CHAPTER 8

ENVIRONMENTAL IMPACT ASSESSMENT

8. ENVIRONMENTAL IMPACT ASSESSMENT

8.1 Phedigaon / Phatbazar CDPP

Table 8.1.1 shows overall rating of the Environmental Impact Assessment of the Phedigaon/Phatbazar CDPP. The results of EIA are as follows:

8.1.1 Physico-chemical Environment

(1) Topography

Structural works on the rivers around Phedigaon will permanently change the 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 will not take place or only limited changes should take place upon completion of the construction works.

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

Construction aggregate will be obtained from the present river bed. The present river bed area is, as a matter of fact, the remnant of debris flow created by the 1993 Disaster. This will cause a change in the "present" topography of the area. But such a change of the natural environment is acceptable.

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

Construction of an access road for construction works and the dike with a road on its crest would change the existing route of the vehicular path along the Palung Khola. With this road, topography of the riverside area would change. This change is acceptable to the local residents.

(2) River Morphology

There will be a number of significant changes in the river morphology of the area. Debris will be checked by 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 the long term, causing less debris flow while scouring action by the river water will be enhanced to some extent.

Although the possibility is very small, the construction of concrete check dams at the bottom of the land mass that has developed cracks in the area above Loche Pakha might develop groundwater outlets in the area. This may trigger mass of landslide 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 site of construction works. Close monitoring and detailed geological investigation should make the construction works possible without causing any major disaster on and around the slope.

(3) Water Quality

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

8.1.2 Biological Environment

(1) Fauna

The construction works will take place in the low altitude area while a few protected animals are possibly found in the forested areas in the high altitude area. They will not be adversely affected 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 wildlife 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 on agriculture in the area should be subject to monitoring.

(2) Flora

Construction of check dams and hillside works will not impose any major adverse impact on the vegetation in the area. Bio-engineering works would contribute to enhance vegetation in the area as they would help to regenerate plants along the river.

The upstream areas of the Ghatte Khola, Dhungakate Khola and Bhottekhoria Khola are covered by the community forestry programme. Thus vegetation in these areas will be enhanced over the time. This will contribute to the local community in the aspect of supply of fodder, fuel and fruit as well as construction materials.

8.1.3 Socio-economic Environment

(1) Population

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

The construction work will certainly raise employment opportunities 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 will enable them to accumulate small capital to start their own business upon completion of the construction works.

The flux of labourers and other local residents who will enter this area will certainly increase the demand of food and beverage during the construction period. The use of liquor will also increase and it will create localised social troubles if construction workers are dominantly those who are not from the local community.

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

Implementation of the Project will introduce advanced technology on river training works. This will create more skilled labour than before. There will be a possibility of emigration of skilled labour to large urban centres in the country. Alternatively, the traditional life style of the Newars and Tamangs and the families of other castes would also be affected by such opportunity.

Organisation of the local community for the evacuation system and installation of monitoring devices in the areas where cracks are developed, such as the area above Loche Pakha, would provide psychological settlement among the local residents.

The plan to organise local community will encourage the local residents to participate in the implementation of 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 works or volunteer works is considered a positive impact for the local population.

(2) Land Use

The improvement of irrigation schemes, roads and extension of cash crop production will cause changes in land use patterns in the area. Irrigation facilities will help to increase agricultural production and improve the local agricultural economy. This would improve the living standards of the farmers as a whole.

The improvement of the road leading to Phedigaon will improve the accessibility to market places such as Kathmandu and Hetauda. Thus land use patterns in the area would 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 on the current patterns of land use.

(3) Infrastructure

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

Construction of the dike with a road on its crest will facilitate safe transportation during the monsoon season. This would provide additional support to raise the level of the local community's economy.

(4) Religious/Cultural Activity

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

8.2 Namtar / Tilar CDPP

Table 8.2.1 shows overall rating of the Environmental Impact Assessment of the Namtar / Tilar CDPP. The results of EIA are as follows:

8.2.1 Physico-chemical Environment

(1) River Morphology

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

(2) Topography and Geology

There will be no major change of the topography and geology as a result of the implementation of the Project.

(3) Water Quality

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

Multipurpose check dams will impound water in the river and the quality of water behind the dams change over the time. The extent and duration of the changes in water quality would be very limited as there is a constant supply of freshwater. The size of the reservoirs to be created behind the dams is also limited.

8.2.2 Biological Environment

(1) Fauna

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

The check dams will be of the gabion type and concrete consolidation dams will have openings for water flow to pass. Thus, there is no possibility of fish culture except the naturally reared hill river fish. The construction of check dams is expected to be beneficial to resident fish species but will have a negative impact on the migratory fish.

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

(2) Flora

Construction of check dams and hillside works will not impose any major adverse impact on vegetation.

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

8.2.3 Socio-cultural Environment

(1) Population

Local residents of Namtar will be employed for the construction works, i.e. job opportunities will be 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 would feel safer upon completion of the Project. Thus their life style and living standards would be stabilised as a result of the implementation of the Project.

After the completion of the disaster prevention plan, modern technologies will be introduced in the village, which will affect the caste groups in their occupational profession. In addition, because of the introduction of modern equipment and technology, those who are willing to change their way of life would be stimulated by the Project.

(2) Land Use

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

Improvement of the rural road would affect the present cropping patterns indirectly as transportation facility will improve availability of chemical fertiliser, insecticides and pesticides in the area. Subsequent increased and uncontrolled use of chemical fertiliser, insecticides and pesticides would then lead to deterioration of top soil.

(3) Infrastructure

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

Rehabilitation of irrigation facilities and the installation of micro-hydropower units for electricity generation will allow a better use of water resources in the area for raising the living standards.

(4) Religious/Cultural Activity

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

(5) Area of Aesthetic/Scientific Value

No significant potential effect is foreseen in the field of aesthetic/scientific values.

8.3 Chisapani CDPP

Table 8.3.1 shows overall rating of the Environmental Impact Assessment of the Chisapani CDPP. The results of EIA are as follows:

8.3.1 Physico-chemical Environment

(1) Topography and River Morphology

Landslide occurred in the Chisapani area 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 landslide 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 will maintain soil in the river over the time, that means scouring action similar to gully erosion will be checked.

During the construction period, some debris will inevitably be accumulated in the downstream area because the construction works are carried out on the steep slope. The debris amount disposed by the construction works would be nominal compared to the amount of debris transported by the river during the rainy season.

Gabion structures and check dams will be constructed to ensure safety of the local community, hence their agricultural land and economic activities will be maintained.

(2) Water Quality

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

The construction works will take place in the area downstream of the water sources for Chisapani. Thus no water supply system will be 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, change of water quality during the construction period does not pose any impact on the aquatic life in the river.

8.3.2 Biological Environment

(1) Wildlife

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

(2) Vegetation

Construction of check dams and hillside works will not pose any major adverse impact on the vegetation in the Chisapani area. Upon implementation of the community forestry programme, the vegetation in Chisapani would be enhanced and it would serve as a source of fuelwood and fodder supply. The agro-forestry programme would also enhance local conditions of vegetation. The bio-engineering works on the slope would also contribute to enhance vegetation as well as to consolidate the top soil.

8.3.3 Socio-cultural Environment

(1) Population

Approximately 0.6 % of the local residents work as porters or agricultural labourers in Chisapani. Some of them will be involved in the construction works. Those who migrate to urban areas for seasonal job will engage in the construction works. There is a programme to organise the local community for the evacuation system as well as to encourage participation of the local residents in the implementation of the project. These should provide a positive image of the Project.

(2) Land Use

Land use in the Chisapani area would greatly change. The present cultivation areas will be equipped with small scale irrigation systems. As the forest area above Chisapani is designated as community forestry area, conditions of the forest would be changed. These changes will function toward raising the local people's living standards over the time.

(3) Infrastructure

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

(4) Religious/Cultural Activity

No part of the local religious or cultural activity would be affected by the implementation of the Project.

(5) Area of Aesthetic/Scientific Value

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

8.4 IDPP for the Mahadevbesi Bridge

Table 8.4.1 shows overall rating of the Environmental Impact Assessment of the Mahadevbesi Bridge IDPP. The results of EIA are as follows:

8.4.1 Physico-chemical Environment

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

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

8.4.2 Biological Environment

(1) Fauna

i) Fish Species
Fish species have already disappeared in the Agra Khola because of heavy exploitation of them. So there is no risk of damaging the habitat of fish in the Mahadevbesi Bridge area.

ii) 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 would be affected to some extent.

(2) Vegetation

The construction of groundsills will take place in the river bed. Vegetation in the river is already sparse around the area. Most of the lands on the sides of the river also are agricultural land and it is estimated that no damage will occur to the vegetation.

Bio-engineering works planned to be provided 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 measures to regenerate further plant species, as well as to enhance some wildlife and bird species.

8.4.3 Social Environment

(1) Population

The construction of groundsills, access road, and spur dikes would create employment opportunities during the construction period. The access road constructed for the Project will remain in the river bed and it will not be of much help to the local community.

The Danuwar Rais involved in the construction aggregate production 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.

(2) Land Use

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

(3) Infrastructure

There will be no improvement or degradation of the infrastructure in the area around the Mahadevbesi Bridge.

(4) Religious/Cultural Activity

The construction works will pose no impact on the religious or cultural activity in the area around the Mahadevbesi Bridge.

(5) Effect on the National Economy

After the completion of the construction works, the Mahadevbesi 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 the national and regional economy.

8.5 IDPP for the Kulekhani Watershed Area

Table 8.5.1 shows overall rating of the Environmental Impact Assessment of the Kulekhani Reservoir IDPP. The results of EIA are as follows:

8.5.1 Physico-chemical Environment

(1) Topography

Afforestation in Phedigaon of Palung VDC is considered as the main activity for protection and prevention of the Kulekhani Reservoir from sedimentation. The afforestation programme suggested under the community forestry programme is one of the major activities considered as preventive measures. Though some forest areas have been already controlled by the community against haphazard 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 tries 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 advice and training.

Settlements are found at different places in many agricultural lands in the entire watershed area, forests have been much in use and patches of degraded land are exposed due to deforestation. With the afforestation and agro-forestry programme, it is 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 on public/government forests.

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

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

(2) River Morphology

No significant changes are anticipated to occur in the river and the climate but the amount of sedimentation would be less once the land is stabilised with plants.

(3) Water Quality

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

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

8.5.2 Biological Environment

(1) Fauna

i) Wildlife
No wildlife species or habitats for wildlife will be affected by the project components.

ii) Fish species
There will be no direct adverse impact on fish species in the Kulekhani Reservoir under the afforestation programme.

Any proposed plan intended to be implemented within the reservoir would exert a major impact on the fish species in the reservoir. The impact of the recommended sediment prevention measures on the fish species should be further studied.

(2) Flora

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

8.5.3 Socio-cultural Environment

(1) 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 tried to highlight the issues which will possibly come up in the construction phase and after completion of the Project as well.

The agro-forestry programme will certainly help the local residents to become self sufficient in fuel and fodder. This in turn will help people, especially women, in their fuel and fodder collection, which is a labour intensive work.

(2) Land Use

The community development activities like the improvement of irrigation schemes, roads, and extension of cash crop production may certainly affect the land use pattern and cropping pattern.

The disaster prevention and community development programme will lead to economic prosperity in the future. Due to the economic prosperity, the labourers and the landless

will temporarily settle in the area. 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 extends to the slopes in the watershed, and so on. Such activities will cause soil erosion, landslides, and slope failures. The eroded soil in the watershed flows into streams and reach the reservoir. The phenomenon threatens power generation of the Kulekhani power plants.

(3) Infrastructure

The disaster management plan is proposed as a two-way plan consisting of a disaster prevention component and a community development component. Under the community development programme, infrastructure development such as construction of a feeder road on the dike between Phatbazar and Phedigaon, river training works, will improve the infrastructure of the area. This development programme will enhance the use of the school in Phedigaon which receives more than 500 students.

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

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

(4) Religious/Cultural Activity

It has been reported that the local residents of Phedigaon, Phatbazar, Palung Bazaar and other areas used to worship at the temples in their own area. In any case, no temples should be adversely affected by the measures recommended to be implemented in the Kulekhani Watershed Area.

(5) Area of Aesthetic/Scientific Value

No significant potential effect is expected in the area of aesthetic/scientific value.

Table 8.1.1 Result of Environmental Impact Analysis for Phedigaon/Phatbazar CDPP

a Before and During the Implementation Period

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Phyisico-chemical Environment												
Topography						N						
River Morphology					D/E/I							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species						N						
Forest Area					D/E/I							
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution						N						
Occupation								D/E/I				
Literacy						N						
Standard of Living/Level of Income							D/E/I					
Safety of the Living Area						N						
Agriculture Land Use					D/E/I							
Economic Activity							D/E/I					
Religious/Cultural Activity					D	E/I						
Area of Aesthetic/Scientific Value						N						

b. After the Completion of the Implementation of the Project

Parameters

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Phyisico-chemical Environment												
Topography						N						
River Morphology	D				E/I							
Geology						N						
Water Quality					E/I	D						
Climate						N						
2 Biological Environment												
Wildlife						I	D/E					
Bird Species						I	D/E					
Fish Species						N						
Forest Area							I		D/E			
Grazing Area							D/E/I					
3 Socio-economic Environment												
Population Distribution						I	D/E					
Occupation						D	E/I					
Literacy								D/E/I				
Standard of Living/Level of Income									D/E/I			
Safety of the Living Area									D/E/I			
Agriculture Land Use									D/E/I			
Economic Activity								D/E/I				
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

Note: I: Intensity
D: Duration
E: Extent
N: Neutral

Table 8.2.1 Result of Environmental Impact Analysis for Namtar/Tilar CDPP

a. Before and During the Implementation Period

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Phyisico-chemical Environment												
Topography						N						
River Morphology			E/I		D							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species					D/E/I							
Forest Area					D	E/I						
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution						N						
Occupation							E/I	D				
Literacy						N						
Standard of Living/Level of Income							D/E/I					
Safety of the Living Area							D/E/I					
Agriculture Land Use						N						
Economic Activity								D/E/I				
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

b. After the Completion of the Implementation of the Project

Parameters

Parameters Parameters	Intensity/Duration/Extent of Impact											Remarks Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Phyisico-chemical Environment												
Topography						N						
River Morphology	D				E/I							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife							D/E/I					
Bird Species							D/E/I					
Fish Species	D		E		I							
Forest Area						N						
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution						N						
Occupation							D/E/I					
Literacy						N						
Standard of Living/Level of Income									D/E/I			
Safety of the Living Area								E	I	D		
Agriculture Land Use									D/E/I			
Economic Activity									D/E/I			
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

Note: I: Intensity
D: Duration
E: Extent
N: Neutral

Table 8.3.1 Result of Environmental Impact Analysis for Chisapani CDPP

a Before and During the Implementation Period

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Physico-chemical Environment												
Topography						N						
River Morphology					D/E/I							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species						N						
Forest Area					D/E/I							
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution						N						
Occupation							D/E/I					
Literacy						N						
Standard of Living/Level of Income							D/E/I					
Safety of the Living Area						N						
Agriculture Land Use					D/E/I							
Economic Activity							D/E/I					
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

b. After the Completion of the Implementation of the Project

Parameters

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative						Positive					
Parameters	10		5		1	0	1		5		10	Remarks
1 Physico-chemical Environment												
Topography						N						
River Morphology	D				E/I							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife							D/E/I					
Bird Species							D/E/I					
Fish Species						N						
Forest Area								D/E/I				
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution							D/E/I					
Occupation									D/E/I			
Literacy							N					
Standard of Living/Level of Income									D/E/I			
Safety of the Living Area									E/I	D		
Agriculture Land Use									D/E/I			
Economic Activity									D/E/I			
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

Note: I: Intensity
D: Duration
E: Extent
N: Neutral

Table 8.4.1 Result of Environmental Impact Analysis for Mahadevbesi Bridge IDPP

a Before and During the Implementation Period

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Phyisico-chemical Environment												
Topography						N						
River Morphology					D/E/I							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species					D/E/I							
Forest Area					D/E/I							
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution						N						
Occupation							D/E/I					
Literacy						N						
Standard of Living/Level of Income							D/E/I					
Safety of the Living Area						N						
Agriculture Land Use						N						
Economic Activity							D/E/I					
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

b. After the Completion of the Implementation of the Project

Parameters

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
Parameters	10		5		1	0	1		5		10	Remarks
1 Phyisico-chemical Environment												
Topography						N						
River Morphology	D				E/I							
Geology						N						
Water Quality					D/E/I							
Climate						N						
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species					D/E/I							
Forest Area						N						
Grazing Area												
3 Socio-economic Environment												
Population Distribution							D/E/I					
Occupation								D/EI				
Literacy						N						
Standard of Living/Level of Income								D/E/I				
Safety of the Living Area							D/E/I					
Agriculture Land Use						N						
Economic Activity								D/E/I				
Religious/Cultural Activity							N					
Area of Aesthetic/Scientific Value							N					

Note: I: Intensity
D: Duration
E: Extent
N: Neutral

Table 8.5.1 Result of Environmental Impact Analysis for IDPP in the Kulekhani Watershed Area

a. Before and During the Implementation Period

Parameters	Intensity/Duration/Extent of Impact											Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Physico-chemical Environment												
Topography						N						
River Morphology					D/E/I							
Geology						N						
Water Quality				D/E/I								
Climate						N						
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species			E/I		D							
Forest Area						N						
Grazing Area												
3 Socio-economic Environment												
Population Distribution						N						
Occupation							D/E/I					
Literacy						N						
Standard of Living/Level of Income							D/E/I					
Safety of the Living Area						N						
Agriculture Land Use							D/E/I					
Economic Activity							D/E/I					
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

b. After the Completion of the Implementation of the Project

Parameters

Parameters Parameters	Intensity/Duration/Extent of Impact											Remarks Remarks
	Negative					N	Positive					
	10		5		1	0	1		5		10	
1 Physico-chemical Environment												
Topography						N						
River/Resrvoir Morphology	D		E	I								
Geology						N						
Water Quality			E		I	D						
Climate												
2 Biological Environment												
Wildlife						N						
Bird Species						N						
Fish Species			E	I	D		(D)	(I)	(E)			Dual effect is possible
Forest Area							D/E/I					
Grazing Area						N						
3 Socio-economic Environment												
Population Distribution						N						
Occupation								D/E/I				
Literacy						N						
Standard of Living/Level of Income							D/E/I					
Safety of the Living Area						N						
Agriculture Land Use						N						
Economic Activity		D	I		E		(E)		(I)	(D)		Dual effect is possible
Religious/Cultural Activity						N						
Area of Aesthetic/Scientific Value						N						

Note: I: Intensity
D: Duration
E: Extent
N Neutral

CHAPTER 9

PROJECT COST ESTIMATE

9. PROJECT COST ESTIMATE

9.1 Basic Conditions of Cost Estimate

The envisaged CDPPs and IDPPs are composed of the various types of sub-projects such as massive structures with big construction equipment, small civil structures by appropriate technologies, and non-structural measures such as institutional set-up, education, agricultural technical assistance, monitoring, and so on.

The implementation of the CDPPs and IDPPs therefore cannot be restricted to a single mode of execution. The following three modes are therefore taken into account in the project cost estimate:

(1) International Competitive Bidding (ICB),
(2) Local Competitive Bidding (LCB), and
(3) People's Participation Program (PPP).

9.1.1 International Competitive Bidding (ICB)

Civil engineering works will be constructed on a contract basis. The contractors for these works will be selected through international competitive bidding. The sub-projects proposed to be executed on the ICB basis generally involve large scale civil construction works and may require some financial assistance from foreign donor agencies. The construction works will usually require major construction machinery as well as well engineering experience and technologies.

The international contractors who undertake these works are expected to transfer some construction and management technologies to the local contractors who will carry out a part of the construction works on a sub-contract basis, under the supervision of the international contractors.

The following sub-projects are assumed for ICB:

(1) Phedigaon / Phatbazar CDPP

a) Two check dams Dh-1D and Dh-2D, training dike Ph-3D, and revetment work Ph-7D on the Dhungakate Khola,
b) Three check dams Gh-6D to 8D, and a coffering dike Ph-2D on the Ghatte Khola.

(2) Namtar / Tiral CDPP

a) Check dam Na-1D on the Manhari Khola,
b) Check dam Na-2D on the Manhari Khola,
c) Check dam Na-3D on the Syarse Khola,
d) Groundsill Na-4D on the Manhari Khola,
e) Channel works for the Manhari Khola (Na-5D).

(3) Chisapani CDPP

a) Check dam Ch-1D on the Chisapani Khola,
b) Two check dams Dr-1D and Dr-2D on the Dharapani Khola.

(4) Mahadev Besi IDPP

a) Groundsill No.1 on the Agra Khola,
b) Groundsill No.2 on the Agra Khola.

(5) Kulekhani Reservoir IDPP

a) Procurement of construction equipment for sand excavation from the reservoir.

9.1.2 Local Competitive Bidding (LCB)

The contractors for these works will be selected through local competitive bidding. The construction of such civil works will be carried out by using construction machinery and equipment which will be provided by the contractors. Villagers may participate in simple labour works, such as collection of materials or simple construction works with tools, or light equipment, if required. The following sub-projects are envisaged to be carried out on the LCB basis.

(1) Phedigaon / Phatbazar CDPP

a) Gully control works Dh-3D through Dh-8D on the Dhungakate Khola tributaries,
b) Hillside works Dh-8D through Dh-10D on the Dhungakate Khola basin,
c) Gully control works Gh-1D through Gh-3D on the Ghatte Khola tributaries,
d) Hillside works Gh-4D and Gh-5D in the Ghatte Khola basin.
e) Channel work Ph-4D on the Dhungakate Khola,
f) Channel work Ph-5D on the Ghatte Khola,
g) Community disaster evacuation system with multipurpose shelter Ph-8D in Phedigaon community.

(2) Namtar / Tiral CDPP

a) Rural road improvement Na-2C,
b) Rehabilitation of rural irrigation scheme Na-3C,
c) Microhydropower plant installation Na-8C.

(3) Chisapani CDPP

a) Gully control works Ch-6D on the Dharapani Khola Mainstream,
b) Gully control works Ch-7D and Ch-8D on the Dharapani Khola Tributaries,
c) Hillside works Ch-10D,
d) Community disaster evacuation system with two multipurpose shelters Ch-12D,
e) Water supply network development Ch-2C.

(4) Mahadev Besi IDPP

a) Spur dikes and riverside park

(5) Kulekhani Reservoir IDPP

a) Improvement of the Kulekhani - Daksinkali Road

The contractors who undertake these works are expected to transfer to the villagers some sustainable skills and technologies which are useful for the maintenance of the system, by partially employing them as common labourers.

9.1.3 People's Participatory Program (PPP)

Civil engineering works will be carried out on the contract basis under an initiative involvement and participation of beneficiary villagers (hereinafter referred to as "villagers") in association with NGO(s). The following sub-projects are proposed for PPP:

(1) Phedigaon / Phatbazar CDPP

a) Formation of user's committee Ph-1C,
b) Land reclamation on alluvium fan area Ph-6C,
c) Community forestry on five forest areas Ph-7C through Ph-11C,
d) Management of stone quarry site Ph-13C,
e) Agro forestry on sloped farm land Ph-14C.

(2) Namtar / Tiral CDPP

a) Formation of user's committee Na-1C,
b) Crop diversification program Na-7C,
c) VHF wireless telephone installation program Na-11C,
d) WID through eri-silk industry research Na-12C.

(3) Chisapani CDPP

a) Formation of user's committee Ch-1C,
b) Community forestry at Chuliban Ch-4C,
c) Improvement of contour farming Ch-13C,
d) Agro forestry on sloped farm land Ch-14C.

(4) Mahadev Besi IDPP

None.

(5) Kulekhani Reservoir IDPP

a) Construction of the Kulekhani - Daksinkali Road under the PLAN International Programme.

The NGO(s) who undertake these works will be selected on the basis of their management and supervision experiences and skills in the past similar projects in which they had been involved. Their qualifications will be evaluated by a third party.

The construction procedures will be as follows:

i) These organisations or groups should consist of several engineers, and they are expected to train villagers for the maintenance work as well as for further sustainable development in the future.

ii) Collection and transportation of materials are classified into two types. Basically, aggregates such as boulder, rubbles, cobbles, etc. will be collected by villagers. Other construction materials such as steel bars, gabion wire, cement, and other ready-made/ precast materials such as pipes and plastic tanks will be fully supplied by a certain agency or organisation according to accurate quantities estimated by NGO(s). These materials will be transported by vehicles up to a motorable road-head, and then transported by villagers to the respective sites.

iii) Compensation to the villagers for their participation will be made in cash payment within the respective project budget.

iv) The construction of the above civil works will be mostly carried out by common labourers under proper technical instruction by project engineers, using simple construction tools and equipment, such as portable mixer, portable hammer, vibrator, etc. However if machinery and equipment are required, they will basically be provided by the NGO(s), in co-operation with the funding agencies.

Project costs for PPP sub-programs are tentatively assumed by the Study Team. Most of the sub-programmes are non-structural measures and the major part of the cost would be for administration, technical support, transportation and so on. The cost is therefore highly depended on the GO or NGO which is expected to support.

9.2 Unit Price Assessment

9.2.1 Material Price and Labour Cost

The unit prices of materials and labour wages are estimated at 1996/97 price level, referring to the Garrigaon Irrigation Project, an example scheme conducted under the people's participation program. This project had been carried out in Phedigaon, Palung VDC, Makwanpur District, during February to July 1996, with assistance of the HMG-N/ ILO/ IFAD/ WFP. Information was also obtained from the Makwanpur district, the Ministry of Local Development, District Irrigation Office of Makwanpur District and a market investigation conducted in Hetauda and Kathmandu. The list of unit prices obtained through investigation in the Makwanpur District (Hetauda) as well as Kathmandu is shown in Table 9.2.1.

Other assumptions are the following:

(1) The cost estimate for the community infrastructure project is in local (L.C.) currency portion only.

(2) The exchange rate used for the cost estimate is as follows:
US$ 1.00 = NRs. 55.75 = ¥ 109.10, as of June 11, 1996.

9.2.2 Equipment Cost

The unit prices of equipment cost are estimated based on the Kulekhani Disaster Prevention Project as of 1992, which is located in Makwanpur districts and the site conditions as well as the type of the construction works are almost similar to the ICB conditions of the CDPP and the IDPP sub-projects. For estimating the equipment cost as of 1996 /97, an annual price escalation of 3% is taken into account. Table 9.2.2 shows the estimated unit prices of the major equipment for the construction works on the ICB basis. It is noted that no operator, fuel and other administrative fees such as insurance, maintenance and so on are included in the unit prices.

9.3 Unit Price Estimate

The unit prices of construction materials at respective sites are analysed under the following conditions:

9.3.1 Unit Prices on the ICB Basis

The unit prices for the major work items to be executed on the ICB basis are shown in Table 9.3.1 for respective construction sites. All these items are disaster prevention works of which scale of construction is rather big.

The unit prices on the ICB basis are composed of the costs for local labour, local and foreign materials and foreign equipment at the basic unit rates. In addition to the basic unit rates, the overhead of contractors (30%) are taken into account. The overhead is included in the administration and supervision fees but is excluded from the insurance charge.

9.3.2 Unit Prices on the LCB Basis

The unit prices on the LCB basis are shown in Table 9.3.1 for disaster prevention works and Table 9.3.2 for community infrastructure construction works. The unit price schedules for the major work items on the LCB basis are estimated based on those on the PPP basis. Since transportation cost as well as indirect cost have been omitted in the unit rate of aggregates as described in section 2.1.3 of Annex-9, 10 % is added to the price schedule on the PPP basis at first. Then 15 % of total price is added as contractor's profit, and finally another 5 % of total price is added as the government tax portion. Therefore, the unit prices on the LCB basis have increased by a total of 30.25 % from those on the PPP basis.

9.3.3 Unit Prices on the PPP basis

The unit prices on the PPP basis are shown in Table 9.3.2 for respective CDPP sites. The unit price schedules for the major work items on the PPP basis merely consist of costs for a specified quantity of labour, materials ("other materials" bear indirect cost, as described in the previous paragraph) and equipment (tools). Indirect cost such as contractor's profit and government tax is not included in these unit price schedules, therefore, the government tax should be exempted for PPP-based construction works.

9.4 Breakdown of the Project Cost

The cost estimate is made at the 1996/97 price level. For all works, the cost is estimated first at the unit price level, based on the work quantities shown in the Bill of Quantities. The quantities are estimated according to the preliminary design at feasibility level.

9.4.1. Direct Construction Cost

The cost estimate was made for each work item based on the unit prices described in the previous sections and work quantities obtained through the feasibility level design.

In addition to the basic direct cost, which is estimated on the B/Q basis, a "miscellaneous" item equivalent to 10% to 20% of the basic direct cost for all the construction works is taken into account.

For the disaster prevention works on the ICB and LCB basis, the preparatory works for the arrangement of site office, water, electricity, access road and other necessary works are taken into account at a rate 10% of the basic direct cost plus miscellaneous item.

The direct construction cost is therefore defined as the total amount of basic direct cost, miscellaneous item, and preparatory works.

9.4.2 Indirect Cost

(1) Administration Cost

Administration cost is taken into account for the disaster prevention works on both the ICB and LCB basis, because the disaster prevention works are expected to be carried out under the leadership of the central government. This cost is estimated to be 5% of direct construction cost in local currency portion.

(2) Engineering services/Technical support

Engineering services are required for detailed survey, detailed design as well as further technical support. For the disaster prevention works on the ICB basis, an amount equal to 20% of direct cost plus administration cost is considered as the cost for engineering services and technical support. As for the works on the LCB or the PPP basis, basically the cost of engineering services is calculated at 30% of direct cost, because the transfer of technologies to the local people is one of the most important components of the engineering services and its execution required a lot of works in various aspects.

(3) Physical contingency

A physical contingency amount is considered to cover the fluctuation of direct construction costs. It is assumed to be 30 % of the sum of direct construction cost for the works on the ICB basis, and 20% for those on the LCB as well as PPP basis. The works on the ICB basis would require some more steps such as basic design, detailed design and construction works, and some major changes are expected in the future stages of the project. For this reason, it is recommended to calculate the physical contingency amount at 30% of direct construction cost for the works on the ICB basis, in this stage.

On the other hand, the construction of the works on the LCB or PPP basis might proceed directly and some adjustments could be made in the course of the construction. The physical contingency amount for these works (20% of direct construction cost) is therefore rather smaller than that for the ICB works.

9.5. Cost Estimate for Priority Projects

According to the above procedures, the cost of the respective projects under the CDPPs and IDPPs is estimated. The detailed cost breakdowns are shown in Annex-4 for the disaster prevention works, and in Annex-9 for the community infrastructure works. The results of project cost estimate for each sub-project are summarised in Tables 9.5.1 through 9.5.5.

Table 9.2.1 Price Investigation

Item	Unit	Rate (NRs)	Remarks
Labourer			
Foreman	m.d	95	
Skilled labour	m.d	105	
Common labour	m.d	60	
Mason	m.d	105	
Carpenter	m.d	105	
Steel worker	m.d	105	
Electrician	m.d	95	
Plumber	m.d	95	
Driver	m.d	85	Light vehicle (80)
Operator (B)	m.d	85	Light equipment
Material			
Sand	m3	140	
Gravel	m3	500	
Boulder	m3	190	
Cement	bag (50 kg)	270	Hetauda (Ex factory)
Steel bar	t	27,500	Varies by size
Timber	m3	900	
Gabion wire	kg	40	Medium coated
HDP Pipe (Inside Dia. mm) *			
12.5	m	17	10 kgf /cm2
25	m	41	10 kgf /cm2
38	m	96	10 kgf /cm2
50	m	154	10 kgf /cm2
100	m	460	10 kgf /cm2
150	m	978	10 kgf /cm2
250	m	1,976	6 kgf /cm2
Ready Made Plastic Water Storage Tank (litre) *			
200	Nos	830	
400	Nos	1,660	
750	Nos	3,113	
1000	Nos	4,150	
Concrete Pipe (Dia. mm)		NP-2 / NP-3	
200	m	280 / 800	NP-2: Light duty
300	m	420 / 960	NP-3: Heavy duty
600	m	890 / 1,850	
900	m	1,720 / 3,640	
1200	m	2,400 / 5,200	
Fuel and Oil			
Petrol	liter	31.5	
Diesel	liter	11	
Lubricant (Engine) O	liter	48	

Note: (1) Rates are obtained from Makwanpur District Office for the Fiscl Year 95/96

(2) * Market Price at Kathmandu

Table 9.2.2 Unit Price for Major Construction Equipment under ICB Basis

No.	Equipment	Capacity	Unit	Unit Price (J.Yen) (1992 price)	(1996/97 price)
1	Back hoe	0.7 m3	Hour	5,570	6,362
2	Bulldozer	21 ton	Hour	10,700	12,222
3	Bulldozer	11 ton	Hour	4,720	5,391
4	Tractor Shavel	2 m3	Hour	6,680	7,630
5	Dump truck	8 ton	Hour	2,988	3,413
6	Belt conveyor		Day	1,560	1,782
7	Air compressor		Hour	2,450	2,799
8	Pick hammer		Day	172	196
9	Leg hammer		Hour	208	238
10	Tamper	80kg	Hour	178	203
11	Vibratory Roller	3 ton	Hour	2,980	3,404
12	Truck crane		Hour	5,210	5,951
13	Aggregate plant		Hour	19,120	21,840
14	Batcher Plant	25 m3 /hour	Hour	8,070	9,218
15	Concrete Mixer		Day	1,080	1,234
16	Crawther Crane	30 ton	Hour	8,250	9,424
17	Concrete bucket	1 m3	Hour	368	420
18	Concrete vibrator		Hour	122	139

Notes: 1)Unit price for equipment under ICB basis is estimated based on the Engineer's Estimate of Kulekhani Disaster Prevention Project (1992)
2) The unit price as of 1996 /97 is estimated based on the 3% of annual price escalation.
3) Operator, fuel and other required costs are not included in the unit price above.

Table 9.3.1 List of Unit Prices for Major Work Items for Disaster Prevention Works

No.	Item	Unit	Unit Rate (NRs.)							
			Phedigaon		Namtar		Chisapani		Mahadev Besi	
			ICB	LCB	ICB	LCB	ICB	LCB	ICB	LCB
1	Excavation, Gravel or Soil	m3	260	130	260	N.A.	260	130	260	130
2	Excavation, Weathered Rock	m3	420	370	420	N.A.	420	370	420	370
3	Excavation, Rock	m3	780	600	780	N.A.	780	600	780	600
4	Plain Concrete	m3	8,160	5,921	8,160	N.A.	10,445	7,584	8,160	6,000
5	Rubble Concrete	m3	4,130	2,493	4,130	N.A.	6,360	3,841	4,130	2,240
6	Wet Masonry	m3	4,350	2,698	4,350	N.A.	6,525	4,046	4,350	2,450
7	Free Drainage Backfill	m3	400	360	400	N.A.	400	360	400	360
8	Boulder Riprap	m3	550	430	550	N.A.	550	430	550	430
9	Gabion	m3	1,500	994	1,500	N.A.	1,523	1,009	1,500	1,000
10	Simple terracing with stones	m	N.A.	200	N.A.	N.A.	N.A.	200	N.A.	200
11	Wicker-work	m	N.A.	390	N.A.	N.A.	N.A.	390	N.A.	N.A.

Note : 1) Unit prices for the IDPP for Kulekhani reservoir are not estimated by the Study Team, so that the road construction works by PPP basis is on-going.

Table 9.3.2 List of Unit Price for Major Work Items for Community Infrastructures

S.N	Description of Item	Unit	Unit Rate (NRs.)					
			Namtar		Chisapani		Phedigaon	
			PPP	LCB	PPP	LCB	PPP	LCB
01.	E/W Excavation in Soft Soil	m3	43.00	57.00	43.00	57.00	43.00	57.00
02.	E/W Excavation in BMS and Hard soil	m3	98.00	130.00	98.00	130.00	98.00	130.00
03.	E/W Excavation in Boulder Mixed Soil under Shallow Water (Depth < 2.0 m)	m3	222.00	295.00	222.00	295.00	222.00	295.00
04.	E/W Backfill with common soil	m3	34.00	45.00	34.00	45.00	34.00	45.00
05.	Stone Soling in Foundation	m3	194.00	258.00	194.00	258.00	194.00	258.00
06.	P.C.C. 1:2:4 incl/ formwork	m3	4,505.00	5,984.00	5,710.00	7,584.00	4,458.00	5,921.00
07.	R.C.C. 1:2:4, incl/ steel & formwork	m3	7,076.00	9,399.00	8,428.00	11,194.00	7,027.00	9,334.00
08.	Stone Masonry Wall (CM 1:3)	m3	2,075.00	2,756.00	3,046.00	4,046.00	2,031.00	2,698.00
09.	Stone Masonry Wall (CM 1:4)	m3	1,876.00	2,492.00	2,841.00	3,774.00	1,830.00	2,431.00
10.	Rubble Masonry (CM 1:3)	m3	1,921.00	2,552.00	2,892.00	3,841.00	1,877.00	2,493.00
11.	Rubble Masonry (CM 1:4)	m3	1,722.00	2,287.00	2,687.00	3,569.00	1,676.00	2,226.00
12.	Dry Rubble Masonry Wall	m3	441.00	586.00	441.00	586.00	441.00	586.00
13.	Plastering 20 mm (CM 1:4)	m2	80.00	106.00	127.00	169.00	77.00	102.00
14.	Gabion Box	m3	751.00	998.00	760.00	1,009.00	748.00	994.00
15.	HDP Pipe Joining, Laying							
	250 mm	Rm	1,990.00	2,643.00	1,993.00	2,647.00	1,992.00	2,646.00
	150 mm	Rm	992.00	1,318.00	994.00	1,320.00	994.00	1,320.00
	50 mm	Rm	161.00	214.00	162.00	215.00	161.00	214.00
	38 mm	Rm	103.00	137.00	103.00	137.00	103.00	137.00
	25 mm	Rm	47.00	62.00	48.00	64.00	48.00	64.00
	12.5 mm	Rm	23.00	31.00	24.00	32.00	24.00	32.00
16	Transportation							
	Cement	100 kg	18.00	24.00	146.00	194.00	46.00	61.00
	G.I. Wire	100 kg	18.00	24.00	146.00	194.00	46.00	61.00
	Binding Wire	100 kg	18.00	24.00	146.00	194.00	46.00	61.00

Note: Contractor's Profit and tax are: Excluded for People's Participation Program (PPP) basis BMS: Boulder mixed soil

Included for Local Competitive Bidding (LCB) basis

Table 9.5.1 Project Cost for Phedigaon / Phatbazar CDPP

No.	ID No.	Sub-project Name and The Component	Sector	Mode of Cost Estimate	Project Cost (NRs.)
1		Phedigaon Basic Sabo Project			53,018,600
(a)	Dh-1D, 2D, Ph-3D, 7D	2 check dams, training dike and revetment works on the Dhungakate Khola	Sabo	ICB	40,909,400
(b)	Gh-6D~8D, Ph-2D	3 groundsills and a coffering dike on the Ghatte Khola	Sabo	ICB	12,109,200
2		Phedigaon Participatory Disaster Prevention Works			44,969,500
(a)	Dh-3D	Series of groundsills on the Dhungakate Khola tributary1	Sabo	LCB	1,694,300
(b)	Dh-4D	Series of groundsills on the Dhungakate Khola tributary2	Sabo	LCB	3,504,600
(c)	Dh-5D	Series of groundsills on the Dhungakate Khola tributary3	Sabo	LCB	1,866,800
(d)	Dh-6D	Series of groundsills on the Dhungakate Khola tributary4	Sabo	LCB	1,731,300
(e)	Dh-7D	Series of groundsills on the Dhungakate Khola tributary5	Sabo	LCB	3,259,100
(f)	Gh-1D	Series of groundsills on the Ghatte Khola tributary1	Sabo	LCB	7,959,300
(g)	Gh-2D	Series of groundsills on the Ghatte Khola tributary2	Sabo	LCB	4,549,000
(h)	Gh-3D	Series of groundsills on the Ghatte Khola tributary3	Sabo	LCB	4,925,200
(i)	Dh-8D~10D, Gh-4D~5D	Hillside works on the Dhungakate and the Ghatte Khola basins	Sabo / Bio-engineering	LCB	6,253,300
(j)	Ph-4D	Channel works on the Dhungakate Khola	Sabo	LCB	4,289,500
(k)	Ph-5D	Channel works on the Ghatte Khola	Sabo	LCB	4,937,100
3	Ph-8D	Community disaster evacuation system with multipurpose shelter	Disaster management / Agriculture	LCB	3,000,000
4	Ph-1C	Formation of users' committee	Institution	PPP(*)	500,000
5	Ph-6C	Land reclamation on alluvium fan area	Disaster recovery	PPP(*)	5,000,000
6	Ph-7C ~ 11C	Community forestry on 5 areas	Forest	PPP(*)	1,500,000
7	Ph-14C	Agro forestry on sloped farmland	Forest / Agriculture	PPP(*)	3,500,000
8	Ph-13C	Management of stone quarry site	Environment	PPP(*)	200,000
		TOTAL PROJECT COST			**111,688,100**

Notes: ICB : International competitive bidding base,
LCB : Local competitive bidding base,
PPP : People's participation program base,
(*) : Assumed cost

Table 9.5.2 Project Cost for Namtar / Tiral CDPP

No.	ID No.	Sub-project Name and The Component	Sector	Mode of Cost Estimate	Project Cost (NRs.)
1		Namtar Multipurpose Sabo Project			271,845,500
(a)	Na-1D	Multipurpose check dam Na-1 on the Manhari Khola	Sabo / Irrigation / Microhydro.	ICB	47,141,000
(b)	Na-2D	Multipurpose check dam Na-2 on the Manhari Khola	Sabo / Transportation	ICB	55,079,800
(c)	Na-3D	Check dam on the Syarse Khola	Sabo	ICB	77,613,800
(d)	Na-4D	Groundsill on the Manhari Khola	Sabo	ICB	39,708,400
(e)	Na-5D	Channel works on the Manhari Khola	Sabo	ICB	52,302,500
2	Na-1C	Formation of user's committee	Institution	PPP(*)	500,000
3	Na-2C	Rural road improvement	Road / Bioengineering	LCB	4,739,000
4	Na-3C	Rehabilitation of rural irrigation	Agriculture / Disaster recovery	LCB	5,026,000
5	Na-7C	Crop diversification	Agriculture	PPP(*)	2,500,000
6	Na-11C	VHF wireless telephone installation	Communication	PPP	50,000
7	Na-12C	WID through eri-silk industry research	WID / Industry / Environment	PPP(*)	1,000,000
8	Na-8C	Microhydropower plant installation	Rural electrification	LCB	7,836,000
		TOTAL PROJECT COST			293,496,500

Notes: ICB : International competitive bidding base,
LCB : Local competitive bidding base,
PPP : People's participation program base,
(*) : Assumed cost

Table 9.5.3 Project Cost for Chisapani CDPP

No.	ID No.	Sub-project Name and The Component	Sector	Mode of Cost Estimate	Project Cost (NRs.)
1		Chisapani Basic Sabo Project			42,985,500
(a)	Ch-1D	Check dam on the Chisapani Khola	Sabo	ICB	15,522,200
(b)	Dr-1D	Check dam on the Dharapani Khola	Sabo	ICB	15,577,800
(c)	Dr-2D	Check dam on the Dharapani Khola	Sabo	ICB	11,885,500
2		Chisapani Participatory Farmland Conservation Project			19,175,800
(a)	Ch-6D	Series of groundsills on the Dharapani Khola mainstream	Sabo	LCB	7,988,100
(b)	Ch-7D, 8D	Series of groundsills on the Dharapani Khola tributaries	Sabo	LCB	5,491,800
(c)	Ch-10D	Hillside works	Sabo / Bioengineering	LCB	5,695,900
3	Ch-1C	Formation of user's committee	Institution	PPP(*)	500,000
4	Ch-12D	Community disaster evacuation system and two multipurpose shelters	Disaster management / Agriculture	LCB	4,500,000
5	Ch-2C	Water supply network development	Water supply / Agriculture	LCB	3,070,000
6	Ch-4C	Community forestry at Chuliban	Forest	PPP(*)	1,000,000
7	Ch-13C	Improvement of contour farming	Agriculture / Soil conservation	PPP(*)	2,500,000
8	Ch-14C	Agro forestry on sloped farmland	Agriculture / Soil conservation	PPP(*)	3,500,000
		TOTAL PROJECT COST			**77,231,300**

Notes: ICB : International competitive bidding base,
LCB : Local competitive bidding base,
PPP : People's participation program base,
(*) : Assumed cost

Table 9.5.4 Project Cost for Mahadevbesi Bridge IDPP

No.	ID No.	Sub-project Name and The Component	Sector	Mode of Cost Estimate	Project Cost (NRs.)
1		Groundsill No.1 on the Agra Khola	Sabo	ICB	47,755,700
2		Groundsill No.2 on the Agra Khola	Sabo	ICB	42,082,100
3		Spurdikes and riverside park on the right bank of the Agra Khola	Sabo / Bioengineering	LCB	2,409,400
		TOTAL PROJECT COST			**92,247,200**

Notes: ICB : International competitive bidding base,
LCB : Local competitive bidding base,
PPP : People's participation program base,
(*) : Assumed cost

Table 9.5.5 Project Cost for Kulekhani Reservoir IDPP

No.	ID No.	Sub-project Name and The Component	Sector	Mode of Cost Estimate	Project Cost (NRs.)
1		Procurement of excavation equipment	Construction equipment	ICB	139,298,000
2		Improvement of Kulekhani - Daksinkali Road	Road improvement	LCB	152,017,000
3		Construction of Kulekhani - Daksinkali Road	Road construction	PPP	60,946,700
		TOTAL PROJECT COST			**352,261,700**

Notes: ICB : International competitive bidding base,
LCB : Local competitive bidding base,
PPP : People's participation program base,
(*) : Assumed cost

CHAPTER 1 0

PROJECT EVALUATION

10. PROJECT EVALUATION

10.1 Economic Evaluation

10.1.1 General

There are multiple ways to evaluate a project. In this chapter, economic evaluation is carried out by using the cost-benefit analysis method (CBA). This method has been developed on the foundation of economic theories and is quite useful to give monetary indices which can be compared among multiple projects.

The CBA, however, does not have a mighty power to evaluate any kinds of projects. In the Study, there are many sub-projects which cannot be evaluated only by the CBA. The typical ones are participatory community development projects in which many social variables are involved.

In this chapter, economic evaluation is made of the sub-projects proposed in the Study by applying the CBA as much as it can go. That is, although there may be many benefits that are intangible and must be overlooked, the indices such as the economic internal rate of return (EIRR) and the net present value (NPV) are derived. Intangible benefits will be dealt with in the next chapter 10.2 "Impact Analysis".

10.1.2 Basic Assumptions

Theoretically speaking, there are so many things to be clarified to carry out the CBA. For example, in order to identify the real economic value of unskilled labour, at least the conditions of the unskilled labour market and its marginal product should be studied. This is just one example and there are many other cases to identify real economic values of many goods and services, so-called shadow prices. This investigation process is cumbersome and time consuming, and much accuracy is not required in this feasibility study stage. Thus basic assumptions are made to simplify the CBA. There must be disputes on some of these assumptions, but they should be cope with in the later study stage if any.

The basic assumptions adopted in the CBA are itemised below:

1) the life span of all projects is set to be 20 years, and no natural disasters will occur during this period,
2) all prices are expressed in 1996 constant prices,
3) the construction period of all projects is within a single year,
4) the wage rate of unskilled labour and the values of traded goods and services are the only things to be converted into real values (see further explanations in the following sections),
5) except for the two items mentioned above in 4), all other goods and services represent real marginal values and their markets are perfectly competitive,
6) the sizes of all projects are so small that they will have no influence on any market price and any volume of supply and demand in Nepal, and

7) relative prices will not change.

There are three types of bidding for implementation; people's participation programme (PPP), local competitive bidding (LCB) and international competitive bedding (ICB). For each of them, the type-specific basic assumptions are made as given below:

ICB
1) All foreign portions are made of traded goods and services.
2) All local portions are made of labour.
3) 90 % of labour in the local portion consists of unskilled labour.
4) Transfer payment is 5 % of the foreign portion.

LCB
1) In labour costs, the ratio of unskilled labour to skilled labour is 9 to 1.
2) There are no traded goods and services.
3) Transfer payment is 5 % of the total cost.

PPP
1) In labour costs, the ratio of unskilled labour to skilled labour is 9 to 1.
2) There are no traded goods and services.

10.1.3 Shadow Prices

As mentioned in the previous section, unskilled labour and traded goods and services are re-evaluated and converted into real economic values. Those real economic values are often called shadow prices in the CBA. For determining the real value of the wage rate of unskilled labour, a shadow wage rate should be derived. For determining the shadow price of traded goods and services, it is needed to determine the real exchange rate, which is called shadow exchange rate. The ratios to convert them into shadow prices are assumed as follows:

Shadow wage rate of unskilled labour : 0.6

Shadow exchange rate of traded goods and services : 1.1

As for the shadow wage rate of unskilled labour, no scientific analysis was made to determine it in the Study, but it was determined based on the field observation and investigation in labour markets, employment opportunities, and the rates adopted in other study reports. The people are mostly engaged in agriculture with family labour forces on a tiny piece of farmland. They are basically self-sufficient in agricultural outputs. Therefore, it is assumed that there are a lot of under employed/unemployed people and their opportunity costs for labour are very low compared to the wage rate for manual labour per day, and that the shadow wage rate of unskilled labour is 60 % of the market wage rate.

Theoretically, the reciprocal of the standard conversion factor (SCF) is the shadow exchange rate. The SCF is often used in many project evaluations and the formula to

determine it is known very well. Based on the numbers of the SCF in the last decade and the observation of the distortion in the current foreign exchange market, the domestic prices of traded goods and services should be multiplied by 1.1 so that they represent the real economic values.

10.1.4 Economic Costs

The basic assumptions and the shadow prices have been explained in the previous two sections. Now, rigorous calculation will give the economic costs for all sub-projects. However, in order to simplify the calculation dramatically, special conversion factors will be introduced in this section.

There are many diversified sub-projects, but when they are combined as one package at each location, the project components of each package at each location are very similar. The Study Team picked up several major sub-projects and calculated their economic costs by applying the assumptions and the shadow prices described in this chapter. Then, based on the bidding types, the financial costs and the corresponding economic costs are compared and the ratios between them in each bidding type were calculated. These ratios are called the special conversion factors in this section. Please do not mix them up with the conversions factors often used in the CBA. The term "special" is attached for the particular use only in this study report.

The special conversion factors by which financial costs are converted into economic costs represent the overall average values for three different bidding types. The factors are as follows:

ICB: 0.95

LCB: 0.79

PPP: 0.83

For example, if the financial costs for a project which will be tendered on the ICB basis are known, the economic costs for that project will be derived by multiplying the financial costs by 0.95. To derive these factors, seven financial cost tables for ICB, nine financial cost tables for LCB, and two financial cost tables for PPP were picked up and detailed calculation was made.

The calculation results are shown in Tables 10.1.1 for Phedigaon/Phatbazar, Table 10.1.2 for Namtar/Tilar, Table 10.1.3 for Chisapani, Table 10.1.4 for the Mahadev Besi Bridge, and Table 10.1.5 for the Kulekhani Reservoir. The summary of these tables is given in the following:

Unit: NRs.

No.	Area	Financial Costs	Economic Costs
1	Phedigaon/Phatbazar	111,688,100	97,144,600
2	Namtar/Tilar	293,496,500	275,519,500
3	Chisapani	77,231,300	68,190,400
4	Mahadev Besi Bridge	92,247,200	87,249,300
5	Kulekhani Reservoir	352,261,700	303,012,300

10.1.5 Economic Benefits

It is not easy or, it should rather be said, it is impossible to calculate the benefit of each sub-project because the influence of each sub-project on the economy cannot be divided properly. In the Study, all sub-projects at each of the four locations, i.e. Phedigaon/Phatbazar, Namtar/Tilar, Chisapani, and Mahadev Besi Bridge, are to be implemented as one package programme and to provide expected benefits as combined effects.

In the following sub-sections, the economic benefits in each study area are discussed.

(1) Phedigaon/Phatbazar

The major benefits are assumed to come from the land reclamation of the currently unused area which has been covered by the debris produced by the 1993 disaster. The total area is about 30 ha. Once it is reclaimed, it is assumed that the whole area is used for cauliflower production, which is the most profitable product in Phedigaon/Phatbazar, and potato production. The land reclamation cost is not included in the costs discussed in the previous section, so it should be calculated. Since it will be done by the people themselves, the economic unit price of excavation of soft soil is to be used. Also the average thickness of the soil covering is assumed to be 1 m.

There are many other big benefits generated by the whole package of all sub-projects in the area. For example, the people who have lost their land and houses in the 1993 disaster will be able to get back to the normal life that they had once enjoyed before the disaster. They are now suffering from being landless, living in relatives' or friends' houses and doing daily manual labour for food without any hope for the future. Another example is that the people in the area will be encouraged very much for their future and start thinking a constructive way for the development of their community. They are currently so pessimistic that they never seriously and logically think about their own lives, families or community. Once the development has started by implementing several sub-projects over there, the people will definitely change and the momentum for development will be created.

However, all those benefits cannot be accounted for by the CBA in this section. They are discussed in the next section of Impact Analysis.

Right after the whole sub-projects are completed, the benefits of cauliflower and potato production are assumed to be generated and to last for the whole project life. The net benefits of cauliflower and potato production are NRs. 11,156 and NRs. 1,127 per ropani of land, respectively (see Table 5.4.1 in Annex-7: Agriculture).

(2) Namtar/Tilar

With the whole package of all sub-projects implemented, the major benefits are assumed to come from the shift in the cropping patterns of agricultural goods produced in Namtar VDC and the land reclamation. With the road construction, the people in Namtar/Tilar and Namtar VDC will be able to conduct much intensive cash-crop production though they are doing agriculture for mainly self consumption and producing paddy, maize, millet and wheat that bring about small net benefits. The road will pave the way to export their agricultural products to large markets like Hetauda and Kathmandu. Thus it is assumed that 100 ha of farmland in Namtar VDC will be used for cauliflower, ginger, or garlic production (there are 74 ha of farmland in Ward No. 2, the central place of Namtar VDC). The net benefits from cauliflower, ginger and garlic are NRs. 8,075, NRs. 9,522 and NRs. 9,386 per ropani, respectively (see Table 7.4.1 in Annex-7: Agriculture). Let us assume that the net benefits are NRs. 9,000 per ropani on average by shifting the cropping pattern. Under the current major cropping pattern in which paddy, maize, millet and wheat are cultivated, there exists no positive net benefit from those crops. Thus there is no need to consider any forgone benefits by shifting the cropping pattern.

With the checkdams and the river control training works, 25 ha of land that were wiped out by the 1993 disaster will be able to be reclaimed and used as farmland. This newly developed farmland is assumed to be used for producing profitable agricultural products such as cauliflower, ginger and garlic. The reclamation cost should not be forgotten as it is done in Phedigaon/Phatbazar.

There will be tremendous impacts on the Namtar people by the road improvement and the sabo construction works. It has been observed that the existing road which is not motorable more than half a year due to the rain hampers any development activities in Namtar VDC. Once the motorable road is constructed, it is sure that the development of Namtar/Tilar and their surroundings will be speeded up and that dramatic development will be realised. Moreover, the security provided by several sabo structures will ease the fear in the people's minds and the Namtar people will become positive and constructive for their future.

All those benefits, however, are not taken into account in the CBA here. They will be treated in Chapter 10.2, Impact Analysis.

(3) Chisapani

The package of sub-projects consists of drinking water supply and several sabo works such as check dams, series of gabions, hillside works, etc. The major benefits are derived from drinking water supply and sustainment of the existing farmland by the sabo works.

Under the drinking water supply sub-project, a total of 78 households will receive tapwater and a part of it can be used for sprinkler irrigation. Each household is designed to be able to irrigate 3 ropani of their farmland by sprinklers. Thus this sub-project reduces the time and laborious works for fetching water and provides irrigation opportunities. The average time for fetching water in Chisapani is 38 minutes (see Table 2.2 in Annex-6: Participatory Community Development), and these time savings are evaluated by the opportunity costs for the people there.

It is assumed that with irrigation, cauliflower, the most profitable agricultural product, will be grown twice a year. Currently cauliflower is grown only once a year in Chisapani. Thus the net benefits produced by irrigation will be from an additional cauliflower production, which is NRs. 11,345 per ropani (see Table 9.4.1 in Annex-7: Agriculture) if it is harvested in summer. Since the second harvest will be in spring, the market price of cauliflower is a little cheaper than that in summer. By assuming that all production costs are the same even in spring and that the productivity in spring is 80 % of that in summer, the assumed net benefits by planting additional cauliflower is to be calculated. It is also assumed that the foregone benefits by the second cauliflower cultivation is negligibly small.

Under the without-the-project condition, the farmland will be lost gradually year by year. Let us assume that the whole farmland in Ward No. 4 in Agra VDC will be lost in 20 years with a fixed yearly volume of farmland (i.e., 5 % of the total current farmland in Ward No. 4). According to the survey by the Study Team, the total number of households in Ward No. 4 is about 125 and the average land holding size per household in Ward No. 4 is about 12 ropani (no statistical data book is available in Agra VDC now). Then the total farmland in Ward No. 4 can be calculated and it is divided by 20 in order to get a yearly size of losing farmland. If the land price there represents a marginal value of product, the land price can be used for the benefit calculation. It is, however, assumed to be not true. Instead, it is assumed that the benefits of cultivating cauliflower and potato in the losing land is used for the benefit calculation. The Chisapani people are mostly cultivating cauliflower and potato on their farmland and the net benefits of doing so are NRs. 11,345 per ropani for cauliflower and NRs. 1,515 per ropani for potato (see Table 9.4.1 in Annex-9, Agriculture).

Sustaining the existing farmland will give tremendous benefits for the people in Chisapani, but it is not possible to quantify how much farmland will be lost without the sabo works every year and how much happy the people will be by keeping their farmland. Thus these benefits are not treated in the CBA here. Right now the Chisapani people are so pessimistic that they really want to migrate to safer places somewhere. They know that not only their farmland is disappearing but even their lives are endangered by every-year landslides and periodical big landslides. With the sabo works, their pessimistic minds will be wiped out and they start working hard in the fields to get more income. These benefits, too, are not treated in the CBA, and they should be discussed in Chapter 10.2.

(4) Mahadev Besi Bridge

The Mahadev Besi Bridge is a major infrastructure located on the Prithivi Highway that is the main artery of Nepal and extremely important in many respects. Protecting this bridge will provide enormous benefits to Nepal as a whole, but when it comes to evaluation, it

should be carried out carefully. In the CBA, the best alternative should be always kept in mind. That is, without the sub-project of sabo works to protect the bridge, what will the best alternative be done for the same purpose? The without-the-project condition is not the one in which the bridge is destroyed by floods and the Kathmandu economy is put into chaos. The proper without-the-project condition is that the best alternative is carried out by the HMG/N in this case.

The Study Team carefully examined the best alternative and determined that it would be the construction of a one-span truss bridge in order to avoid disasters by future floods. This truss bridge is assumed to be constructed completely with foreign technology and foreign materials. Then the economic benefits will be the whole costs for construction of this one-span truss bridge.

It is completely sure that the sabo works proposed do not have the same capability as the one-span truss bridge does in securing smooth and safe transportation along the Prithivi Highway. Therefore, the economic benefits may be overvalued.

(5) Kulekhani Reservoir

The proposed sand resources development approach to mitigate the Kulekhani reservoir is expected to generate various benefits which are not limited to the hydropower economy but for the rural economy by constructing the Kulekhani-Daksinkali road. The direct benefits of which are countable in monetable values as follows:

1) kW and kWh values of the hydropower plant due to mitigation of sedimentation in the effective storage,
2) Regional economic benefit of receiving the tax by selling sand to sand transporters,
3) Regional economic benefit by cash crop production in the villages along the proposed Kulekhani- Daksinkali Road.

The detailed procedures to estimate the economic benefit are as follows:

1)-1 : kW value of the Kulekhani Hydropower Plant

The Kulekhani No.1 and No.2 power plants have been so far capable of generating 92 MW of power with an original effective storage of 73.3 million m^3. However, if they have no reservoir, they can generate only 7.164 MW as shown below:

a) 95% of annual draught flow = 0.48 m^3/s (refer to Figure 2.2.1, Annex-3)
b) P = 9.8 x 0.48 m^3/s x (550 m +310m) x 0.85 = 7,164 kW.
note : 550 m : net head of the Kulekhani No.1 power plant,
310 m : net head of the Kulekhani No.2 power plant,
0.85 : overall generating efficiency.

According to the above calculation, it is tentatively estimated that the kW value of the reservoir is :

c) kWV = (92,000 - 7,164) kW/73,300,000 m^3 = 0.001157 kW/m^3.

It means that a loss of 1 m^3 of reservoir storage by sedimentation would be equivalent to a decrease of 0.001157 kW of installed capacity of the Kulekhani hydropower plants. The lost capacity will affect the power generation in the dry season, and it should be covered by the alternative thermal power generating plant because water resources for power generation are scores in the dry season. The gas turbine power plant is therefore selected as the alternative thermal plant and its kW value is calculated at 124.91 US$/kW which is equivalent to 6,964 NRs/kW (the details are shown in Table 10.1.11). The kW value of reservoir excavation is therefore calculated as follows:

d) kWV = 0.001157 kWV/m^3 x 6964 NRs/kW/year = 8.057 NRs/m^3/year

The economic benefit of sand excavation in kW value is therefore calculated based on the 50,000 m^3 per year excavation of the reservoir as shown below:

e) $8.057 \times \sum(50{,}000 \times n)$, n =1,20

1)-2 kWh value

The stored water in the Kulekhani reservoir can yield electric energy at a rate of 1.99 kWh / m^3 in the dry season, according to the following calculation:

a) 9.8 x 1.0 m^3/s x (550 m + 310 m) x 0.85 = 7,163.8 kWh (for 1 hour)
b) 7,163.8 kWh/3600 sec. = 1.99 kW/m^3/year

It means that a loss of 1 m^3 of reservoir storage by sedimentation would be equivalent to a decrease of 1.99 kWh of energy generated by the Kulekhani hydropower plant in the dry season. Since water is scarce in the dry season, the lost electric energy should be covered by other thermal power plants to satisfy the demand. The gas turbine power plant is therefore selected as the alternative thermal plant and its kWh cost is calculated at 0.09927 US$/kWh, which is equivalent to 5.53 NRs/kWh (the details are shown in Table 10.1.11). The kWh value of the reservoir excavation is therefore calculated as follows:

c) kWhV = 1.99 kWh/m^3/year x 5.53 NRs/kWh = 11.00 NRs/m^3/year

The economic benefit in kWh value is therefore calculated based on the 50,000 m^3 per year excavation of the reservoir as shown below:

d) $11.00 \times \sum(50{,}000 \times n)$, n=1,20

2) Regional benefit of selling sand as construction material

The plan proposes that the excavated sand from the effective storage of the reservoir is transported to Kathmandu valley and sold as a construction material. According to a marketing survey conducted by the Study Team, the sand is expected to be marketable. The detailed study results are shown in Chapter 6.3 of Annex-2. It is expected that a local tax amount of about 260 NRs per truck will be paid by the sand buyers to the DDC as well as VDC, which would be allocated to the rural development activities in and around the Kulekhani watershed. An income of 51.6 NRs/m^3 (260 NRs/5.04 m^3) is counted as the

regional benefit of the sand excavation and sale. The annual benefit of sand marketing is therefore calculated as follows:

a) 51.6 NRs./m^3 x 50,000 m^3 = 2,580,000 NRs/year

3) Regional economic benefit of cash crop production

Although it is quite difficult to quantify the regional economic benefit brought about by rural road construction, it is sure that a tremendous economic impact can be expected from the road construction. For example, there is undoubtedly a big difference in agricultural activities between the villages along the road and the isolated villages. The Palung and Daman VDCs along the Tribhuvan Highway are aggressively producing cash crops such as cauliflower, radish, cabbage, carrot, and so on. On the other hand, the villages located far from the road are generally producing various crops for self consumption and transport very few products to the market.

The construction Kulekhani-Daksinkali road will be quite beneficial to the five VDCs along the route because it will facilitate the transport of their agricultural products to the vegetable market in Kathmandu and, as a result, they are expected to shift cropping from cereals to cash crops gradually.

In the economic evaluation, it is assumed that the shift of cropping pattern will take place for 20 years from the commencement of road operation, and the net benefit of such shift is tentatively assumed at NRs 9,000 per ropani, referring to the case of Namtar.

The benefit of cash crop production is then calculated as follows:

No.	VDC	No.of House-holds	Assumed Farmland (ropani)	Assumed Economic Benefit for 20 Years (NRs)
1	Markhu	581	5,810	52,290,000
2	Fakhel	772	7,720	69,480,000
3	Kulekhani	535	5,350	48,150,000
4	Sisneri	612	6,120	55,080,000
5	Chhaimale	668	6,680	60,120,000
	TOTAL	3,168	31,680	285,120,000

10.1.6 EIRR, NPV and B/C

The cash flows of economic costs and benefits by area are given in Tables 10.1.6 to 10.1.10. The EIRR, NPV and B/C (benefit cost ratio) values are shown at the bottom of each table. For calculating the NPV and the B/C, a discount rate of 10 % is adopted.

A summary of these tables is given below:

No.	Area	EIRR (%)	NPV (NRs)	B/C
1	Phedigaon/Phatbazar	4.35	-31,273,944	0.71
2	Namtar/Tilar	5.21	-76,331,197	0.76
3	Chisapani	-2.25	-41,379,935	0.37
4	Mahadev Besi Bridge	14.90	27,992,616	1.49
5	Kulekhani Reservoir	24.67	628,296,112	3.61

Except for Chisapani, at least positive benefits will be obtained. The Namtar/Tilar CDPP projects give the best result while the Chisapani CDPP projects give a negative result. The EIRR for the Mahadev Besi Bridge and the Kulekhani reservoir that these projects are highly viable from the economic viewpoint.

10.1.7 Results of Economic Evaluation

First of all, it should be mentioned again that some kinds of indices must be provided in order to evaluate the sub-projects somehow and that this economic evaluation method is used though it cannot give perfect indices. Therefore please do not too much count on the results given by the CBA in this chapter. They should be regarded as one of those indices that can give some clues to make comparison and evaluation among many projects. There are so many intangible benefits that are not dealt with in the CBA. This is because many proposed sub-projects invite people's participation and so many sociological variables will be changed during implementation.

In most areas, the major benefit-producing source is high-valued agricultural products with the cropping pattern change and the improved productivity. There must be many other benefits generated by the sub-projects, but they are intangible and cannot be evaluated in monetary terms. Thus they are discussed in Chapter 10.2, Impact Analysis.

(1) Phedigaon/Phatbazar

The major benefits are from cauliflower cultivation on the new farmland reclaimed after the completion of the sabo works. The EIRR is 4.35 % which is at least positive, though it is very small. With the sub-projects, the local economy will start developing, the sociological situation will be improved very much, and the area will become far less likely to suffer from another disaster, but these benefits are not considered in the CBA.

(2) Namtar/Tilar

The major benefits are from the production shift to high-valued cash crops such as cauliflower, ginger, and garlic. This shift will be made possible by the road improvement. The EIRR is 5.21 %. Considering the huge costs for constructing several large concrete structures, it is good to have a positive EIRR. It can be said that the road

itself is a highly profitable project of all. With the road, many economic and social activities will be upgraded and flourished, but they are not counted here.

(3) Chisapani

The major direct benefit producer is the drinking water supply sub-project. Without the sabo works, however, everything will be in vain, though. The EIRR is -2.25 % which is a negative value and that will automatically lead to the conclusion that the package of sub-projects in Chisapani should not be implemented. However, under the without-the-project condition, the Chisapani people will leave their villages sooner or later, or end up with being involved in disasters and the community of Chisapani will disappear. Thus it is too early to make such a conclusion now. The decision should be made after evaluating the intangible benefits.

(4) Mahadev Besi Bridge

By using the costs for the best altemative, a one-span truss bridge, the benefits are derived. The EIRR is 14.90%, which is good enough to conclude that the package of sub-projects for the Mahadev Besi Bridge should be implemented. But it should be noticed again that the proposed sabo works are not perfectly comparable to the one-span truss bridge with respect to the capability of protecting the bridge from floods.

(5) Kulekhani Reservoir

The major benefit are from shifting cropping pattern from cereals to cash crops in the five VDCs along the Kulekhani-Daksinkali road. It means that the proposed countermeasures against the reservoir sedimentation are highly beneficial to the local people rather than the electricity users. This tendency would be better to solve the current opinion that the local people do no benefit from the hydropower project. The EIRR is 24.67%, which is good enough to conclude that the package of sub-projects for the Kulekhani Reservoir should be implemented.

10.2 Impact Analysis

10.2.1 General

As mentioned frequently in Chapter 10.1, there are so many benefits that cannot be evaluated in the CBA. All those things are treated in this chapter. Since they cannot be evaluated in monetary terms, they should be evaluated in a descriptive way. One effective presentation is to use tables in which short descriptions are given in the cells. In addition, at the end column on the right hand side, there are five-grade indices to figure out the evaluation results easily. Please notice that these grades are just arbitrary numbers given by the Study Team and no scientific foundation exists behind.

Let us call these unexplainable benefits by the CBA intangible benefits. Most intangible benefits are related to human matters. That is, humans themselves and the society or the community created by people are intangible and constitute the main concerns in impact analysis.

The impact analysis is carried out only for the three CDPP projects because the intangible benefit would be more important to evaluate the CDPP projects than the economic viability. For the IDPP projects, the importance would be the economic viability for project justification, and high economic viability is estimated for both the IDPP projects.

10.2.2 Intangible Benefits

In this section, intangible benefits from the multiple sub-projects at each location are discussed in a descriptive way with matrix representation. Tables 10.2.1 to 10.2.3 give short descriptions for categorised items of intangible benefits with five-grade scores given arbitrarily by the Study Team. Since each table contains limited information, additional explanations are given in this main body so that the way of thinking and the reasons for determining the scores are understood.

(1) Phedigaon/Phatbazar

The following is an additional explanation of each category indicated in Table 10.2.1.

1) Community

Prior to implementation of any sub-project, the formation of users' groups is a must and a ticket to success. Through and after forming users' groups for the sub-projects, a sense of "commons" will be created in the people's minds. (Commons means a special community often formed in Europe during the modern period for using pastures and water as well as for protecting it from outside attacks in a co-operative way.) Within a small users' group, the members should help each other and work together. They should throw away their selfish minds and think about the success of the group they belong to. The

users' groups and the community as a whole will change the people's living environment dramatically.

Some of the proposed sub-projects are classified as participatory community development projects. The participation of the people in the sub-projects will help achieve the empowerment of the people. The community forestry programme will be most effective on this matter since most of the participatory community development sub-projects there are related to construction and maintenance activities.

The economic activities organised by the community will bring about an efficient use of the natural resources available in the area. Since the community forestry programme is the only one that has a close relationship with organised community-based activities for utilising the natural resources and that programme is supposed to be implemented slowly with a small magnitude, the efficiency in using the natural resources is not much impressive.

Although the community forestry programme is the only one that is purely related to participatory implementation, the magnitude of all sub-projects to be implemented in Phedigaon/Phatbazar is relatively large. Thus other outputs, such as self-help minds and mutual support, produced by forming users' groups and implementing those sub-projects, will be also expected to be large in volume.

2) Women

If the workload on women is decreased, they have much spare time to do something else. Sometimes they use their time for chatting with friends to have fun, or for learning language and arithmetic to improve their educational level. Higher education leads consequently to the awareness of sanitation and health care, so that the infant mortality rate will go down. Once they understand that the rate has gone down, they will think that they do not have to have more children. In order to use their spare time for education, their income should be increased as well, otherwise they use it for making money.

Judging from the types of the sub-projects proposed, the workload on the women will be reduced very much. The hardest and the most time-consuming works are fetching water and collecting firewood and fodder. The proposed sub-projects will not contribute to eliminating these works very much. Overall income in the area will be definitely increased. More income and higher education will help empower the women to some degree.

3) Children

Since not much effect is expected on reducing the workload of water fetching and firewood/fodder collection, the children will continuously suffer. However, more income generated by the sub-projects will reduce the hard works imposed on the children to a small extent.

Like the women, the children will have a little more spare time. With higher education in the parents and more spare time for the children, they will have more chances to go to school. Currently many children are so busy helping their

parents that they cannot go to school. Also some parents do not recognise the importance of education and they do not let their children go to school. This situation will be improved.

4) General Issues

The development in the area will stop out-migration and help the existing landless people by providing the land to them. The sabo works will reduce the probability of disaster occurrence and make it possible to reclaim the unused land covered by the debris.

Higher income and higher education will reduce the number of child births, but it will take a little while to attain a proper rate of child births to contain the population explosion.

The environment will be conserved by the management of the natural resources by the community. But except for the community forestry programme, most sub-projects are construction-oriented and not much positive effects on environmental conservation can be expected. Sustainable development is, to some extent, related to environmental conservation. When the people realise the concept of sustainable development, it will be possible to achieve it through community-based development activities, but it should not be expected too much at this stage.

The problem of income disparity and unbalanced growth will be solved by the development in the area. But as the degree of development will not be able to compete with that in the urban areas like in Kathmandu, such problem will not vanish completely.

5) Disaster

Needless to say, the main purpose of the sabo works planned in the Study is to protect the people from disasters. The degree of danger in people's lives and property damage will be definitely lessened. The design concept of the sabo structures in the Study, however, is based on the urgent and short-term measures. Thus no perfect protection from disasters can be expected.

6) Economy

There are no direct measures among the sub-projects to develop the economy in the area. But indirectly the sub-projects will help develop the economy. Less probability of further disasters will encourage the people to be active in economic activities such as reclaiming the debris-covered land and/or starting up new business.

But these indirect effects on the economy will be slow and in a small magnitude at the beginning. It is necessary to wait sometime for the people to gear up for it, but it will come later for sure.

7) Information

A telephone system has been already available in the area. Also as the area is just adjacent to the Tribhuvan Highway, there is a relatively good access to the outside world. The sub-projects themselves will have no clear effect on improving any information system, but it will be improved a little through economic development.

8) Health/Sanitation

Economic development is expected to induce further public services like public health care service. However, a public health post is already existing not far from the area and no big improvement on it is foreseen.

On the contrary, private health care will be improved through the development in the area, i.e., higher income and higher education.

(2) Namtar/Tilar

The following is an additional explanation of each category indicated in Table 10.2.2. Since there are some descriptions in Section 10.2.1, only the important points different from the descriptions in Section 10.2.1 are given in this section.

1) Community

The people in Namtar/Tilar are mature and ready to engage in any participatory community development projects. In all respects, intangible benefits concerning the community will be large. They will easily digest the logic behind forming users' groups and unifying the community, and solve the difficulties they will face.

2) Women

With regard to women's workload, the rural road improvement sub-project will contribute to a dramatic reduction in their workload for transportation between their villages and the Tribhuvan Highway. The most painstaking works for women, however, are fetching water and collecting firewood and fodder, which will not be lessened very much by the sub-projects.

With better transportation, higher income and higher education, the awareness of health care/sanitation by the women will be improved. Consequently the number of child births will be reduced and the safety of delivering babies will be improved. But these things will be realised slowly and gradually.

3) Children

The children's situation is the same as the women mentioned above. Not much dramatic change in children's workload will be expected. But the road improvement will indirectly improve it slowly and gradually.

4) General Issues

The development in the area will stop out-migration and help the existing landless people by providing the land to them. The sabo works will reduce the probability of disaster occurrence and make it possible to reclaim the unused land covered by the debris. The road improvement will provide a lot of business chances which will be a centripetal force for the people to stay in the community.

Since there is no activity to manage and utilise the natural resources by the community, no effect on environmental conservation will be expected. At the same time, the cropping pattern will be changed from more varieties with small quantities to less varieties with big quantities. Thus the environment will not be improved. But the improved road and activities of the community will provide an opportunity for sustainable development.

5) Disaster

The sabo structures will definitely improve the situation against future disasters.

6) Economy

The rural road improvement will give a tremendous effect on economic development in the area. It can be said that everything related to economic development will come by the completion of the road sub-project. The road will be useful not only for Namtar/Tilar but also for the whole Namtar VDC and the vicinity around the downstream area of the Manahari Khola. Many development potentials around there will be materialised by the road.

Along with economic development, entrepreneurship, market economic system and employment opportunities will be brought about.

7) Information

A telephone system will be soon installed in the area with a little assistance provided by the Study Team in the course of the Study. This will improve the situation of the Namtar people. Currently they are so isolated from the outside world that they have to go to Hetauda to make contact with others. The telephone system should not be undervalued in a sense that it will make it possible to realise the efficient economic system observed in developed countries.

The road improvement will improve the postal service system to a great extent.

8) Health/Sanitation

There is a sub health post in Namtar which is not good enough to take care of the people there. Economic development and road improvement will induce further public services. This sub health post may be promoted to a health post which can provide better services for the people in and around Namtar VDC.

(3) Chisapani

The following is an additional explanation of each category indicated in Table 10.2.3. Since there are some descriptions in Section 10.2.1, only the important points different from the descriptions in Section 10.2.1 are given in this section.

1) Community

The people in Chisapani are so pessimistic of their community development that they want to migrate somewhere if possible. But once a sub-project starts to be implemented, especially the drinking water supply sub-project that will generate tangible benefits in a short period, the people will stay in the villages and work hard for development . Then it can be expected that the community will be consolidated and active in many respects.

2) Women

Fetching water will become easy owing to the drinking water supply sub-project. The workload of collecting firewood and fodder will be eased by the community forestry sub-project, but it will be realised in a long term.

3) Children

The children's situation will be saved like the women from painstaking water fetching. The momentum for development will help them go to school more often.

4) General Issues

The migration mind will be wiped out by development. The people know that their farmland generates good income, but the gradual loss of the land by landslides and periodical life-threatening landslides discourage them to stay there and work hard for development.

No new land will be created by the sub-projects, so that the existing landless people will not be saved, but the existing land owners will be helped very much by the sabo structures.

Since the farmland in Chisapani can make a lot of money, if the people can live there safely without losing their farmland, sustainable development with good income will be realised.

The community forestry sub-project will help conserve the environment.

5) Disaster

The sabo structures will definitely improve the situation against future disasters. The situation, however, is not that easy. The proposed sabo structures will not be able to stop completely the landslides with an overwhelming power.

6) Economy

High cash income from high-valued vegetable production will contribute to economic development in the area. Even if it is true, few business opportunities can be foreseen there.

7) Information

A telephone system is available up to Phedigaon, so it will be extended to Chisapani some day. The sub-projects themselves will not contribute to speeding up that extension very much.

The accessibility to Phedigaon will not also be improved very much, the postal service will not be improved, either.

8) Health/Sanitation

The people in Chisapani are visiting a health post located along the Tribhuvan Highway near Phatbazar now when they are ill. The sub-projects proposed in the Study will not change this situation very much. If a health post is to be established around Agra VDC, it should be located far into the hills because there are many other people living in inconvenient remote areas.

10.3 Overall Project Evaluation

Overall project evaluation for proposed CDPPs and IDPPs are assessed based on the results of economic evaluation, project impact analysis and environmental impact assessment.

For Community Disaster Prevention Plans, it is found that the economic viability are rather small in the short-term viewpoints, however, the project benefit is mainly distributed to the poor or weak people such as landless people, severely damaged people by the disaster and women. Considering to the reduction of regional vulnerabilities, it is judged that the proposed CDPPs would be effective. In the environmental aspects, no negative impacts are expected but there are various positive effects such as forest conservation, slope stabilisation and so on.. Taking into consideration of the bottom-up effect and environmental improvement effects, it is judged that the CDPPs are recommendable to implement.

For Infrastructure Disaster Prevention Plans, they have enough economic feasibility. Based on the economic evaluation, the proposed IDPPs would be recommendable to implement by the concerned agencies. However, the detailed environmental impact analysis would be required for IDPP for Kulekhani reservoir in the view of the effects to the aqua-culture activities in the reservoir by sand excavation activities.

Table 10.1.1 Economic Costs in Phedigaon / Phatbazar

Unit: NRs.

No.	Sub-project Name	ICB	LCB	PPP
1	Phedigaon Basic Sabo Project	53,018,600		
2	Phedigaon Participatory Disaster Prevention		44,969,500	
3	Community Disaster Evacuation System		3,000,000	
4	Formation of User's Committee			500,000
5	Land Reclamation on Alluvium Fan Area			5,000,000
6	Community Forestry on Five Forest Areas			1,500,000
7	Agro Forestry on Sloped Farmland			3,500,000
8	Management of Stone Quarry Site			200,000
	Sub-totals of Financial Costs	53,018,600	47,969,500	10,700,000
	Grand Total of Financial Costs	**111,688,100**		
	Special Conversion Factors	0.95	0.79	0.83
	Sub-totals of Economic Costs	50,367,700	37,895,900	8,881,000
	Grand Total of Economic Costs	**97,144,600**		

Table 10.1.2 Economic Costs in Namtar / Tilar

Unit: NRs.

No.	Sub-project Name	ICB	LCB	PPP
1	Namtar Multipurpose Sabo Project	271,845,500		
2	Formation of User's Committee			500,000
3	Rural Road Improvement		4,739,000	
4	Rehabilitation of Rural Irrigation		5,026,000	
5	Crop Diversification Program			2,500,000
6	VHF Wireless Telephone Installation			50,000
7	WID through Eri-silk Industry Research			1,000,000
8	Micro-hydropower		7,836,000	
	Sub-totals of Financial Costs	271,845,500	17,601,000	4,050,000
	Grand Total of Financial Costs	**293,496,500**		
	Special Conversion Factors	0.95	0.79	0.83
	Sub-totals of Economic Costs	258,253,200	13,904,800	3,361,500
	Grand Total of Economic Costs	**275,519,500**		

Table 10.1.3 Economic Costs in Chisapani

Unit: NRs.

No.	Sub-project Name	ICB	LCB	PPP
1	Chisapani Basic Sabo Project	42,985,500		
2	Chisapani Participatory Disaster Prevention		19,175,800	
3	Formation of User's Committee			500,000
4	Community Disaster Evacuation System		4,500,000	
5	Water Supply Network Development		3,070,000	
6	Community Forestry at Chuliban			1,000,000
7	Improvement of Contour Farming			2,500,000
8	Agro Forestry on Sloped Farmland			3,500,000
	Sub-totals of Financial Costs	42,985,500	26,745,800	7,500,000
	Grand Total of Financial Costs	**77,231,300**		
	Special Conversion Factors	0.95	0.79	0.83
	Sub-totals of Economic Costs	40,836,200	21,129,200	6,225,000
	Grand Total of Economic Costs	**68,190,400**		

Table 10.1.4 Economic Costs in Mahadevbesi Bridge

Unit: NRs.

No.	Table Title	ICB	LCB	PPP
1	Groundsill No. 1	47,755,700		
2	Groundsill No. 2	42,082,100		
3	Spur Dikes and Riverside Park		2,409,400	
	Sub-totals of Financial Costs	89,837,800	2,409,400	0
	Grand Total of Financial Costs	**92,247,200**		
	Special Conversion Factors	0.95	0.79	0.83
	Sub-totals of Economic Costs	85,345,900	1,903,400	0
	Grand Total of Economic Costs	**87,249,300**		

Table 10.1.5 Economic Costs in Kulekhani Reservoir

Unit: NRs.

No.	Sub-project Name	ICB	LCB	PPP
1	Procurement of excavation equipment	139,298,000		
2	Construction of Kulekhani-Daksinkali road			60,946,700
3	Improvement of Kulekhani-Daksinkali road		152,017,000	
	Sub-totals of Financial Costs	139,298,000	152,017,000	60,946,700
		352,261,700		
	Special Conversion Factors	0.95	0.79	0.83
	Sub-totals of Economic Costs	132,333,100	120,093,400	50,585,800
		303,012,300		

Table 10.1.6 Economic Cash Flow in Phedigaon/Phabazar

Unit: Rs.

No.	Year	Cost	Benefit	Net Benefit
1	1997	97,144,600		-97,144,600
2	1998		7,369,800	7,369,800
3	1999		7,369,800	7,369,800
4	2000		7,369,800	7,369,800
5	2001		7,369,800	7,369,800
6	2002		7,369,800	7,369,800
7	2003		7,369,800	7,369,800
8	2004		7,369,800	7,369,800
9	2005		7,369,800	7,369,800
10	2006		7,369,800	7,369,800
11	2007		7,369,800	7,369,800
12	2008		7,369,800	7,369,800
13	2009		7,369,800	7,369,800
14	2010		7,369,800	7,369,800
15	2011		7,369,800	7,369,800
16	2012		7,369,800	7,369,800
17	2013		7,369,800	7,369,800
18	2014		7,369,800	7,369,800
19	2015		7,369,800	7,369,800
20	2016		7,369,800	7,369,800
21	2017		7,369,800	7,369,800

EIRR	4.35%
NPV (10% discount rate, Rs.)	-31,273,944
B/C (10% discount rate)	0.71
B/C (3%)	1.16

Table 10.1.7 Economic Cash Flow in Namtar/Tilar

Unit: Rs.

No.	Year	Cost	Benefit	Net Benefit
1	1997	275,519,500		-275,519,500
2	1998		22,500,000	22,500,000
3	1999		22,500,000	22,500,000
4	2000		22,500,000	22,500,000
5	2001		22,500,000	22,500,000
6	2002		22,500,000	22,500,000
7	2003		22,500,000	22,500,000
8	2004		22,500,000	22,500,000
9	2005		22,500,000	22,500,000
10	2006		22,500,000	22,500,000
11	2007		22,500,000	22,500,000
12	2008		22,500,000	22,500,000
13	2009		22,500,000	22,500,000
14	2010		22,500,000	22,500,000
15	2011		22,500,000	22,500,000
16	2012		22,500,000	22,500,000
17	2013		22,500,000	22,500,000
18	2014		22,500,000	22,500,000
19	2015		22,500,000	22,500,000
20	2016		22,500,000	22,500,000
21	2017		22,500,000	22,500,000

EIRR	5.21%
NPV (10% discount rate, Rs.)	-76,331,197
B/C (10% discount rate)	0.76
B/C (3%)	1.25

Table 10.1.8 Economic Cash Flow in Chisapani

Unit: Rs.

No.	Year	Cost	Benefit	Net Benefit
1	1997	68,190,400		-68,190,400
2	1998		2,663,100	2,663,100
3	1999		2,663,100	2,663,100
4	2000		2,663,100	2,663,100
5	2001		2,663,100	2,663,100
6	2002		2,663,100	2,663,100
7	2003		2,663,100	2,663,100
8	2004		2,663,100	2,663,100
9	2005		2,663,100	2,663,100
10	2006		2,663,100	2,663,100
11	2007		2,663,100	2,663,100
12	2008		2,663,100	2,663,100
13	2009		2,663,100	2,663,100
14	2010		2,663,100	2,663,100
15	2011		2,663,100	2,663,100
16	2012		2,663,100	2,663,100
17	2013		2,663,100	2,663,100
18	2014		2,663,100	2,663,100
19	2015		2,663,100	2,663,100
20	2016		2,663,100	2,663,100
21	2017		2,663,100	2,663,100

EIRR	-2.25%
NPV (10% discount rate, Rs.)	-41,379,935
B/C (10% discount rate)	0.37
B/C (3%)	0.60

Table 10.1.9 Economic Cash Flow in Mahadevbesi Bridge

Unit: Rs.

No.	Year	Cost	Benefit	Net Benefit
1	1997	87,249,300		-87,249,300
2	1998		13,865,072	13,865,072
3	1999		13,865,072	13,865,072
4	2000		13,865,072	13,865,072
5	2001		13,865,072	13,865,072
6	2002		13,865,072	13,865,072
7	2003		13,865,072	13,865,072
8	2004		13,865,072	13,865,072
9	2005		13,865,072	13,865,072
10	2006		13,865,072	13,865,072
11	2007		13,865,072	13,865,072
12	2008		13,865,072	13,865,072
13	2009		13,865,072	13,865,072
14	2010		13,865,072	13,865,072
15	2011		13,865,072	13,865,072
16	2012		13,865,072	13,865,072
17	2013		13,865,072	13,865,072
18	2014		13,865,072	13,865,072
19	2015		13,865,072	13,865,072
20	2016		13,865,072	13,865,072
21	2017		13,865,072	13,865,072

EIRR	14.90%
NPV (10% discount rate, Rs.)	27,992,616
B/C (10% discount rate)	1.49

* Capital recovery factor of One span Truss bridge:
0.11746 (20 years, 10% of annual discount rate)

B/C (3%)	2.44

Table 10.1.10 Economic Cash Flow in Kulekhani Reservoir

Unit: Rs.

No.	Year	Cost	Benefit	Net Benefit
1	1997	303,012,300		-303,012,300
2	1998		17,789,102	17,789,102
3	1999		32,998,204	32,998,204
4	2000		48,207,306	48,207,306
5	2001		63,416,408	63,416,408
6	2002		78,625,510	78,625,510
7	2003		93,834,612	93,834,612
8	2004		109,043,714	109,043,714
9	2005		124,252,816	124,252,816
10	2006		139,461,918	139,461,918
11	2007		154,671,020	154,671,020
12	2008		169,880,122	169,880,122
13	2009		185,089,224	185,089,224
14	2010		200,298,326	200,298,326
15	2011		215,507,428	215,507,428
16	2012		230,716,530	230,716,530
17	2013		245,925,632	245,925,632
18	2014		261,134,734	261,134,734
19	2015		276,343,836	276,343,836
20	2016		291,552,938	291,552,938
21	2017		306,762,040	306,762,040

EIRR	24.67%
NPV (10% discount rate, Rs.)	628,296,112
B/C (10% discount rate)	3.61

*Benefit (1) kW value of reservoir : 0.001157 kW/m3 = 8.05NRs./m3
*Benefit (2) kWh value of reservoir : 1.99 kWh/m3=11.00NRs./m3
*Benefit (3) Regional income by sand selling : 51.6NRs. / m3 (every year)
*Benefit(4) Regional income by cash crop production :
NRs.9,000/ropani (for 20 years)

Table 10.1.11 Capacity Value and Energy Value Calculation

1.Basic Condition of Gas Turbine Plants

(a)	Capital cost	670 US$ / kW
(b)	Economic Life	15 years
(c)	Capital recovery factor	0.1315
(d)	O&M cost	3.5% of capital cost
	- Fixed O&M	2.45% of capital cost (70% of O&M)
	- Valuable O&M	1.05% of capital cost (30% of O&M)
(e)	Fuel price	37.5 US cent /kg
(f)	Heat efficiency	36%

2. Loss Rate Difference between Thermal and Hydropower Plants

Losses	Loss of kW (%)		Loss of kWh (%)	
	Hydro	Thermal	Hydro	Thermal
Loss by repair	0.4	10.0	0.0	0.0
Accident loss	0.5	2.5	0.0	0.0
Own consumption	0.5	6.0	0.2	5.0

3. Adjustment Factor between Thermal and Hydropower

(1) Adjustment factor for kW value :

Hydro / thermal = {(1-0.004)x(1-0.005)x(1-0.005)} / {(1-0.1)x(1-0.025)x(1-0.06)}

= 1.195

(2) Adjustment factor for kWh value :

Hydro / Thermal = (1-0.002) / (1-0.005)

= 1.051

4. Capacity Cost of Gas Turbine Plants

(a) Capital recovery cost	88.11 US$ / kW /year
(b) Annual O&M cost	16.42 US$ / kW / year
(c) Total annual cost	104.653 US$ / kW /year

5. Energy Cost for Gas Turbine Plants

(a) Fuel per kWh	0.239 kg / kWh
(b) Fuel cost	8.963 US cent / kWh
(c) O&M cost	0.482 US cent / kWh
(d) Energy cost	9.445 US cent / kWh

6. Capacity Value of Hydropower Plants

104.53 US$/kW x 1.195 = 124.91 US$ / kW

7. Energy Value of Hydropower Plants

9.445 US cent / kWh x 1.051 = 9.927 US cent / kWh

*** Source : Comparative Study on Alternative Countermeasures for Kulekhani Disaster Prevention Project, Stage III - Phase II, NEA, November 1994.

Table 10.2.1 Intangible Benefits in Phedigaon/Phatbazar

S.N.	Category	Description of Intangible Benefits	Score
1	Community		
	1) Empowerment	People are empowered and take initiative for development activities through forming users groups and implementing subprojects.	★★★
	2) Efficiency	United as one, local resources are used effectively and efficiently.	★★
	3) Self Help	People realise the importance of self-help minds and wipe out their dependency attitude through users group activities.	★★★★
	4) Mutual Support	With forming a solid community, people help each other, which contributes to the improvement of living quality.	★★★
2	Women		
	1) Work Load	By increased income and afforestation, women's work load is reduced.	★
	2) Education Level	With more free time, women have more time for education and training.	★★
	3) Child Birth	Higher education leads to understanding of birth control.	★★★
	4) Safety in Child Birth	Higher education and awareness of sanitation contribute to safer delivery.	★★★
	5) Empowerment of Women	More income and higher education make women empowered.	★
3	Children		
	1) Work Load	By increased income and afforestation, children's work load is reduced.	★
	2) Education Level	With more free time, children have more time for attending school and doing homework.	★★
	3) Child Abuse	With less work load and higher income, children are not abused very much.	★★
4	General Issues		
	1) Migration	With flourishing economy around the area, more employment opportunities are available and there is little need for migration.	★★★
	2) Landlessness	Land reclamation and sabo works provide and secure the farmland for landless people and land owners.	★★★★
	3) Population Explosion	Higher education and higher sanitation, health care services contribute to changing people's understanding on reproduction and contain population explosion.	★★
	4) Environmental Conservation	The community control over the forest use and other natural resources helps to conserve the environment.	★★
	5) Sustainable Development	Conserving and effectively using environment by the community leads to attaining sustainable development.	★★
	6) Income Disparity	Increase in income in the area reduces income disparity between urban and rural areas.	★★★
	7) Unbalanced Growth	Too much concentration of development in urban areas is eased by rural development.	★★★
5	Disaster		
	1) Danger in Life	Sabo structures protect human lives from disasters.	★★★★
	2) Property Damage	Sabo structures protect private properties and public infrastructures from disasters.	★★★★
6	Economy		
	1) Regional Economic Development	The project implementation contributes to regional economic development.	★★
	2) Entrepreneurship	Economic development leads to emerging entrepreneurship among the people.	★★
	3) Market Economy	The market-oriented economic system prevails through development activities.	★
	4) Employment Opportunities	Economic development provides more employment opportunities.	★★★
7	Information		
	1) Information Network	Development leads to improvement of telephone and postal systems.	★★
	2) Information Imbalance	With improved information system, information imbalance between urban and rural areas is reduced.	★★
8	Health/Sanitation		
	1) Public Health Care	Development invites further public health care services.	★
	2) Private Health Care	Higher education and higher income improve the awareness of private health care.	★★★
9	Others		

Note: The more ★ marks there are, the better the situation is. (The five ★ marks is the maximum and one ★ mark is the minimum score.)

Table 10.2.2 Intangible Benefits in Namtar/Tilar

S.N.	Category	Description of Intangible Benefits	Score
1	Community		
	1) Empowerment	People are empowered and take initiative for development activities through consolidating the community.	★★★★★
	2) Efficiency	Local resources are used effectively and efficiently by developing a strong access to outside markets.	★★★★
	3) Self Help	People realise the importance of self-help minds and wipe out their dependency attitude.	★★★★★
	4) Mutual Support	In a community, people help each other, which contributes to the improvement of living quality.	★★★★
2	Women		
	1) Work Load	By increased income and good road transportation, women's work load is	★★★
	2) Education Level	With more free time, women have more time for education and training.	★★★
	3) Child Birth	Higher education leads to understanding of birth control.	★★★
	4) Safety in Child Birth	Higher education and awareness of sanitation contribute to safer child delivery.	★★★
	5) Empowerment of Women	More income and higher education make women empowered.	★★
3	Children		
	1) Work Load	By increased income and good road transportation, children's work load is	★★★
	2) Education Level	With more free time, children have more time to use for attending school and homework.	★★★
	3) Child Abuse	With less work load and higher income, children are not abused very much.	★★★
4	General Issues		
	1) Migration	With flourishing economy around the area, more employment opportunities are available and there is little need for migration.	★★★★★
	2) Landlessness	Land reclamation and sabo works secure the farmland for landless and land owners.	★★★
	3) Population Explosion	Higher education and higher sanitation and health care services contribute to containing population explosion.	★★
	4) Environmental Conservation	The community control over the surrounding natural resources helps to conserve the environment.	★
	5) Sustainable Development	Community activities lead to attaining sustainable development.	★★★
	6) Income Disparity	Increase in income in the area reduces income disparity between urban and rural areas.	★★★
	7) Unbalanced Growth	Too much concentration of development in urban areas is eased by rural development.	★★★
5	Disaster		
	1) Danger in Life	Sabo structures protect human lives from disasters.	★★★
	2) Property Damage	Sabo structures protect private properties and public infrastructures from disasters.	★★★
6	Economy		
	1) Regional Economic Development	The project implementation contributes to regional economic development.	★★★★
	2) Entrepreneurship	Economic development leads to emerging entrepreneurship among the people.	★★★
	3) Market Economy	The market-oriented economic system prevails through development activities.	★★★
	4) Employment Opportunities	Economic development provides more employment opportunities.	★★★
7	Information		
	1) Information Network	Development leads to improvement of telephone and postal systems.	★★★★
	2) Information Imbalance	With improved information system, information imbalance between urban and rural areas is reduced.	★★★★
8	Health/Sanitation		
	1) Public Health Care	Development invites further public health care services.	★★★
	2) Private Health Care	Higher education and higher income improve the awareness of private health care.	★★★
9	Others		

Note: The more ★ marks there are, the better the situation is. (The five ★ marks is the maximum and one ★ mark is the minimum score.)

Table 10.2.3 Intangible Benefits in Chisapani

S.N.	Category	Description of Intangible Benefits	Score
1	Community		
	1) Empowerment	People are empowered and take initiative for development activities through consolidating the community.	★★★
	2) Efficiency	Local resources are used effectively and efficiently by developing a strong access to outside markets.	★★
	3) Self Help	People realise the importance of self-help minds and wipe out their dependency attitude.	★★★
	4) Mutual Support	In a community, people help each other, which contributes to the improvement of living quality.	★★
2	Women		
	1) Work Load	By increased income and tapwater system, women's work load is reduced.	★★★★
	2) Education Level	With more free time, women have more time to use for education and training.	★★
	3) Child Birth	Higher education leads to understanding of birth control.	★★★
	4) Safety in Child Birth	Higher education and awareness of sanitation contribute to safer child delivery.	★★★
	5) Empowerment of Women	More income and higher education make women empowered.	★★
3	Children		
	1) Work Load	By increased income and tapwater system, children's work load is reduced.	★★★★
	2) Education Level	With more free time, children have more time to use for attending school and homework.	★★
	3) Child Abuse	With less work load and higher income, children are not abused very much.	★★
4	General Issues		
	1) Migration	With flourishing economy and reduction of fear against disasters around the area, there is little need for migration.	★★★★★
	2) Landlessness	Sabo works secure the farmland for landless and land owners.	★★
	3) Population Explosion	Higher education and higher sanitation and health care systems contribute to containing population explosion.	★★
	4) Environmental Conservation	The community control over the forest use and other natural resources helps to conserve the environment.	★★★
	5) Sustainable Development	Conserved environment and community activities lead to attaining sustainable development.	★★★
	6) Income Disparity	Increase in income in the area reduces income disparity between urban and rural areas.	★★★
	7) Unbalanced Growth	Too much concentration of development in urban areas is eased by rural development.	★★★
5	Disaster		
	1) Danger in Life	Sabo structures protect human lives from disasters.	★★
	2) Property Damage	Sabo structures protect private properties and public infrastructures from disasters.	★★
6	Economy		
	1) Regional Economic Development	The project implementation contributes to regional economic development.	★★★
	2) Entrepreneurship	Economic development leads to emerging entrepreneurship among the people.	★
	3) Market Economy	The market-oriented economic system prevails through development activities.	★
	4) Employment Opportunities	Economic development provides more employment opportunities.	★★
7	Information		
	1) Information Network	Development leads to improvement of telephone and postal systems.	★
	2) Information Imbalance	With improved information system, information imbalance between urban and rural areas is reduced.	★
8	Health/Sanitation		
	1) Public Health Care	Development invites further public health care services.	★
	2) Private Health Care	Higher education and higher income improve the awareness of private health care.	★★★
9	Others		

Note: The more ★ marks there are, the better the situation is. (The five ★ marks is the maximum and one ★ mark is the minimum score.)