Palung VDC were damaged in upper Kulekhani Watershed Area. "Gairigaon irrigation project" introduces water from Dhungakate Khola and irrigates about 100 ha. of land on the right bank of Palung Khola. The rehabilitation was mainly by beneficial farmers, under technical assistance of IFAD and district engineers. In this FMIS, rehabilitation programme, materials have been fully provided after the designing including survey. And the rest of individual project budget has been spent on labour wage to the farmers on quantity basis. In west Phedigaon (ward no. 9), 2 intake (1 in Dhungakate Khola and 1 in Ghatte Khola), irrigated about 30 ha, were destroyed. A 70 ha irrigation scheme on the left bank of Palung Khola (20 ha in Phedigaon and 50 ha in Soltu ward no. 7) is also not in use due to the destruction of both intake in Bhottekhorla Khola and piped aquaducts (4nos. within the systems. In Bhangkhorla, Karkigaon and Palung (ward no. 4,5,6), several intakes formerly installed in Mahadev Khola were washed out and the

total of about 70 ha of farmland is under shortage of water. Cultivation of maize is the common attitude of the farmers among these short water supply area hoping to retrieve their old practices, i.e., paddy cultivation.

Table 2.35 shows general cropping patterns and the cropping calendar in the Kulekhani Watershed Area.

Harmful Insects to Crops

The different insects damage the crops in the field and when stored as well. It has been reported that the main insects are Field crickets, Stem Borers, Hispa and Mealy Bugs in the paddy field; Cut worms, Field crickets, in the maize; Thrips and Aphids in wheat and Moths in potato. Generally all these insects are found in vegetable farms. The farmers have used the insecticides and pesticides for the treatment of crops and vegetables when it will start to damage. Likewise, the farmers use pesticides before harvesting vegetables due to the fear of damage of their harvested vegetables.

Livestock Holding

The average livestock holding in Kulekhani Watershed Area is 4.3 Goat, 2.3 cattle and 0.5 buffalo per household. Sheep is rarely found in the area despite the sheep farm in Chitlang. It was found that only in Daman VDC sheep farming is practiced. Goats are found to be in maximum number in the livestock which is one of the source of some income for the local residents as well as to offer to gods during festivals. But grazing goats are found to be most damaging to natural environment as goats eat up the small new branch which make the plant difficult for re-growing and it takes time.

Fishing in Kulekhani Reservoir

Fishermen in around Palung Khola before the lake formation used to trap fish with local made bamboo basket type trap. They also use net which they themselves weave out of cotton threads. In some places, where the stream is small and only small fish are found, they trap with hand by making a diversion in the stream itself.

In the reservoir now, fishery development programme of the government is running fishery where local people were allowed to fish as much as they can either by using their cage or just by nets. There is also a fishermen association where they have to pay certain amount after fishing.

The fishery development programme had released the improved varieties fishlings often. The local fish mentioned above are also found coming in the lake from the rivers. Here, people were not allowed to use fish poison or blasts of any kind and allowed only to use nets, cage, and traps for fishing.

When 1993 disaster occurred, it was most devastating to the fish as many big fishes were thrown away from the lake outside. People recall the amount of big fishes seen below the reservoir lying after the flood had subsided. People did not take fish for some period after the flood saying that they had consumed human as people had been brought from the flood water in the reservoir.

About 100 kg of fish is sold each day by about 20 fishermen. However, the

fishermen have made their turn for fishing every alternative days so that it does not make pressure on the fish population. These fishermen used to live on fishing even before the formation of lake. So after the formation of reservoir, they were remained as fishermen who have to invest on cage or net of the fishing equipment.

Every fishing person have to pay charges to the Fishermen's Cooperative as licence to fish in the river. It costs Rs.4 per kilo of catch.

iii. Forestry

Use of Forest Product

The local residents of Kulekhani Watershed have collected fuelwood mostly from community or public forest to about 79.7 % followed by 14.9 % from private land. Similarly the fodder are also collected 59.9 % from their ownland and followed by 30.1 % from community forest as well. It is due to the introduction of the community forestry programme by HMG/N to conserve the watershed area for the Kulekhani Reservoir. The detail breakdown is shown in the Table 2.29.

Use of Energy Sources

The Kulekhani Watershed Area is accessible by the Tribhuvan highway and a link road up to Kulekhani dam. The link road cross the watershed area and develop into the rural road to each VDC in their own effort. Only the limited portion of the watershed area have electricity facility as in Markhu bazar, Palung VDC and some bazar area of Daman area. Generally the local residents of watershed area use kerosene for lighting and have use fuelwood for cooking and heating.

iv. Infrastructure

Road

During the construction works of the Kulekhani Dam, access road was constructed. It became one of the very important infrastructures for the local residents of watershed area as it served to enhance local economy. Many have changed their cropping patterns for self-sustaining farming to cash crop production.

Health Facility

There are two Ilaka health post in Daman and Markhu, one sub-health post in Chitlang. The Ilaka health posts are providing MCH mobile clinic in other VDC in the watershed area.

Besides these, one newly established hospital in Bajrabarahi VDC known as Bajrabarahi Peoples' Hospital is established and managed the local people and run by a committee. It has sub-committee in other VDC's as well to provide support function. Every member of the beneficiary have to pay the premium Rs. 5/- per person in a month.

Despite the facility, people have strong faith in traditional rituals and local faith healers. People believe that the reason for sickness is due to the deities around who are not honored properly. In order to please the deities, pujas are performed by faith healers. They wait for some time hoping that the sick person would get better. The pujas cost a lot of money which include sacrifices of animals such as chickens, ducks, and goats.

Sanitary Condition

There are few piped water pipes about 27 village taps in the Kulekhani Watershed which are poorly maintained. The pipe water could not meet the demand of the watershed area. Particularly in Bajrabarahi VDC, there is no pipe water supply facility. Non-facilitated households of the area fetch water from springs and spouts.

There is no practice of using latrine and defecate everywhere in the bank of streams, forests, and other open public field. However it is not a significant problem because of scattered household location.

Education Facility

There are 28 schools which serve about 7000 students for education. Physical conditions of the schools as buildings, furniture and education materials are poor and inadequate. It can be observe in schools that the enrollment rate of girls are very low against the boys.

Communication Facility

There are four telephone public call office in the Kulekhani Watershed Area. These are mostly concentrated in bazar area as in Palung bazar, Shikharkot, Bajrabarahi and Taukhel. Except these, there are about 5 post offices for postal services.

v. Commerce and Industry

There are no big industries observed in the watershed area except a small scale rice mills (diseal plant).

There are a number of service institutions located in Shikharkot bazar of Daman VDC and Markhu bazar of Markhu VDC. Nepal Bank, Agriculture Development Bank/SFDP, Agriculture Service Centre, Sahakari Sanstha, Horticulture Center, Vegetable Farming Development Branch, Department of Road, Women Development Section Unit office, Nepal Electricity Authority, and Matsya Palan provide service in the watershed area.

There are some community based organizations which participate in uplifting the underprivileged backward people such as PLAN International Makwanpur, CBO Lhyamu Pucha in Palung, CBO Nava Jagriti club in Daman, NGO called COSAN and CSD in Markhu, CBO Bajrabarahi Youth club in Bajrabarahi.

vi. Religious/Cultural Activity

It has been reported that there are more than 100 temples of Gods/Goddess

which are worshiped by the local residents of the watershed area. Generally they are outside of the areas where the project components are implemented.

vii. Area of Aesthetic/Scientific Value

After the completion of Kulekhani Hydropower project, it has become one of the major tourist centers. Daman is the major tourist center for long period of time.

2.6.2 Environmental Impact Analysis

(1) Proposed Activities

The activities proposed for the Infrastructure Disaster Prevention Plan in Kulekhani Reservoir mainly focussed on the afforestation programme under the community forestry, in the upper parts of Palung Khola in Palung VDC. Once the afforestation and community forestry programme be successful, similar activities will be replicated to entire Kulekhani Watershed Area.

Palung Khola originating in the upper slope of Phedigaun in the Ward No. 9 of Palung VDC is estimated to be the major area of producing sediment to the Kulekhani Reservoir. Thus there is a proposal to construct a series of check dams, and the river training works in the reservoir. These works are proposals subject to further study and that they are not any part of the Project. Location map of proposed check dam site in and around reservoir is shown in the Figure 2.16.

Since the Study conducts to make a series of recommendations for sediment prevention measures and that there is no basic design has been conducted for any one of them, the following environmental impact analysis has been conducted based on the preliminary data available at the time of the Study only. Thus no in-depth analysis has been conducted and no tables representing the result of analysis was produced.

(2) Physico-chemical Environment

i. Topography

Afforestation in the Phedigaun of Palung VDC is considered as the main activity for protection and prevention of Kulekhani Reservoir from sedimentation. The afforestation programme suggested under the community forestry programme is one of the major activity considered to be a prevention measure. Though there are some forest areas which were already controlled by the community from hapahazard lopping and fodder collection, there still is a great need to develop local knowledge and understanding for the conservation and preservation of forested areas. The proposed activity also try to strengthen the local capability to manage the community forestry by registering into community forestry by which they can get help from the government for technical advise and trainings.

There are many agricultural lands in the entire watershed area with settlements found at different places, forest have been much in use and can patches degraded land, exposed due to deforestation. With the afforestation and agro-forestry programme, it was estimated that further deforestation will be minimised as

people will be planting required plants in and around their private lands. The agro-forestry practice will provide fodder and fuel from their own land as much as possible so that they do not have to encroach public/government forest.

Thus this programme will have positive impact on the natural environment of the watershed area. However, care should be taken for the afforestation programme that no monoculture of plants be done which might again cause adverse impact on wildlife, without natural balance.

For massive afforestation programme at certain place, seedlings have to be propagated for which nursery have to be established. The construction of big nursery at certain places may also cause unperceived adverse impact. This aspect has to be further detail studied.

ii. River Morphology

There will be no significant changes estimated to occur in the river and climate but the amount of sedimentation would be less once the land be stabilised with plants.

iii. Water Quality

As there is no direct involvement of river by the afforestation programme, no significant change will occur in water quality.

Any recommendations for sediment prevention measures that are planned to take place within the reservoir should change water quality of the reservoir. Turbidity of the water would particularly be the cause of major impacts.

(3) Biological Environment

i. Fauna

Wildlife

There is no direct involvement of wildlife species or the involvement of habitat for wildlife that are affected by the project components.

Fish species

There will be no direct adverse impact on fish species in Kulekhani Reservoir with the afforestation programme.

Any proposed plan intended to implement within the reservoir should be the major source of impact to the fish species in the reservoir. The impact on the fish species caused by the recommendations for sediment prevention measures should be further study.

ii. Vegetation

There will be some adverse impact due to the local residents during the

implementation of afforestation activities. It was expected that the vegetation will be better with the plantation activity due to awareness among people as they are involved in plantation activities. Afforestation of careful planning that is planting mixed plants and more local species will help regenerate vegetation to the barren lands as well as to improve the community forest activities.

(4) Socio-cultural Environment

i. Population

Although the short socio-economic survey was not able to capture the exact number of families likely to be directly affected by the Disaster prevention plan but it tries to highlight the issues possibly come up on construction phase and after completion of the project as well.

The Agro-forestry programme will certainly help the local residents to make them self sufficient in fuel and fodder requirements. This in turn will help people specially women in their work of fuel, fodder collection which is a labour intensive work.

ii. Land Use

The community development activities like the improvement of irrigation schemes, road and extension of cash crop production may certainly effect on land use pattern and cropping pattern. Because the disaster of 1993 damages the irrigation scheme and (Khet land) lowland changes into upland due to scarcity of water for irrigation, farmland covered by debris accumulation by flood. After the completion of the rehabilitation of the irrigation schemes the upland will change into the lowland and the cropping pattern will also certainly change. The irrigation facility will help to increase the agricultural products and help to betterment the economy of the farmers. Due to the better economy the living standard of the farmers will also develop than before after the completion of the community development programme.

The disaster prevention and community development programme will develop the economic prosperity for the future. Due to the economic prosperity the labourer and the landless will temporarily settle there. And it will be problematic for the future generation who will face the environmental pollution in that area due to the increasing settlements everywhere in the area.

Intensive economic activities tend to degrade the environment conditions : the forest is degraded, terrace farming expands to steep slopes, irrigation canal network extend to the slopes in the watershed and so on. Such activities will cause soil erosion, land slides, and slope failures. The eroded soil in the watershed flowed into streams and reach to the reservoir. The phenomenon threatens power generation of the Kulekhani Reservoir.

iii. Infrastructure

The disaster management plan proposed the two way plan as disaster prevention

and community development plan. Among the community development programme, infrastructure development programme such as the construction of feeder road on the dike between Phantbazar and Phedigaon, river training works, improves the infrastructural development of the area. This development programme will enhance the use of school in Phedigaon which serves for more than 500 students.

The improvement of drinking water will provide additional water to the east boundary of Phedigaon, Phantbazar and Soltu. This will make decrease the workload and save time for rural women and can join in productive work.

The construction of the road on the dike will facilitate a safe transportation during monsoon season. It creates positive feeling among the members of the local community

iv. Religious/Cultural Activity

It has been reported that the local residents of Phedigaon, Phat bazar and Palung bazar and other bazar area use to worship mainly in the Temples residing in their own area. These temples are already disturbed by the flood disaster occurred in 1993. The development programme and construction work will disturb Matsenarayan Temple, Indrayeni Temple, Mahadev Temple and the Bhairav Temple of Phedigaon.

v. Area of Aesthetic/Scientific Value

No significant potential effect will occur in the area of aesthetic/scientific value.

2.6.3 Environmental Management Programme

Any recommendations made for sediment prevention measures that are planned to take place within the reservoir are subject to further study in relation to the water quality and the fish species and its sales. In general, the measures of preventing silt from spreading over to the fish pen or any fish growing areas should be considered.

2.6.4 Environmental Monitoring Programme

During and after the implementation of the project components recommended to conduct within the framework of the Study, monitoring on the fish species in the Kulekhani Reservoir should be very closely conducted for their growth and catch.

Table 2.1 Result of Water Quality Test

Parameters	Unit	Sampling Points						WHO Standard
		1	2	3	4	5	6	
1 pH	-	7.84	7.47	7.46	7.96	8.7	7.75	6.5-8.5
2 Conductivity	micro mhos/cm	106	45	19	149	125	106	-
3 Turbidity	NTU	0	1	0.5	31	2	0.5	5
4 Colour	Chromaticity Unit	0.77	0.6	0.43	0.25	0.62	0.39	15
5 Total Suspended Solids	mg/l	1.8	1.4	0.8	476.8	5	2.8	1000
6 Total Dissolved Solids	mg/l	130	56.5	45	219.5	190.86	190	-
7 Total Solids	mg/l	131.8	57.9	45.8	696.3	195.86	192.8	-
8 Hardness as CaCO ₃	mg/l	40	16	6	72	52	50	-
9 Alkalinity CaCO ₃	mg/l	23.375	4.675	4.675	42.075	32.725	32.73	-
10 Acidity	mg/l	20.41	20.41	20.41	20.41	20.41	20.41	-
11 Ammonia	mg/l	trace	0.01	0.031	0.062	trace	0.087	-
12 Nitrate	mg/l	3.19	0.73	0.22	1.41	1.14	1.49	45
13 Nitrite	mg/l	0.0064	0.0021	0.0011	trace	0.0161	trace	-
14 Sulphate	mg/l	3.33	trace	trace	6.99	6.58	4.52	400
15 Phosphate	mg/l	0.086	0.202	0.11	1.91	0.067	0.13	-
16 Chloride	mg/l	1.92	2.88	3.84	4.8	3.84	1.92	250
17 Calcium	mg/l	14.4	4	1.6	25.6	19.2	17.6	-
18 Manganese	mg/l	0.97	1.46	0.49	1.94	0.97	1.46	-
19 Iron	mg/l	0.17	0.17	0.52	2.11	0.21	0.13	0.3
20 Manganese	mg/l	0.023	0.046	0.2	0.39	0.1	0.08	0.1
21 Sodium	mg/l	3.15	2.15	1.2	3.51	2.85	3.5	200
22 Potassium	mg/l	2.15	1.15	0.3	3.16	1.5	1.02	-
23 DO		7.61	7.93	9.49	6.754	8.99	6.87	-
24 COD		trace	trace	trace	trace	6	15	-

Note: Sampling Points are as follows:

- 1 Phedi Khola, Palung, Palung VDC
- 2 Manahari Khola, Namtar, Namtar VDC
- 3 Chalti Khola Chisapani, Agra VDC
- 4 Agra Khola, Mahadevbesi Bridge, Bhumeshtan VDC
- 5 Kulekhani Reservoir
- 6 Lower Palung Khola

Table 2.2 Average Rainfall Patterns Recorded by Daman Weather Station

Year	Total Amount of Rainfall	Amount of Rainfall During Monsoon Period		Max.Rainfall of the Year	
	mm	mm	%	mm	Date
1981	1417	1081	76.5	120	29-Sep
1982	258	944	75	59	6-Jul
1983	1649	1100	66.8	111	17-Jul
1984	1658	1353	81.6	91	16-Sep
1985	2135	1474	69	97	5-Sep
1986	2196	1575	71.7	151	27-Aug
1987	1847	1410	76	124.5	20-Oct
1988	1695	1184	69.8	61.5	9-Aug
1989	1367	1011	74	76	6-Jul
1990	2084	1524	73	100.8	14-Jul

Table 2.3 List of Wildlife and Bird Species Found in Palung VDC, Agra VDC and Mahadev Besi Bridge

(1/3)

English Name	Scientific Name	Nepalese Name	Habitat	Local Status
1 Porcupine	Hystrix sp.	Dumsi	Cropland	Common
2 Jackal	Canis aureus	Shyal	Cropland	Abundant
3 Rabbit	Lepus sp.	Kharayo	Forest	Common
4 Wild Cat	Felis chaus	Ban Biralo	Forest	Common
5 Mongoose	Herpestes edwardsi	Nyauri musa	Cropland	Common
6 Squirrel	Funambulus sp.	Lokharke	Forest	Common
7 Langur	Presbytis	Dhendu Bandar	Forest	Rare
8 Monkey	Macaque mulata	Bandar	Cropland	Common
9 Leopard	Panthera sp.	Nigale Chituwa	Forest	Hardly seen

(2/3)

English Name	Scientific Name	Nepalese Name	Habitat	Local Status
1 Pheasant	Lophora sp.	Kalees	Forest	Decreased
2 Partridge	Francolinus sp.	Titra	Shrubland	Common
3 Red Vented Bulbul	Pycnonotus Cafer	Jureli	Forest	Common/Abundant
4 White Cheaked Bulbul	P. Leucogenys	Jureli	Forest	Common/Damaging Mustard & Radish
5 Dove	Spreptopelia sp.	Dhukkur	Forest/Cropland	Common/Migratory Bird
6 Hawk	Accipiter Risusu	Baaz	Cropland	Common
7 Wint	Delichon Nipalensis	Gauthali	Cropland	Rare/Migratory Bird
8 Sparrow	Passer sp.	Bhangera	Cropland	Common/Damaging crops
9 Myna	Acridotheres sp.	Sarung	Cropland	Common
10 Drongo	Dicrusus sp.	Cheebe	Cropland	Rare/Winter Migratory Bird
11 Crow	Corvus sp.	Kaag	Cropland	Common
12 Egret	Bubulcus ebis	Bakulia	Cropland	Common
13 Owl	Bubo nepalensis	Latokosero	Riverside	Rare
14 Woodpecker	Peckerpicus sp.	Kath	Forest	Common
15 Drongo Cuckoo	Surniculus lugubris	Koeli	Cropland	Common/Winter Migratory Bird
16 Little Pied Flycatcher	Muscicapa Westermanni	Khabe	Riverside/cropland	Common
17 Bailion's Crane	Porzana pusilla	Sim kukhura	Riverside	Common

Table 2.3 List of Wildlife and Bird Species Found in Palung VDC, Agra VDC and Mahadev Besi Bridge (continued)

(3/3)

c. Fish Species

English Name	Scientific Name	Nepalese Name	Remarks
1 Schizothorax	Schizothorax sp.	Asala	Resident, all year
2 Nepalese katle	Accrossocheilus hexagonolus	Katle	Resident
3 Stone loach	Noemacheilus sp.	Gadela	Resident
4 Nepalese stone	Garra gotyla	Buduna	Disappearing
5 -	Bariilus barana	Faketa	Resident
6 -	Loreglanis kishinouyei	Teichapre	Rare

Table 2.4 List of Plant Species Found in Palung VDC and Agra VDC

a. Tree Species

	English Name	Botanical Name	Nepali Name	Altitude	
				1,940 m	2,000 m
1	Pine	<i>Pinus roxbourghii</i>		-	++
2	Blue Pine	<i>Pinus wallichiana</i>	Gobre salla	-	++
3		<i>Lyonia ovalifolia</i>	Angeri	++++	-
4	Wooly Oak	<i>Quercus pubescens</i>	Bajha	++	+
5		<i>Quercus semecarpifolia</i>	Khasru	-	+
6		<i>Schima wallichii</i>	Chilaune	++	+
7		<i>Rhododendron arboreum</i>		++	++
8		<i>Oxyrus pashia</i>		++	+
9		<i>Ficus nemoralis</i>		+	++
10	Bottle Brush	<i>Callistemon viminalis</i>	Kalki	+	++
11		<i>Castanopsis indica</i>		-	+
12		<i>Choerospondias axillaris</i>	Lapsi	++	+
13		<i>Michaelia champaka</i>		-	+
14	LulLule			-	+
15		<i>Coelogyne cristata</i>	Orchid	+	+
16	Silky Oak	<i>Grevillea robusta</i>	Kangiyo	++	+
17		<i>Gultheria fragrantissima</i>		++	++
18		<i>Eupatorium adenophorum</i>		+	++
19	Nepalese Alder	<i>Alnus nepalensis</i>	Utis	+	+
20		<i>Osbeckia sp.</i>		+	-
21		<i>Eurya acuminata</i>		++	+
22		<i>Pyracantha crenulata</i>		-	++
23	Wild Pear	<i>Pyrus pashia</i>	Mayel	+	++
24	Plum	<i>Prunus cerasoides</i>	Painyun	-	+
25	Bantarul		Wild Yam	-	+
26		<i>Barberis aristata</i>		-	++
27		<i>Achyranthus bidentata</i>		+	-
28		<i>Myrica esculenta</i>	Kaphal	+	++
29		<i>Mahonia nepalensis</i>		-	++

b. Medicinal Wildplant

	English/Nepali Name	Botanical Name	Portion to be used
1	Pakharved	<i>Bergenia ciliate</i>	root
	Everlasting	<i>Anaphalis busua</i>	fresh and dry flower
	Eklebir	<i>Lobelia pyramidalis</i>	whole plant
	Wild Onion	<i>Allium spp.</i>	root
	Sugandhawal	<i>Valeriana wallichii</i>	nodes

Note: + abundant
- not present

Table 2.5 Demographic Characteristics in Palung VDC

a. Population

Ward No.	No. of Total H/H	Male Population	Female Population	Total Population
1	111	348	369	717
2	112	344	349	693
3	73	285	274	559
4	103	352	382	734
5	64	292	265	557
6	73	210	205	415
7	117	394	401	795
8	64	185	196	381
9	260	797	806	1603
Total	977	3207	3247	6454

b. Ethnicity

Caste/Ethnic Group	Percentage
Brhamin/Chhetri/Thakuri	38.8
Newar	25.7
Tamang	26.0
Magar	2.2
Gurung	1.1
Occupational Caste*	2.9
Others	3.3
Total	100.0

Note: * - Composed of Kami, Damai & Sharki.

c. Occupation

Occupation	Percentage
Agriculture	89.9
Business	2.0
Services	5.1
Wage Work	3.0
Total	100.0

Table 2.6 Land Holding in Palung VDC

Classification	Hodling (Ropani)	No.of H/H	%
Landless	0	60	6.1
Mariginal	0-5	339	34.7
Small	6-10	257	26.3
Medium	11-20	245	25.1
Large	>21	76	7.5

Table 2.7 General Cropping Patterns in Palung VDC

a. Arrangement of Crops (Rainfed Area)

Initial crops	Following Crops
Maize + Potatoes	- Cauliflower - Cabbage
Potatoes	- Cauliflower - Cabbage
Maize+Millet Maize	- Fallow - Radish

b. Arrangement of Crops (Irrigated Area)

Initial crops	Following Crops
Potatoes	- Paddy
Potatoes-Cabbage	- Cauliflower
Potatoes Paddy	- Cabbage - Wheat

c. Cropping Calendar

Crops	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Paddy												
Potato												
Maize												
Millet												
Wheat												
Cauliflower												
Cabbage												
Raddish												

Note:



Planting Season



Harvesting Season

Table 2.8 Agroforestry Trees Accepted in Palung VDC

a. Forest Species

English/Nepalese Name	Botanical Name
Nepalese Alder/Uti	<i>Alnus nepalensis</i>
-/Chilaune	<i>Schima wallichii</i>
Plum/Paiyum	<i>Prunus cerasoides</i>
Wooly Oak/Bajha	<i>Quercus pubescens</i>
Blue Pine/Gobre salla	<i>Pinus wallichii</i>
-/Angeri	<i>Lyonia ovalifolia</i>

b. Fodder Species

English/Nepalese Name	Botanical Name
-/Dudhilo	<i>Ficus nemoralis</i>
-/Nimaro	<i>Ficus roxburghii</i>
-/Khanyu	<i>Ficus semicordata</i>
-/Gogan	<i>Saurauia nepalensis</i>
Blue Pine/Gobre salla	<i>Pinus wallichii</i>

c. Fruit Trees

English/Nepalese Name	Botanical Name
Pear/Naspati	<i>Pyrus communis</i>
Peach/Aru	<i>Prunus persica</i>
Plum/Alubakhada	<i>Prunus domestica</i>
Lime/Kagati	<i>Citrus aurantifolia</i>
Pomegranate/Darim	<i>Punica granatum</i>

Table 2.9 Religious Establishment in Palung VDC

Name of the Temple	Location	Remarks
Pandukeshwor Temple	Palung Bazaar	Worship every day
Mahadeo Temple	Phal Bazaar	Worship every day
Bhairav Temple	Phedigaon	Worship every day
Matsenarayan Temple	Ward No.7	Festival ever 3 yrs.
Bhagawati Temple	Ward No.6	Worship every Dashain
Jhamkeshori Mahadev Temple	Ward No. 1	Festival in every Nov-Dec.

Table 2.10 Result of Environmental Impact Analyses for Phedigaon/Phatbazar CDDP

(1/2)

Note: The methodology of assessment is based on the National Environmental Impact Assessment of 1993, IUCN

a. Abbreviation of the Impact Prediction

Magnitude	Extent	Duration
H - High	L - Local	S - Short Term
M - Medium	R - Regional	M - Medium Term
N - Minor	N - National	L - Long Term

+N : Denotes positive impact
N - : Denotes negative impact

b. Result of Impact Analysis

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
1. Clearing and construction of gabion structures & dams	Removal of soil and vegetation and the materials from the site to be dumped should cause some impact to the near-by area	N -	L -	S -	Select spoil bank for disposal of top soil and other materials in the area causing no impact to the natural and socio-economic environment
For construction, the riverbed, gully have to be cleared and water is diverted	Water diverted to other part causes further riverbed scouring	N -	L -	S -	Work during dry period so that less water have to be diverted and for safety
2. Aggregate for construction of gabions, check dams	A large quantity of stone are available in Phedigaon	L -	L -	+ L	Use of available stone from the area and excavate from nearby without putting much pressure at one place only.
	Construction aggregate is proposed to transport to Chisapani to use for the construction works	N -	L -	+ L	Debris accumulated by the 1993 Disaster in Palung Bridge near Thana Bazaar can be utilised for the construction of check dams and gabions in Phedigaon and Chisapani.
3. Access road/dike road	River training works lead to the construction of dike road	N -	L -	+ L	
	The dike road disturbs the aquatic life and bird species residing in the riverside	N -	L -	L -	
	Dike road construction leads to reclamation of farm land covered by debris	N -	L -	L -	There is positive impact with the construction as many farm land could be reclaimed for farming
4. Water quality	During construction period water will be polluted with the construction materials	N -	L -	S -	Avoid using water for drinking during the construction period

Table 2.10 Result of Environmental Impact Analyses for Phedigaon/Phatbazar CDDP
(continued)

(2/2)

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
5. Vegetation	No direct adverse impact as there is no such trees and plants that should be removed except for the growing Alnus trees in Dhungakate Khola riverbed	N -	L -	S -	Some private land should be left without reclamation as the owner(s) desire to keep Alnus tree seedlings growing in the area for income by cutting and selling them.
	Indirect impact due to the pressure on the forest by people from outside for work during the construction period	N -	L -	S -	Arrange non-wood source of fuel for cooking if construction workers are brought in
6. Wildlife	Not much damage to wildlife as there are very few wildlife	N -	L -	S -	Employment of the local people for the construction works will cause no disturbances to the natural environment
7. Camps for workers group	Construction camp for a large group of people may cause environmental and social problems	M -	L -	S -	Employment should be conducted locally, or encourage participation of the local residents
8. Agricultural Programme	Use of chemical fertilizers in excessive amount for better vegetable production may cause health hazard for the local residents	M -	L -	S -	Encourage people to produce and use the compost which is manufactured locally with high organic contents
9. Afforestation Programme	Soil erosion control with ground cover as well as trees in the open hill slopes	+ M	L -	+ L	Beneficial for the community as well as to the natural environment
	There is a local interest on planting mulberry which enable to develop sericulture later for income generation	+ N	+ L	+ L	
10. Impact on population	organization of the local residents for evacuation system may function to cause further disputes. It may take up time for their agricultural activities.	+ M	+ L	+ L	Careful planning on the appropriate organization of the local residents is essential not to cause troubles to their agricultural activities

Table 2.11 Wildlife and Bird Species Found in Namtar

a. Wildlife Species

English Name	Scientific Name	Nepalese Name	Habitat	Local Status
1 Wild Cat	Felis sp.	Ban Biralo	Forest	Common
2 Porcupine	Hystrix sp.	Dumsi	Cropland/Forest	Rare
3 Bear	Melursus ursinus	Bhal	Forest	Rare
4 Jackal	Canis aureus	Shyal	Cropland	Common
5 Mongoose	Herpestes sp.	Nyauni Musa	Cropland	Occasionally
6 Squirrel	Funambulus sp.	Lokharke	Forest	Common
7 Monkey	Presbytis entallus	Bandar	Forest	Common
8 Leopard	Panthera sp.	Chitwa	Forest	Rare
9 Rat	Rattus sp.	Musa	Cropland	Abundant
10 Bat	Pteropus sp.	Chamero	Forest	Common
11 Lizard	Eumeces sp.	Chheparo	Forest	Common
12 Wall Lizard	Hemidactylus sp.	Mausuli	Household	Occasionally
13 Green Snake	Ophiodryas sp.	Hareu sarpa	Cropland/Forest	Occasionally
14 Cobra	Naja sp.	Goman	Cropland/Forest	Occasionally
15 Rattle Snake	Crotalus sp.	Dhaman	Cropland/Forest	Occasionally
16 Water Snake	Acrochordus sp.	Panisarpa	Riverside Area	Occasionally

b. Birds Species

English Name	Scientific Name	Nepalese Name	Habitat	Local Status
1 Myna	Acridotheres sp.	Sarung	Cropland	Common, Resident
2 Wren	Delichon nepalensis	Gauthali	Household	Common, Resident
3 Sparrow	Passer sp.	Bhangera	Cropland	Common, Resident
4 Bulbul	Pycnonotus cafer	Jureli	Forest	Common, Resident
5 Dove	Streptopelia	Dhukur	Forest	Common, Resident
6 Robin	Erithacus sp.	Dhobini Chara	Cropland	Rare, Migratory
7 Drongo	Dicrurus sp.	Cheebe	Cropland	Common, Migratory
8 Parrot	Psittacus sp.	Suga	Cropland	Common, Migratory
9 Crow	Corvus sp.	Kag	Cropland/Forest	Common, Migratory
10 Vulture	Aegypius sp.	Giddha	Openland	Rare, Resident
11 Partridge	Francolinus sp.	Titra	Forest	Rare, Resident
12 Eagle	Aquila sp.	Chheel	Forest	Rare, Resident
13 Cuckoo	Paucyrococcyx sp.	Koel	Forest	Rare, Resident
14 Lapwing	Vanellus sp.	Huttilyang	Riverside	Rare, Resident
15 Owl	Bubo nepalensis	Oolli	Cropland/Forest	Rare, Resident
16 Woodpecker	Picus sp.	Kath Phoruwa	Forest	Rare, Resident

c. Fish Species

English Name	Scientific Name	Nepalese Name	Remarks
Nepalese Stone Roller	Garra gotyla	Buduna	Rare after the Flood
Schizothorax	Schizothorax sp.	Asala	Migratory
Barilius	Barilius endelisis	Faketa	Resident
Barana	Amphipnous chuchia	Adhobam	Resident
Mud Eel	Macrognathus culicatus	Chucha bam	Resident
Garfish	Accrossocheilus hexagonolepis	Kalle	Migratory
Nepalese Katle	Glyptothorax telchitta	Papre	Resident
-	Psilorhynchus pseudocheneis	Titae	Resident
Cat fish	Pseudecheneis sulcatus	Capra	Resident
-	Loregtansis kishouyei	Telchapre	Resident
-	Tortor ham	Sahar	Appear when raining

Table 2.12 Species of Vegetation in Namtar

(1/2)

a. Tree Species

Botanical Name	English Name	Nepalese Name	A	B	C	D	E
1 Rhododendron arboreum		Lali Gurans	+++				
2 Schima wallichai		Chilaune	+++	+++	+++		
3 Castanopsis indica		Katush	++	+++	++		
4 Pinus roxbourghii	Chir Pine	Khote sallo	++				
5 Pinus wallichii	Blue Pine	Gobre salla	+				
6 Shorea robusta		Sal	+	++++	+		+
7 Mallotus sp.		Sindure	++	++		+++	
8 Emblica officinalis		Amala			+		
9 Semecarpus anacardium		Bhalayo			+		
10 Lyonia ovalifolia	Angeri	Angeri			+++		
11 Quercus pubescens	Wool Oak	Bajha				++	
12 Bauhinia purpurea		Tanki			+		
13 Dalbergia sisoo		Sisoo				++	
14 Alnus nepalensis	Nepalese Alder	Utis					+
15 Ficus conica		Khanayo				+	+
16 Castanopsis hystrix	Chestnut	Katus				+	
17 Bombax seiba	Cotton Tree	Simal					+++
18 Michelia champaca	-	Chanp				++	
19 Ficus bengalensis		Bar					+

b. Shrub Species

Botanical Name	Nepalese Name	A	B	C	D	E
1 Osbeckia sp.	Chulsi	++	+			++
2 Mussaenda frondosa	Asare	+	++	++	+	+
3 Eupatorium adenophorum	Sano banmara		++++	++	++	++
4 Eupatorium glandulosum	Banmara				+	+
5 Desmodium sp.	Bhatte		++			
6 Achyranthus bidentata	Datiwan		+	+	++	+
7 Woodfordia fruticosa	Dhayaro		++	++	++	+
8 Maesa macrophylla	Bhagte			++		++
9 Rubus ellipticus	Ainselu			+	+	+
10 Thysanolaena maxima	Amriso			+	+	++++
11 Buddelia paniculata	Bhimsenpati			+		
12 Pilea wightii	Kamle			+	+	+
13 Artemisia vulgaris	Titepati			++	+++	+
14 Caesalpinia decapetala	Areli			+		
15 Arisaema tortuosa	Sarpa makai				+	
16 Urtica dioica	Sisnu					+
17 Solanum verbosifolium	Dhursul				+	
18 Barleria cristata	Vende kuro				++	+
19 Solanum verbosifolium	Bihee				++	
20 Polygonum sp.	Pahare jhar					++
21 Adhatoda vesica	Asuro					+
22 Jatropa curcas	Sajiwan				++	
23 Desmodium microphyllum	Bakhre					++
24 Buchneria latifolia	Adchal					+
25 Arundinaria sp.	Nigalo Bans				+	

Note: A - Bhadaure Danda

B - Jalesworegaon

C - Manahari Khola

D - Syarse Khola

E - Garduwa khola

+ - Rate of Abundance

Table 2.12 Species of Vegetation in Namtar (continued)

(2/2)

c. Herb and Grass Species

Botanical Name	Nepalese Name	A	B	C	D	E
<i>Garcinia xanthochymus</i>	Chunyel					++
<i>Oxalis hispida</i>	Chari Amilo	++	+++			+
<i>Coelogyne cristata</i>	Chandigava	+++		++		
<i>Imperata cylindrica</i>	Siru	++		+++		
<i>Ficus lacor</i>	Kharru	+		+++	++	+++
<i>Saccharum spontaneum</i>	Kans				+++	
<i>Colocasia sp.</i>	Phyakse				+++	
<i>Dioscorea deltoidea</i>	Bantarul	++			+++	+
<i>Commelia benghalensis</i>	Kane Banso		++		+	++
<i>Vitex repens</i>	Pureni		++		+	
<i>Ageratum conyzoides</i>	Gandhe		++			++
<i>Cyperus doformis</i>	Mothe			++	++	
<i>Wikstroemia sp.</i>	Salaipate				+	++
<i>Setaria ellipticus</i>	Golphukre				+	+
<i>Curcuma sp.</i>	Besare Phul				++	
<i>Stephenia hermandifolia</i>	Bantulo Pate				+	++
<i>Erograstis tenella</i>	Banso				++	++
<i>Nephrolepis tuberosa</i>	Pani Amala					
<i>Selagenella</i>	Sindure Jhar				++	++
<i>Elastostema sessile</i>	Gaultho					+
<i>Polygonum sp.</i>	Ankhe Jhar					++
<i>Rhus semialata</i>	Bhikimlo					
<i>Lichen sp.</i>	Jhyau				+++	++

Note: A - Bhadaure Danda
B - Jalesworegaon
C - Manahari Khola
D - Syarse Khola
E - Garduwa khola
+ - Rate of Abundance

Table 2.13 Demographic Characteristic of Namtar VDC

a. Population

Ward No.	No. of Total H/Hold	Male	Female	Total
1	189	549	484	1,033
2	166	462	484	946
3	161	451	406	857
4	114	437	443	880
5	150	232	190	422
6	120	438	431	869
7	124	519	510	1,029
8	136	412	454	866
9	92	558	539	1,097
Total	1,252	4,058	3,941	7,999

b. Ethnicity

Name of Group	%
Brahmin/Chhetri/Thakuri	27.8
Tamang	62.2
Kami and Damai	4.0
Chepeng	3.9
Others	2.1
Total	100.0

c. Distribution of Occupation

Occupation	%
Agriculture	90.7
Business	0.7
Services	2.5
Construction/Agri-cultural Labour	6.1
Total	100.0

d. Land Holding in Namtar

Classification	Area (ropani)	No. of H/H	%
Landless	-	56	4.2
Marginal	0-5	281	21.1
Small	6-10	334	25.1
Medium	11-20	500	37.6
Large	>21	160	12.0
Total		1,331	100.0

Table 2.14 Cropping Patterns in Namtar

(1/2)


a. Arrangement of Crops (High Altitude Area)

Initial crops	Following Crops
Maize+Millet-Fallow	Potato-Radish
Maize+Early Paddy - Fallow	Maize+Cabbage
Maize-Mustard	Maize+C/flower
Maize-Karu	Maize - peas
Maize-Buckwheat	

b. Cropping Calendar (High Altitude Area)

Crops	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Potato												
Maize												
Millet												
C/flower												
Peas												
Radish												
E/Paddy												
Mustard												
Karu												
Cabbage												

Note:  Planting Season

 Harvesting Season

(2/2)

Table 2.14 Cropping Patterns in Namtar (continued)

c. Arrangement of Crops (Low Altitude Area)

Initial crops	Following Crops
Early paddy-paddy -Wheat	Paddy-Garlic Onion
Maize-Paddy-Mstd.	C/flower
Maize-Paddy-Wheat	Cabbage
Maize-Paddy-Garlic	Tomato
	Chili

d. Cropping Calender (Low Altitude Area)

Crops	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
E/Paddy												
Paddy												
Wheat												
Mustard												
Maize												
Garlic												
Onion												
C/flower												
Chilli												
Cabbage												
Tomato												

Note:



Planting Season



Harvesting Season

Table 2.15 Agro-forestry Species Acceptable in Namtar

a. Forest Species

	English/Nepalese Name	Botanical Name
1	-/Chilaune	Schima wallichii
2	-/Painyun	Prunus cerasoides
3	Nepalese Alder/Utis	Alnus nepalensis
4	Sissoo	Dalbergia sissoo
5	Wooly Oak/Bajha	Quercus pubescens

b. Fodder Species

	English/Nepalese Name	Botanical Name
1	-/Khanyu	Ficus Semicordata
2	-/Nimaro	Ficus roxburghii
3	-/Gogan	Saurauis nepalensis
4	-/Tanki	Bauhinia purpurea
5	-/Kulmiro	Litsea monopetala
6	-/Dudhilo	Ficus nemoralis

c. Fruit Species

	English/Nepalese Name	Botanical Name
1	Per/Naspati	Pyrus communis
2	Peach/Aru	Prunus persica
3	Lemon/Nibuwa	Citrus limon
4	Lime/Kagati	Citrus aurantifolia
5	Banana	Musa paradisiaca
6	Jack Fruit	Artocarpus integrifolia
7	Mango	Magnifera indica
8	Litchi	Litchi chinensis
9	Plum/Alubakhada	Prunus domestica
10	Pomegranate/Darim	Punica grantum

Table 2.16 Use of Forest Product in Namtar

	Fodder		Fuelwood	
	kg	%	kg	%
Government Forest	49,552	29.9997	39,641	4.1
Community Forest	-	-	-	-
Own Farming Area	115,623	70	924,991	95.9
Total	165,175	99.9997	964,632	100

Table 2.17 Result of Environmental Impact Analysis for Namtar CDPP

Note: The methodology of assessment is based on the National Environmental Impact Assessment of 1993, IUCN.

a. Abbreviation for the Impact Prediction

Magnitude	Extent	Duration
H - High	L - Local	S - Short Term
M - Medium	R - Regional	M - Medium Term
N - Minor	N - National	L - Long Term

+N : Denotes positive impact
N - : Denotes negative impact

b. Result of Impact Analysis

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
1. Clearing and construction of gabion structions & dams	Removal of soil and vegetation and the materials from the site to be dumped should cause some impact to the near-by area	N -	L -	S -	Select spoil bank for disposal of top soil and other materials in the area causing no impact to the natural and socio-economic environment
For construction and reclamation, works, riverbed and gully have to be cleared and water is diverted	Water diverted to other part causes further riverbed scouring	N -	L -	S -	Work during dry period so that less water have to be diverted and for safety
2. Aggregate for construction of gabions, check dams	A large quantity of aggregate available in the riverbed	L -	L -	+ L	Use of available stone from the area and excavate from nearby without putting much pressure at one place only.
3. Access Road Construction works and Up-grading of the Rural Road	Construction works disturb the aquatic life and bird species residing in the riverside	N -	L -	L -	
	During construction period water will be polluted with the construction materials	N -	L -	S -	
5. Vegetation	No direct adverse impact as there is no such trees and plants that should be removed	N -	L -	S -	
	Indirect impact due to the pressure on the forest by people from outside for work during the construction period	N -	L -	S -	Employment of the local people for the construction works will cause no disturbances to the natural environment
6. Wildlife	Not much damage to wildlife as there are very few wildlife	N -	L -	S -	Employment should be conducted locally, or encourage participation of the local residents
	Territory of fishes are bisected	H -	R -	L -	

Table 2.17 Result of Environmental Impact Analysis for Namtar CDDP (continued)

(2/2)

b. Result of Impact Analysis

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
7. Camps for workers group	Construction camp for a large group of people may cause environmental and social problems	M -	L -	S -	Encourage people to produce and use the compost which is manufactured locally with high organic contents
8. Agricultural Programme	Use of chemical fertilizers in excessive amount for better vegetable production may cause health hazard for people and extinction of some plants, insects which can be used as biological control	M -	L -	S -	
9. Afforestation Programme	Soil erosion control with ground cover as well as trees in the open hill slopes	+ M	L -	+ L	Beneficial for the community as well as to the natural environment
	There is a local interest on planting trees	+ N	+ L	+ L	Careful planning on the appropriate organization of the local residents is essential not to cause troubles to their agricultural activities
10. Impact on population	Influx of jobseekers and small entrepreneurs, in-migration, shift within the area, haphazard settlement around the roadside	+ M	+ L	+ L	

Table 2.18 Demographic Characteristic of Agra VDC

a. Population Distribution

Ward No.	No. of Total H/Hold	Male	Female	Total
1	189	519	491	1,010
2	166	444	442	886
3	161	441	427	868
4	114	341	322	663
5	150	425	469	894
6	120	330	344	674
7	124	326	342	668
8	136	355	317	672
9	92	248	256	504
Total	1,252	3,429	3,410	6,839

b. Ethnicity

Name of Group	No. of Pop.	%
Brahmin/Chhetri/Thakuri	2,162	31.6
Newar	1	0.0
Tamang	4,105	60.0
Kami and Damai	271	4.0
Magar	164	2.4
Gurung	109	1.6
Others	4	0.1
Those from Terai	23	0.3
Total	6,839	100.0

c. Distribution of Occupation

Occupation	%
Agriculture	98.4
Business	1.0
Services	-
Construction/Agri-cultural Labour	0.6
Total	100.0

d. Land Holding

Classification	Area (ropani)	No. of H/H	%
Landless	-	-	-
Marginal	0-5	187	14.9
Small	6-10	295	23.6
Medium	11-20	446	35.6
Large	>21	324	25.9
Total		1,252	100.0

Table 2.19 Land Use Patterns of Agra VDC

Area	ha	%
Forest	928	43.4
Cropland		
Upland(Bari)	743	34.7
Lowland(Khet)	109	5.1
Pasture	360	16.8
Total	2140	100.0

Table 2.20 Annual Use of Forest Product in Agra VDC

Forest Product	Govt. Forest	Private Land	Total
Fuelwood (kg)	8,800	590	9,390
Fodder (kg)	14,150	9,430	23,580

Table 2.21 Cropping Patterns in Agra VDC

a. Arrangement of Crops for Lowland(Khet)

Initial crops	Following Crops
Paddy/Puse - Wheat Paddy	- Fallow

b. Arrangement of Crops for Upland(Bari)

Initial crops	Following Crops
Maize/Potato Maize/Soybean Maize/Millet Maize Barley	-Cauliflower/Peas/Radish -Fallow -Fallow

c. Cropping Calendar

Crops	Jan	Feb.	Mar	Apr.	May	June	July	Aug.	Sep	Oct	Nov	Dec
Paddy												
Pulse												
Potato												
Maize												
Millet												
Wheat												
Barley												
Soybean												
Cauliflower												
Cabbage												
Peas												
Radish												

Note:



Planting Season



Harvesting Season

Table 2.22 Result of Environmental Impact Analysis for Chisapani CDDP

(1/2)

Note: The methodology of assessment is based on the National Environmental Impact Assessment of 1993, IUCN.

a. Abbreviation of the Impact Prediction

Magnitude	Extent	Duration
H - High	L - Local	S - Short Term
M - Medium	R - Regional	M - Medium Term
N - Minor	N - National	L - Long Term

+N : Denotes positive impact
N - : Denotes negative impact

b. Result of Impact Analysis

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
1. Clearing and construction of gabion structures & check dams	Removal of soil and vegetation and the materials from the site to be dumped should cause some impact to the near-by area	N -	L -	S -	Select spoil bank for disposal of top soil and other materials in the area causing no impact to the natural and socio-economic environment
	For construction, the riverbed, gully have to be cleared and water is diverted	N -	L -	S -	Work during dry period so that less water have to be diverted and for safety
2. Aggregate for construction of gabions and check dams	A large quantity of stone are available in Phedigaon	L -	L -	+ L	Use of available stone from the area and excavate from nearby without putting much pressure at one place only.
	Construction aggregate is proposed to transport to Chisapani to use for the construction works	N -	L -	+ L	Debris accumulated by the 1993 Disaster in Palung Bridge near Thana Bazaar can be utilised for the construction of check dams and gabions in Phedigaon and Chisapani.
3. Access road/dike road	River training works lead to the construction of dike road	N -	L -	+ L	
	The dike road disturbs the aquatic life and bird species residing in the riverside	N -	L -	L -	
	Dike road construction leads to reclamation of farm land covered by debris	N -	L -	L -	There is positive impact with the construction as many farm land could be reclaimed for farming
4. Water quality	During construction period water will be polluted with the construction materials	N -	L -	S -	Avoid using water for drinking during the construction period

Table 2.22 Result of Environmental Impact Analysis for Chisapani CDDP (continued)

(2/2)

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
5. Vegetation	No direct adverse impact as there is no such trees and plants that should be removed except for the growing Alnus trees in Dhungakate khola riverbed	N -	L -	S -	Some private land should be left without reclamation as the owner(s) desire to keep Alnus tree seedlings growing in the area for income by cutting and selling them.
6. Wildlife	Not much damage to wildlife as there are very few wildlife	N -	L -	S -	Employment of the local people for the construction works will cause no disturbances to the natural environment
7. Camps for construction workers	Construction camp for a large group of people may cause environmental and social problems	M -	L -	S -	Employment should be conducted locally, or encourage participation of the local residents
8. Agricultural Programme	Use of chemical fertilizers in excessive amount for better vegetable production may cause health hazard for the local residents	M -	L -	S -	Encourage people to produce and use the compost which is manufactured locally with high organic contents
9. Afforestation Programme	Soil erosion control with ground cover as well as trees in the open hill slopes	+ M	L -	+ L	Beneficial for the community as well as to the natural environment
	There is a local interest on planting mulberry which enable to develop sericulture later for income generation	+ N	+ L	+ L	
10. Impact on population	Organization of the local residents for evacuation system may function to cause further disputes.	+ M	+ L	+ L	Careful planning on the appropriate organization of the local residents is essential not to cause troubles to their agricultural activities

Table 2.23 Slope Gradient of the Kulekhani Watershed Area

Classification	Description of Slope	Slope Angle
i	Very Steep	> 40
ii	Steep	25-40
iii	Moderate	16-25
iv	Gentle	4-16
v	Flat	<4

Table 2.24 Rainfall Patterns in Kulekhani Reservoir
at Markhu Weather Station

Year	Annual Rainfall	Average Rainfall		Max. Rainfall of the Year	
		Jun.-Sep.	%	mm	Date
1981	1028	746	72.5	190	29-Sep
1982	1115	876	78.5	76	6-Nov
1983	1462	998	68	144	17-Jul
1984	1498	1238	82.6	107	17-Sep
1985	1928	1308	67.8	121	11-Nov
1986	1758	1296	73.7	89	29-Jun
1987	1503	1097	73	110	20-Oct
1988	1345	955	71	103	26-Dec
1989	1143	756	66	76.1	7-Jun
1990	1455	1061	73	85.5	27-Aug

Table 2.25 List of Fish Species in Kulekhani Reservoir

a. Original Fish Species

	English Name	Scientific Name	Nepalese Name	Remarks
1	-	Acrossocheilus hexagonolepis	Karanga	Resident, all year
2	Nepalese katle	Acrossocheilus hexagonolepis	Katle	Resident
3	Schizothorax	Schizothorax sp.	Asala	Resident
4	-	Torputitora sp.	Sahar	Disappering
5	-	Chelwa sp.	Chelwa	Resident
6	Barbus	Barbus sp.	Tikia	Rare

b. Introduced Species

	English Name	Scientific Name	Nepalese Name
1	Big-head Carp	Aristichthys nobilis	-
2	Common Carp	Cyprinus carpio	-
3	Silver Carp	Hypophthalmichthys	-
4	Grass Carp	Ctenopharyngodon idella	-
5	Rohu	Labeo rohita	-
6	Mrigala	Cirrhina mrigala	-
7	Bhakura	Catla catla	-

Table 2.26 Demographic Characteristics in the Kulekhani Watershed Area

a. Population

Ward No.	No. of Total H/H	Male Population	Female Population	Total Population	%
Palung	977	3,207	3,247	6,454	21.7
Daman	1,245	3,276	3,562	6,838	23.0
Bajrabarahi	1,371	3,506	3,362	6,868	23.1
Chitlang	1,136	3,212	3,230	6,442	21.7
Markhu	581	1,594	1,543	3,137	10.6
Total	5,310	3,207	3,247	29,732	100.0

b. Ethnicity

Caste/Ethnic Group	Percentage
Brahmin/Chhetri/Thakuri	31.5
Newar	32.2
Tamang	26.9
Magar	2.2
Gurung	1.0
Occupational Caste*	2.9
Others	3.3
Total	100.0

Note: * - Composed of Kami, Damai & Sharki.

c. Occupation

VDC	Agriculture	Business	Service	Labour	%
Palung	89.9	2.0	5.1	3.0	100.0
Daman	75.0	1.0	5.0	19.0	100.0
Bajrabarahi	87.0	2.0	1.0	10.0	100.0
Chitlang	93.0	1.1	3.7	2.2	100.0
Markhu	89.7	0.8	6.1	3.4	100.0
Total	86.9	1.4	4.2	7.5	100.0

d. Average Land Holding in the Kulekhani Watershed Area

Classification	Land (Ropani)	Palung	Daman	B/barahi	Markhu	Chitlang	Total	%
Landless	-	60	43	40	9	-	152	3.0
Marginal	0-5	339	101	354	175	319	1,288	25.2
Small	6-10	257	602	400	173	393	1,825	35.7
Medium	11-20	245	295	150	179	306	1,175	23.0
Large	>20	76	285	150	45	118	674	13.2
Total		977	1,326	1,094	581	1,136	5,114	100.0

Table 2.27 Land Area by Type in Kulekhani Watershed Area (unit:ha)

VDC	Forest	Farming Area			Total
		Upland	Lowland	Total	
Palung	738.0	n.a.	n.a.	1,132.0	1,870.0
Daman	714.3	301.1	55.0	356.1	1,070.4
Bajrabarahi	1,090.8	1,295.1	224.6	1,519.7	2,610.5
Markhu	942.0	n.a.	n.a.	673.0	1,615.0
Chitlang	1,478.2	460.2	173.3	533.5	2,011.7
Total	4,963.3	-	-	4,214.3	9,177.6

Table 2.28 General Cropping Patterns in the Kulekhani Watershed Area

a. Arrangement of Crops (Rainfed Area)

Initial crops	Following Crops
Maize + Potato	- Cauliflower
Maize + Potato	- Cabbage
Potato	- Cauliflower
Potato	- Cabbage
Maize+Millet	- Fallow
Maize	- Radish

b. Arrangement of Crops (Irrigated Area)

Initial crops	Following Crops
Potato	- Paddy
Potato-Paddy	- Cauliflower
Potato-Paddy	- Cabbage
Potato-Paddy	- Carrot
Paddy	- Wheat

c. Cropping Calendar

Crops	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Potato												
Maize												
Cauliflower												
Cabbage												
Millet												
Radish												
Paddy												
Wheat												
Carrot												

Note:



Planting Season



Harvesting Season

Table 2.29 Use of Forest Product in the Kulekhani Watershed Area

(Unit:kg)

Type & Source of Forest Product	VDC					Total
	Palung	Daman	B/barahi	Markhu	Chitlang	
Fuelwood	Govt.Forest	-	147,690	-	372,750	1,147,240
	Com.Forest	4,251,487	2,658,420	4,313,925	372,750	16,923,982
	Own Land	313,400	223,763	239,663	2,236,500	3,161,016
	Total	6,267,600	4,475,250	4,553,588	2,982,000	21,232,238
Fodder	Govt.Forest	-	24,615	39,330	2,973,200	4,016,445
	Com.Forest	5,668,650	443,070	255,645	2,073,200	9,419,865
	Own Land	5,875,900	298,350	98,325	12,439,200	18,736,390
	Total	7,834,500	5,967,000	393,300	17,485,600	32,172,700

Table 2.30 Rainfall Patterns in Dhunibesi, Dhading District

Year	Annual Rainfall		%	Max. Rainfall	
	mm	Jun.-Sep.		mm	Date
1981	1,142	977.0	85.6	128.0	29 Sep.
1982	1,133	939.0	82.9	85.0	27 Aug.
1983	1,714	1,158.0	67.6	212.0	6 May.
1984	1,308	1,033.0	79.0	66.0	8 Jul.
1985	2,131	1,658.0	77.8	70.0	28 Jul.
1986	1,758	1,370.0	77.9	109.0	27 Jul.
1987	1,304	996.0	76.4	102.3	20 Oct.
1988	1,717	1,324.0	77.1	124.7	26 Aug.
1989	1,023	847.0	82.8	80.6	26 Aug.
1990	1,674	1,429.0	85.4	86.5	27 Aug.

Table 2.31 Demographic Characteristics in the Mahadev Besi Bridge Area

a. Population

VDC Ward	No. of Total H/H	Male Population	Female Population	Total Population	Size of Household
Thakre					
1	110	279	301	580	5.3
2	123	374	348	722	5.9
3	234	701	681	1,382	5.9
4	184	492	456	948	5.2
5	97	252	239	491	5.1
6	62	172	152	324	5.2
7	110	275	266	541	4.9
8	140	371	349	720	5.1
9	189	580	554	1,134	6.0
Total	1,249	3,496	3,346	6,842	5.5
Bhumesthan					
1	128	323	337	660	5.2
2	152	451	454	905	6.0
3	168	490	457	947	5.6
4	185	639	465	1,104	6.0
5	65	240	257	497	7.6
6	150	445	445	890	5.9
7	175	525	507	1,032	5.9
8	186	514	515	1,029	5.5
9	172	453	461	914	5.3
Total	1,381	4,080	3,898	7,978	5.8
Tasarpu					
1	86	266	220	486	5.7
2	99	287	261	548	5.5
3	55	153	159	312	5.7
4	80	184	215	399	5.0
5	56	168	189	357	6.4
6	61	175	155	330	5.4
7	90	284	241	525	5.8
8	116	299	306	605	5.2
9	144	392	367	759	5.3
Total	787	2,208	2,113	4,321	5.5
Grand Total	3,417	9,784	9,357	19,141	5.6

Table 2.31 Demographic Characteristics in the Mahadev Besi Bridge Area (continued)

b. Ethnicity

Caste/Ethnic Group	Percentage
Brhamin/Chhetri/Thakuri	45.3
Newar	1.5
Tamang	37.1
Magar	3.4
Gurung	1.5
Occupational Caste*	7.9
Others	3.3
Total	100.0

Note: * - Composed of Kami, Damai & Sharki.

c. Occupation

Occupation	Bhumesthan	Tasarpu	Thakre	Percentage
Agriculture	94.2	72.2	67.0	77.8
Business	0.5	1.2	3.0	1.6
Services	0.8	1.6	5.0	2.5
Wage Work	4.5	25.0	25.0	18.2
Total	100.0	100.0	100.0	100.0

d. Land Holding in the Mahadev Besi Bridge Area

Classification	Holding (ropani)	VDC			Total H/holds	%
		Bhumesthan	Tasarpu	Thakre		
Landless	-	70	8	9	87	2.5
Marginal	0-5	210	118	125	453	13.2
Small	6-10	350	197	250	797	23.2
Medium	11-20	420	275	312	1,007	29.3
Large	>20	351	189	553	1,093	31.8
Total		1,401	787	1,249	3,437	100.0

Table 2.32 Result of Environmental Impact Analysis for Mahadev Besi Bridge IDPP

(1/2)

Note: The methodology of assessment is based on the National Environmental Impact Assessment of 1993, IUCN.

a. Abbreviation of the Impact Prediction

Magnitude	Extent	Duration	
H - High	L - Local	S - Short Term	+N : Denotes positive impact
M - Medium	R - Regional	M - Medium Term	N - : Denotes negative impact
N - Minor	N - National	L - Long Term	

b. Result of Impact Analysis

Project Components	Possible Impacts	Impact Prediction			Mitigation Measure
		Magnitude	Extent	Duration	
1. Clearing and construction of gabion structures & ground sills	Removal of soil and vegetation and the materials from the site to be dumped should cause some impact to the near-by area	N -	L -	S -	Select spoil bank for disposal of top soil and other materials in the area causing no impact to the natural and socio-economic environment
For construction, the riverbed, gully have to be cleared and water is diverted	Water diverted to other part causes further riverbed scouring	N -	L -	S -	Work during dry period so that less water have to be diverted and for safety
2. Aggregate for construction of gabions and ground sills	A large quantity of stone are available in Phedigaon	L -	L -	+ L	Use of available stone from the area and excavate from nearby without putting much pressure at one place only.
	Construction aggregate is proposed to transport to Mahadev Besi Bridge Area to use for the construction works	N -	L -	+ L	Debris accumulated by the 1993 Disaster in Palung Bridge near Thana Bazaar can be utilised for the construction of ground sills and gabions in Phedigaon and Mahadev Besi Bridge Area.
3. Access road/dike road	River training works lead to the construction of dike road	N -	L -	+ L	
	The dike road disturbs the aquatic life and bird species residing in the riverside	N -	L -	L -	
	Dike road construction leads to reclamation of farm land covered by debris	N -	L -	L -	There is positive impact with the construction as many farm land could be reclaimed for farming
4. Water quality	During construction period water will be polluted with the construction materials	N -	L -	S -	Avoid using water for drinking during the construction period

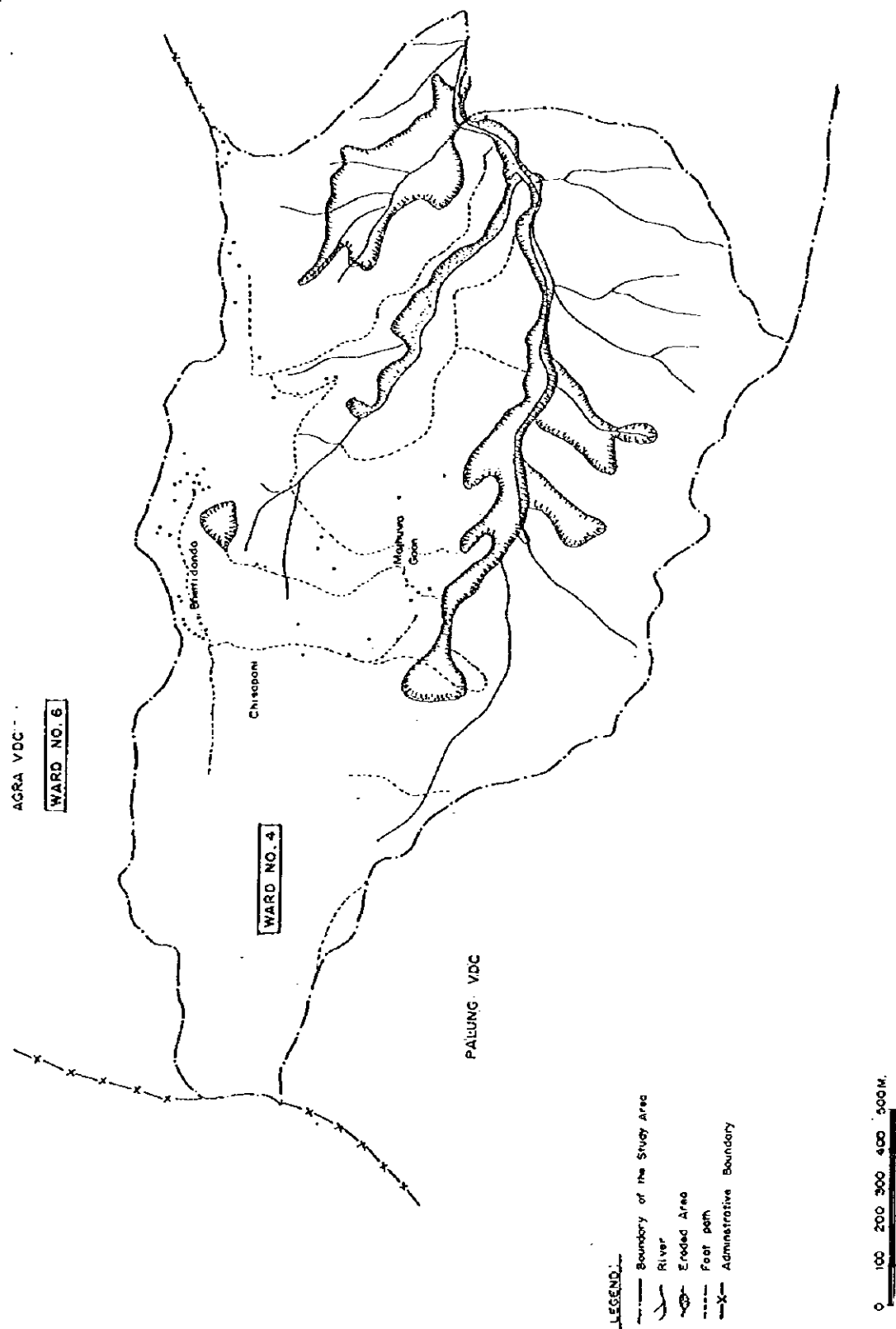


Fig. 2.3
Study Area - Chisapani

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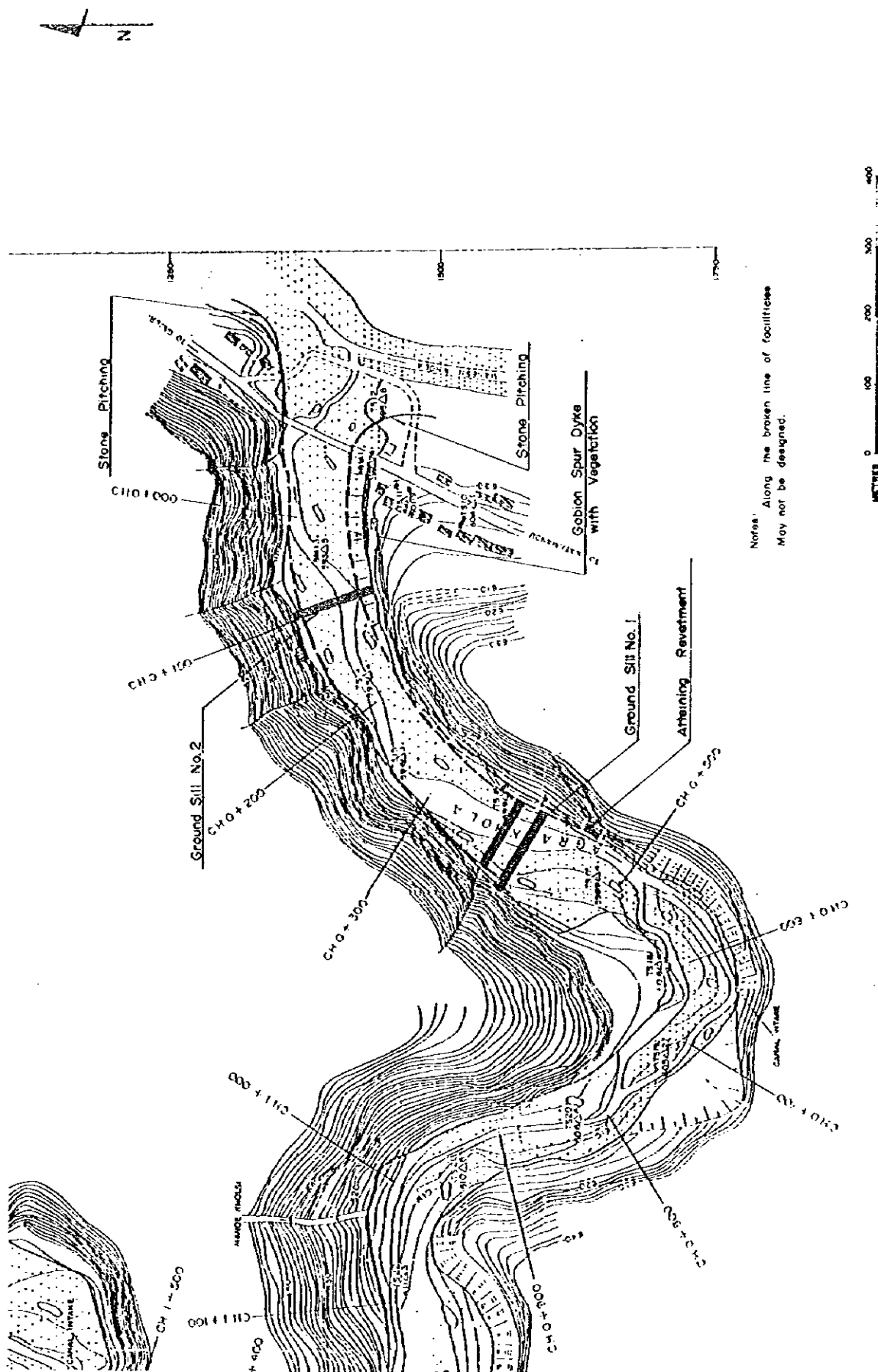


Fig. 2.5
Proposed Structures for
Mahadev Besi Bridge

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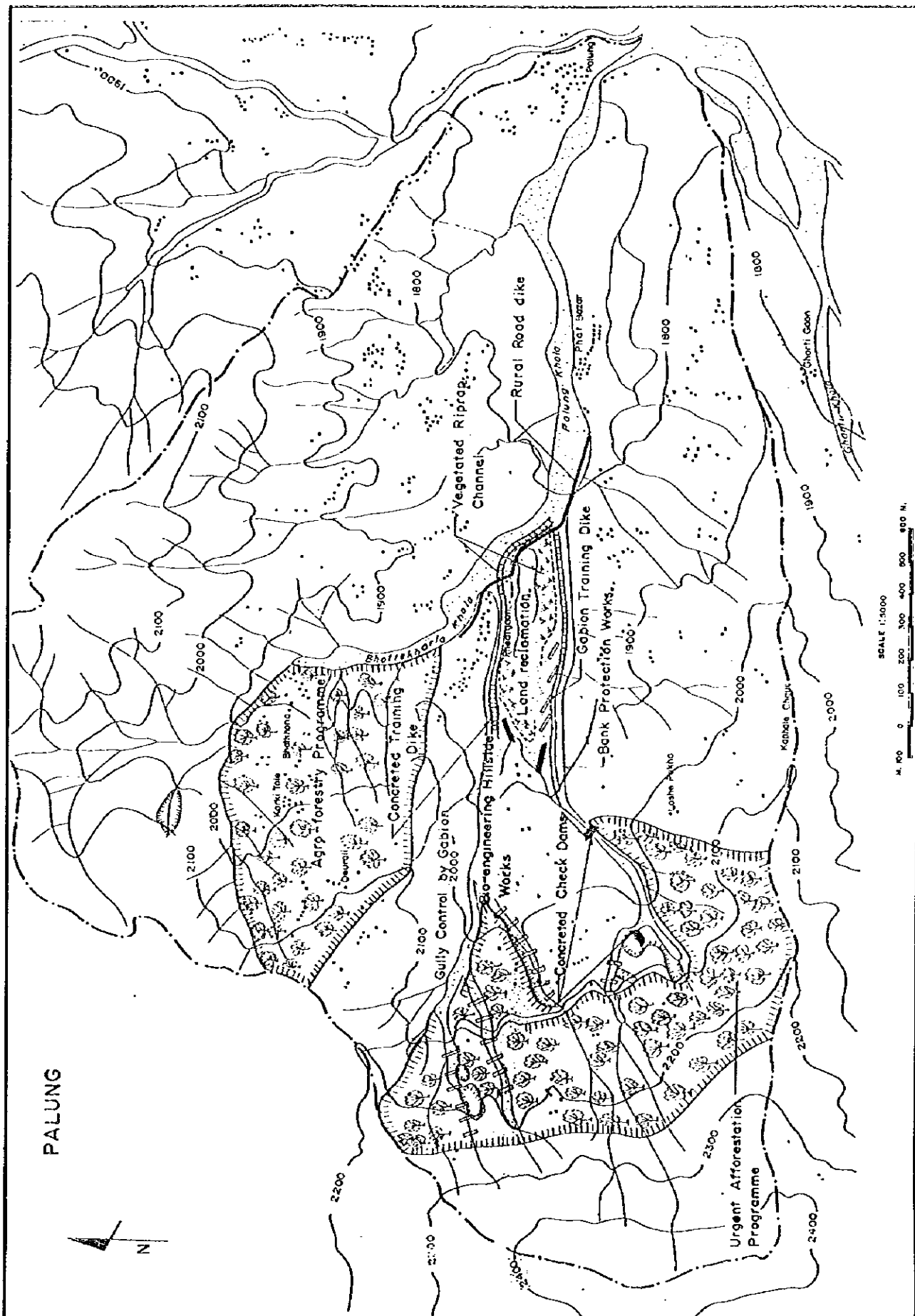
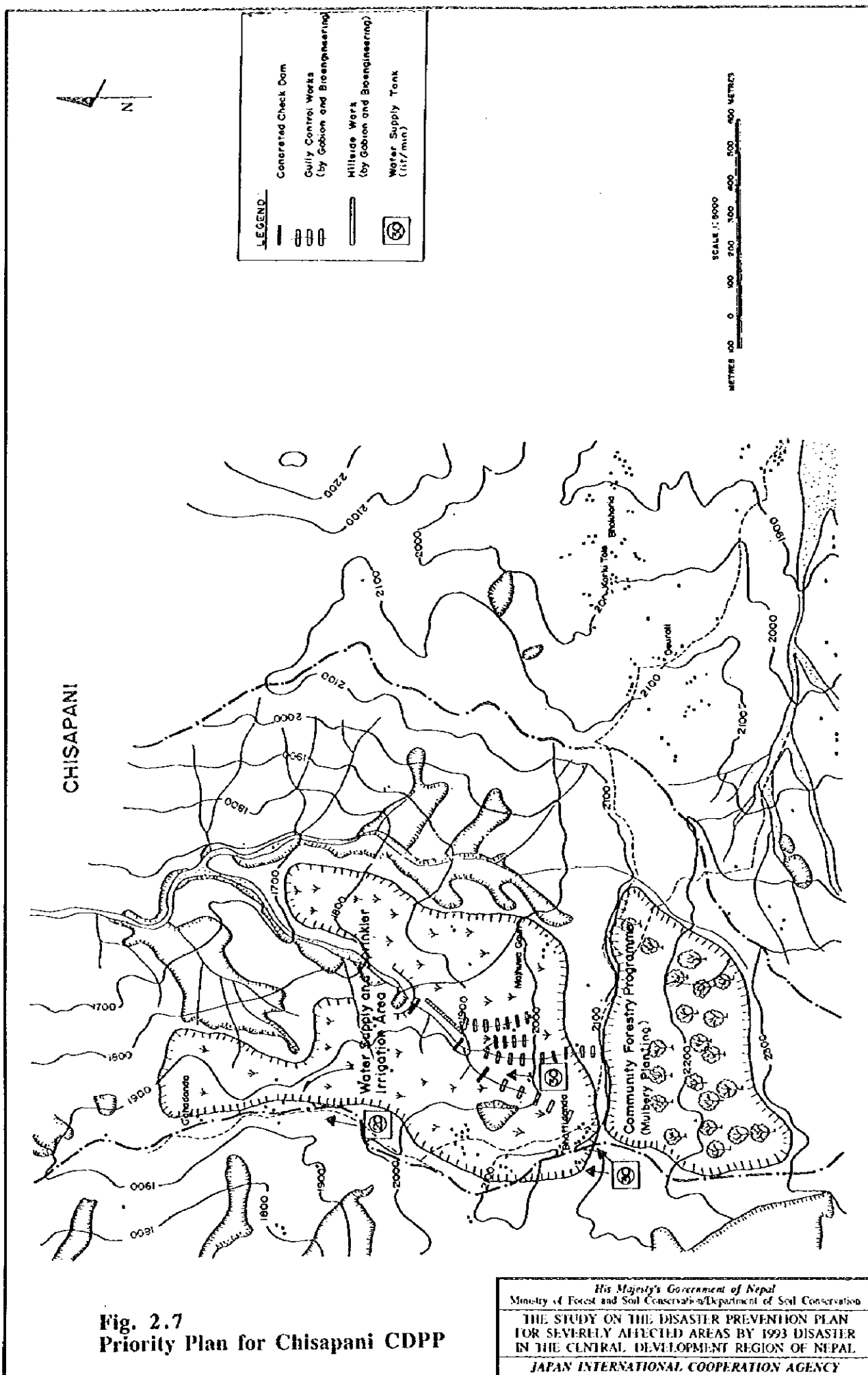
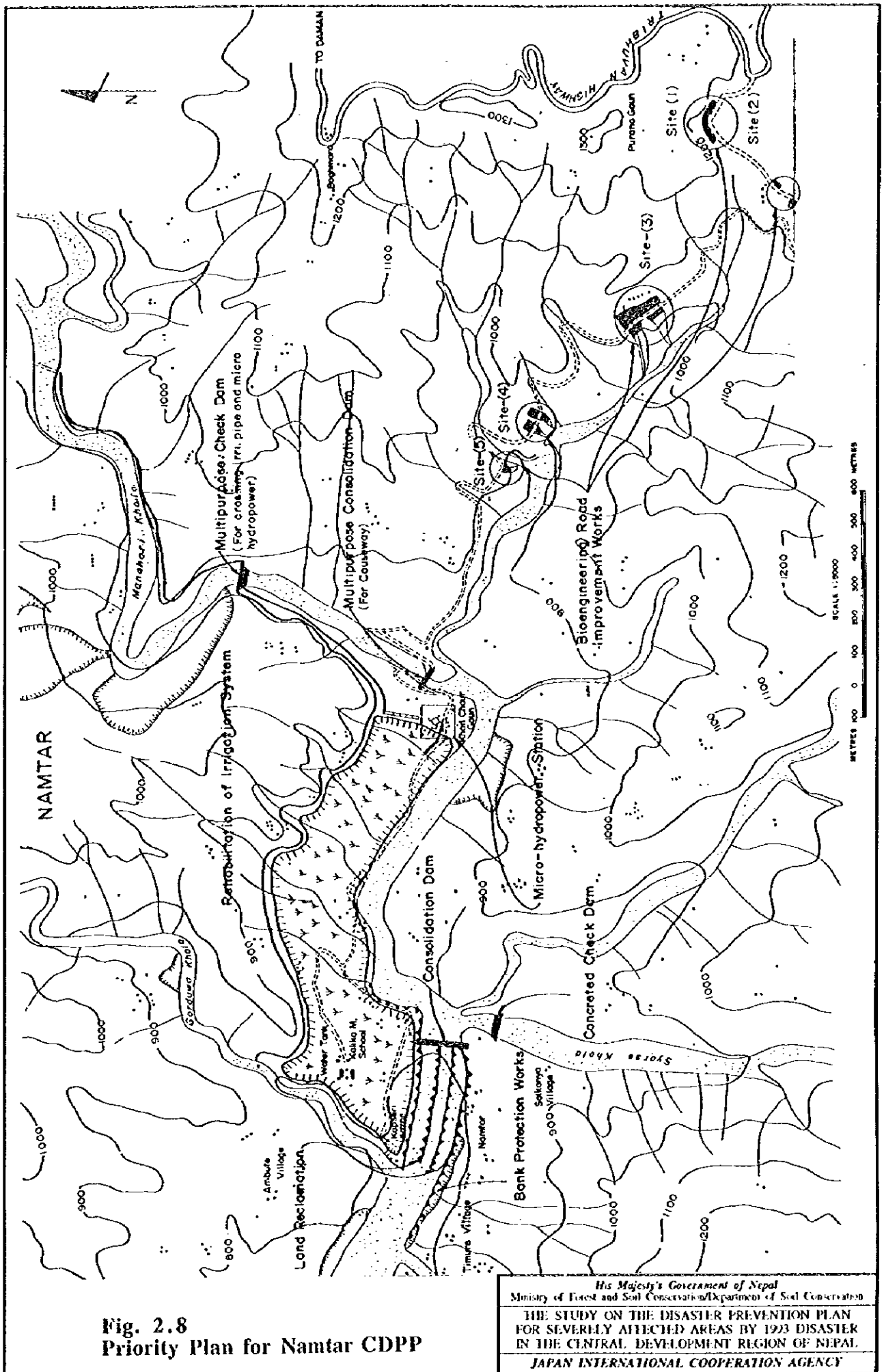











Fig. 2.6
Priority Plan for
Phedigaon/Phatbazar CDPP

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	VDC or municipality boundary
	Road
	Foot track
11587	Spot height
	Temple
	House
	River
	Lake
	Ward Boundary
F	Forest.
C	Cultivated Land
	Question Mark

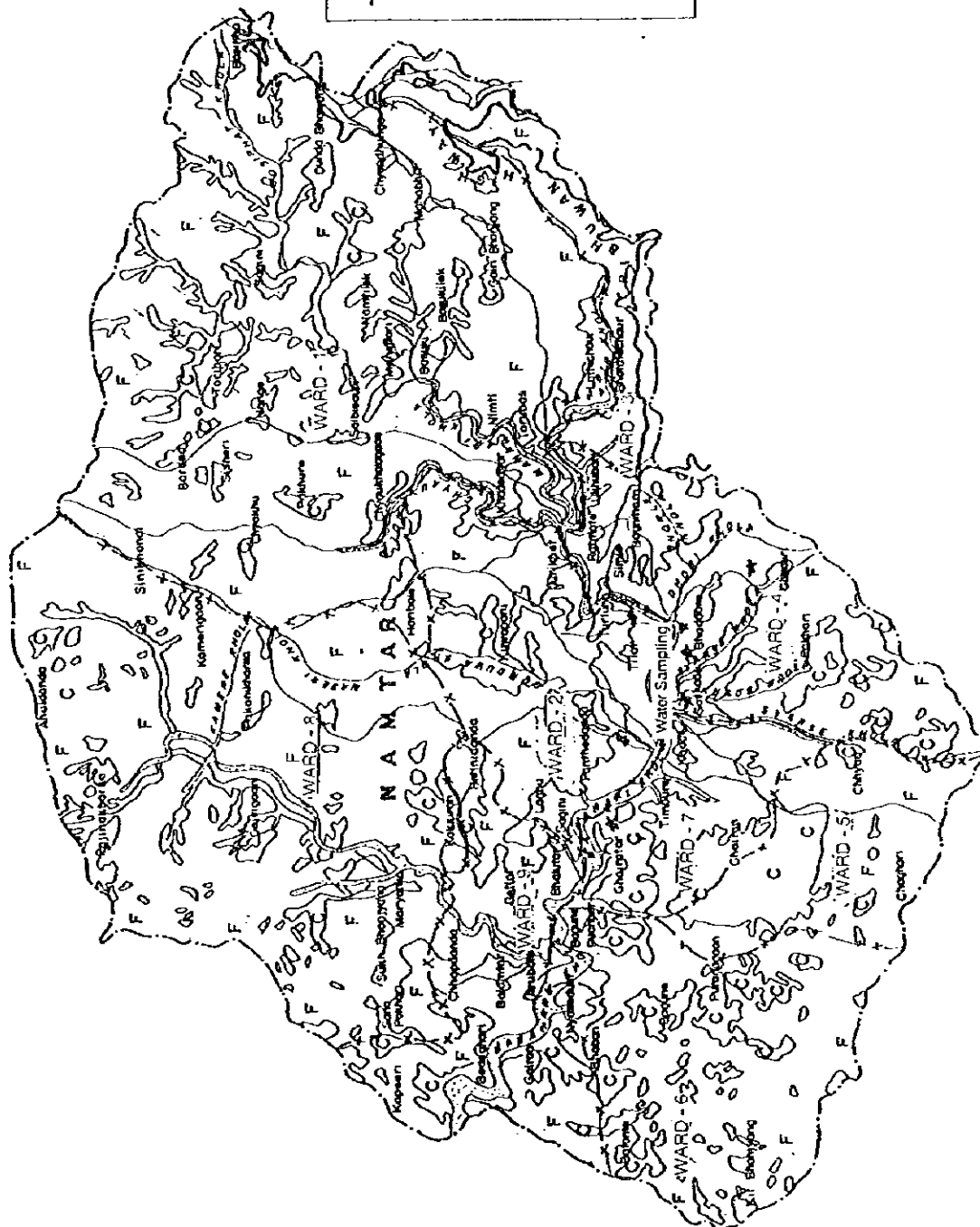
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NAMTAR VDC



LEGEND:	
—	VDC or municipality boundary
—	Road
—	Foot track
1587	Spot height
△	Temple
••	House
—	River
—	Lake
F	Forest
C	Cultivation
—	Ward Boundary
*	Quarantine Duty

Fig. 2.11
Land Use Patterns in Namtar VDC

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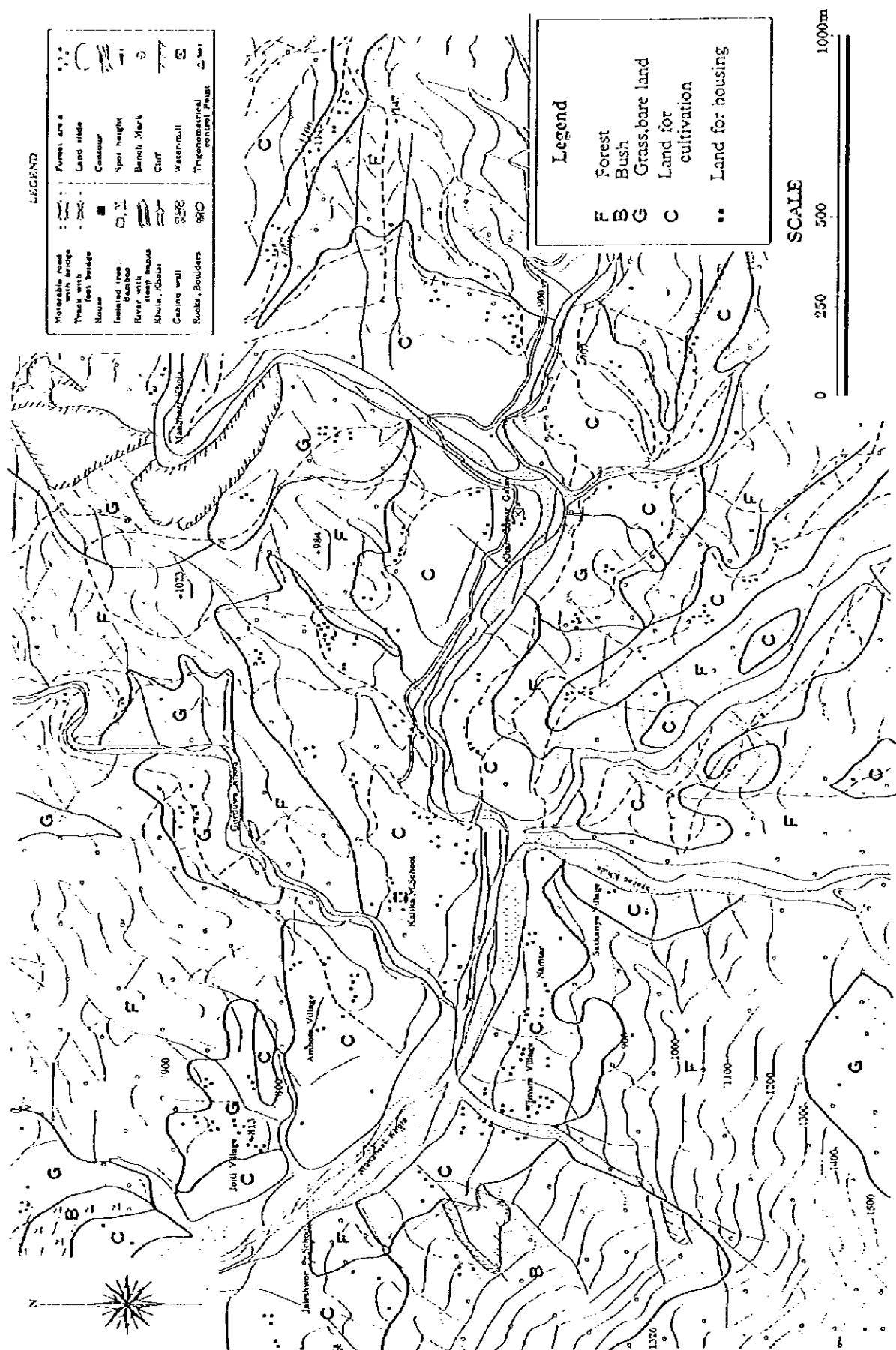


Fig. 2.12
Detailed Land Use in Namtar

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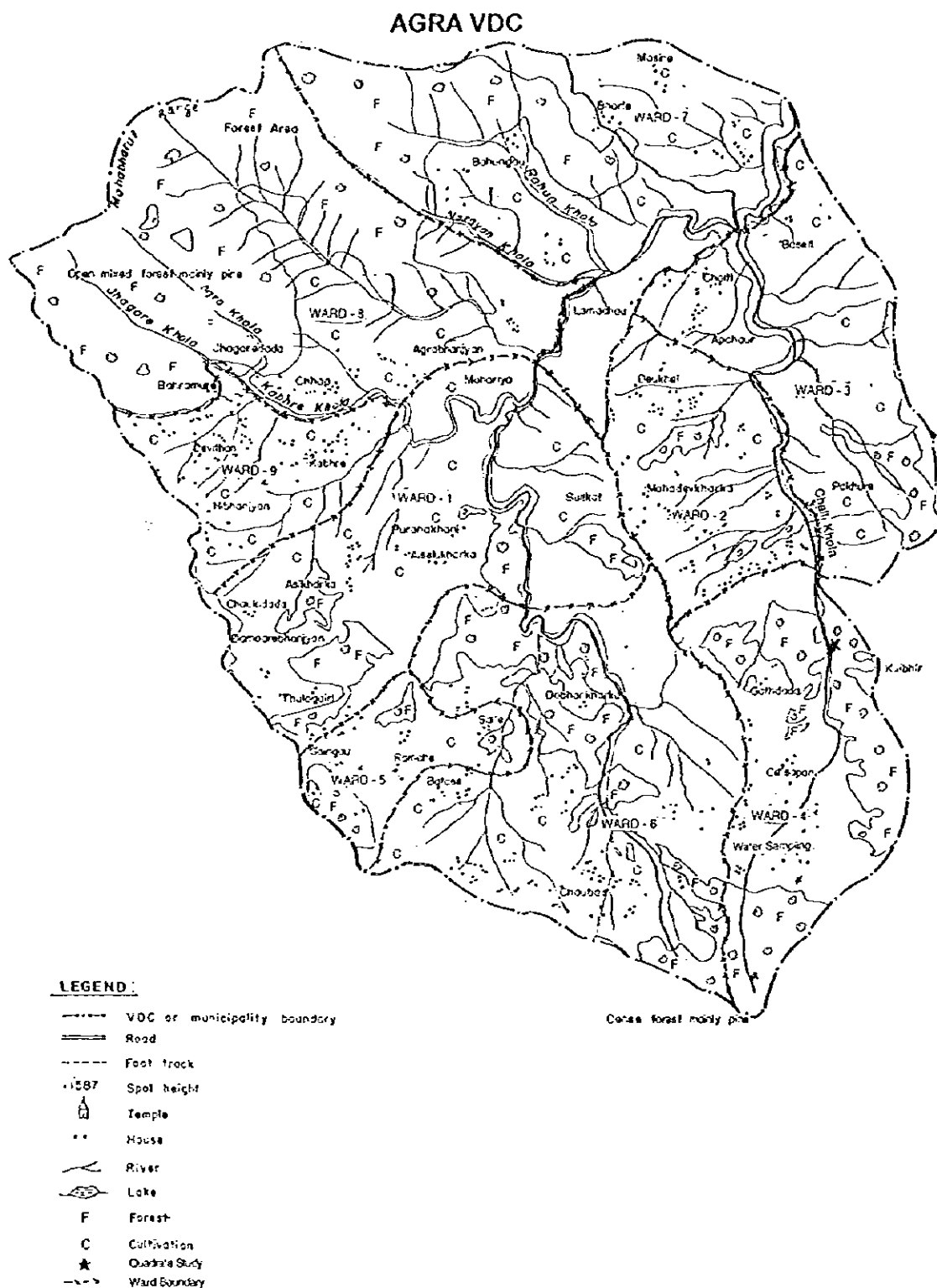
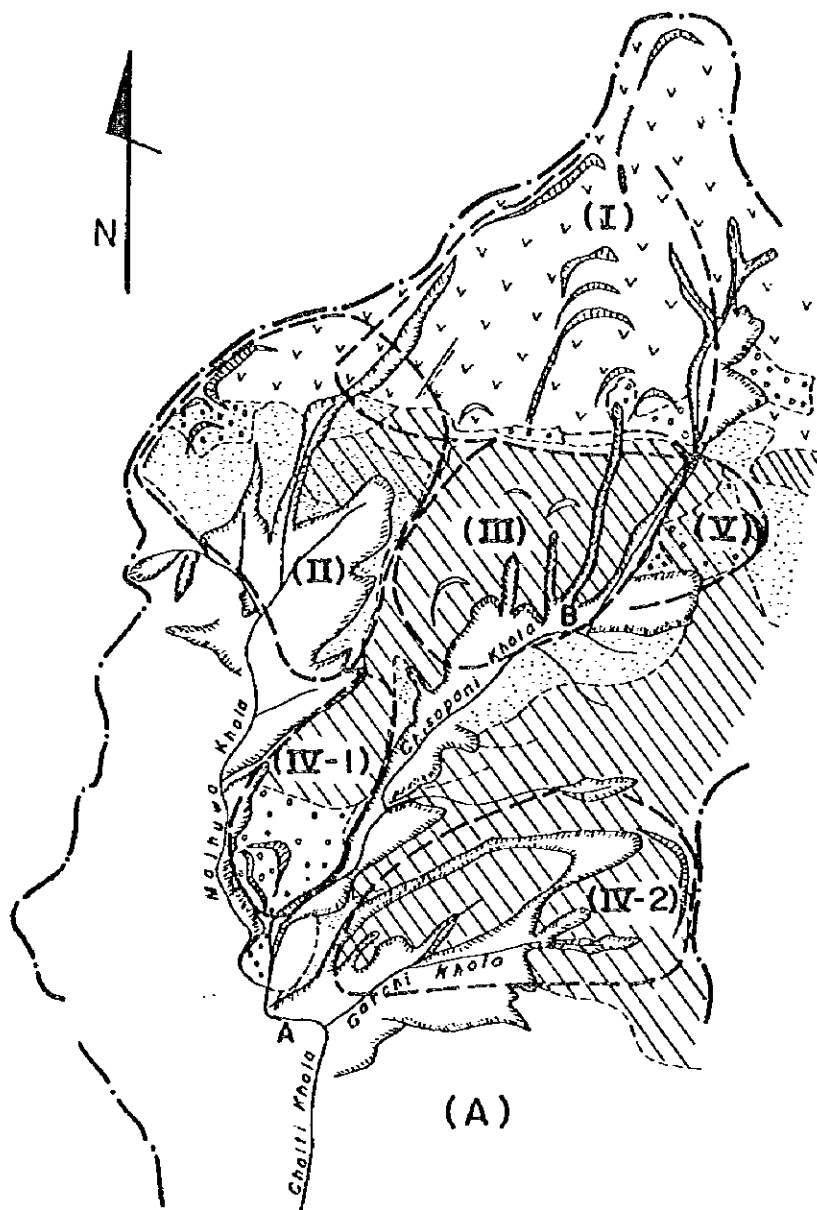


Fig. 2.13
Land Use Patterns in Agra VDC

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Used photo : L-4 , 9401 - 23 ~ 24
Scale = 1:20000 enlargement
(24 March , 1994)



Used photo
Scale = 1:42,000
(November , 1992)

(B)

LEGEND

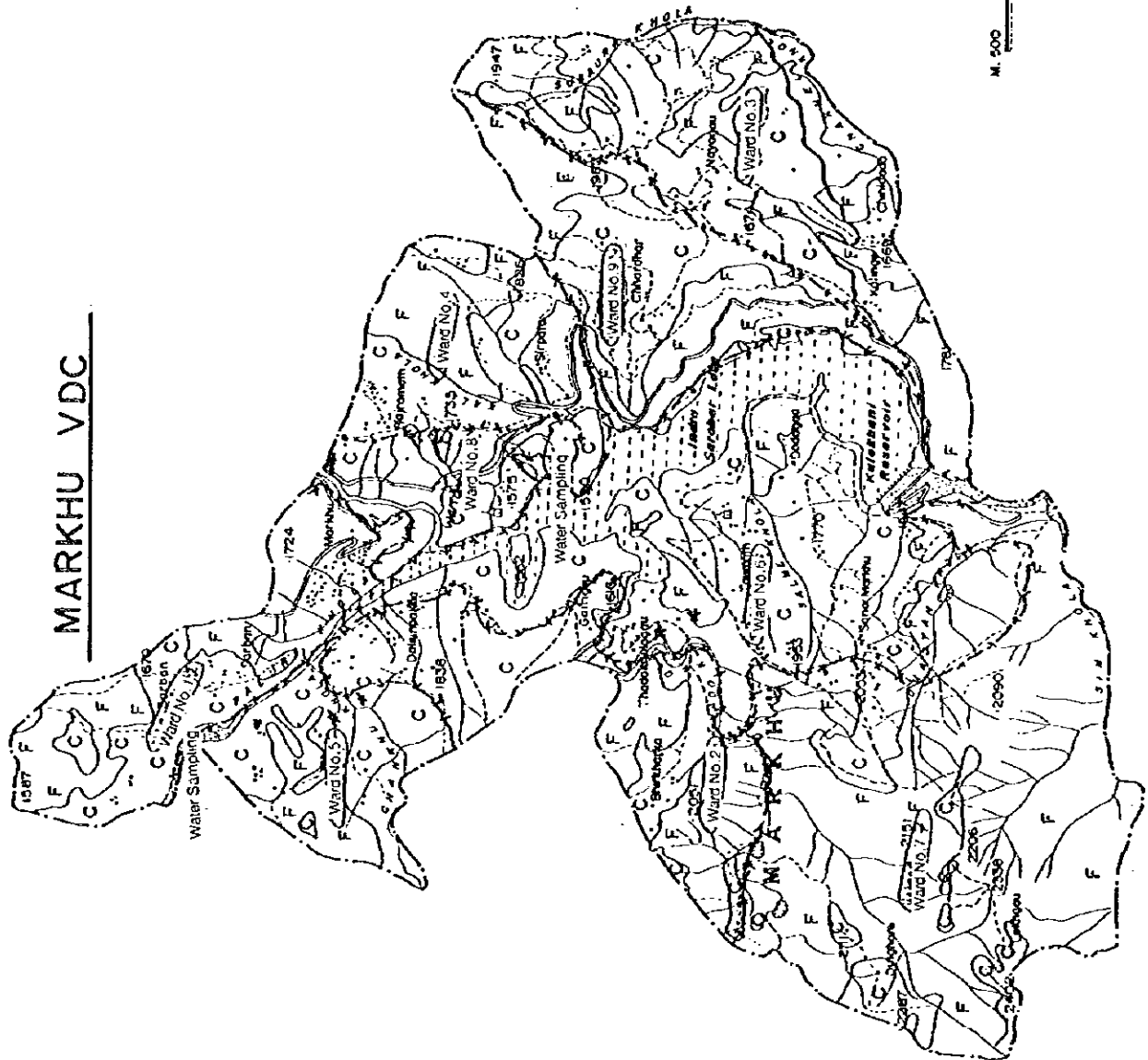
- forest (copse)
- shrub forest (shrubbery)
- thin shrubbery mixed with bush
- bush, barren land
- farmland
- farmland shifted to barren land due to surface deformation (Not use)
- thin shrubbery shifted from farmland due to surface deformation
- divided area
- landslide due to 1993 disaster
- head scarp of landslides
- ridge
- valley

Fig. 2.14
Detailed Land Use in Chisapani

The Ministry of International Cooperation
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MARKHU VDC



LEGEND	
—	VDC or municipality boundary
—	Road
—	Foot track
—	Spot height
—	Temple
—	House
—	River
—	Lake
—	Forest
—	Cultivation
—	Ward Boundary
—	Quadrat Study

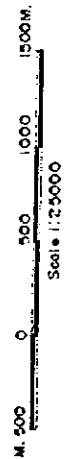


Fig. 2.15
Land Use Map with Ward
Boundary and Settlement Pattern
of Markhu VDC

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KULEKHANI RESERVOIR

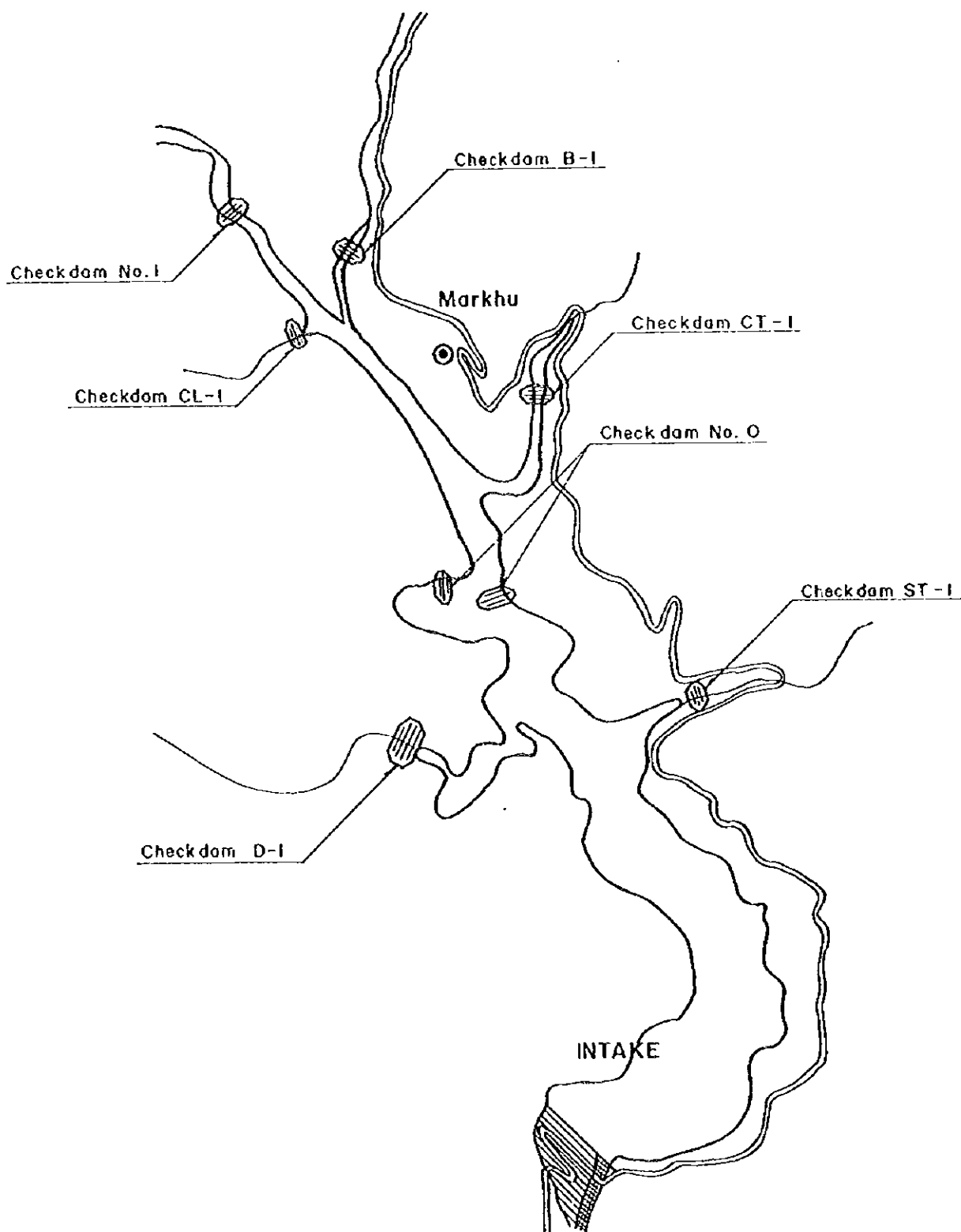


Fig. 2.16
Location Map of Proposed Check Dam Site
in and around Reservoir

<p style="text-align: center;"><i>His Majesty's Government of Nepal</i> Ministry of Forest and Soil Conservation/Department of Soil Conservation</p> <p style="text-align: center;">THE STUDY ON THE DISASTER PREVENTION PLAN FOR SEVERELY AFFECTED AREAS BY 1993 DISASTER IN THE CENTRAL DEVELOPMENT REGION OF NEPAL</p> <p style="text-align: center;">JAPAN INTERNATIONAL COOPERATION AGENCY</p>
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