

CHAPTER

3

**EXISTING ENVIRONMENTAL CONDITIONS**

**3. EXISTING ENVIRONMENTAL CONDITIONS**

This chapter documents existing environmental conditions, particularly in the areas of physical, biological, socio-economic and cultural resources in relation to the Project activities.

**3.1. Physical Environment**

**3.1.1. Topography and Climate**

The Sunsari River Irrigation Project (SRIP) area is located in the south-western part of the Sunsari District located between 26°24'N to 26°30'N in latitude and 87°04'E to 87°12'E in longitude. The elevation ranges from 64 meters to 80 meters above the mean sea level. The study area is rectangular in shape with E-W width varying from 4 to 8 kilometres and N-S length of about 22 kilometres. The western and southern part of the project area is bordered with India.

The Project area is located at the eastern bank of the Sapta Koshi River. The terrain starts from foothills of the Siwalik range and slopes gently down to south with an inclination of 5 degrees on an average and is formed by alluvium of old and present rivers. The Project area is dominated by sandy soils having low to moderate water holding capacity.

The climate in the project area is sub-tropical. Temperatures are high between March and October, the hottest month being the April, during which the mean daily maximum temperature is about 34°C. During the cool period from November to February, mean monthly temperatures are in the range of 16 to 22°C. The annual average rainfall between 1970 and 1993 was 1,867mm, raining intensively in the monsoon period, from late May to September.

Long-term patterns of annual rainfall from 1973 to 2001 for Dharan Bazar and Chatra stations, and for Tarahara and Biratnagar Airport are given in the figure (Figure 3-1). No significant difference is observed amongst the available stations. The figures indicate that the rainfall fluctuates almost in 7 to 8 years term. In addition, rainfall at Biratnagar airport is noticeably high in 1974 and low in 1994.

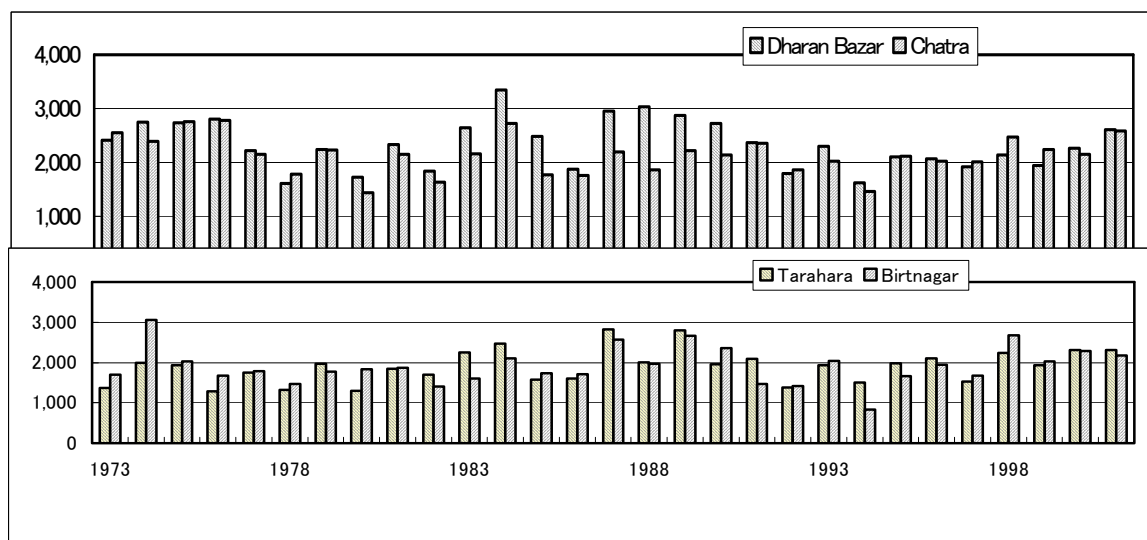


Figure 3-1 : Annual Rainfall from 1973 to 2001

Mean annual rainfall and monthly rainfall are summarized as follows (Table 3-1). Annual rainfall ranges from 1900 mm to 2400 mm and increases northward. Monthly distribution of rainfall is almost same among the stations with about 80 percent rainfall occurring in the monsoon season. However, correlative coefficient of daily rainfall among stations is about 0.6 only.

Table 3-1 : Mean Annual and Monthly Rainfall

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Dharan Bazar	13	15	24	61	173	374	631	572	408	143	15	7	2441
Chatra	17	14	24	58	161	394	603	474	353	143	17	7	2265
Tarahara	14	13	18	62	163	323	525	380	300	102	14	11	1925
Biratnagar	10	13	15	52	165	323	526	375	313	108	10	7	1917

Source: Climatological Records (different years)

### 3.1.2. Hydrology and Drainage System

The prospective water resources for the project area are; 1) Sunsari River, 2) groundwater either shallow or deep, 3) water release from SMIP if extra water available is in the Chatra main canal, and 4) other rivers such as Budhi and its tributaries. The last one, Budhi River, provides already a diversion weir at a place named Kathale Nadi and Budhi Khola merge into the main Budhi River. The diversion weir commands about 1,800 ha of the area near the international border. Therefore, the downstream from the weir has no possibility that further water exploitation could be made.

Though Kathale Nadi demarcating upstream eastern boundary of the project area seems an option to develop, the runoff is very little as suggested by the catchment area of only 20 km<sup>2</sup>. Also, a diversion in the Kathale Nadi will reduce the water release to the already functioning weir of the Budhi River. Therefore, the potential of the Sunsari River as the first development priority source and the groundwater as the supplemental water source together with the possibility of getting water from SMIP for the project area.

There are two main rivers flowing through the study area in a direction parallel to the Sapta Koshi River. The Sunsari River – the source river for the irrigation project – flows southwest through the central part of the study area and the Budhi River flows towards the south along the eastern border of the study area. Mariya Dhar, abandoned course of the Sunsari River, is in the central part of the study area between Jalpapur and Kaptanganj.

Sunsari River has a catchment area of 300 km<sup>2</sup> at the prospective headwork site which is 600 m downstream from the E-W highway crossing point. This River originates in the Siwalik Range that is located in the northern part of Sunsari district. The river flows from the north to south and is meandering. The upper stream of the Sunsari River after confluence of Belaha Khola and Thalaha Khola is called the Sunsari River.

As to the tributaries of the Sunsari River, there are two major ones; Kakar (Sardu) and Kuruwa (Seuti) Kholas. These rivers also originate in the Siwaliks. Kakar Khola flows along the right edge of alluvial fan in Dharan to the southeast and passes through the Terai plain. This tributary joins the Sunsari River at about 35 km from the top of Dharan alluvial fan. Kuruwa Khola flows along the left edge of Dharan alluvial fan to the south. It joins the Sunsari River at about 36 km from the top of Dharan alluvial fan.

### 3.1.3. Geology and Geomorphology

The project area is the northern part of the Indo-Gangetic plain. Tectonically/geologically, the surrounding areas of the project can be divided into four zones: the Alluvial Formation, Siwalik Group, Takure Formation and Seti Formation. The Alluvial Formation un-conformably overlies the Siwalik Group. Siwalik Group contacts in fault with Takure Formation. Also, Takure Formation contacts in fault with Seti Formation. Table 3-2 summarizes the stratigraphic classification and outline of the general geology around the Study area:

Table 3-2 : The Stratigraphic Classification of the Study Area

Quaternary (Recent)	Alluvium	Boulder, Gravel, sand and Silt-Clay	The Study Area, Bhabar Zone (Alluvial Fan)
Mid-Miocene - Pleistocene	Siwalik Group (Churia)	Fine to medium grained arkosic pebbly sandstone, unconsolidated conglomerate. Fine grained, hard gray sandstone inter-bedded with purple coloured shale	Siwalik Range (Mountain)
Permo - Carboniferous	Takure Formation	Sandstone, quartzite sandstone, graphitic coals, chloritic phyllites	(Mountain)
Precambrian	Seti Formation	Gray to greenish gray phyllites, quartzites with minor conglomeratic	(Mountain)

The Terai plain was created by tectonic upheaval of Himalayas and development of fore deep of Indo-Gangetic basin a million years ago<sup>1</sup>. When Himalayas rose to this final shape, a fore deep was created in which Siwalik and older sediment layers sunk in the trough. Now Siwalik rock lies at a depth of 1.2 to 1.5 km below the Terai alluvium.

The alluviums in Terai were deposited by sediment derived from nearby mountains. Lithology of top part of the alluvium beds is found to be similar to those rocks exposed in the nearby mountains. Not all rivers which are at presents flowing through Terai have contributed to the deposition. Only major rivers like the Koshi, having antecedent nature, had deposited first in the basin. Later on when other rivers came into existence, and they also started depositing the older material on the top part of the alluvium beds.

The study area is underlain by unconsolidated alluvial deposit. This formation is irregular alternating beds of silt, sand and gravel. These deposits grade laterally and vertically into each other. Local boulders are found with a scattered pattern outcrops at a construction site of road and bridge. The unconsolidated sediment deposits are mostly pervious and make an excellent aquifer.

### 3.1.4. Soil Type and Quality

Based on the result of Land Resource Mapping Project (RMP) which was conducted as a technical co-operation by the Canadian International Development Agency (CIDA), most of the study area is classified into the areas suitable for diversified crop due to the sandy soils except for limited spots scattered in Ghuski, Rajganj Sinuwari, Madhya Harsahi and Gautampur VDCs (see Figure 3-2). The sandy soil is found more as one goes to southern part of the study area.

Number of soil samples were taken for the determination of the soil characteristics. The results of soil analysis have been summarized in (Table 3-3).

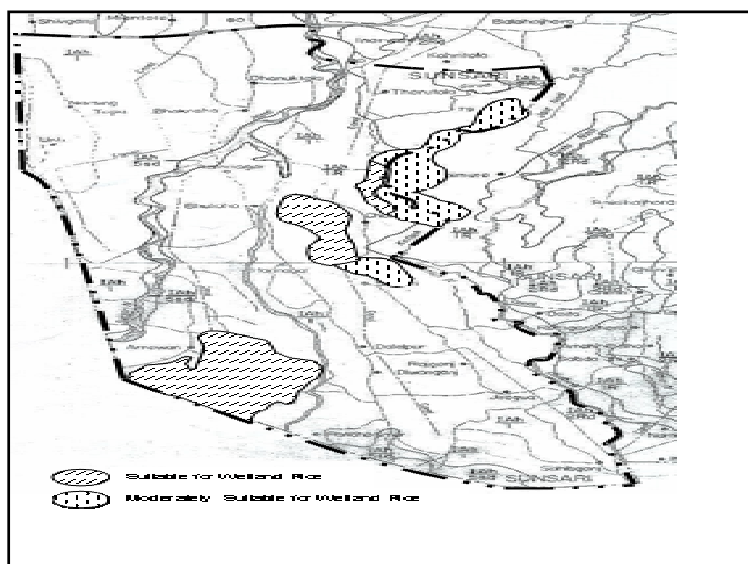


Figure 3-2 : Areas Suitable for Paddy

<sup>1</sup> Sedimentary environment on the Study area is based largely on Sharma C.K., 1995 Shallow Aquifers of Nepal.

Table 3-3 : The Result of Soil Analysis

Items	Standard	Max.	Min.	Classification		
				Low/ Deficit	Medium/ Adequate	High/ Toxic
(1) Texture		65.8 % <sup>1)</sup>	35.8 % <sup>1)</sup>	2 <sup>2)</sup>	6 <sup>2)</sup>	11 <sup>2)</sup>
(2) pH	6.0 - 8.0	5.7	7.2	5	14	-
(3) Organic Matter	2.5 - 5.0%	9.7 %	0.7%	8	9	2
(4) Major Elements						
Nitrogen (N)	-	0.28 %	0.03%	6	8	5
Phosphorous (P)	28 - 56 kg/ha <sup>3)</sup>	969 kg/ha	189 kg/ha	-	-	19
Potash (K)	112 - 280 kg/ha <sup>4)</sup>	591 kg/ha	836 kg/ha	-	-	19
(5) Micronutrients						
Boron (B)	20 - 60 ppm	80 ppm	44 ppm	-	8	11
Molybdenum (Mo)	0.2 - 1.0 ppm	53.1 ppm	2.3 ppm	-	-	19
Zinc (Zn)	25 - 150 ppm	65.8 ppm	14.0 ppm	11	8	-
Copper (Cu)	5 - 20 ppm	24.5 ppm	4.5 ppm	4	12	3
Iron (Fe)	50 - 250 ppm	153 ppm	63 ppm	-	19	-
Manganese (Mn)	20 - 500 ppm	680 ppm	250 ppm	-	8	11

1) Contents of sand (%)

2) Low/Deficit: silt loam, Medium/Adequate: loam, High/Toxic: sandy loam

3) P<sub>2</sub>O<sub>5</sub> basis

4) K<sub>2</sub>O basis

### 3.1.5. Evapo-transpiration

Crop water consumption is estimated as a product of the Potential Evapotranspiration (ET<sub>o</sub>) and crop coefficient (K<sub>c</sub>), which varies according to the crop growth stage. The ET<sub>o</sub> is calculated using the Modified Penman Method recommended in "Crop Water Requirements, FAO Irrigation and Drainage Paper No.24, 1977". Based on this, the ET<sub>o</sub> is calculated as the minimum of 2.3 mm/day for December, the maximum of 7.2 mm/day in April and the annual total is 1,679 mm (Table 3-4).

Table 3-4 : Potential Evapotranspiration (PET<sub>o</sub>) Unit (mm/day)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
2.4	3.6	5.6	7.2	7.0	5.8	4.7	4.9	4.2	4.0	3.3	2.3	1,679

Being the soil sandy, percolation loss was also considered to estimate paddy water requirement. A total of 42 field tests of water depth measurement (percolation test) were carried out from April to August in 2001 and from July to August in 2002. N-type water requirement test in depth measurement (240×480 mm no bottom box) was carried out with pan evaporation kit and the rainfall-gauging kit.

The result ranges from 9.9 mm/day to as much as 38.7 mm/day. No test has shown the percolation less than or close to the SMIP design percolation that is 3.00 mm/day in Suksena area. In the southern part of the study area, the soil is getting sandy. The percolation test results are very correlative to the observation. If the Study area is divided into three parts; northern, mid and southern, average percolations are 14.4 mm/day, 17.0 mm/day and 20.8 mm/day from the north to south respectively. Taking into account area coverage corresponding to its averages, the overall average percolation arrives at 17.26 mm/day.



Table 3-5 : Design Percolation Rate (mm/day)

Zone	Area, ha	Excluded, ha	Area, ha	Sample No.	Avg Percor'n	Weighted Avg
Upstream	2,926		2,926	14	14.4	17.26 mm/day
Midstream	4,518		4,518	14	17.0	
Downstream	3,100	397	2,703	14	20.8	
Total Area	10,544	397	10,147	42	mm/day	

### 3.1.6. Watershed Condition, Soil Erosion and Sedimentation

The catchment area of the Sunsari River is estimated to about 300 km<sup>2</sup> and most of its area lies in the Siwalik Range that is characterised by weak geological formations with unstable and steep slopes, making it vulnerable to exogenous factors. The intense monsoon rainfall that occurs within a short span of time is one of the important causes of soil erosion. The improper land use practices, deforestation and intense rainfall in the Churia hills undergo degradation every rainy season. Consequently, flooding, sediment deposition and bank erosion affect the project area. In general, the catchment condition is relatively disturbed, erosion potential is high and resultant effect is the sedimentation in the riverbed and the farmland.

### 3.1.7. Land use

According to the Rural Socio-economic Survey conducted by the Study Team in July 2002 (hereinafter referred as "Rural Socio-economic Survey"). Out of the total agricultural land in the study area, currently irrigated (fully and partially irrigated) land occupies only 17 percent (Table 3-6). In the southern part of the Study area, there is no fully irrigated land.

Table 3-6: Land Use on the Basis of Individual Land Holding

Land Use Area	Agricultural Land (ha)				Pasture (ha)	Forest <sup>1)</sup> (ha)	Others <sup>2)</sup> (ha)	TOTAL (ha)
	Fully Irrigated	Partially Irrigated	Rain- fed	Sub- total				
Northern Area	0.35	0.31	1.51	2.17	0.02	0.03	0.19	2.41
Central Area	0.20	0.20	1.32	1.72	0.01	0.04	0.15	1.92
Southern Area	-	0.10	2.12	2.22	0.00	0.03	0.16	2.41
<b>TOTAL</b>	<b>0.15 (8%)</b>	<b>0.19 (9%)</b>	<b>1.68 (83%)</b>	<b>2.02 (100%)</b>	<b>0.01</b>	<b>0.04</b>	<b>0.17</b>	<b>2.24</b>

Note :

1) Includes bamboo, orchard and timber woods etc.

2) Includes house and surroundings etc.

The large part of agricultural land (about 83 percent) in the study area is cultivated under the rain-fed condition. However, it does not mean that there is no water source for irrigation except rainfall. STW irrigation has widely been applied in the study area. 91 percent of sample households cultivate winter crops by using STW. Even in monsoon season, supplementary irrigation by STW is indispensable to transplant paddy seedling in the southern part of the study area.

The Study area was originally included in the command area of SMIP covered by both Suksena and Shankarpur Canals. However, these canals can only provide irrigation water to limited farmlands along the canals upstream due to incomplete watercourse network as well as insufficient water supply from Chatra Main Canal (CMC).

### 3.1.8. Water Availability and Quality

#### i. Water Availability

The Sunsari River is the source of water for the Project. About 80 percent reliable mean monthly flow of the river is given below (Table 3-7):

Table 3-7 : 80% Reliable Mean Monthly Flows

Months	80% cum/s			Average cum/s		
	First 10 days	Middle 10 days	Last 10 days	First 10 days	Middle 10 days	Last 10 days
January	4.048	4.191	3.835	4.953	5.128	4.693
February	3.902	3.954	3.845	4.774	4.838	4.704
March	3.694	3.719	4.093	4.519	4.550	5.007
April	4.136	4.382	5.793	5.061	5.362	7.088
May	6.461	8.689	10.120	7.905	10.631	12.382
June	13.484	21.225	21.183	16.498	25.969	25.918
July	32.703	30.060	35.121	40.013	36.779	42.972
August	26.513	29.928	24.463	32.439	36.617	29.931
September	22.445	26.809	19.647	27.462	32.801	24.038
October	14.871	12.640	7.355	18.195	15.465	8.999
November	5.598	4.928	4.059	6.849	6.030	4.966
December	4.280	3.962	4.084	5.237	4.848	4.997

The flow and water quantity in the river is less than the irrigation requirements during winter and spring seasons surface.

#### ii. Water Quality

In order to collect general water quality data in the Command Area of the Project, to check whether surface water and ground water are suitable for irrigation, and to analyse the water pollution caused by the two paper mills (Arvind and Baba Paper Mills) near the proposed headwork site of the Project, water samples of the representative areas were collected and analysed.

Water quality is a main concern in terms of both efficient irrigation and environment protection. The F/S Team has conducted a series of water quality tests in both monsoon and winter seasons of year 2001. Six points from surface water had been sampled for the water quality test. The locations of sampling points are shown below :

Table 3-8 : Location of the Sampling Points

Sample No.	River/Ground Water	Location
1.	Chatara main canal	Main canal at intake
2.	Sunsari – U/S	At upstream of Sunsari river on the E-W highway bridge
3.	Sunsari – M/S	At midstream of Sunsari river near at Siphon
4.	Sunsari – D/S	At downstream of Sunsari river, in Sucumbashitor
5.	Budhi – U/S	At upstream of Budhi river in Jalkapur
6.	Budhi – D/S	At downstream of Budhi river in Laljtol
7.	Shallow tube well	At Babiya VDC
8.	Shallow tube well	At Harinagar VDC
9.	Deep tube well	At intake of Chatla to Suksena canal
10.	Deep tube well	Kaptanganj VDC
11.	Test deep tube well	Kaptanganji VDC, well with 120 m depth constructed by this study

The parameters analyzed are as follows; pH, Electrical Conductivity (EC), bacteriological test, Dissolved Oxygen (DO), T-C in TSS, Suspended Solids (SS), Total Nitrogen in Total Suspended Solids ( T-N in TSS), Bicarbonate, Nitrate, Nitrite, Ammonia, Total Phosphate, Chloride, Sulphate, Calcium, Magnesium, Total Hardness, Iron, Sodium, Potassium, Arsenic, Manganese, PV value which equals to Dissolved Organic Carbon, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD).

Most particulars of water quality show less value than irrigation standard values adopted in Nepal; namely, "FAO Recommendation of Irrigation Water" and "Recommendation on Maximum Concentration of Trace Element in Irrigation Water in England". For example, the EC ranges from 9.1 – 56.17 mS/m. According to the EC values prescribed in the FAO standard, less than 75 mS/m is suitable for irrigation without any restriction. The pH value ranges from 7.1 – 8.3, and this also satisfies the standard of 6.5 – 8.4. Results of the water quality analysis are presented in Annex - 2. Results are summarized in this section.

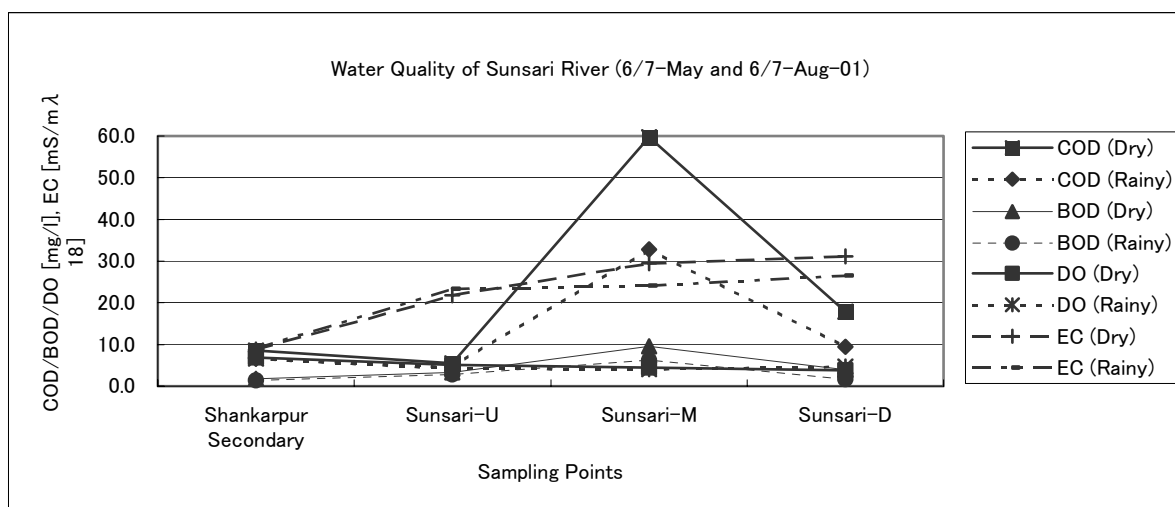


Figure 3-3: Water Quality of the Sunsari River in Dry and Rainy Seasons

Results of the analysis show that most of above parameters except COD, BOD, DO for Sunsari River water are within standard of FAO for irrigation water and recommended maximum concentration of trace element in irrigation water in England. EC value in the Sunsari-D (downstream) is slightly over than the standard in the dry season. According to the EC values prescribed in the FAO standard, less than 75 mS/m is suitable for irrigation without any restriction. Similarly, pH value is also within the range. Therefore, it can be concluded that water quality in surface water is suitable for irrigation purposes in the Project area as long as the headwork is constructed upstream of two paper mills to avoid entry of wastewater of these paper mills in the canal water. These two paper mills are located along the Sunsari River near E-W Highway Bridge which is just downstream of the sampling point of Sunsari-U (upstream).

### iii. Ground Water Quality

Arsenic value was found less than 0.01 mg/l in all the samples except in sample # 11 where it exceeds 0.03 mg/l in the newly constructed deep tube well. This is higher than WHO limits for drinking water but still permissible for irrigation purposes based on the recommendation of England. The standard for arsenic in England for irrigation use is 0.1 mg/l. Similarly, sample # 10 showed iron content of 8.38 mg/l which exceeds the standard value of 5 mg/l in England and it has been considered this high value is due to rusted steel casing in sample # 10.

Dissolved Oxygen (DO) in most of the samples analysed do not satisfy the Japanese irrigation standard which is more than 5 mg/l as the limit for irrigation in Japan. DO in the samples of groundwater ranges from 1.24 to 3.79 mg/l only. In sum, judging the water quality parameters of the Sunsari River, Budhi River and groundwater in the study area could be used for irrigation purposes except the water of the Sunsari River after mixing with the effluents of the paper mills.

**iv. Wastewater Quality of Paper Mills**

Of the two paper mills, the Baba Paper Mill consumes approximately 4 million liters of water per day and Arvind Paper Mill consumes approximately 150 thousand liters of water per day. The water quality parameters of these Mills are given in Table 3-9. These paper mills discharge untreated wastewater directly into the Sunsari River near the proposed site for the headwork. The smell of the wastewater is strong and residents living downstream of the paper mills are complaining about smells, dying of fishes, skin rashes and funny taste of head part of the fishes caught at the Sunsari River. They sometimes protest against the paper mills about the water pollution, and it has become a social problem and it is cited in newspaper several times.

Table 3-9 : Wastewater Quality of the Paper Mills

Parameters	Results (Aug-01)		NS*	German Standard 1)	Units
	ARVIND	BABA			
Total Suspended Solids	1,634.6	1,445.9	30 – 200	<20	mg/l
Ammonia (NH <sub>3</sub> )	1.64	133.00	< 50	–	mg/l as N
Chloride (Cl)	139.5	744	–	<350	mg/l
Lead (Pb)	0.06	0.17	< 0.1	–	mg/l
Chromium (Cr)	0.08	0.26	< 0.1	–	mg/l
Sodium (Na)	25	1,104	–	–	mg/l
COD	252	2,965	< 250	<85	mg/l
BOD	168	2,025	30 – 100	<25	mg/l

Source: Field Study Report, 2002.

NS\* = Nepal Bureau of Standards and Metrology (Ne. Gu. Na. 229-2047).

Resource: 1) Galvonotechnic (1971, 62, No.12sss; L'ultima acqua, A.Canuti, 1974, AFEE 2482/2)

HMGN has also issued following effluent standards for paper mills in May 2002.

- pH 5.5 – 9
- Suspended Solids (mg/l) 100
- BOD<sub>5</sub> days at 20°C, mg/l max 100

Based on this legal standard, effluent discharge of both paper mills exceeds the standards for suspended solids, and BOD.

With due consideration on pollution situation, the Danish International Development Agency (DANIDA) is promoting Cleaner Production (CP) as a part of the Environment Sector Programme Support (ESPS) in five industrial sectors including paper mills in Nepal. Construction of an effluent treatment plant jointly managed by Baba and Arvind Paper Mills is expected to start in December 2002. This initiative will likely minimise the pollution load in the Sunsari River.

Furthermore, the river water is also physically degraded due to silt load. Hence the water degradation in the source river system is due to discharge of untreated effluents of the paper mills and sediment load.

**3.1.9. Air Quality and Noise Level**

The study area does not experience air quality degradation and high noise level at present. However, dust problem is frequently noticed in the earthen roads during the dry season. Vehicular noise is also an emerging issue along the settlement areas.

**3.1.10. Flood Affected Areas**

When the Sunsari River discharge reaches more than 250 m<sup>3</sup>/s, and/or precipitation in the study area exceeds 150 to 200 mm/day, the study area experiences flooding problems. Based on the present level of information, about 380 ha is inundated for about 2-3 months in the Narsimha VDC. The depth ranges from 0.3 to 0.8m during the flooding time. In Basantapur VDC, about 690 ha is inundated for about 4 to 7 days with the depth ranging from 0.3 to 0.8m. While in Ghuski and Kaptangunj VDCs, a total of 880 ha is inundated for about 30 to 50 days and estimated depth is similar to Basantapur VDC, i.e., 0.3 to 0.8m. Hence, a total of 1,950 ha of land is frequently flooded in the study area due to precipitation and/or river discharge.



Based on the interviews with the local farmers from April to May 2001 and after observing a big flood that occurred in July 2002, there are eight areas experiencing notable inundation in the study area. These areas are concentrated in a nearly level valley floor, southern part of the study area, although a few flood areas show up in the north and northeast. These areas are limited in the active flood plains in the study area, meaning that most of the cases the inundation takes place due to flood coming from nearby rivers such as Sunsari and Budhi and also replenished by rainfall.

Inundation of the Study area is characterised by flood type and submergence type. Water in the flood type flows from river into downstream pass through the cultivated land and residential land over gently sloping alluvial surfaces during the heavy rain. But in case of submergence type, the water is piled up over the areas at a nearly level valley floor during heavy rain. About 8 VDCs out of 13 VDCs experience either flood or submergence problem. These inundation areas are shown in Figure 3-4.

**1) Babiya VDC**

Around Miyatol – gently slope to south, flood covers about 1 km<sup>2</sup> for 1 to 2 days in every rain-season with a depth of 30 to 50 cm above surface. The water flows from NW to SE, and the banks of Shankarpur Canal is sometimes eroded.

**2) Babiya VDC**

Eastern side of Jalpapur Batartol along west bank of Budhi River, flood covers about 1 km<sup>2</sup> with 0.5 km width and 2 km long 1 to 2 days in rain-season. The Budhi River gives floods during the heavy rain.

**3) Rajganj Sinuwari VDC**

Between Sinuwari and Rajganj and in a nearly level valley floor, about 3 km<sup>2</sup> of area is submerged with 0.3 meter above surface for 15 to 30 days in rain-season. The flow is from north to west.

**4) Sahebganji VDC**

Between Dhanuktol and Teliyaritol Suritol and in a nearly level valley floor, about 2 km<sup>2</sup> of the area is submerged with a maximum of 1 meter above surface for 7 to 10 days in the rain-season. The Budhi River gives the floods during heavy rains.

**5) Narshimha VDC**

Between Narsimha and Jhabatol and in a nearly level valley floor, 3 km<sup>2</sup> of the area is submerged with about with 1 to 1.5 m above surface for one week in a rain-season. The Sunsari River floods during the heavy rains.

**6) Narshimha VDC**

Soniyahi Miyatol and in a nearly level valley floor, about 5 km<sup>2</sup> of the area is submerged with maximum 1 meter above surface for 10 days in rain-season. The Sunsari River floods during the heavy rain.

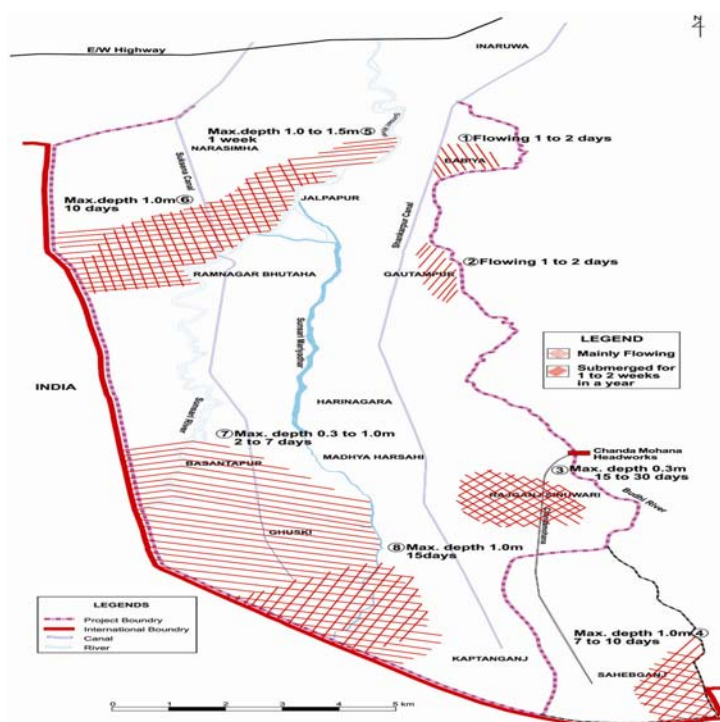


Figure 3-4 Inundation Condition in the Study Area

### 7) Basantapur VDC - Ghuski VDC

Between Suksena to Kabilasa Daksintol and along east bank of the Sunsari River, flood covers about 10 km<sup>2</sup> with 0.3 to 1.0 meter above surface for maximum 10 days in the rainy season. The Sunsari River floods during the heavy rain.

### 8) Kaptanganji VDC

Around Shivaganj Raghunathpur in nearly level valley floor particularly in the poorly drained area along the Sunsari River with Indian-border, about 6 km<sup>2</sup> was calculated submerged with maximum 1.5 meter above surface for about 15 days in rain-season. The Sunsari River floods during the heavy rain.

## 3.2. Biological Environment

### 3.2.1. Forests and Vegetation

A natural forest named Ramdhual forest with total area of about 4.4km<sup>2</sup> lies to the north of the study area. It is located sufficiently far away from the project site at about 3.7km. It is considered that it is too far to encroach by the construction workers. The study area was once covered with climax primary forest dominated by terai hardwoods. However, the construction of the Koshi dike, the East-West Highway, and Sunsari Morang Irrigation Project caused the conversion of the forestland into agricultural, residential and industrial lands. At present most of the area is agricultural land. Although the catchment area of the Sunsari River has some forests, it is decreasing gradually due to extraction of firewood and fodder by local people. In nutshell, there is no forest area along the command area and canal construction sites.

### 3.2.2. Wild Animals

Because of the lack of forests, the study area is not a habitat for wild fauna, particularly the mammals. Few birds are occasionally seen in the command area. However, local people informed that reptiles are frequently seen in the command area.

### 3.2.3. Fishery

Main vertebrate in the area is fish, and the number of species reported during the survey in the Sunsari River and the Budhi River totals to 48. The Sunsari River supports species diversity of carps, catfishes, loaches and minnow. These collections represent from upstream to downstream of the proposed and existing dam axis of the Sunsari and Budhi Rivers respectively. The principal fish species of Sunsari River are grouped as follows:

- Carps** : River carp (*Lebeo rohita*, *L. gonius*, *L. dero*, *L. pangusia*, *Catla-catla*, *Cirrhina mrigal*) and other species like *Crossocheilus latius*, *Chagunius chagunio*, etc.
- Cat fishes** : *Clupisoma garua*, *Mystus spp.*
- Loaches** : Stone loach (*Noemacheilus beavani*, *N. botia*, *Lepidvcephalichthys guntea*, *L. nepalensis*, *heteropneustes fossils*).
- Eels** : Swamp eel (*Amphipnous Cuchia*, *Mastacembelus pancalus*, *Macrognathus aculatus*) fresh water eel (*Anguilla bengalensis*).
- Barbs** : *Puntius sophore*, *P.ticto*, *P.titius*, *P.sarana*, *Chanda nama*, *Colisa patius*, *Sicamugil cascasia*.
- Minnows** : *Barilius shacra*, *B. barna*, *Essomus dandricus*, *Rasbora daniconius* etc.

The fish species indicates diversity in aquatic plants, particularly in phytoplankton and zooplanktons.

### 3.2.4. Endemic, Threatened and Protected Species

No ecologically sensitive area was identified in the study area. The ecologically vulnerable area – the Siwaliks – lies above the proposed headwork site or it is only the catchment area of the project. Furthermore, neither the ecologically important areas nor the endemic, threatened and protected species were noted in the command area and adjacent to the intake site.

### 3.3. Socio-economic Environment

#### 3.3.1. Population, Households and Ethnicity

Based on the 2001 Census, the total population of the study area is 97,700 consisting of 50,400 and 47,300 of male and female respectively with male and female ratio of 1:0.94. Total number of households is 16,187 and the average family size is calculated at 6.0/household. This population live in an area of 16,800 ha – the study area – and hence population density is 581 persons/km<sup>2</sup>. The annual growth rate from 1991 to 2001 is 2.5 percent, which is less than district population growth rate of 3.0 percent. Although the population growth of Sunsari district is relatively rapid due to hill-terai migration, it seems that the migration in the study area located on the southern most part of the district is not significant. Indian migration to the project area was not noticed in the recent years.

Demographic features of the study area are presented in Table 3-10. Of the 13 VDCs, the population density is high in Dewanjung, and low in Sahebgunj. It is interesting to note that there is a negative growth rate in Sahebgunj and Basantpur VDCs. The highest population growth rate of 5.2 percent is noticed in Narsinmha VDC.

Table 3-10 : Demographic Features of the Study Area

VDC/Municipality	2001 Results of Census					Population Density (p/km <sup>2</sup> )	Annual Growth Rate 1991-2001 (%)
	No. of HH	Male	Female	Total	Ave. HH		
Sahebganj	643	1,763	1,663	3,426	5.3	254	-2.9
Kaptanganj	1,327	4,253	3,893	8,146	6.1	555	3.0
Dewanganj	1,111	3,376	3,122	6,498	5.8	1,738	4.0
Ghuski	1,476	4,845	4,735	9,580	6.5	660	1.9
Rajgunj Sinuwari	1,439	4,329	3,922	8,251	5.7	419	2.0
Madhya Harsahi	827	2,583	2,318	4,901	5.9	781	2.1
Basantapur	753	2,413	2,289	4,702	6.2	478	-1.7
Harinagara	1,148	3,641	3,397	7,038	6.1	646	1.9
Ramnagar Bhutaha	1,698	5,684	5,403	11,087	6.5	842	3.3
Jaipapur	1,084	2,927	2,754	5,681	5.2	947	2.9
Narsinmha	2,769	8,943	8,422	17,365	6.3	489	5.2
Gautampur	698	1,955	1,828	3,783	5.4	463	1.7
Babiya	1,218	3,716	3,503	7,219	5.9	589	2.7
<b>Total</b>	<b>16,191</b>	<b>50,428</b>	<b>47,249</b>	<b>97,677</b>	<b>6.0</b>	<b>581</b>	<b>2.5</b>
Inarwa Municipality	4,497	11,844	11,356	23,200	5.2	1,666	2.3
Biratnagar	33,678	87,664	79,010	161,036	4.8	2,688	2.2
Sunsari District	120,295	315,530	310,103	625,633	5.2	498	3.0

Note: Growth rate indicate annual growth rate (1991-2001) in percentage.

According to the Household Survey Data, 70 percent of female, 51 percent of male and in total 60 percent of the people in the Study area are illiterate. Graduates in primary school and secondary school are 15 percent and 19 percent respectively. Disparity of education status by sex increases as the grade goes higher.

There are around 30 sub-castes mixed in the Study area. In fact, Muslim (Miya) population is the majority as 23.4%, followed by Meheta (Hindu), 19.25%, Yadav (Hindu), 10.7 % and the rest are consisted of sub-caste of Hindu. As it could be observed, as a whole, Muslim population is one of the majority in the Study area. Distribution of caste at VDC level is shown in the Table 3-11.

Table 3-11 : Caste Distribution at VDC levels

VDC Name	Population	No. of HH	Miya (Muslim)	Meheta	Yadav	Musahar	Mandal/Dalmuk	Ansari (Muslim)	Baniya	Teli	Oranwa	Kumal (Pandit)	Others
Sahebganj	3,426	643	0	61	191	24	122	0	144	76	0	0	24
Kaptanganj	8,146	1,327	126	531	139	291	13	0	58	0	8	99	60
Dewanganj	6,498	1,111	230	433	166	72	0	0	18	3	0	3	188
Ghuski	9,580	1,476	0	77	36	75	102	639	0	13	0	42	495
Rajgunj Sinuwari	8,251	1,439	61	431	440	135	95	0	0	0	0	48	231
Madhya Harsahi	4,901	827	41	615	59	26	61	0	0	0	0	1	24
Basantapur	4,702	753	236	119	156	0	190	0	10	0	29	0	15
Harinagara	7,038	1,148	239	297	0	79	0	0	88	61	0	58	325
Ramnagar Bhutaha	11,087	1,698	1,110	0	0	0	0	0	0	35	0	0	553
Jaipapur	5,681	1,084	645	1	0	158	68	0	101	0	0	0	113
Narsingmha	17,365	2,769	970	40	444	375	197	0	114	115	200	0	315
Gautampur	3,783	698	69	286	4	19	15	0	63	76	67	6	95
Babiya	7,219	1,218	246	242	102	253	0	0	0	76	0	0	299
<b>Total</b>	<b>97,677</b>	<b>16,191</b>	<b>3,973</b>	<b>3,133</b>	<b>1,737</b>	<b>1,507</b>	<b>863</b>	<b>639</b>	<b>596</b>	<b>455</b>	<b>304</b>	<b>257</b>	<b>2,737</b>
	%		24.5	19.4	10.7	9.3	5.3	3.9	3.7	2.8	1.8	1.6	17.0

### 3.3.2. Occupation, Migration and Settlement Pattern

#### i. Occupation

Most of the people in the study area are engaged in agriculture. Those who earn living from agriculture are categorised to land owner, tenant and farm labour. Women are mostly engaged in agricultural labour. Livestock rearing has also been a source of considerable income. Fishery in rivers and fishponds is also a common occupation, especially of the landless people. About 200 households are engaged in fishing activities and they are mostly the landless. It has been estimated that average maximum fish catch reach to about 6/kg/day during October to December and minimum catch is about half a kg/day during July to August.

There are four fishing settlements in four different VDCs in the Command Area and the total members of the fishermen households are 202 with approximately 1,250 population. The average family size of these fishermen is 6. Most of them are very poor, landless or have small pieces of land for erecting their houses. The largest fishing settlement is in Ward No.8 of Ramnagar Bhutaha VDC and almost every villager goes for fishing everyday. However, few of them have other income sources as well. The fishermen of Ramnagar Bhutaha, Ghuski and Narsingh VDCs catch fishes in the Sunsari River and the Sunsari Mariya Dhar. Out of 202 households, about 175 households are reported involved in regular fishing (Table 3-12).

Table 3-12 : Fishing Community

Name of VDC	Fishermen Households	Total Members	Regular Fishermen
Ramnagar Bhutaha	100	600	100
Ghuski	60	400	50
Bhokraha	22	125	12
Narsingh	20	125	13
<b>Total</b>	<b>202</b>	<b>1250</b>	<b>175</b>

Source: Field Study, 2002.

Inarwa, the nearest municipality to the study area, and Biratnager, the second biggest city in Nepal, are the two significant cities and market areas. They are also the major link of the economy with the study area.

**ii. Migration**

The number of young generations (20-25 years old) who go for India or middle-east countries to work is increasing regardless of the fluctuation of agriculture production. Mostly, they are not head of the house, since it is preferable culturally that head of the house should be at home to take care of his family. According to Ghuski VDC, around 50% of young males go to India as labor as well as big cities such as Kathmandu and Biratnagar, according to the interview to farmers. In the case of Kaptangang VDC, the number of issued I.D., which is necessary to be carried when people go to India, was around 400-500 during 2 to 3 months (May – July). This number can be calculated as around 35% of the male population between 15 to 34 years old<sup>2</sup> and from this number, the tendency of huge number of migrant work could be observed. Especially people prefer to work in India, since there is no language problems since Hindi language and Maithali which is the language most common in the Study area is quite similar, or some of them have been using Hindi in their daily life.

According to the interview, the major reasons to go for migrant work are as follows;

- Impossible to survive with his agriculture production and labor work in Nepal
- Wage is comparatively high as such as 130 Rs/day (without meal)
- There is job-availability through a year.

It seems that the reason to go for migrant work is not necessarily due to poorness, but also for surplus income generation. According to an interview in Dewanganj VDC, the money sent from migrant worker will be used to build house, buy extra land, and so on. Majority of the people who have experience to work abroad say that they have intention to go again if they are physically healthy, but others say that they prefer to stay at home considering the labor are physically healthy, but others say that they prefer to stay at home considering the labor condition.

As for social impact by migrant work, prominent impact could not be seen, since they usually only work in farm without having time to be affected culturally, in addition to the cultural similarity. As for positive impact, an example was given to say that they could get a job of tractor driver after they returned from India since they learnt the skill in India.

It is expected that the number of migrant workers will be continuously increased if there is not enough job available in their living area.

**iii. Settlement Pattern**

Majority of the settlements are clustered with densely populated with the possibility of higher number of local workforce for the construction of the project.

**3.3.3. Land Holding Pattern**

Due to the land Reforms Act in Nepal, nobody can have more than 11 bigha (7,37 ha) of land in Terai region, and people heritage the land to sons equally but not to daughters basically. Following to this regulation, even if it seems that there are few big-landowners according to census, there are big landowners who own big land as a family. The tendency of land holding size at VDC wise is shown in the Table 3-13.

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<sup>2</sup> According to the population census in 2001, the male population between 15 to 34 years old is around 1,340.

Table 3-13 : Land Holding Size at Each VDC

Location	VDC Names	Landless	Less than 1 bigha	1 to 3 bigha	3 to 6 bigha	More than 6 bigha	Total Share (%)
Lower Stream	Sahebganj	16	36	39	6	3	100
	Kaptanganj	9	38	26	16	11	100
	Dewanganj	20	66	9	3	2	100
	Ghuski	10	53	24	9	4	100
Middle Stream	Rajgunj Sinuwari	11	48	26	10	5	100
	Madhya Harsahi	16	61	12	7	4	100
	Basantapur	27	16	39	11	7	100
	Harinagara	17	48	23	9	3	100
	Ramnagar Bhutaha	54	30	10	4	2	100
	Jaipapur	13	54	16	12	5	100
Upper Stream	Narsinmha	25	26	29	14	6	100
	Gautampur	11	76	8	5	0	100
	Babiya	9	61	18	8	4	100
	<b>Total</b>	<b>19.0</b>	<b>45.9</b>	<b>21.6</b>	<b>9.0</b>	<b>4.5</b>	

Generally in Terai, “Landless” has two (2) meanings; one has completely no land even the place to stand his house, and another has 1-3 katha (0.03 – 0.09 ha) of land, which is not enough for cultivation. In Ramnagar Bhutaha VDC where around 65% of the population are Muslim, more than half of the population are completely landless, which is the highest rate in the Study area. According to interviews, most of them have small piece of land at least enough to stand their houses. In the case of Basantapur VDC, on the other hand, 27% of the households are completely landless and living on the communal land. Their livelihood is totally depending on the wage from farm labor or whatever other labor type work.

The majority, namely around 48% of the Study area in categorized as landholder with less than 1 bigha (0.67 ha), except for Basantapur and Sahabganj VDC.

### 3.3.4. Agriculture

Agriculture is the primary source of income. Major crops in the Study area are monsoon paddy, wheat, potato, oilseeds (mustard and linseed etc.), pulses (lentil, mungbean and local varieties etc.), vegetables (cucumber family, okra, eggplant, bitter guard, cauliflower, cabbage, onion and tomato etc.), jute and sugarcane. Cropping season is divided into three; spring, monsoon and winter. Typical cropping pattern is presented as follows.

1. Paddy (early maturity) - Wheat/Pulse/Oilseed/  
Potato/Winter Vegetables
2. Paddy (early maturity) - Wheat - Mungbean
3. Paddy (late maturity) - Wheat/Pulse
4. Summer Vegetables - Wheat/Potato/Winter Vegetables
5. Jute - Paddy/Fallow - Wheat/Potato/Winter Vegetables
6. Sugarcane

The overall cropping intensity in the area is about 164 percent (Table 3-14). Paddy and wheat are dominant crops, as the cropping intensities of paddy and wheat are estimated at 68.1 percent and 58.5 percent respectively. The Study area is also well known for vegetable production area, particularly for potato and early cauliflower. Sugarcane and jute are the most important cash crops as well as potato and vegetables. Jute occupies almost 20 percent of the overall agricultural land during spring/monsoon season. However, jute and sugarcane suffer from sharp fluctuations in price as compared with vegetables.

Table 3-14 : Cropping Intensity and Area Planted

Season	Crops	Cropping Intensity (%)	Area Planted (ha)
Spring/Monsoon	Paddy	68.1	7,180
	Jute	19.3	2,035
	Vegetables <sup>1)</sup>	1.4	148
	Pulse (Mungbean)	1.9	200
Winter	Wheat	58.5	6,168
	Potato	8.7	917
	Vegetables <sup>2)</sup>	1.0	105
	Oilseed (Mustard)	1.0	105
	Pulse (Lentil)	2.4	253
Through the year	Others (Sugarcane)	1.4	148
<b>TOTAL</b>		<b>163.7</b>	<b>17,259</b>

Source: Rural Socio-economic Survey, JICA Study Team

1): Cucumber and okra represent summer vegetables

2): Cauliflower and cabbage present winter vegetables

Cropping intensity of monsoon paddy in the study area is lower than that of other SMIP command areas. Overall command area of SMIP resulted in 97.1 percent of the cropping intensity of paddy in the year 2001/2002. When the irrigation facility will be provided, the average cropping intensity will reach to 180 percent (Table 3-15).

Table 3-15 : Proposed Cropping Pattern With Project Condition

Season	Cultivated Area	Upland Area		Irrigable Area		TOTAL	
		397ha		10,147ha		10,544ha	
	Crops	Cropping Intensity (%)	Area Planted (ha)	Cropping Intensity (%)	Area Planted (ha)	Cropping Intensity (%)	Area Planted (ha)
Spring / Monsoon	Paddy	-	-	60.0	6,088	57.7	6,088
	Jute	25.0	99	15.0	1,522	15.4	1,621
	Vegetables (Summer <sup>1)</sup> )	60.0	238	10.0	1,015	11.9	1,253
	Pulse (Mungbean)	-	-	5.0	507	4.8	507
Winter	Wheat	40.0	159	50.0	5,074	49.6	5,233
	Potato	25.0	99	10.0	1,015	10.6	1,114
	Vegetables (Winter <sup>2)</sup> )	20.0	79	10.0	1,015	10.4	1,094
	Oilseed (Mustard)	5.0	20	5.0	507	5.0	527
	Pulse (Lentil)	5.0	20	10.0	1,015	9.8	1,035
Through the year	Others (Sugarcane)	-	-	5.0	507	4.8	507
	<b>TOTAL</b>	<b>180.0</b>	<b>714</b>	<b>180.0</b>	<b>18,265</b>	<b>180.0</b>	<b>18,979</b>

1): Cucumber and okra represent summer vegetables

2): Cauliflower and cabbage present winter vegetables

Paddy and wheat are the dominant cereals in the area with the average existing cropping intensity of about 135 percent. Once the irrigation facility is provided it will reach to about 200 percent. At present the average yield rate of wheat is 1.95 t/ha, and that of paddy is 2 t/ha. It is estimated that the total production of cereals is about 28,850 MT (paddy – 16,514 MT, and wheat – 12,335 MT) (Table 3-16). The area faces about 18,000 MT of cereals deficit at present. These yields are below the district averages which may be attributed to low amount of water available and/or high dependence on monsoon rain. In other words, about 53 percent of the total households live with inadequate food for more than nine months. Local people also raise vegetables in the study area. Sugarcane and jute is also grown as the principal cash crops. As the processing industry, e.g., jute and sugar is monopolised and people may not get appropriate price, its production is reported fluctuating.

Table 3-16 : Production and Yield Rate

Season	Crops	Production (MT)	Yield (MT/ha)
Spring/Monsoon	Paddy	16,514	2.3
	Jute	3,460	1.7
	Vegetables <sup>1)</sup>	2,501	16.9
	Pulse (Mungbean)	100	0.5
Winter	Wheat	12,336	2.0
	Potato	14,947	16.3
	Vegetables <sup>2)</sup>	2,069	19.7
	Oilseed (Mustard)	42	0.4
	Pulse (Lentil)	177	0.7
Through the year	Others (Sugarcane)	13,169	40.0
<b>TOTAL</b>		<b>65,315</b>	

Source: Rural Socio-economic Survey, JICA Study Team

1): Cucumber and okra represent summer vegetables

2): Cauliflower and cabbage present winter vegetables



**Paddy Planting: Dominant**



**Wheat: Dominant**

In order to increase cereal production, local people also use fertilisers and chemicals. Urea, DAP and potash is commonly applied as a source of nitrogen, phosphate and potassium respectively. However, use of the fertilisers is estimated up to 70 percent lower than the recommendable amount which may be attributed to the lack of the capital and/or poor access to official agricultural credit scheme. The soil analysis also indicate the use of chemical fertilisers in relatively higher amount.

### 3.3.5. Food Security

According to a household survey carried out in 1998 by LGP (hereafter referred as “LGP Household Survey”), 53% of households answered that they live with inadequate food for more than nine months. The word “Inadequate” in this survey is defined that household who cannot support their food from their own farmland. So the meaning of inadequate rather indicates self-sufficiency at household level. Table 3-17 presents food supply situation in the VDCs of the Project area.



Table 3-17 : Number and Share of Households having Inadequate Food in 1998

VDC/Municipality	No. of Families having inadequate food					% of Families having inadequate food			
	Up to 3 months	Up to 6 months	Upto 9 months	More than 9 months	Total	Upto 3 months	Upto 6 months	Upto 9 months	More than 9 months
Sahebganj	25	68	16	38	147	17	46	11	26
Kaptanganj	21	43	4	81	149	14	29	3	54
Dewanganj	13	45	17	194	269	5	17	6	72
Ghuski	12	86	67	216	381	3	23	18	57
Rajgunj Sinuwari	11	84	9	169	273	4	31	3	62
Madhya Harsahi	25	77	62	16	180	14	43	34	9
Basantapur	9	30	20	85	144	6	21	14	59
Harinagara	28	77	28	82	215	13	36	13	38
Ramnagar Bhutaha	43	84	37	245	409	11	21	9	60
Jaipapur	5	40	3	187	235	2	17	1	80
Narsinmha	113	169	35	156	473	24	36	7	33
Gautampur	22	31	9	47	109	20	28	8	43
Babiya	1	17	13	170	201	0	8	6	85
<b>Study Area Total</b>	<b>328</b>	<b>851</b>	<b>320</b>	<b>1,686</b>	<b>3,185</b>	<b>10</b>	<b>27</b>	<b>10</b>	<b>53</b>

Source : Local Governance Program Sample Household Data Tabulation 1998

### 3.3.6. Income and Expenditure

According to the household survey done by this Study, which the sample number is 200 with targeting to landholders, average gross income was around 121,000 Rs/ year. As a mode, 47 households have income between 100,000 to 150,000 Rs, whose average landholding size is around 67 katha(2.0 ha.). The big difference could not be found by the location. Among income, 67.0% is from agriculture product (including home consumption), 8.5% is from livestock, selling fish and forestry product (bamboo), around 12.0% is from salary of employment including farm labor, and migrant work is 5.0% and rest is from other work.

Table 3-18 : Major Income Sources by Caste

	Caste	Annual Income		Average Income from Agriculture		Average Income from Livestock		Average Income from Forestry Product		Average Income from Farm Labour		Average Income from other Paid Work		Average Income from business		Average Income from Migrant Work		Average Income from Others	
		(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%
1	Muslim	142,433	59.8	85,160	6.5	9,194	3.9	5,613	0.3	375	4.9	6,925	7.2	10,233	1.3	1,867	7.6	10,887	
2	Sudhi	91,917	68.2	62,667	7.8	7,200	16.2	14,850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Yadav	110,538	58.6	64,826	9.6	10,629	0.2	268	2.1	2,331	1.9	2,141	3.3	3,656	7.7	8,483	7.0	7,769	
4	Bramin	72,040	41.1	29,640	10.7	7,700	0.0	0.0	0.0	0.0	0.0	0.0	10.4	7,500	27.1	19,500	0.0	0.0	
5	Tharu	95,360	56.1	53,520	21.9	20,920	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	Meheta	132,182	69.4	91,784	4.9	6,464	1.8	2,406	1.5	2,029	3.0	3,990	3.8	5,075	3.8	4,994	6.9	9,107	
7	Khatwe	75,806	55.0	41,673	4.8	3,675	0.0	0.0	9.5	7,200	11.5	8,750	0.0	0.0	5.5	4,167	8.8	6,667	
8	Other Terai	135,086	60.7	81,950	3.3	4,455	1.6	2,107	2.7	3,610	5.4	7,355	12.5	16,857	4.9	6,554	5.9	7,932	
9	Chetri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8,054
10	Newar	245,400	60.9	149,400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.1	96,000	0.0	0.0	
11	Tamang	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	Others	126,563	62.1	78,623	5.2	6,570	2.4	3,000	2.8	3,600	5.7	7,200	0.0	0.0	0.0	0.0	0.0	16.6	21,000

Observing from caste respectively, the caste which takes highest share of agriculture production is Meheta, which the share is around 70% of total income. They are traditionally vegetable growers and these days it is for commercial purpose. Tharu, in turn, gets around 22% of income from livestock, since they traditionally keeps and eats meat including pork. Khatwe, which is one of the lowest castes, gets around 12% of income from farm labor work even the farmers who have their own land, which could guess higher proportion in the case of landless people.

The average expenditure is 110,000 Rs/year. The mode of expenditure is between 50,000 to 80,000Rs/year, which the number of sample is 61 out of 200 samples. The proportion by categories are as follows; Agriculture 41.8%, food 27.2%, cloths and other goods, 7.3% repayment of credit 6.3% medication 4.7%, religious event 4.1%, education 3.3%, livestock 1.3% , tax 0.3%, energy 0.2%, and rest 3.5% is others. It is no wonder the expenditure for agriculture is the highest among total expenditure, followed by food, however around 30% could be used for other purpose including both for basic living and surplus items. For instance, average expenditure for miscellaneous goods including cloths is around 16,000Rs, and the one for religious purpose is 500-50,000Rs, of which the mode is around 5,000Rs/year are represented as 74 out of 200 samples are in this category.

About 10% of the respondent has savings of 2,000 – 100,000 Rs, of which the mode is around 50,000Rs. In turn, around 50% of the respondent have loan of 3,000 – 500, 000Rs, of which the range of mode is between 20,000 to 50,000Rs as shown in the result of 30 out of 103 samples who have loan. The major purpose is for mostly agriculture input from the result of household survey.

### 3.3.7. The Relationship between Land Holding Size and Income

The relationship between landholding size and income could be analyzed as below, according to the household survey done by the Study team. As it could be obviously seen, the income level is corresponding to land holding size, and the income of the farmer with more than 4ha is more than four (4) times higher than the one of farmers with less than 1 ha. of land. Comparing to the range of income and land holding size, the average landholding size of the farmer who has gross income of 100,000 to 150,000Rs is 2.0ha. On the other hand, the farmer who has more than 200, 000Rs of income has more than 7.0ha of land.

Table 3-19 : Average Annual Income and its Source by Land Holding Size

Land Size	Sample No	Share (%)	Average Annual Income		Average Income from Agriculture		Average Income from Livestock		Average Income from Forestry Product		Average Income from Farm Labour		Average Income from other Paid Work		Average Income from business		Average Income from Migrant Work		Average Income from Others	
			(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%	(Rs.)	%
4 ha more	25	12	299,306	78.6	226,915	75.8	10,734	3.6	18,600	6	0.0	0.0	3,600	1.6	15,640	6.9	5,520	6.9	7,879	3.5
1-4 ha	110	54	124,743	64.6	80,582	64.6	7,315	5.9	0.0	0.0	1,336	1.1	3,570	4.4	5,848	7.3	6,858	7.3	11,660	14.5
Less than 1 ha	67	33	70,732	41.7	29,508	41.7	5,879	8.3	1,589	2.0	4,702	6.6	7,323	24.8	7,912	26.8	4,284	26.8	4,165	14.1
	202	100																		

As it could be seen, big landholders (more than 4 ha) draw 78.6% of income from agriculture production. In turn, the share of agriculture income of small landholders (less than 1ha) is less than 50%. It shows that farmers cannot rely on agriculture as major income if the landholding size is less than one (1) ha. Other sources of income of small landholders are from 24.8% of paid work except farm labor, 6.6% from farm labor, 26.8% from small business such as small-scale trading (e.g. buying vegetables in local market and sell them in Inarwa, or buy less expensive products in Indian market and sell them in local market), and 14.5% is from the money sent by migrant workers.

### 3.3.8. Social Service Facilities

The project area has education, health and drinking water facilities at different locations. Most of the people depend on tube wells for drinking water. Marketing facility also exist in the study area. Farm products are brought to the local market by using bicycle, cattle cart and tractor.

Based on the LGP Household Survey, about 60 percent of the total people are illiterate. A total of 35 percent of the sample population receive education from primary to tertiary level of education institutions in the study area (Table 3-20).

Table 3-20 : Education Status in the Study Area (Percent to Sample Population in 1998)

SN	Grade	Female	Male	Total
1	Illiterate	70	51	60
2	Primary School	12	18	15
3	Lower Secondary School	6	11	8
4	Secondary School	6	12	9
5	Higher Secondary School	0	1	1
6	Diploma level	0	1	1

### **3.3.9. Infrastructures**

The agricultural product in the study area is mostly self-consumed and some surplus and the produce of relatively large-scale farmers are sold at local markets such as Ramnagar Buthaha, Dewanganj, Harinagara and Ghuski in the Study area. Municipalities like Inarwa, Junka, Itahari and Biratnagar are also the major markets, including Indian market of the agricultural products of the study area. Farm products are brought to the local market by individual farmers or through local assemblers using bicycle, cattle cart and tractor. In winter season, about 4 MT of early cauliflower are shipped to Kathmandu by bus or truck. Collective marketing activity is not observed active.

The road network is established in the study area. Road along the Sukusena and Shankarpur canals are in good condition and there are, apart from E-W highway, three roads in east-west direction between Biratnagar and the study area that are connected with Inarwa, Harinagara and Dewanganji VDCs.

Four jute-processing factories, 7 rice mills, 3 flour mills and 4 vegetable oil refining factories are operated along Biratnagar – Dharan road<sup>3</sup>. In addition, two sugar mills are operated around the study area. A private sugar factory established along the right eastern side of the study area in 1997 has processing capacity of 250,000 t/year, which is the biggest magnitude in the whole eastern region. However, it is operating at 50 percent capacity and is on the decreasing trend. Similarly, small-scale milling machines for rice and wheat are operated in the study area.

### **3.3.10. Local Level Institutions**

Relevant line agencies working and/or contributing in irrigation development in the study area are Eastern Regional Irrigation Directorate (ERID), Eastern Regional Agriculture Directorate (ERAD) (both of them are located at Biratnagar), and Sunsari District Irrigation Office (DIO) and Sunsari District Agriculture Development Office (DADO). Also a regional agricultural research station of the National Agriculture Research Council (NARC) is located at Tarahara. It has been planned to merge Morang DIO with the Sunsari DIO and make the later as Divisional Office from the fiscal year 2002/03, which will look after irrigation activities over the both Sunsari and Morang districts. The ERID has so far 37 staff, inter alia, with engineers, geologist, agronomists and sociologist. Similarly, the Sunsari Irrigation Office has 29 officials with engineers, and hydrologist.

The study area is also facilitated with the agricultural office in the district with 15 extension centres (4 Agricultural Service Centres and 11 Sub-centres). This organisation has the broader objective of increasing agricultural production through introduction of appropriate technology and making the best use of the limited sources, developing farming skills and so on. Agriculture extension services are provided through its Agricultural Service Centre (ASC) and 3 Sub-centres (SC). Group approach as a method of extension service is introduced for the purpose of raising up farmers' participation. In the Study area, there are 24 farmers groups certificated by the Sunsari DADO.

At present, the project area is serviced through Local Governance Programme (LGP) funded by UNDP, Decentralized Planning for Child Programme (DPCP) by UNICEF, Sunsari-Morang Programme by PLAN International, an international NGO, and Nepal Participatory Learning and Advisory Project (NPLAP) funded by DFID of the United Kingdom.

About 903 local NGOs have so far been registered with the Sunsari District Administration Office. However the NGOs, which had renewed their registration in 2001, is counted at 171 only. There are 11 NGOs considered to be somehow active in the study area. These NGOs are run by the local graduates. Capacity building of the local NGOs is provided by Nepal Participatory Learning and Advisory Project (NPLAP) which is funded by DFID. The project will involve one local NGO as a programme partner and continue working with other local NGO for its capacity building programme.

## **3.4. Cultural and Historical Sites and Religious Activities**

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<sup>3</sup> Inventory Survey by the Study Team in 2002

CHAPTER

**ALTERNATIVE ANALYSIS**

**4**

**4. ALTERNATIVE ANALYSIS**

Alternative analysis has been carried out with due consideration on the command area, amount of water to be diverted from the intake (headwork), location of the intake, its design and water sources. Raw materials and construction techniques have also been taken into consideration. The alternative to the canal alignment has not been taken into account because two canals of the Project – Suksena Canal and Shankarpur Canal – were constructed by SMIP and already exist in the area. The command area of the Project is also the command area of SMIP, and the latter irrigation project has been implemented since 1964. No-action alternative (do-nothing alternative) was considered to evaluate crop production in "with and without" project scenario. Furthermore, the southern part of the Project area requires irrigation facility to increase farm production. Hence, alternative analysis has been carried out within the Project itself, and following aspects were considered.

**4.1. Do-Nothing Alternative**

Southern part of the SMIP does not have adequate water to increase food production and the Project aims to increase farm production with the provision of the year-round irrigation facility. If the Project is not implemented the production of spring/monsoon and winter crops will not increase. In this condition, it is likely that the food deficit will continue. Hence the Project has been designed to increase the production of the cereal and cash crops. Implementation of the project will likely increase yield rate of paddy from 2.5 to 4.2 t/ha, 1.9 to 2.5 t/ha of jute, and 17.9 to 22 t/ha of potato and so on (Table 4-1). The table clearly illustrates the "with" and "without" project on cereal and cash crops production and do-nothing alternative is ruled out to provide the local farmers an opportunity to grow more foods and cash crops.

Table 4-1 : Expected Yield and Production Without/With Project Condition

Season	Crops	Without Project	With Project	Potential Yield (t/ha)
		Yield (t/ha)	Yield (t/ha)	
Spring/Monsoon	Paddy	2.5	4.2	3.5 - 6.0
	Jute	1.9	2.5	2.1 - 3.1
	Vegetables (Summer1))	18.6	20.0	20.0 - 30.0
	Pulse (Mungbean)	0.5	1.0	1.0 - 1.5
Winter	Wheat	2.2	3.5	4.0 - 5.0
	Potato	17.9	22.0	20.0 - 35.0
	Vegetables (Winter2))	19.7	20.0	20.0 - 30.0
	Oilseed (Mustard)	0.4	1.0	0.9 - 1.1
	Pulse (Lentil)	0.8	1.3	1.5 - 3.5
Through the year	Others (Sugarcane)	44.0	80.0	52.0 - 80.0

1): Cucumber and okra represent summer vegetables  
2): Cauliflower and cabbage present winter vegetables

**4.2. Implementation of the Proposed Project**

Various alternatives have been considered to optimise water supply and crop production, and minimise project impacts on the environment. They are:

#### 4.2.1. Command Area Alternative

The proposed canal water will not irrigate about 397 ha of land in Kaptanganj VDC by gravity because of the higher elevation of the area. As the project will follow the gravity flow of water, the feasibility study has recommended to promoting shallow tube wells (STWs) for this area from technical and economic feasibility.

#### 4.2.2. Amount of Water in the Intake

Water flow in the Sunsari River is not enough for full irrigation of the command area. If all water is diverted, it will have severe impact on the aquatic life and also on the life of the fishermen. In addition, the water quality, downstream of the proposed intake, is heavily polluted due to discharge of untreated effluents from Arvind and Baba paper mills. It is predicted that pollution resistant species are abundant downstream of the effluent discharge sites. Water downstream of effluent discharge sites is unfit for human use and irrigation. Directly discharge of untreated effluent from these two paper mills are legal. But, attention of MoPE has not been attracted yet. No water can be withdrawn from the proposed intake unless the two paper mills construct the efficient treatment plants.

#### 4.2.3. Alternative to the Intake Site

Sunsari District Irrigation Office originally proposed the intake site at downstream of the outlets of the Arvind and Baba Paper Mills. With due consideration on high level of pollution, the proposed site has been moved to 600 m downstream of the East-West Highway, and upstream of the effluent discharge sites. It has been done so to avoid mixing of the effluents in the irrigation water. Also the new location is on a relatively straight reach of the river. Construction of the intake upstream of E-W highway was also ruled out based on the techno-economic ground.

#### 4.2.4. Alternative to the Intake Design

In the basic engineering design and need for ensuring the fish migration from the intake, a fish passage has been included in the intake design to minimise impact on the migratory fish species.

#### 4.2.5. Alternative to the Water Source

Since the Sunsari River during the lean season will have less than the required amount of water for irrigation, alternative water source of SMIP water, groundwater as well as preventive irrigation which requires less water was considered.

In view of the present level of information, and possible impacts of the alternatives, it is necessary to implement the Project with due consideration on the adverse environmental impacts of several alternatives analysed above (Table 4-2).

Table 4-2 : Analysis of the Alternatives and Potential Environmental Impacts

SN	Alternatives	Potential Adverse Impacts
1	<b>Command Area</b> <ul style="list-style-type: none"> <li>▪ Inclusion of the command area as designed</li> <li>▪ Exclusion of 397 ha of Kaptanganj</li> </ul>	<ul style="list-style-type: none"> <li>▪ Need for deep tube well and electricity or pump-up station and fuel thereby increasing cost for irrigating the land</li> <li>▪ No benefit for the local people who will not have the irrigation water</li> </ul>
2	<b>Water Intake</b> <ul style="list-style-type: none"> <li>▪ Divert 50 percent of the water in the Sunsari River in the lean season</li> <li>▪ Divert 80 percent of the water in the Sunsari River in the lean season</li> <li>▪ Divert 90 percent of the water in the Sunsari River in the lean season</li> </ul>	<ul style="list-style-type: none"> <li>▪ Possible severe water pollution in the Sunsari River as long as two paper mills do no operate ETP, and possible water use conflict due to limited water supply;</li> <li>▪ Likely high magnitude of the impact from water pollution due to discharge of untreated paper effluents; ETP can remove only 80 percent of the pollutant load, and COD value decrease from 3000 to 600 mg/l</li> <li>▪ Likely to have high water pollution problem even if the discharge of the paper mills is below the Nepal's standard, particularly on COD, also fish will not migrate in the lean season due to diversion of water for irrigation purposes.</li> </ul>

SN	Alternatives	Potential Adverse Impacts
3	<b>Intake Site</b> <ul style="list-style-type: none"> <li>▪ Downstream of the outlets of the two paper mills</li> <li>▪ Upstream of the outlets of the two paper mills, and downstream of the E-W highway</li> <li>▪ Upstream of the E-W highway</li> </ul>	<ul style="list-style-type: none"> <li>▪ Water after mixing of paper effluents will not be suitable for irrigation purposes</li> <li>▪ No impact of paper effluents and can be safely used for irrigation purposes</li> <li>▪ Not suitable technically and economically</li> </ul>
4	<b>Intake Design</b> <ul style="list-style-type: none"> <li>▪ Weir and under sluice</li> <li>▪ Barrage, under sluice and fish passage</li> </ul>	<ul style="list-style-type: none"> <li>▪ Likely to have adverse impacts on fish</li> <li>▪ Possible minimum adverse impacts on fish species and population due to fish passage</li> </ul>
5	<b>Water Source</b> <ul style="list-style-type: none"> <li>▪ Sunsari River only</li> <li>▪ Sunsari River and SMIP water</li> <li>▪ Sunsari River and deep wells</li> <li>▪ Sunsari River and shallow wells</li> </ul>	<ul style="list-style-type: none"> <li>▪ Possible water use conflicts due to very limited water supply</li> <li>▪ Possible water use conflicts in secondary water canals</li> <li>▪ Need for electricity, possible lowering of groundwater table, and groundwater pollution in the long-term</li> <li>▪ Possible lowering of groundwater table along the river and impact on the villagers using shallow tube wells</li> </ul>

### **4.3. Selection of the Best Alternative**

Based on the potential impacts predicted in Table 4-2, the intake of the proposed project should be constructed at upstream of the effluent discharge site of the paper mills and downstream of the E-W highway. About 50 to 80 percent of the water of the Sunsari River should be diverted to the canal and this would be the appropriate option. This alternative also considers the construction of the fish passage in the intake. Hence, the proposed project with construction of the intake as proposed and canal system as conceived could be considered appropriate to irrigate the land in the southern part of the command area of SMIP.

The following chapter identifies evaluates the impacts of the project activities on the environment, and propose environmental protection measures followed by the environmental monitoring and auditing.

CHAPTER  
**ENVIRONMENTAL IMPACTS AND PROTECTION  
MEASURES**

5

## 5. ENVIRONMENTAL IMPACTS AND PROTECTION MEASURES

The Sunsari River Irrigation Project will pose both desirable and undesirable impacts on the environment. Major components of the Project are to construct intake, canals (main, secondary and tertiary canals), agriculture production and capacity building. Environmental impacts are likely to occur during the construction stage, particularly the headwork and canals including access roads. Environmental impacts have been identified, predicted and evaluated for a number of issues based on site observation, field study and information obtained from the local people. Impacts have been quantified to the extent possible and some of them are evaluated based on value judgement. The following sections describe possible beneficial and adverse environmental impacts for both construction, and operational and maintenance stages.

### 5.1. Beneficial Impacts and Benefit Augmentation Measures

#### 5.1.1. Construction Stage

- A1. Employment Opportunity: This project will be constructed through joint management approach. Earthworks and concrete works in the headwork, canals and for river training are the primary activities during the construction stage. It has been estimated that about 2020 unskilled labour man/day will have employment opportunities for earthworks and 460 man/day for concrete works for 3 working season and similarly about 80 skilled labours will also have employment opportunity for same period. For earthworks, almost all the employees will be unskilled labourer while some skilled manpower will be required for concrete works (Table 1.4, see chapter 1).

This indicates that a large number of local people could have employment opportunities and this will contribute to improve the living condition of the employed families. In addition, construction workers will use the local materials and products and it will promote trade and business in the project area. Increase in per capita income will likely improve health, education and other social service sector including community development activities. Hence the employment generation is a beneficial impact of the project activity.

The project will encourage the local people to get involved as construction workers in order to augment this beneficial impact. The project will adopt a policy of involving over 80 percent of the total construction workers to the local people with due consideration on their willingness. Furthermore, the Project will encourage the project officials and the workers to maximise the use of local goods, products and services.

- A2. Enhancement of Technical Skills: Involvement of the local people in the headwork and canal construction will likely improve their skills. Some of the local people were also noted involved during the construction of previous irrigation canals. However, it is predicted that a large number of people are still unskilled.

In order to augment this beneficial impact, the Project will offer them practical training to upgrade their skill. In addition, the Project will organise training programme on construction supervision, operation and maintenance of the canals and to strengthen local institutions. It is expected that the training programmes will contribute to attain the goals of sustainable irrigation development. The training and skill development programme will also contribute to enhance building organisational capability.

- A3. Enhancement of Social Service Facilities: Increase in per capita income of the local people will likely promote to invest on social service facilities, particularly the health, sanitation and education.

The Project will encourage the local people to contribute for community development works and invest their income in developing and/or upgrading health and sanitation and drinking water facilities. In addition, the Project will also assist in strengthening the existing health posts by providing additional medicines if the health posts are involved in providing medicines and primary health care to the construction works. Similarly physical facilities of the local schools will be improved if the children of the outside construction workers are enrolled in the local schools. Such physical facilities will be limited for chairs and benches. If a separate section in any class is required to be launched, the Project will also contribute for partial payment of the teachers' salary, including class room development.

### **5.1.2. Operational Stage**

- B1. Increase in Cropping Intensity, Production and Productivity: After completion of the construction stage, the project area will receive continuous supply of water for irrigation and it will increase cropping intensity from existing 165 percent to more than 180 percent. Water availability in the sandy soil will promote crop diversification. This will also enhance soil fertility. Furthermore, this will increase productivity and overall crop production. It is expected that the paddy, jute, wheat, potato and sugarcane will increase from existing 2.5 to 4.2 t/ha, 1.9 to 2.5 t/ha, 2.2 to 3.5 t/ha, 17.9 to 22 t/ha and 44 up to 80 t/ha respectively (Table 4-1). The more income from farmland will lead to invest for agricultural inputs such as high yielding variety of seeds, environment-friendly fertilisers and agro-chemicals, and farming technologies. This may also promote to integrated pest management (IPM) and integrated plant nutrient management (IPNM). Increased agricultural activities will also generate more job opportunities to the landless people as farm labourers.

In order to augment and/or maximise this beneficial impact, the Project will avoid or minimise leakage of irrigation water in the canal system. The Project will provide necessary information and training on the appropriate seeds, fertilisers and agro-chemicals, including IPM and IPNM. In addition, agriculture supporting services as mentioned in 1.4.11 will be provided to the local farmers. It is expected that the promotional programmes for vegetables, post-harvesting and marketing will help the local people in maximising the farm outputs.

- B2. Institutional Development of WUAs: This Project follows the joint management policy and the Project and water users associations (WUAs) will be involved in the project construction and management. In this process, the capacity of the local people, particularly the WUAs will be enhanced.

This beneficial impact will be augmented by providing necessary training to the beneficiaries and/or the member of the WUAs. The Project will involve the WUAs right from the project design to implementation stage, and it will also provide counselling services to form WUAs, develop necessary constitution, facilitate in registration, and develop and implement action programmes taking into account of the willingness of the local people and/or the members of the WUAs

- B3. Increase in Land Value: The southern part of the project area is predominated by the sandy soil and lack of necessary water has further limited scope for increasing crop production. Although, this area is good for agriculture development, the land price at present is low as compared to SMIP command area. Hence, once the irrigation water is provided, it is expected that the land value will also be increased.

The Project will encourage the landowners not to change the land use, i.e., farmland should not be changed to other purposes. The command area however should be used for crop production – cereal and cash crops. However, if the land is sold, local people may experience substantial change in land price.

The beneficial impacts and proposed augmentation measures are presented in the summary impact matrix (Table 5-1).



Table 5.1 A Summary of Beneficial Impacts of the Sunsari River Irrigation Projects and Benefit Augmentation Measures

Activity	Potential Impacts	Environmental Impacts				Benefit Augmentation Measures	Responsibility
		Nature	Magnitude	Extent	Duration		
Construction Stage							
<ul style="list-style-type: none"> <li>▪ Headwork</li> <li>▪ Canals</li> <li>▪ Road improvement etc.</li> </ul>	Employment opportunities to about 2020 man/day for earthworks and 460 man/day for concrete works	Direct	High	Local	Short-term	Employ local people and it should be about 80 percent of the total construction workers based on their willingness	Project/contractor
	Increase in trade and business in the local area	Indirect	Low	Local	Short-term	Promote the use of local products	Project, contractor and local people
	Enhancement of technical skill and organisational capability	Direct	Medium	Local	Long-term	Organise training programme on construction supervision, operation and maintenance of the irrigation facilities, including institutional strengthening	Project/consultant
	Enhancement of social service facilities	Indirect	Low	Local	Long-term	Encourage the construction workers in investing for social service facilities	Project/consultant
Operational and Maintenance Stage							
<ul style="list-style-type: none"> <li>▪ Continuous supply of irrigation water</li> <li>▪ Agriculture support facilities etc.</li> </ul>	Availability of reliable year-round irrigation water	Direct	High	Local	Long-term	Ensure operation and maintenance, control of leakage of water and also ensure regular cleaning of silt in the canal with WUAs involvement	Project/WUAs
	Increase in cropping intensity from 164 percent to over 180 percent	Direct	Medium	Local	Long-term	Encourage to adopt proper cropping pattern and operate canal properly	Project/WUAs
	Increase in production of paddy, jute, wheat, potato and sugarcane from existing 2.5 to 4.2 t/ha, 1.9 to 2.5 t/ha, 2.2 to 3.5 t/ha, 17.9 to 22 t/ha and 44 up to 80 t/ha respectively	Direct	Medium	Local	Long-term	Provide agriculture extension services, and agriculture inputs, discourage use of agro-chemicals, organise training on agriculture techniques, promote IPM and IPNM, distribute information on impacts of the use of agro-chemicals	Project/DADO/WUAs
	Institutional development of WUAs	Indirect	Medium	Local	Long-term	Provide training and necessary assistance to WUAs	Project/DADO/WUAs
	Increase in land value by almost double	Indirect	Low	Low	Long-term	Encourage for multiple cropping, and discourage land use change	Project/DADO/WUAs
	Development of agro-based industries, animal husbandry and fish cultivation	Indirect	Low	Local	Long-term	Provide assistance and training to target farmers, encourage for cereals, cash crop and fodder production, also provide training for fish culture	Project/Line agencies/ Farmers
	Land Protection by river training works	Direct	Medium	Local	Long-term	Proper maintenance of the river training and use of bio-engineering measures	Project/WUA

## 5.2. Adverse Impacts and Mitigation Measures

### 5.2.1. Pre-Construction Stage

- C1. Land Acquisition: A total of 372.3 ha of land should be acquired for the construction of canal system. Of this 5.6 ha of land will be used for headwork construction, and 19.8 ha will be occupied by conveyance canal. A total of 32.5 ha and 115.9 ha of land will be used for the construction of secondary and tertiary canals respectively. Similarly, the Project has estimated to use about 154.6 ha for on-farm development (water course) and 0.7 ha for road improvement to maintain 1.5 km long road. Furthermore, about 43.2 ha of the land will be developed as fishpond, as a part of environmental mitigation measures.

Besides, the proposed length of the main canal, secondary canal and tertiary canal is estimated at 35.83, 60.53 and 172.41 km respectively. The Project has planned to construct extensive road network along with secondary and tertiary canal networks and the road width will be maintained at 3m. For this, above mentioned ha of farmland (about 372 ha) will be acquired.

Almost all the land of the main canal is already acquired by the SMIP. This Project will encourage the farmers, particularly the fishermen community to raise fish as the main sources of subsistence living. As this is a joint management project (Project and farmers), compensatory environmental protection measures will be limited, to the extent possible, for the construction of headwork only. For other land, local people will be compensated as per the prevailing laws. In case of road, local people will extend their cooperation to provide necessary farmland or other categories of land.

- C2. Leasing of Land for Work Camp, Labour Camp and Spoil Disposal Site: A part from the land required for the construction of canals and drains, land will be required work camp, labour camp and spoil disposal. The land required for work camp and labour camp will be temporary in nature. Such space could be leased for the project duration.

The study has not identified the requirement of the area for the work camp and labour camp. However, the provision will be made in the contract and bill of quantities for the procurement or leasing of the land for the purpose of work camp and labour camp.

### 5.2.2. Construction Stage

Construction and operation of the proposed Project will likely cause some adverse impacts on the environment. Most of the construction related impacts will be temporary in nature, and operation stage impact will particularly be related to flow reduction in the long run. These impacts have been grouped for physical, biological and socio-economic and cultural environment as follows:

#### 5.2.2.1. Physical Resources

- D1. Earthworks and Concrete Works: The volume of excavation and backfill for headwork construction are 39,000m<sup>3</sup> and 19,000 m<sup>3</sup> respectively. Remaining 20,000 m<sup>3</sup> is planned to spread to level the field around the construction site. Furthermore, some volume of this will be used for embankment construction in the river training works. This will reduce the quantity of construction waste to be disposed off. Disposal of construction waste will be limited around headwork site.

During canal construction, earthwork materials will be used for embankment and will be compacted around the field by the bulldozer. The canal shape will be made with excavation materials and spread to the field along the canal. Hence, no spoil disposal area is located for operation.

As the impacts of earthwork has not been predicted, any impact occurred during the construction stage will be insignificant. Hence, no mitigation measure is proposed.

- D2. Quarry Site: The Project will require about 36,700 m<sup>3</sup> of aggregate, 19,100 m<sup>3</sup> of sand and 10,600 m<sup>3</sup> of timber for the construction of headwork and canals (Table 5-2).

Table 5-2 : Volume of the Local Materials Required

	Aggregate (m <sup>3</sup> )	Sand (m <sup>3</sup> )	Timber (m <sup>3</sup> )
Headwork	11,400	5,700	10,600
Canals	25,300	13,400	-
Total	<b>36,700</b>	<b>19,100</b>	10,600

Source: Feasibility Study Report, 2002.

The local construction materials like coarse, aggregate, boulders will be collected from the riverbank around the construction site without disturbing the morphology of the area concerned.

In order to minimise impacts associated with quarry operation and collection of aggregates, boulders and sand, Project will take into consideration the river course, materials deposition trend, and manual extraction on the construction materials along the river course. The unused materials will be disposed off safely nearby the headwork site. It will be ensured that that disposal of construction and quarry waste will not damage the river course, other water bodies and landform. Hence this impact is also considered relatively insignificant.

- D3. Environmental Pollution: As the construction activities will be undertaken during the dry seasons, it will likely generate dust and gaseous emission. Such impact may be intense at the headwork and canal excavation site. It is likely that the local people and the construction workers will be affectedly due to dust and vehicular emission. As the construction work will be carried out during the dry season, this impact will be severe.

Plying of heavy vehicles will also emit gaseous emission and create noise due to unnecessary use of pressure horn and practice of calling the passengers through horn. Local people and the construction workers are predicted to be affected by the pollution problems.

If the construction materials such as cement slurry, mobile, diesel etc. are leaked into the water bodies, water pollution may also increase.

Operation of the labour camp and work camp is likely to create environmental pollution due to the solid wastes and wastes water.

In order minimise environmental pollution, and its effect on local people and construction workers, the Project will instruct the supervising consultant and the contractor to spray water at regular interval to arrest the dust, maintain vehicles to minimise gaseous emission, and prohibit the use of pressure horn particularly along the settlement, hospitals and health posts and school areas. Similarly no horn and safety signs will be erected in these areas. Furthermore, vehicle speed breakers will be kept at appropriate places in such areas. The Project will avoid the leakage of cement slurry, mobile or diesel into the water bodies to the extent possible. Labour camps and work camps will be provided with sanitary latrines and solid wastes disposal area.

- D4. Stockpiling of Construction Materials : The majority of the construction works will be carried and in the vicinity of the agriculture land. The general altitude of the contractor will be to stockpile the materials near by which will be cultivated land. The agriculture production of these land will be loss during the construction period or as long as the material occupy the land.

The contract document will have specific clause that the Contractor will have to lease the land for such purpose depending upon the period or pay compensation for the loss of agriculture production.

- D5. Possible Change in downstream water regime : The construction activities at the headworks site may change downstream water regime. However, this impact will be in temporary nature and insignificant in magnitude during construction period.

### 5.2.2.2. Biological Resources

As there is no forest in the project area including the headwork site, no significant impact will occur on the forests and the wildlife. The natural forest – Ramdhual – lies to the north of the Study area, about 3.7 km far from the project area. Hence, no encroachment is predicted from the project and the construction workers. However, the aquatic life, particularly the fish population will be affected greatly by the project activities, particularly due to diversion of river water for irrigation purposes. High demand for fish by the construction workers and project officials will likely affect its population and in the worse condition, the species itself.

In order to minimise this impact, the Project has planned to release water to maintain aquatic habit, and proposed to instruct Arvind and Baba paper mills to operate effluent treatment plants (ETPs). The Project will instruct the supervising consultant and contractor to avoid the involvement of the project officials and the construction workers in fishing activities. Fishermen will be encouraged for fishing the only fish which are appropriate for harvesting. Furthermore, a special package of fish culture has been developed to about 180 households of fishermen in Mariya Dhar area. The Project will provide training to fishermen on raising the fish and harvesting technique as appropriate. In nutshell, the Project will take every possible and cost-effective measure to minimise adverse impacts of the Project activities on fish species and aquatic habitats.

### 5.2.2.3. Socio-Economic and Cultural Resources

E1. Loss of Agriculture Land: The proposed tertiary canals and the watercourse will pass through the agricultural land. About 270 ha of agricultural land will be affected from these two major activities of the Project.

This adverse impact will be mitigated through compensation. The Project will provide necessary compensation to the landowners based on existing regulatory provisions, particularly by following the provisions of the *Land Acquisition Act, 1977*. Alternatively, the farmers – the Project beneficiaries – may also be encouraged to provide land for the construction of tertiary canals. However, the farmers losing over 50 percent of the total land through land acquisition process will be compensated considering them as the Severely Project Affected Families (SPAFs).

E2. Pressure on Social Service Facilities: High number of construction workers including outside labourers will exert pressure particularly on drinking water, health and sanitation, and education facilities. As the Project will be constructed during the dry season, local drinking water supply may be inadequate to cater the needs of the construction workers. Similarly, health facilities are primarily developed for local people, and construction workers may need additional medicines. Furthermore, high number of workers in the limited area may exert pressure on sanitation facilities and it may be unhealthy thereby increasing the menace of water pollution/sanitation-related diseases. There are also possibilities that the children of the outside construction workers may be enrolled in the local school thereby creating additional pressure on sanitation and school facilities. It is also likely that the construction workers may suffer from snakebites and it could be fatal.

In order to minimise and/or mitigate the above problems, the Project will provide drinking water facility to the outside labourers. It will also provide medicines and physical facilities in the school if the construction workers and their families are provided with these facilities. Furthermore, provisions for health and sanitation, and drinking water facilities will be the pre-requisite for labour camp operation. The Project will also keep in place necessary medicines for the Project officials and the construction labourers. If severe health injuries are noted due to Project activities, the Project will bear the cost for medication.

E3. Occupational Health and Safety: During the construction of the headwork in the Sunsari River, and canals, some workers may have injuries and there is a possibility of minor accidents.

In order to minimise this problem, the Project will provide the workers necessary information on occupational health and safety. Furthermore, the Project will have first aid facilities for primary health care, and provide necessary health cost for treatment elsewhere.

- E4. Law and Order Situation: The large number of outside construction workers will likely create conflict with the social norms and values.

This problem is considered minor and insignificant and no mitigation measure is proposed. However, in order to resolve any conflicts, malpractices of the workers will be immediately reported to the nearest security official, and the Police Post for necessary action. The Project will also take actions to expel the workers to those violating the laws and creating problems in the society. However, the supervisory consultant and the contractor(s) will be encouraged to inform the workers on these arrangements.

- E5. Inflation: With the increase in the number of outside workers and Project officials, the demand for food items and other consumables will likely increase. High cash flow may also invite inflation and the price of commodities will increase unexpectedly.

This impact is natural and has been evaluated insignificant. Hence, no mitigation measure is proposed. However, the local farmers will be informed on the long-term implication of price rise of the commodities and will be advised not to inflate the price of the local food commodities.

- E6. Culture and Religion: The construction of irrigation system is not likely to effect any religious and/or cultural site. However, influx of large number of outside construction workers may have some impact on the cultural practice of the project area.

Project will provide separate labour camps for the outside workers, which will avoid direct contact with the local people.

### 5.2.3. Operational Stage

A number of environment-related impacts may occur during the operational and maintenance stages of the Project. The potential environmental impacts their are presented here below.

#### 5.2.3.1. Physical Resources

- F1. Siltation, Sedimentation and Erosion: Most parts of the catchment area of the source River lies in the geologically fragile Siwaliks. Its steep and unstable slopes will likely increase soil erosion and landslides thereby increasing the load of sediments in the river system during the rainy season. If so, this will potentially increase the siltation problem in the canal system. This also might increase bank cutting. Based on the preliminary assessment, annual sediment volume from Sunsari River is estimated as follows:

Annual water volume from Sunsari River	161 MCM
Estimated sediment volume entering into canal system	189,000 m <sup>3</sup> /year

The amount of sediment that may be deposited in the canal system will be about 189,000 m<sup>3</sup>/yr and this is equivalent to 0.2m depth of sediment in canals. This will gradually reduce the water conveying capacity of the canal system. In addition, the silt load may reach to the farmland and reduce soil fertility and crop production.

In order to mitigate this problem, two alternatives measures will be implemented. They are: construction of spillway and removal of silt periodically. Based on the field study and arrangement of joint management of this project (by the Project and farmers), the study team judges that this amount of sediment can be removed by farmers. Therefore, a separate sedimentation basin has not been proposed as the mitigation measure. Sediment removal annually will likely solve the problem. Furthermore, the main canal will have spillway to wash away the silt and minimise it in the canal system. In addition, if the water carries over 5,000 ppm of silt in the River during the rainy season, it is recommended to close the canal gate as in other similar irrigation projects.

- F2. Water Pollution: As mentioned before, there are two paper mills located at downstream of proposed headwork, which are discharging polluted effluent into the river. The irrigation water will not receive any of the industrial effluent. However, the effluent content against the Sunsari river flow will increase after the headwork starts diverting the Sunsari river water into

Shankarpur and Suksena canals. The present content in the leanest season is estimated to be about 1.6% of the river flow (leanest flow is assumed at  $3\text{m}^3/\text{s}$ ). It would, however, become as high as 16% of all the leanest season flow if the head work diverted as much as 90% river water as usually practiced in Nepal.

Since the present situation is not already permissible, SRIP may not be allowed to take any more water during lean period unless otherwise the factories take any kind of measures of reducing the effluent. Though the factories are already violating a regulation in Nepal, the practice on the ground might continue. Faced with this situation, impact assessment on Sunsari river water quality should be done in terms of how further deterioration of the river water can be avoided upon the SRIP coming into operation.

There is a possibility that the factories construct ETP under the assistance from DANIDA. This ETP, however, is not supposed to run up to the level at which Nepal Standard is satisfied but to reduce the effluent by 80% from the present. For example; present COD value is around 3,000 mg/l, in case of ETP installed the value of COD will be about 600 mg/s against the standard of 250 mg/s in case of Baba. Also, Baba factory would probably increase the production to as much as four times owing to the new production line.

The impact assessment considers these two scenarios, ETP construction and production increase under different diversion volumes. Impact associated with the water diversion can be discussed in terms of change of the concentration of COD and BOD since these are the main wastes coming through the paper production. Assessment on COD change is exemplified below, and the change of COD and BOD is summarized in Table 5-3 and Figure 5-1.

**Condition:**

COD of Baba effluent	:	2,965 mg/l
Water consumption of Baba	:	4,000 $\text{m}^3/\text{day}$
COD of Arvind effluent	:	252 mg/l
Water consumption of Arvind	:	150 $\text{m}^3/\text{day}$ (4,150 $\text{m}^3/\text{day}$ in total water consumption by both factories)
COD at 3 km downstream	:	59.7 mg/l in dry season (measured on 6 and 7 May 2001)
Discharge of Sunsari River	:	2.7 $\text{m}^3/\text{s}$ (the leanest runoff, measured on 6 and 7 May 2001)

**COD Load** (concentration value times the amount of water):

2,965 mg/l x 4,000 $\text{m}^3/\text{day}$	:	11,860 kg/day of COD load from Baba Paper Mill
252 mg/l x 150 $\text{m}^3/\text{day}$	:	37.8 kg/day of COD load from Arvind Paper Mill
		Say 12,000 kg/day of COD load in total from paper mills
2.7 $\text{m}^3/\text{s}$ x 86,400 s/day	:	233,280 $\text{m}^3/\text{day}$ in Sunsari River in the leanest season
233,280 $\text{m}^3/\text{day}$ + 4,150 $\text{m}^3/\text{day}$	:	237,430 $\approx$ 240,000 $\text{m}^3/\text{day}$
12,000 kg/day / 240,000 $\text{m}^3/\text{day}$	:	50 mg/l of additional COD downstream in the leanest season, and this corresponds to the actual measured value of 59.7 mg/l.

It is very simple way of estimating the COD assuming the value downstream is proportional to the amount of discharge. The minimum runoff calculated by tank model in 80% probability is 3.69  $\text{m}^3/\text{s}$ , and diversion of river water is considered at 50%, 80% and 90% of the 3.69  $\text{m}^3/\text{s}$ . Baba factory's present capacity is 10 ton/day but has already installed a new line with additional are also considered.

**Base flow (80% probability of Sunsari river runoff) :**

$3.69 \text{ m}^3/\text{s} \times 86,400 \text{ s/day} = 318,816 \approx 320,000 \text{ m}^3/\text{day}$  of water

50% diversion :  $0.5 \times 320,000 = 160,000 \text{ m}^3/\text{day}$  in river

80% diversion :  $0.2 \times 320,000 = 64,000 \text{ m}^3/\text{day}$  in river

90% diversion :  $0.1 \times 320,000 = 32,000 \text{ m}^3/\text{day}$  in river

**Case 1. No ETP :**

50% diversion :  $12,000 \text{ kg/day} / (320,000 \text{ m}^3/\text{day} \times 0.5) = 75 \text{ mg/l}$

⊕

**Case 2. COD load is reduced to 20% (target for DANIDA ESPS) by ETP :**

$12,000 \text{ kg/day} \times 0.2 / 320,000 \text{ m}^3/\text{day} \approx 7.5 \text{ mg/l}$  of additional in dry season

50% diversion :  $12,000 \text{ kg/day} \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.5) = 15.0 \text{ mg/l}$

⊗

80% diversion :  $12,000 \text{ kg/day} \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.2) = 37.50 \text{ mg/l}$

⊗

90% diversion :  $12,000 \text{ kg/day} \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.1) = 75.0 \text{ mg/l}$

⊕

**Case 3. Production doubled but COD unit load is reduced to 20% by ETP :**

$12,000 \text{ kg/day} \times 0.2 / 320,000 \text{ m}^3/\text{day} \approx 15 \text{ mg/l}$  of additional

50% diversion :  $12,000 \text{ kg/day} \times 2 \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.5) = 30 \text{ mg/l}$

⊗

80% diversion :  $12,000 \text{ kg/day} \times 2 \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.2) = 75 \text{ mg/l}$

⊕

**Case 4. Production four times but COD unit load is reduced to 20% by ETP :**

$12,000 \text{ kg/day} \times 4 \times 0.2 / 320,000 \text{ m}^3/\text{day} \approx 30.0 \text{ mg/l}$  of additional

50% diversion :  $12,000 \text{ kg/day} \times 4 \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.5) = 60 \text{ mg/l}$

⊕

80% diversion :  $12,000 \text{ kg/day} \times 4 \times 0.2 / (320,000 \text{ m}^3/\text{day} \times 0.2) = 150 \text{ mg/l}$

⊕

**Case 5. Production doubled but COD of effluent follows Nepali Standard of 250 mg/l :**

$250 \text{ mg/l} \times 4,150,000 \text{ l/day} \approx 1,037.5 \text{ kg/day}$  of COD load in total

$1,037.5 \text{ kg/day} \times 2 / 320,000 \text{ m}^3/\text{day} \approx 6.5 \text{ mg/l}$  of additional

50% diversion :  $1,037.5 \text{ kg/day} \times 2 / (320,000 \text{ m}^3/\text{day} \times 0.5) = 13 \text{ mg/l}$

⊗

80% diversion :  $1,037.5 \text{ kg/day} \times 2 / (320,000 \text{ m}^3/\text{day} \times 0.2) = 32.4 \text{ mg/l}$

⊗

90% diversion :  $1,037.5 \text{ kg/day} \times 2 / (320,000 \text{ m}^3/\text{day} \times 0.1) = 64.8 \text{ mg/l}$

⊕

**Case 6. Production four times but COD of effluent follows Nepali Standard of 250 mg/l :**

$250 \text{ mg/l} \times 4,150,000 \text{ l/day} \approx 1,037.5 \text{ kg/day}$  of COD load in total

$1,037.5 \text{ kg/day} \times 4 / 320,000 \text{ m}^3/\text{day} \approx 13 \text{ mg/l}$  of additional

50% diversion :  $1,037.5 \text{ kg/day} \times 4 / (320,000 \text{ m}^3/\text{day} \times 0.5) = 25.9 \text{ mg/l}$

⊗

80% diversion :  $1,037.5 \text{ kg/day} \times 4 / (320,000 \text{ m}^3/\text{day} \times 0.2) = 64.8 \text{ mg/l}$

⊕

Note :

⊕ Water quality will be worse than the present COD condition of 50 mg/l

⊗ Water quality will be better than the present condition of 50 mg/l

Table 5-3: Estimated additional COD and BOD values from the mills (mg/l)

	Rate for irrigation of the River	Case 2 load 20% (DANIDA)	Case 3 doubled with 20% (DANIDA)	Case 4 times with 20% (DANIDA)	Case 5 doubled with NS*	Case 6 four times with NS*	Present Condition
COD	50%	15.00	30.00	60.00	13.00	25.90	50
	80%	37.50	75.00	150.00	32.40	64.80	
	90%	75.00	150.00	300.00	64.80	129.70	
BOD	50%	10.10	20.30	40.50	5.10	10.10	33.8
	80%	25.30	50.60	101.30	12.70	25.30	
	90%	50.60	101.30	202.50	25.30	50.60	

Water quality will be worse than the present condition.

Findings from the above table and figures are as follows :

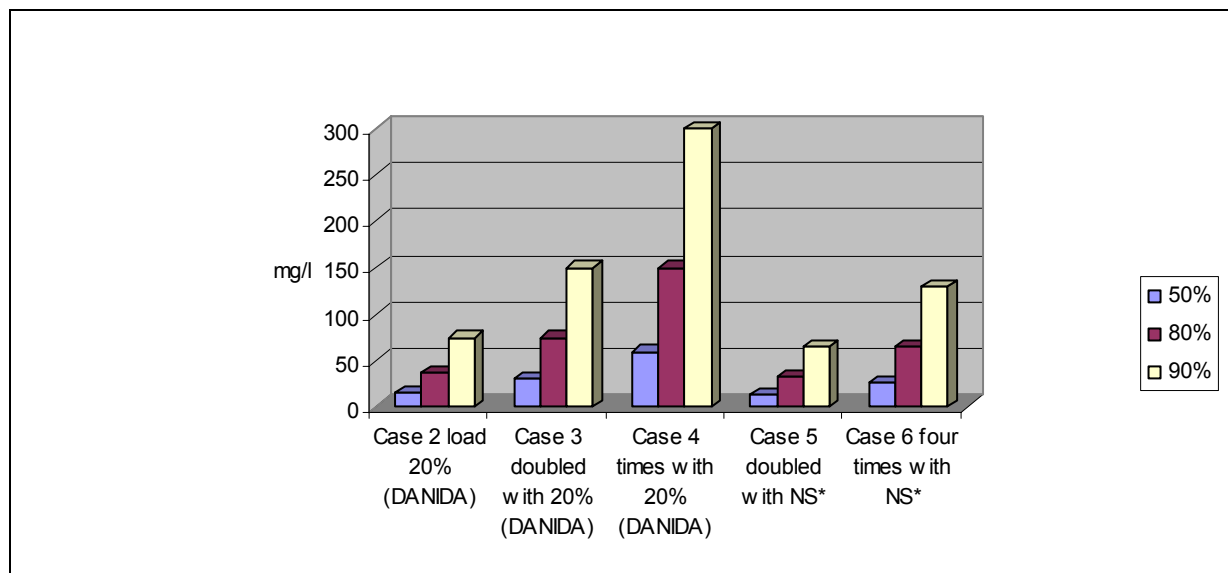


Figure 5-1 : Estimated COD Values

- In case of 50% water diversion during lean period :

As far as the paper factories reduce the load to 20% of the present value by ETP, even if the production is doubled, values of COD and BOD will not exceed the present condition and it is likely to have less adverse to the water. However, if the production is increased to four times, the values of COD and BOD will exceed the present condition unless the factories obey the Nepal Standard.

- In case of 80 % water diversion during lean period :

If the paper production remained same as the present with the ETP reducing the effluent to 20%, 80% water diversion would not worsen the values of COD and BOD. However, if the paper production is doubled, the COD and BOD will be worsening than the present condition. If the factories reduce the effluent to the level of Nepal Standard, 80% diversion



would not so worsen the present condition though COD under four times production would become a little worse than the present.

- In case of 90 % water diversion during lean period :

90 % water diversion may be out of consideration since the COD and BOD would be worsening very much even under the condition that the factories abide by the Nepal Standard except BOD under doubled production with Nepal Standard compliance.

Taking into account above findings, this Study recommends :

- The factories should reduce the effluent with assistance from DANIDA or otherwise by their own responsibility. If the present situation prevails, the SRIP should not take any water during lean period since the present situation is already beyond the permissible level.
- On condition that the factories install and ETP reducing the effluent to 20%, the SRIP may take Sunsari water upto 50%. However, if Baba factory runs the production line with the full capacity (four times production than the present), the situation would become worse than the present situation even with the ETP. According to the table above, three times more production would be still within the present condition. Therefore, 50% water diversion during lean period should accompany careful monitoring of both paper production and the river water quality. Also, compensation for fisheries may have to be considered.
- If the SRIP intends 80% water diversion, the Government should enforce the factories to obey the Nepal Standard. Unless otherwise the factories abide by the Nepal Standard, the SRIP should not proceed to the 80% water diversion. Compensation for fisheries should also be considered in case that the SRIP diverts 80% water.

- F3. Water Logging: Feasibility study has identified flood prone and possible inundation area at eight locations. Application of irrigation water is likely to water logged these low lying areas if the proper drainage system provided. In addition the ground water level may rise. Some of the agro-chemicals which are likely to be used by the farmers may accumulate in the water logged area and in due course of the time, the salinity the soil may increase thereby may have effect on agriculture productivity.

In order to drain out the irrigated water from the field, extensive drainage development have been proposed as the integral part of the project. In addition, the canal embankment running along the Sunsari River have been strengthening to protect the possible breach.

#### 5.2.3.2. Biological Resources

As mentioned above, the Project activities will have no impact or insignificant impacts on the forest environment. However, it will affect the aquatic habitat and its flora and fauna. The potential impacts are:

- G1. Aquatic Invertebrates: Flow reduction in the Sunsari River downstream of the headwork will have adverse impacts on micro flora and fauna, the aquatic invertebrates. Based on the existing level of information, three groups of fauna, *Plecoptera*, *Ephemeroptera*, and *Tricoptera* are likely to be greatly affected. These faunal groups have a narrow range of tolerance to changes in environmental factors such as temperature, dissolved oxygen, pH, carbon dioxide level etc.

It is also predicted that site-specific rare faunal groups such as *Leptophlebitidae*, *Tricorythidae* and *Lepidostomidae* will be greatly affected and may disappear from the river due to changes in existing environmental quality. As macro-invertebrates are considered the major food sources for fish, some groups of fishes may also severely be affected. It is also predicted that some groups of fish species may either disappear or change their feeding habit. Although the ecological importance of these groups of species will be high, conservation value and ecological functioning of these species is unclear.

This impact is evaluated significant, and it is proposed to discharge at least, 0.7 m<sup>3</sup>/s of water from the intake site into the Sunsari River so that the aquatic habitat of these species can be improved. In addition, operation of the effluent treatment plant by the paper mills will also contribute to improve the aquatic habitat of phytoplankton and zooplankton. In addition, the Project has proposed to launch special programmes of fish culture to improve the living standard of the fishermen.

- G2. Fish Population: Fish species, which are ecologically adapted to the flowing condition, will find new habitat and/or they should depend on pools, i.e., they should adapt for new conditions. Changes in the composition and abundance of both the planktonic and benthic communities resulting from the changes in water flow condition would also affect the food supply of some fish species. Some species may be affected adversely while others may also be benefited as it depends on the specific behaviour of the species in question. This will eventually influence the species composition and population as well. Hence, it is predicted that the construction of barrage in the Sunsari River may result to the disappearance of some species, emergence of new species or only decline on the population of some fish species. Based on the fish species in the Sunsari River, they are grouped as flowing water lover, and pool-dwellers.

Table 5-4 : Habitat Preferences of Major Fishes

SN	Pool Dwellers Fish Species	Flowing Water Fish Species
1	<i>Cirrhinus rewa</i>	<i>Anguilla bengalensis</i>
2	<i>Channa marulius</i>	<i>Barrilius sp.</i>
3	<i>Channa panctatus</i>	<i>Catla catla</i>
4	<i>Clarius betrachus</i>	<i>Labeo rohita</i>
5	<i>Channa striatus</i>	<i>Mystus sp.</i>
6	<i>Cirrhinus mrigala</i>	<i>Noemacheilus sp.</i>
7	<i>Heteropneustes fossilis</i>	<i>Puntius sp.</i>
8	<i>Labeo gonius</i>	<i>Wallago attu</i>
9	<i>Macrognathus aculeatus</i>	<i>Xwenentodol concila</i>
10	<i>Mastacemblus puncaulus</i>	
11	<i>Oxygaster bacaila</i>	

After the diversion of required water on to the canal system, pool habitat will be maintained in selected areas. If so, about 11 species of fish could adopt to the new aquatic environment. However, the flowing water-lovers, i.e., 9 species of fish, will be greatly affected due to the diversion of the water of the Sunsari River for irrigation purposes. Furthermore, the long-distance migratory fish species such as eel may be affected due to barrage construction.

In order to minimise this impact including of migratory fish species, the Project will construct fish passage in the headwork, and discharge at least 0.7 m<sup>3</sup>/s even if 80 percent of the flow is diverted for irrigation purposes. This comes to about 20 percent of the river water flow and complies with the standard as stipulated in the Hydropower Development Policy, 2002. Furthermore, operation of the ETPs and compliance of the environmental standards by the paper mills will also improve fish habitat. In addition, the Project will launch fish culture programme to benefit the fishermen which are likely to be affected by the Project activities.

### 5.2.3.3. Socio-Economic and Cultural Resources

- H1. Fishing Community: As mentioned in G2, the fish diversity and population will be severely affected after the completion of the headwork and diversion of water for irrigation purposes. Furthermore, higher concentration of industrial effluents in the downstream of the headwork will have additional pressure on fish species and their population. As also mentioned in Chapter 3, about 180 families depend on fishing activities for subsistence livelihood. In this context, the life of the fishermen will be significantly impacted and the Project activity will disturb their living and nutrition as well. Hence, the fishermen community, who are landless and poor, would be much poorer.

This impact is evaluated as most significant, and could be lowered down by encouraging the fishermen in raising fishes in the fishponds. The Park and People Programme funded by the United Nations Development Programme has promoted fish culture in the study area apart from other rural development activities since 1995. They have facilitated the fishermen to organise the group and provided necessary training for raising the fish together with the construction of fishponds. Furthermore, DADO has been the in-charge of fish culture promotion and this Project will best utilise their experience. Furthermore, research results and experiences of the public sector fish hatcheries in the Eastern Development Region including of Fishery Research Centres of Tarahara, Fattepur of Saptati district, Lahan of Siraha district will also be utilised to develop training package and provide necessary training to the needy fishermen.

In order to develop fishponds and promote fish culture, the land available in the Mariya Dhar (old Sunsari River) will be considered initially by solving its ownership problem. There are three systems of fish culture in Nepal. They are: extensive culture, semi-intensive culture, and intensive culture. It has been estimated that about 0.2 ha of semi-intensive fishpond can compensate for the decrease of fish production in the Sunsari River, and this semi-intensive system of fish culture is also recommended for the Project area. As about 180 households are now engaged in fishing in the study area, development of about 36 ha of land as fishponds would be sufficient for the introduction of semi-intensive fish culture as compensation. Based on the local information (DADO), about NRs. 200,000/ is required to construct a hectare of fishpond excluding the cost for land acquisition. The land price in the Mariya Dhar is about NRs. 100,000/ha and the land rate in the farmland is about NRs. 300,000/ha. As this impact can neither be prevented nor corrected, compensatory mitigation measure has been proposed, i.e., purchase appropriate land, provide 0.2 ha of land to each family and also provide training and other necessary services to the fishermen who will be affected by this Project.

- H2. Pump Irrigation along the Sunsari River: Local people are involved in pumping water from the Sunsari River to meet their water demand for irrigation and drinking water. Practice of water extraction includes pumping of water into a circular earthen bund. Small earthen canals carry the water from the pool of water into the circular bund to the fields. However, such canals irrigate fields only up to 200 m from the bank of the River, as irrigating land at a distance more than that becomes economically unfeasible. Thus, farmers in general use shallow tube wells (STWs) for irrigating their field that are more than 200 m away from the riverbank.

A total of 266 pumping stations were observed in May 2002 at the downstream of the East-West Highway to the border with India. It is estimated that about 230 ha of land is being served by these pumping stations along the Sunsari River corridor. By considering the pumping capacity of 20 l/s and number of 20 pumps available in the nearby villages (based on interview) are simultaneously operated, about 400 l/s (20 x 20) or 0.4 m<sup>3</sup>/s (at maximum) of water is extracted during the dry season from the Sunsari River.

In order to minimise this impact on the existing pump irrigation, SRIP will release about 50 percent of the total water which is 1.8 m<sup>3</sup>/s to downstream during the winter season. This amount of water will not disturb the pump irrigation facilities, as they need about 0.4 m<sup>3</sup>/s at maximum. At later stage and after the operation of the effluent treatment plants by Arvind and Baba Paper Mills, the Project intends to divert about 80 percent of the total water available in the Sunsari River. Also in this option, about 0.7 m<sup>3</sup>/s will be released which is still more than the total pump irrigation requirement based on the present practice. Hence, this impact is also considered insignificant in view of the policy adopted in the SRIP, and no mitigation or compensatory measure is proposed to avoid or mitigate the possible impacts on pump irrigation facilities.

In view of the higher load of industrial pollutants, and lack of effluent treatment facilities in the paper mills, this study strongly recommends to stop pumping of the polluted water, and to promote STWs for irrigation purposes in the areas which shall not be covered by this Project.

- H3. Use of Agro-Chemicals: Water availability for irrigation and increase in cropping intensity will likely encourage the local people to use more agro-chemicals like chemical fertilisers, insecticides and pesticides to increase crop production. Excessive use of chemicals will not

only affect the soil properties and reduce its fertility but also affect the natural environment and human being through biological magnification process.

This impact could be minimised, if not avoided, through agricultural extension programmes proposed as a part of the irrigation project. The Project will encourage the local people to use of green manure and adopt integrated plant nutrients in the spirit of the existing policies. Furthermore, necessary information will be provided to the farmers about the implications of agro-chemicals on human health, soil and food items as well. It is hoped that this will discourage the use of agro-chemicals particularly the pesticides/insecticides and adopt integrated pest management.

- H4. Workload to the Women: In rural parts, women are more involved in agriculture farming and the year-round facility for irrigation water may increase cropping intensity and also increase workload to the women. Women as they are involved in planting, weeding, harvesting, threshing and storing of the farm products may have little time for other activities, and caring their children.

The beneficial impact outweighs this adverse impact, as crop production will increase through irrigation system. This predicted adverse impact is also insignificant and is more a cultural practice. However, the Project will disseminate information on possible implications of additional workload to women in the area, and encourage men as well to reduce such workload.

A summary matrix of the adverse environmental impacts and recommended mitigation measures is given in Table 5-5

Table 5.5 A Summary of Adverse Impact of the Sunsari River Irrigation Project and Mitigation Measures

Activity	Potential Impacts	Environmental Impacts				Mitigation Measures	Responsibility
		Nature	Magnitude	Extent	Duration		
<b>Pre-Construction Stage</b>							
Land Acquisition	Acquisition of about 372.3 ha of land for canal system	Direct	High	Site-specific	Long-term	Provide adequate compensation as per the prevailing laws	Project
<b>Construction Stage</b>							
Earthworks and Concrete Works	Generation of about 39,000m <sup>3</sup> and 19,000 m <sup>3</sup> as excavation and backfill materials during headwork development	Direct	Low	Site-specific	Short-term	About 20,000 m <sup>3</sup> will be spread to field around the construction site, some of its to be used for embankment due to river training, remaining construction waste to be disposed off safely	Project/Contractor
Canal construction	Change in land use due to conversion of 19.8 ha, 32.5 ha and 115.9 ha of land for conveyance, secondary and tertiary canals respectively.	Direct	High	Site-specific	Short-term	Provide adequate compensation as per the prevailing laws, and line the canal to avoid and/or minimise water percolation loss	Project
Watercourse development	Conversion of 154.6 ha for on-farm development (water course) and 0.7 ha for road improvement to maintain 1.5 km long road. Furthermore,	Direct	High	Site-specific	Short-term	Provide adequate compensation as per the prevailing laws	Project
Fish pond	Conversion of 43.2 ha of land for fishpond development	Direct	High	Site-specific	Short-term	Provide adequate compensation as per the prevailing laws	Project
Quarry Site	Operation of quarry to meet the demand for 36,700 m <sup>3</sup> of aggregate, 19,100 m <sup>3</sup> of sand and 10,600 m <sup>3</sup> of timber for the construction of headwork and canals	Direct	Low	Site-specific	Short-term	Collect the required materials with due consideration on the river morphology, and purchase the required timber from the market	Project/Contractor
General activities	Generation of dust in the headwork and canal excavation site	Indirect	Low	Site-specific	Short-term	Ensure water spraying to arrest dust, and maintain vehicles regularly	Project/Contractor
	Gaseous emission and high noise level due to vehicle movement	Indirect	Low	Site-specific	Short-term	Maintain vehicles regularly, provide mask and air plugs to construction workers, erect no horn signs near settlement, school and health posts	Project/Contractor
	Increase in water pollution due to disposal of construction materials such as cement slurry, mobile, diesel etc.	Indirect	Low	Site-specific	Short-term	Avoid discharge of construction materials into water bodies	Project/Contractor
	Change in fish diversity and population due to over fishing	Indirect	Low	Site-specific	Short-term	Discourage over fishing and provide alternative employments to fishermen	Project/Contractor
	Obstruction to fish migration such as for eel and Jalkapoor	Direct	Moderate	Local	Long-term	Construct <i>appropriate</i> fish passage in the headwork for migratory fish species	Project/Contractor
	Increased pressure on social service facilities due to outside construction workers and project officials	Indirect	Low	Site-specific	Short-term	Allocate funding to health post(s), education institutions to cater services for construction workers and provide separate drinking water facility to construction workers in the labour camp	Project/Contractor

Activity	Potential Impacts	Environmental Impacts				Mitigation Measures	Responsibility
		Nature	Magnitude	Extent	Duration		
General activities (contd.)	Increase in occupational health and safety (OHS) problems on headwork and canals	Indirect	Low	Site-specific	Short-term	Allocate fund for health post and/or keep in place the first aid facilities for immediate treatment, also provide information to the construction workers on OHS	Project/Contractor
	Possible violation of law and order	Indirect	Low	Local	Short-term	Observe and report for any violation to local security office for necessary action, and expel the workers involved in violation of norms	Project/Contractor
	Increase in the price of commodities and possible high inflation	Indirect	Low	Local	Long-term	Discourage the local people to increase price of the local commodities	Project/Contractor
<b>Operational and Maintenance Stage</b>							
Water diversion from the Sunsari River	Increase amount of silt in the canal system, possible sedimentation and river bank erosion due to fragile watershed area (Siwaliks), and also obstruction to cattle movement	Direct	Low	Local	Long-term	Annual cleaning of all canals and safe disposal of silt and sediments, provide cattle pass by constructing bridges along the main canal	WUAs and farmers
Continuous supply of water to the farmland	About 189,000 m <sup>3</sup> /year sediment volume entering into canal system from annual water volume from Sunsari River of 161 MCM which is equal to 0.2m depth of sediment in canals thereby reducing the water conveying capacity of the canal system	Direct	Low	Local	Long-term	Annual cleaning of all canals and safe disposal of silt and sediments	WUAs and farmers
	Possible siltation in the farmland and decline in the productivity	Direct	Low	Local	Long-term	Annual cleaning of all canals and safe disposal of silt and sediments	WUAs and farmers
	High pollutants load (12,000 kg/day of COD alone) from Arvind and Baba Paper Mills in the downstream	Direct	High	Local	Long-term	Make necessary arrangement to establish and operate effluent treatment plan and comply with the environmental standards	Arvind and Baba paper mills, MOPE
	Possible leakage of irrigation water and also possible water logging in the farmland	Indirect	Low	Local	Long-term	Provide drainage facilities, strengthening the canal embankment along the Sunsari River.	Project/ Contractor
	Possible impact on <i>Plecoptera</i> , <i>Ephemeroptera</i> , and <i>Tricoptera</i> groups of invertebrates due to narrow range of tolerance to changes in temperature, dissolved oxygen, pH, carbon dioxide level etc.	Direct	High	Local	Long-term	Make necessary arrangement to establish and operate effluent treatment plan by paper mills, and comply with the environmental standards, and also discharge water to maintain downstream flow to the extent applicable	Paper mills and Project
Continuous supply of water to the farmland (contd..)	Also impact on <i>Leptophlebiidae</i> , <i>Tricorythidae</i> and <i>Lepidostomidae</i> groups of invertebrates and possible decline or disappearance of some group of fish species	Direct	High	Local	Long-term	Make necessary arrangement to establish and operate effluent treatment plan and comply with the environmental standards, and also discharge water to maintain downstream flow to the extent applicable	Paper mills and Project

Activity	Potential Impacts	Environmental Impacts				Mitigation Measures	Responsibility
		Nature	Magnitude	Extent	Duration		
	Disappearance of water flowing fish species and good habitat for pool-dweller fish species	Direct	Low	Local	Long-term	No mitigation measure but monitoring to know flowing water lovers and pool dwellers	
	Impact on about 180 families who depend on fishing activities for subsistence livelihood and making the poor people poorer	Direct	Medium	Local	Long-term	Involve fishermen in farming in fishpond through necessary compensation, and provision for 36 ha of land in Mariya Dhar for fish culture	Project/Consultant/ Fishermen
	Impact on about 266 pumping stations used for irrigating about 230 ha of land along the Sunsari River	Direct	Low	Local	Long-term	Release a minimum of 20 percent of the total water to meet downstream requirement during the winter season; and stop pumping of the polluted water, and promote STWs for irrigation purposes	Project, WUAs and farmers
	Possible use more agro-chemicals such as chemical fertilisers, insecticides and pesticides to increase crop production, and also possible change in soil properties and reduction of soil fertility	Indirect	Low	Local	Long-term	Launch agricultural extension programmes as proposed and encourage local people to use of green manure and adopt integrated plant nutrient management, and integrated pest management by providing adequate information on their benefits	Project/Contractor / WUAs
	Possible increase in the workload of women due to their involvement in planting, weeding, harvesting, threshing and storing of the farm products	Indirect	Low	Local	Long-term	Disseminate information on possible implications of additional workload to women in the area, and encourage for gender balance	Project/Consultant

### 5.3. Significance of Impacts and Type of Mitigation Measures Proposed

Although a number of beneficial and adverse impacts have been identified and predicted, these impacts are evaluated as significant or insignificant in view of their importance. They are tabulated as follows:

Table 5-6 : A Summary of Significance of Environmental Impacts and Type of Measures

SN	Impacts	Significance of Impacts			Total Score ( $\Sigma$ MED)	Mitigation Measure	Significance of Impact
		Mag.	Ext.	Dur.			
<b>Beneficial Impacts</b>							
<b>Construction Stage</b>							
	Employment opportunity	60	20	05	85	Corrective	Significant
	Enhancement of technical skills	20	20	20	60	Corrective	Moderate
	Enhance of social service facilities	10	20	20	50	Corrective	Insignificant
<b>Operational and Maintenance Stage</b>							
	Increase in cropping intensity, production and productivity	20	20	20	60	Corrective	Moderate
	Institutional development of WUAs	10	20	20	50	Corrective	Moderate
	Increase in land value	20	20	20	60	No measure	Moderate
<b>Adverse Environmental Impacts</b>							
<b>Pre-Construction Stage</b>							
	Land acquisition	60	10	20	90	Compensatory	High
<b>Construction Stage</b>							
	Earthworks and concrete works	10	10	05	25		Insignificant
	Quarry site	10	10	05	25		Insignificant
	Environmental pollution	10	10	05	25		Insignificant
	Increase in fishing activities	10	10	05	25		Insignificant
	Loss of agriculture land	10	10	05	25		Insignificant
	Pressure on social service facilities	10	10	05	25		Insignificant
	Occupational health and safety	10	10	05	25		Insignificant
	Law and order situation	10	20	05	35		Insignificant
	Inflation	10	20	20	50		Insignificant
	Culture and religion						
<b>Operational and Maintenance Stage</b>							
	Siltation, sedimentation and erosion	10	20	20	50	Corrective	Insignificant
	Water pollution	60	20	20	100	Corrective	High
	Leakage and water logging						
<b>Back water effect</b>							
	Aquatic invertebrates	60	20	20	100	Corrective	High
	Fish population	10	20	20	50	Corrective	Moderate
	Migratory fish	20	60	20	100	Corrective	Significant
	Fishing community	20	20	20	60	Corrective	Moderate
	Water pumping for irrigation	10	20	20	50	Corrective	Moderate
	Use of agro-chemicals	10	20	20	50	Corrective	Moderate
	Workload to the women	10	20	20	50	No measure	Insignificant

**Note:** Based on National EIA Guidelines, 1993 following numerical values assigned and they have been used in the above table.

Magnitude	Extent	Duration
High/Major (H)	Regional ®	Long-term (LT)
Moderate (M)	Local (L)	Medium-term (MT)
Low/Minor (L)	Site Specific (SS)	Short-term (ST)

Mag. = Magnitude; Ext. = Extent; and Dur. = Duration

High and moderate impacts are predicted and evaluated through Delphi Method for the significance of the impacts of the Project on the environment.

Based on the above table (Table 5.5), the Project will emphasise to involve the local people as construction workers and will provide technical skills in order to augment the beneficial impacts. The WUAs will be strengthened through institutional development and capacity building activities. Land acquired for the construction of the headwork and canal will be compensated at the prevailing rates and as determined by the Compensation Fixation Committee. Due care will be taken to address the



insignificant impacts during the detail design. In other words, preventive and corrective measures will be implemented to minimise the insignificant impacts as well. The evaluated environmental impacts related with siltation, sedimentation and erosion, water pollution, aquatic invertebrates, migratory fish species, fishing community, water pumping and use of agro-chemicals will be mitigated to an acceptable level through corrective/rehabilitative environmental protection measures as included in Table 5-5 and Table 5-6. Based on these tables, adverse environmental impacts could be minimised to the acceptable level.

CHAPTER  
**ENVIRONMENTAL MANAGEMENT PLAN**

6

**6. ENVIRONMENTAL MANAGEMENT PLAN**

Although there is a lack of clear guidance on the nature and content of the Environmental Management Plan (EMP), the EMP has been developed, as mentioned in the Schedule 6 of the *Environment Protection Rules 1997*, with due consideration on the ingredients that have been included in the approved EIA reports of different sectors such as road, hydropower and irrigation projects.

Taking into account the basics of the management and also the elements that should be considered to make the project environmentally sound and sustainable, the POSDCORB (planning, organization, staffing, directives, coordination, reporting and budgeting) concept has been adjusted to prepare this EMP. Based on it, a plan has been proposed for the implementation of the environmental protection measures (EPMs), environmental monitoring and auditing. Similarly, necessary organisation and staff, directives and coordination including reporting and budget have also been included in this EMP. Within this broad framework, efforts are made to address 5W (what, where, how, when and whom) for the implementation of benefit augmentation and mitigation measures, and conduction of environmental monitoring and auditing. EMP guides the project management in such a way that EPMs are adequately implemented, effectiveness of these measures is monitored and environmental auditing is carried out to know the project performance on environmental ground.

**6.1. EPMs Implementation Plan**

The benefits augmentation and mitigation measures as included in Chapter 5 will be implemented as follows.

**6.1.1. Benefit Augmentation Measures**

Benefits augmentation measures included in the Chapter 5 will be implemented based on the following indicative plan.

Table 6-1 : A Plan for the Implementation of Benefits Augmentation Measures

SN	Activity	Location	Time	Method	Estimated Cost (NRs)	Responsibility
1	Application of engineering standards	Designer's office	Pre-construction stage	Review and design	No cost	Project / Consultant
2	Application of technical specification	Designer's office	Pre-construction stage	Review and design	No cost	Project / Consultant
3	Employment opportunity to local people	Construction site	Construction and operational stages	Inclusion in contract document and recruitment	Include in tender document	Project / Contractor
4	Enhancement of technical skills	Project area	Pre-construction stage	Prepare training materials and organise training	200,000/ (Lump sum)	Project / Consultant
5	Capacity building of WUAs Environmental awareness	Project area	Construction stage	Organise training	200,000/ (Lump sum)	Project / Consultant
6	River training works	River side	Construction stage	Bioengineering application	Included in Project	Project / Contractor
<b>Total</b>					<b>400,000/</b>	

**Note:** Cost for training depends upon the type and number of training. This is only an indicative commitment of the Proponent. Other cost will be included in the detail design and contract document.

### 6.1.2. Adverse Impacts Mitigation Measures

In order to mitigate the predicted environmental impacts, a number of mitigation measures have been proposed in Chapter 5 of this report. These mitigation measures will be implemented in a phased manner during the construction and operational stages.

Table 6-2 : A Plan for the Implementation of Mitigation Measures

SN	Activity	Location	Time	Method	Estimated Cost (NRs)	Responsibility
<b>Pre-Construction Stage</b>						
1	Land compensation	Project area	Before headwork and canal construction	Cash distribution at prevailing market rate	Included in project cost	Project / Consultant
<b>Construction Stage</b>						
2	Lining of the canal	Canals	After earthwork	Standard practice	Included in project cost	Project / Contractor
3	Drainage facility	Canals	After earthwork	Standard practice	Included in project cost	Project / Contractor
4	Proper disposal of construction spoils	Near canal side	After earthwork	Spoil disposal, level the site and protect with bioengineering treatment	Included in project cost	Project / Contractor
5	Water sprinkling and maintenance of vehicles	Dusty area	During earthwork	Water spraying daily during dry season	Included in project cost	Project / Contractor
6	Provision for mask and air plugs	Dusty area	During earthwork	Purchase and provide	Included in project cost	Project / Contractor
7	Erection of no-horn signs	Settlement, school and health post	Construction stage	Prepare and erect	Included in project cost	Project / Contractor
8	Support for social service facilities	School, drinking water and health post	Project period	Allocate cost for Medicine Furniture drinking water	100,000/ 100,000/ 300,000/	Project / Contractor
9	Training and information dissemination	Project area	Pre-construction stage	Prepare materials, conduct training, distribute information	300,000/	Project / Contractor
10	Installation of effluent treatment plant by paper mills	Effluent discharge points	Before water diversion in canal	Standard practice and design	20,000,000/ (to be borne by the mills)	Arvind and Baba Paper mills
11	Development of fishponds	Mariya Dhar	Before water diversion in canal	Standard practice	30,000,000/	Project / Fishermen / WUAs/VDCs
12	Fish passage (consider its location)	Headwork	Construction stage	Standard design	Included in project cost	Project / Contractor
13	Cattle pass on the main canal	Main canal	After water release	Standard bridge	Included in project cost	Project / Contractor
<b>To be borne by the Project</b>					<b>30,800,000</b>	
<b>Operational and Maintenance Stage</b>						
12	Canal cleaning	Canals	Each year	Cleaning and disposal of silt	WUAs labour	WUAs
	Downstream release of 20 % water	Sunsari River	Dry season	Headwork gate opening	No cost	Project/WUAs
	Development of STW	River side	Dry season	Standard method	No cost	Farmers
<b>Total</b>					<b>30,800,000</b>	
Contingency 10 %					3,080,000	
<b>Grand Total</b>					<b>33,880,000</b>	

Note: Land Compensation Cost has not been allocated.

## 6.2. Environmental Monitoring

Monitoring provides useful information for proponents, planners and decision-makers to evaluate the implication of the environmental protection measures implemented. It involves the systematic collection of data to determine the actual environmental effects of the project, compliance of the environmental requirements, and to know the degree of implementation and effectiveness of EPMS (Lohani et al, 1997). Environmental monitoring also provides an opportunity to further identify any unpredicted impacts and implement necessary measures to avoid costly mistakes, if any.

In accordance with Rule 13 of the EPR 1997, the concerned agency – the Ministry of Water Resources (MOWR) in this case – is legally responsible for environmental monitoring. However, the Project, and WUAs will also be equally involved in monitoring aspects. The Environment Section of the Department of Irrigation will be involved for environmental monitoring on behalf of MOWR. In accordance with the Schedule 6 of the EPR, 1997, the type of monitoring, time-schedule and monitoring indicators are proposed as follows:

### 6.2.1. Type of Monitoring

The prevailing EIA Guidelines outline three types of environmental monitoring. They are *baseline monitoring*, *compliance monitoring* and *impact monitoring*. The project will be implemented soon and hence, there will be no major change in the baseline condition. Hence, baseline monitoring has not been considered important for this project. The Project will monitor the compliance of the technical specifications as an in-built practice. Impact monitoring is generally carried out to know the effectiveness of the environmental protection measures. The Project has planned to carryout the impact monitoring study at the middle of the project construction phase and after the project completion so as to provide input for environmental auditing as well.

An inter ministerial environmental impact monitoring, committee will be formed to make the impact monitoring study. The committee will comprise of representative from DOI Environmental Unit, MoWR, MoPE and MoAC.

Based on the activities and likely environmental impacts identified, predicated and evaluated for this Project, a number of indicators have been proposed to monitor the changes on the environment during construction and operational stages of the Project, and also to check the effectiveness of the proposed environmental protection measures.

### 6.2.2. Monitoring Parameters

Based on the level of site-specific information or existing data series and impacts predictions, efforts are made to make the indicators measurable and diagnostic with low natural variability and broad applicability. Various indicators will be monitored during the project preparation, construction and operational stages (Table 6-3).

### 6.2.3. Monitoring Locations, Schedules and Responsibilities

Timing for environmental monitoring depends on the nature of parameters. It can be done regularly or intermittently. In general, observation, inspection, interview, counting and/or measurement will be the major methods for monitoring.

A summary of monitoring indicators parameters, location of monitoring, schedules and responsible agencies, including monitoring methods is presented in Table 6-3.

Table 6-3 : Monitoring Parameters, Location, Schedules and Responsibilities

Parameters	Location	Schedule	Method	Main Actor(s)
<b>Pre-Construction/Preparation Stage</b>				
Inclusion of environmental protection measures (benefit augmentation and mitigation measures) in the design and tender document	Central office	During approval	Review process	Project, DOI, MOWR
Integration of this report as a part of project administration	Central office	During approval	Review process	MPPW and MOPE
Production, water consumption and environment management of paper mills	Paper mills	Once a month	Observation, inquiry and sampling	Project / Irrigation Development Division (IDD)
Construction of ETP at paper mills	Paper mills	Once a month	Observation and inquiry	IDD
Water quality analysis of the Sunsari River	Effluent discharge sites	Once a month in lean season and once in 3 months in monsoon	On-site check	IDD
Land acquisition and compensation	Project area	During compensation	Record inspection	Project
<b>Construction Stage (C.S.)</b>				
Water quality	Sunsari River	Once a month	On-site check	Project/Consultant
Health and sanitation facilities	Work and labour camps	Once in three months	Observation and inquiry	Project/Consultant
Heavy traffic, noise, social disharmony	Project area	Once a year or with complaint	Public hearing	Project
TSP	Project site	Once a month	HVAS	Project/Consultant
PM <sub>10</sub>	Project site	Once a month	HVAS	Project/Consultant
Noise level (dBA)	Project site	Once a month	Sound Level Meter	Project/Consultant
Wind direction	Project site	Once a month	Hand held cup anemometer	Project/Consultant
Water sprinkling	Project site	Twice a week	Observation, inquiry	Project/Consultant
Vehicle maintenance	Work camp	1 in 6 months	Record inspection	Project/Consultant
Number and type of safety equipment such as mask/ear plugs provided to workers	Project site	Once a year	Record inspection inquiry, and observation	Project/WUAs
Informatory, safety and no horn signs	Settlement, school, road bends and health post	1 in 3 months	Observation, inquiry, record inspection	Project/WUAs
Number of construction workers	Project site	Thrice a year	Record, inquiry and observation	Project/WUAs
Percentage of local construction labourers	Project site	Thrice a year	Record, inquiry and observation	Project/WUAs
Number of women employed	Project site	Thrice a year	Record, inquiry and observation	Project/WUAs
Number of outside labourers and their dependants	Project site	Thrice a year	Record, inquiry and observation	Project/WUAs
Number of children employed as the worker	Project site	Thrice a year	File record	Project/Consultant
Number of children of construction workers enrolled in the local school	Project site	Once a year	School record	Project/Consultant
Physical facility in school and number of teachers	Project site	Once a year	School record, observation	Project/WUAs
Number of labour force using public drinking water tap	Settlement	Twice a year	Inquiry	Project/WUAs
Rate of compensation for land and property	Project site	Pre-construction stage	File record, inquiry	Project
Usage of compensation	Project site	Once a year	Inquiry or study	Project/WUAs
Loss of agri- products	Project site	Twice a year	Inquiry	Project
Number of in-migration and out-migration	Project site	Once a year	Inquiry	Project/WUAs
Frequency of illness of the construction workers	Project site	Thrice a year	Health record	Project
Cases of respiratory diseases	Project site	Once a month	Inquiry, file record	Project
Type and number of accident	Project site	Once a year	File record	Project

Parameters	Location	Schedule	Method	Main Actor(s)
First-aid and emergency services	Project site	Twice a year	Observation	Project
Public awareness on OHS	Settlement	Twice a year	Inquiry, information materials	Project
Social disharmony and related disputes	Settlement	Thrice a year	Inquiry, file record	Project/WUAs
Price of essential commodities	Project site	Once a year	Inquiry	Project
<b>Operational and Maintenance Stage</b>				
Water quality after mixing of effluents from paper mills	Sunsari River	Twice a year, once a year in lean season	On-site check	Project / IDD
Sunsari River water flow	Headwork	Everyday	Measurement	Project/WUAs
Fish diversity and population	Sunsari river	Once a year	Observation and inquiry	Project/WUAs
Water pumping	Sunsari river	Once a year	Observation and inquiry	Project/WUAs
Compensatory fish culture	Mariya Dhar	Once a year	Observation and inquiry	Project
Downstream sedimentation at the initial stage	Sunsari river	Once a year for 3 years	Observation and inquiry	Project/WUAs
Water leakage and water logging	Canals and farmlands	Once a year in lean period	Observation and inquiry	Project/WUAs
Silt load	Sunsari river	Daily during monsoon season	On-site check	Project
Silt deposit in canal system	Canals	Once after and before monsoon	Observation	Project/WUAs
Plant growth	Spoil banks	Twice a year	Observation	WUAs
Vector-borne diseases	Project area	Once a year or with complaint	Observation	Project/WUAs
Use of agro-chemicals	Project area	Once a year	Observation and inquiry	Project/WUAs
Rehabilitation of work camp(s) and labour camp(s)	Work/labour camp(s)	Once after completion of construction stage	Observation	Project
Fish production	Fishponds	Twice a year	Inquiry, observation	Project
Changes in socio-economic conditions of the local people	Project area	Once in three years	Study	Project

Note: HVAS = High Volume Air Sampler, Envirotech, India, Model APM 441

### 6.3. Environmental Auditing

Environmental auditing helps to evaluate the project impacts on the environment and to compare changes on the environmental quality. The findings will provide a basis for integrating environmental aspects in the planning and development of future irrigation projects in similar ecological areas. The auditing assesses the actual environmental impacts, accuracy of prediction, effectiveness of environmental impact mitigation and enhancement measures and functioning of the monitoring mechanisms (HMG, 1993).

In accordance with Rule 14 of the EPR, 1997 (amendment 1999), the Ministry of Population and Environment (MOPE) is responsible to conduct such auditing after two years of the commencement of the service from the Project. Although the Project implementing agency – the Department of Irrigation – is not legally responsible for environmental auditing, it would be in its interest to carry out such studies for obtaining feedback for integrating environmental aspects in future irrigation projects. Whoever will conduct the environmental auditing, indicative parameters and methods have been proposed as follows:

#### 6.3.1. Type of Auditing

The National EIA Guidelines, 1993 proposes six types of environmental auditing. They are: decision point auditing, implementation auditing, performance auditing, project impact auditing, predictive techniques auditing, and EIA procedure auditing to examine the effectiveness of EIA as decision-making tool, or techniques and overall environmental changes arising from the Project. Of them, it is recommended to carry out project impact auditing as it helps in evaluating environmental changes as a result of project implementation.

### **6.3.2. Auditing Parameters and Methods**

Environmental auditing should pay attention to all issues mentioned under environmental protection measures and monitoring. However, emphasis should be given to minimum downstream release of water during lean period, water quality, quality and quantity of effluents from paper mills, fish population, water logging, socio-economic changes, adequacy and reliability of irrigation service, crop production and productivity, use of agro-chemicals and changes in soil characteristics etc. Furthermore, functioning of the fish passage in the headwork, health risk associated with the pollution, fish culture and production and/or economic condition of the fishermen, stabilizations of the spoil banks, and implication of the change in water pumping to operation of shallow tube wells etc. should also be taken into account. Such parameters should be focused in the areas where environmental protection measures will be implemented and environmental monitoring carried out.

A team of expert can be hired to conduct environmental auditing. The study team may employ methods such as literature review, observation and field study, questionnaire and checklist, measurement of air and water quality parameters, and noise level. However, the method used during the preparation of this study has been recommended to follow, to the extent possible, in order to minimize method-based errors.

## **6.4. Institutional Arrangement**

The proponent of the Project, i.e., the Department of Irrigation/SRIP will have the overall responsibility for ensuring the implementation of the environment protection measures (EPMs), conduction of environmental monitoring, and for making the Project environment-friendly and sustainable. For this, an organization and necessary staff has been proposed.

### **6.4.1. Organisational Structure**

The Environment Section of the Department of Irrigation will assist the SRIP in implementing the proposed EPMs and conducting environmental monitoring and/or this EMP. The Section will also be involved in surveillance monitoring. As an in-built mechanism, the Project will establish an Environment Unit to ensure the integration of EPMs in the detail design, and monitor the implementation of the EPMs.

The EU of the Project will be mandated to:

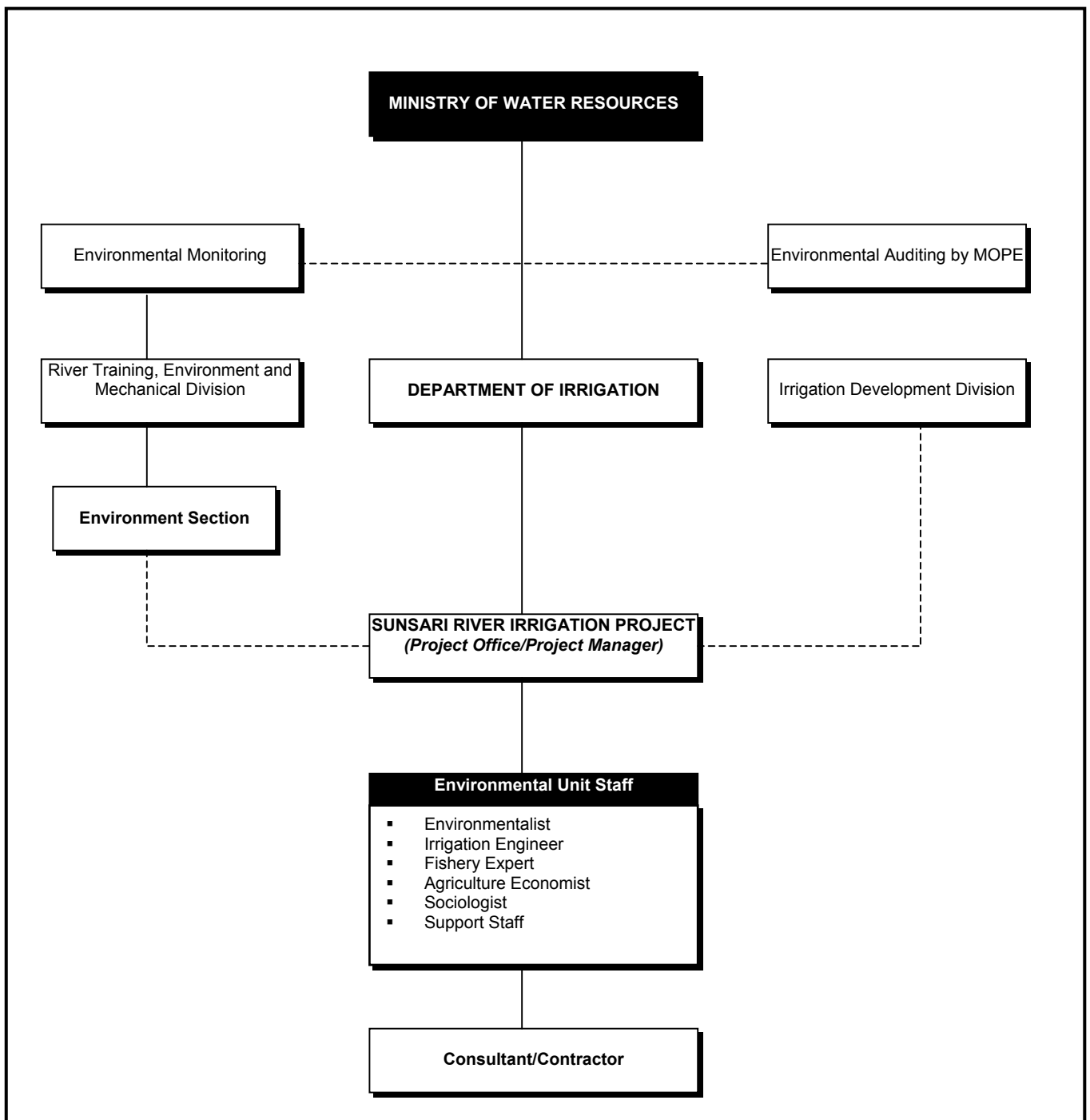
- Incorporate benefits augmentation measures, and mitigation measures in the detail design, to the extent applicable;
- Allocate necessary budget for the implementation of EPMs, and conduction of environmental monitoring;
- Prepare necessary monitoring formats and conduct both compliance and impact monitoring;
- Monitor construction contractor's performance on environmental aspects;
- Carry out environmental record keeping during the construction and operational phases of the Project; and
- Participate in environmental acceptance of the construction completion of this Project from the contractor officially.

The Environment Unit will be located in the following proposed organizational structure of the Project (SRIP):

### **6.4.2. Staffing and Location**

In order to integrate the environmental aspects in the project design, facilitate the implementation of EPMs and also conduct environmental monitoring, the Environment Unit will be directly involved. The Unit will be supported by environmentalist, irrigation engineer, fishery expert, agriculture economist and sociologist. It will also have necessary support staff and they will be involved in environmental inspections (site inspection), record collection and keeping. The Project Manager will provide autonomy for the staff on environmental matters. The EU staff should have extensive EIA project management experience, to the extent possible.

The EU staff will be located at the project site. However, an Environmentalist will station at Project Management Office and conduct frequent field visit.



Environmental Unit in the SRIP with Coordination and Supervision Provisions

## 6.5. Directives and Coordination

### 6.5.1. Necessary Directives

In view of the nature of the project and its location, the irrigation project will be developed smoothly and it is considered that additional environmental directives are not required besides EPMs implementation and conduction of environmental monitoring. The Ministry of Water Resources and the Ministry of Population and Environment could advice the Ministry of Land Reform and Management to facilitate land registration process in the Mariya Dhar area so that fish culture could be developed along with the project implementation for the benefit of the fishermen.



### **6.5.2. Coordination Mechanism**

The Project will ensure coordination with a number of central and local level institutions. During the implementation, the Project will seek assistance and coordination with different line agencies, particularly the fishery development, district agriculture, WUAs and local NGOs as and when needed. The fishery centres will be one of the most important institutions for coordination so as to promote fish culture as a part of the project activities.

Water Users Associations (WUA) will have pivotal role in implementing the project activities. As per the Irrigation Policy, the beneficiaries, in an organized way, are to be involved in the Project from the very beginning through consultation, collaboration and contribution. In this Project, the farmers will have to contribute part of the Project cost most likely in the form of construction of watercourses. After the completion, the Project will be operated and maintained under Joint Management mode. For this, the WUA having suitable structure will be formed and registered as per the prevailing laws. The WUAs will be involved in the implementation of environmental protection measures and in environmental monitoring.

The Project will implement all activities in close coordination with MOWR and DOI. The Environment Section of the DOI will provide necessary policy and technical guidance and assistance to the Project's EU. The field level information and also results of the environmental monitoring will be timely communicated with these organizations.

### **6.6. Reporting Requirements**

The Environmental Unit will prepare necessary reports about the implementation of the environmental protection measures and monitoring results at regular interval and disseminate them through the Project Management Office. EU will also prepare an annual report and make public about the environmental compliance by the Project. The report will basically focus on the implementation of the Project performance on environmental matters. Such reports will be provided to the concerned environmental authorities for necessary comments and suggestions.

After the completion of the Project, EU will prepare and disseminate a Project Completion Report with elaborated information on the environmental compliance and monitoring results. Then an environmental impact report will be prepared and distributed to the concerned agencies. EU will also conduct environmental auditing for its own purpose although it is the responsibility of MOPE.

### **6.7. Estimated Budget**

The Project will implement EPMS, and conduct environmental monitoring during the project construction and operational stages. The cost for EPMS, environmental monitoring and auditing is estimated based on the existing practices. However, it may fluctuate during the implementation stage. The Project will include the costs for EPMS and monitoring in the Project cost.

#### **6.7.1. Environmental Protection Measures**

Most of the costs for EPMS will be included in the Project cost. A total of NRs. 34,320,000 has been estimated as additional costs proposed for the implementation of the selected EPMS (Table 6-4).

Table 6-4 : Costs for Selected Environmental Protection Measures

SN	Activities	Estimated Cost (Rs)
1	Training Enhancement of Technical Skill Environmental Awareness	200,000 200,000
2	Social Service Facilities Medicine School furniture Drinking water	100,000 100,000 300,000
3	Training and Infrastructure Dissemination	300,000
4	Installation of effluent treatment plan by paper mills	20,000,000 (to be borne by the mills)
5	Fishponds development	30,000,000
	<b>Sub-Total</b>	<b>31,200,000</b>
	Contingency 10 %	3,120,000
	<b>Grand Total</b>	<b>34,320,000</b>

### 6.7.2. Environmental Monitoring

The Project will conduct the environmental monitoring activities through the establishment of an Environmental Unit within the Project Management Office. A total of NRs. 8,958,180/ as presented in the following table (Table 6-5) is estimated to be necessary for environmental monitoring. The Project will make necessary arrangement to allocate this cost.

Table 6-5 : Estimated Cost for Environmental Monitoring

SN	Description	Unit	Quantity	Rate (NRs)		Amount (NRs)
				Salary	Others	
1	Coordinator/Environmentalist	Man month	9	144,000	80,000	2,016,000
2	Agri-Engineer/Civil Engineer	Man month	12	120,000	40,000	1,920,000
3	Fishery Expert	Man month	2	120,000	40,000	320,000
4	Socio-Economist	Man month	2	120,000	40,000	320,000
5	Supervisor	Man month	20	84,000	30,000	2,280,000
6	Field Enumerators	Man month	10	50,000	20,000	700,000
7	Vehicles, logistics, equipment, stationeries etc.	Lump sum				200,000
8	Sub-total					7,756,000
9	Price escalation (5 %)					387,800
10	Sub-total (8 + 9)					8,143,800
11	Contingencies (10 %)					814,380
	Grand Total					<b>8,958,180</b>

In addition an amount of Rs. 200,000/ will be allocated for the impact monitoring by the inter-ministerial environmental impact committee.

### 6.7.3. Environmental Auditing

In accordance with the provision of the environmental law, an environmental auditing should be carried out by the Ministry of Population and Environment. However, an estimated following cost has been included in this report (Table 6-6). The Project also intends to carry out such auditing to judge its environmental performance.

Table 6-6 : Estimated Cost for Environmental Auditing

SN	Description	Unit	Quantity	Rate (NRs)		Amount (NRs)
				Salary	Others	
1	Coordinator/Environmentalist	Man month	3	144,000	80,000	672,000
2	Irrigation Engineer /Civil Engineer	Man month	2	120,000	40,000	320,000
3	Fishery Expert	Man month	1	120,000	40,000	160,000
4	Socio-Economist	Man month	2	120,000	40,000	320,000
5	Supervisor	Man month	2	84,000	30,000	228,000
6	Field Enumerators	Man month	4	50,000	20,000	280,000
7	Vehicles, logistics, equipment, stationeries etc.	Lump sum				200,000
8	Sub-total					2,180,000
9	Price escalation (5 %)					109,000
10	Sub-total (8 + 9)					2,289,900
11	Contingencies (10 %)					228,990
	Grand Total					2,517,900

In sum, the total cost for the implementation of the EPMS, environmental monitoring and environmental auditing is estimated at NRs. 45,996,080/ (Table 6-7).

Table 6-7 : Estimated Cost for EMP Implementation

SN	Description	Estimated Cost (NRs)
	Implementation of EPMS	34,320,000
	Environmental Monitoring	9,158,180
	Environmental Auditing	2,517,900
	<b>Total</b>	<b>45,996,080</b>

CHAPTER

**CONCLUSIONS AND RECOMMENDATIONS**

**7**

**7. CONCLUSIONS AND RECOMMENDATIONS**

**7.1. Conclusions**

The Project (SRIP) will provide irrigation facility to about 10,147 ha net command area of 13 VDCs on the southern part of SMIP which has sandy soil and lacks water for the production of cereal and cash crops. The Project will be managed through joint effort – the Project and the WUAs – for its sustainability.

Water intake will be constructed at downstream of the E-W Highway and upstream of the effluent discharge sites of the Arvind and Baba Paper Mills. The main canal will be 35.83 km long, followed by 60.52 km long secondary canal and 172.41 km long tertiary canal. The volume of excavation and backfill for headwork construction are 39,000m<sup>3</sup> and 19,000 m<sup>3</sup>, respectively. Remaining 20,000 m<sup>3</sup> of materials will be spread in the field around the construction site. A total of about 2480 mandays per day for three years will be used for the construction, and about 80 percent of the total construction workers are considered to be the local people.

Considering the location of the headwork, nature of construction raw materials and project design, river gradient, overall site condition of the project area, and analysis of both positive and negative impacts of alternatives, the proposed project should be implemented by implementing benefit augmentation measures, and adverse impacts mitigation measures. Implementation of the project will help in increasing cropping intensity from 164 to 180 percent. The irrigation facility will increase in production of paddy, jute, wheat, potato and sugarcane from existing 2.5 to 4.2 t/ha, 1.9 to 2.5 t/ha, 2.2 to 3.5 t/ha, 17.9 to 22 t/ha and 44 up to 80 t/ha respectively.

The Project aims to strengthen the WUAs, propose canal cleaning annually to remove silt deposition in the canal system, employ local people as construction workers, compensate for land acquisition, introduce special fish culture package for fishermen, launch agriculture support programmes including promotion of integrated plant nutrient system and so on.

Major adverse impact from the project will be diversion of water from the Sunsari river for the purpose of irrigation. Diversion requirement is higher than minimum flow in the dry season. Aquatic life will be significantly affected. Fish population will be affected substantially. This will have direct impact on the income level of the fishermen families. The project area comprises of about 180 fishermen families who are mostly landless and economically very poor.

One of the major complication of this project is the currently practice of direct discharge of untreated effluent from two paper mills located down stream of the proposed headwork site. This activity is legal but it is going on. Abstraction of water from the river will increase the level of pollution. Hence it is suggested not to implement the project unless the effluents discharged into the river from the two paper mills do not meet Nepal Standard. For which the concern authority, MoPE needs to take proper action.

Other environmental impacts of this Project are related to land acquisition, possible percolation/loss of water from the canal system, disposal of construction wastes, degradation of air quality from dust and vehicular emission, high noise level and water pollution (both non-point and point sources). The construction workers from outside the project area will also likely exert pressure on social service facilities such as drinking water, health and sanitation, and education.

The benefit impact could be enhanced by providing the employment opportunity to the local people, providing the construction related training to the local people, running counseling programme on the effective use of the income, conducting environmental awareness on the different aspects of health and sanitation.

Adverse impact could be minimized and/or mitigated by applying the standard engineering practice. Some of the impacts will have to be compensated when the mitigation measures are not possible. Impact like loss of land and property will be compensated. In order to maintain the aquatic environment, 20 % of the minimum flow in the river (equivalent to 0.7 m<sup>3</sup>/s) will be released in the river from the headwork during the dry season. In addition, the fish culture has been proposed in 36 ha. to support the income of 180 families of the fishermen.

In general adverse impacts on the socio-economic resources will be minimized through compensatory, rehabilitative and preventive measures. It is recommended to strengthen WUAs, provide information on the use of agro-chemicals, and involve local people as construction workers to the extent possible.

In order to make the project environmentally sound and sustainable, implementation of the environmental management plan has been proposed. Besides the proposal for in-built mitigation measures, a total of NRs 34,320,000/ has been proposed as additional cost for the implementation of the environmental protection measures. Similarly, NRs. 8,958,180/ and NRs. 2,517,900/ have been proposed for environmental monitoring and environmental auditing respectively. In sum, NRs. 46,456,080 has been proposed for environmental improvements in the Project area.

In view of the nature and scale of the Project, impacts identified predicted and evaluated, and existing relevant policies, legislation, guidelines and institutions, this Project can be implemented by minimizing the potential environmental impacts through coordinated effort and joint management concept. Implementation of the environmental protection measures and conduction of environmental monitoring and auditing as proposed will make the Project environment-friendly. Also in view of the irrigation facility for over 10,000 ha of command area, possible increase in cropping intensity and farm production, and nature of the negative impacts, it is concluded that the beneficial impacts outweighs the adverse impacts. Hence, this study recommends implementing the project as designed with the assurance that the proposed mitigation measures are implemented effectively with the participation of the WUAs and concerned agencies, and environmental monitoring is conducted during project construction and operational stages.

## **7.2. Recommendations**

Prior to the implementation of the Project, this study recommends making necessary arrangement to solve landownership problem in the Mariya Dhar area to promote fish culture for the socio-economic upliftment of the fishermen. It is also most urgent to enforce legal provisions so that Arvind and Baba Paper Mills establish and operate effluent treatment plant before discharging the effluents.

The Project will divert up to 80 percent of the water from the Sunsari River, and it is recommended to perform surveillance from the central level organization.

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Annex - 1

**Checklist and Household Survey  
Questionnaire**

**Questionnaire for Rural Socio-Economic Survey**

No. \_\_\_\_\_

Date of Survey: \_\_\_\_ / \_\_\_\_ / \_\_\_\_ , Time: from \_\_\_\_ to \_\_\_\_  
Name of Surveyor: \_\_\_\_\_

Name of Village: \_\_\_\_\_  
Name of VDC: \_\_\_\_\_ Ward No. \_\_\_\_\_

**1. Personal Data:**

1.1 Name:		1.2 Marital status: M / S / widow	
1.3 Age:	1.4 Sex: M / F	1.5 Occupation	
1.6 Highest degree:			
1. illiterate, 2. Pre-primary, 3. Primary, 4. Lower Secondary, 5. Secondary, 6. Higher Secondary, 7. Diploma, 8. Degree			

\* "illiterate" means those who can not read and write.

**2. Family Structure**

No	Names of household members	Sex (M/F)	age	Relation with you	Highest degree or actual education status*	Occupation	Head of the family (check)
1							
2							
3							
4							
5							
6							
7							
8							

\* Refer the number of 1.6

**3. Culture**

3.1 What is your caste / ethnic group? (circle one)  
1. Muslim / 2. Sudhi / 3. Adav / 4. Bramin / 5. Tharu / 6. Mehita / 7. Khatwb / 8. other Terai / 9. Chetri / 10. Newar / 11. Tamang / 12. Others ( )

3.2 What is your religion?  
1. Hindu, 2. Muslim, 3. Buddhism, 4. Others ( )

**4. Land Ownership**

4.1 Land Holding

Form of Land tenure	Land Tenure (Katha)	No. of Parcels held
a. Owned		
b. Leased		
c. Share cropping		
d. Tenanted		
Total (a+b+c-d)		

4.2 Who decide how to use the land? \_\_\_\_\_

4.3 In terms of contract, \_\_\_\_\_

**4.3.1 Landowner and leaseholder**

1. Product:	kg per katha / (crop / year / others )	to be given to landowner
2. Cash:	Rs per katha / (crop / year / others )	to be given to landowner
3. Others:		

**4.3.2 Landowner and sharecropping farmer**

1. Product:	% of the total yield to be taken by landowner to be taken by landowner
2. Inputs:	% of the total input shared by farmers
3. Others:	

**4.3.3 Tenant and Landowner**

1. Product:	kg per katha / (season / year / others )	to be taken by landowner
2. Cash:	Rs per katha / (season / year / others )	
3. Others:		

4.3.4 In the case of leaseholder, do you have difficulty to pay land rent? ( Yes / No )

4.3.5 If the answer of 4.3.4 is yes, what is the difficulty?

1. Low productivity of land,	2. Low price / unit of agricultural yield,	3. High rent of land,
4. Others ( )		

**4.4 How has the land been used?**

Manner of use	Area (katha)	Manner of use	Area (katha)
1. Farmland		2. Pasture	
a. Fully		3. Forest	
b. Partially irrigated land		4. House and its surroundings	
c. Rain fed land		5. Others ( )	
d. Sub-total			

4.5 How long does it take from your house to the farm?

1. to the nearest farm: ( ) min. by ( 1. foot / 2. bicycle / 3. others ( ) )
2. to the farthest farm: ( ) min. by ( 1. foot / 2. bicycle / 3. others ( ) )

**5. Agriculture**

**5.1 Cereals**

5.1.1 What kind of cereals do you cultivate, its variety, planted/harvested area, yield, etc.

P. R *	Major Crops	Variety	Planted area / (katha)	Harvested area (katha)	Yield (kg/katha)		Crop mixed, if any
					This season	Last season	
	Paddy (Monsoon)						
	Paddy (Spring)						
	Wheat						Mixed crop with ( )
	Pulse ( )						



( )												
( )												
Oil seed												
( )												
( )												
Potato											Mixed crop with ( )	
Jute												
Sugarcane												
Others												
Total												

\* P.R. : Priority Ranking: Which plant do you prefer must? Put the number from 1 to 5, as 1 is the first priority.  
\* The total might be larger than the actual land held, since some crops are planted as mixed.

5.1.2 What is the reason why there is difference between planted area and harvested area?

a. Lack of water, b. Calamity, c. Pest/Disease  
d. Others

5.1.3 When do you plant and harvest different varieties of paddy?

Crops	Month*	1	2	3	4	5	6	7	8	9	10	11	12
		Paddy (Monsoon)											
Paddy (Spring)													

\* Nepalese calendar is used in the Nepalese version.

5.1.4 Why do you want to grow paddy?

1. I have knowledge and skill of growing paddy, 2. lack of knowledge & skills for other crops, such as vegetables, 3. Necessary for self-consumption since rice is main food, 4. Others ( )

5.2 Vegetables

5.2.1 Do you grow vegetables? ( Yes / No )

5.2.2 If the answer of 5.2.1 is yes, is it for commercial purpose? ( Yes / No )

\* If the answer is yes, go to 5.2.3, and if the answer is no, go to 5.2.4.

5.2.3 If the answer of 5.2.2 is yes, what kind of vegetables do you cultivate, its variety, planted/harvested area, yield, etc?

P R *	Major Crops	Total Area (katha)	Yield (kg/katha)		Crop mixed, if any
			This season	Last season	
	Vegetables				Mixed crop with ( )
	( )				Mixed crop with ( )
	( )				Mixed crop with ( )
	Others				
	Total				

5.2.4 If the answer of 5.2.2 is no, what kind of vegetables do you grow for your self-consumption?

Summer :  
1. lady finger, 2. beans, 3. Eggplant, 4. Cucumber family, 5. Others ( )  
Winter:  
1. Cauliflower, 2. Potato, 3. Tomato, 4. Others ( )

5.2.5 Do you have any problems for cultivation of vegetables? ( Yes / No )

5.2.6 If the answer of 5.2.5 is yes, what are those problems?

1. lack of knowledge for cultivation, 2. lack of irrigation facilities, 3. Lack of improved seeds, fertilizer, etc. (inputs), 4. The land is not suitable for cultivating vegetables, 5. Drainage problem, 6 Others ( )

5.3 Opinion about crop-diversification

5.3.1 Even if there is inadequate water in summer, do you still want to grow rice, or think of shifting to summer vegetables?

a. stick to grow rice, b. shifting to summer vegetables, c. Others ( )

5.3.2 If you stick to rice (If the answer of 5.3.1 is a), where do you get water from?

1. Rain, 2. from nearest pond and river, 3. STW, 4. Others ( )

5.3.3 What is the reason to stick to rice?

1. Following to tradition to cultivate paddy, 2. Lack of knowledge for other crops, 3. Self-sufficient for own food, 4. Others ( )

5.3.4 If you shift to summer vegetables (If the answer of 5.3.1 is b), what kind of vegetables do you want to shift?

1. Cucumber families (pumpkin, cucumber, etc.), 2. Egg plant, 3. Beans, 4. Okra, 5. Chillies, 6. Others ( )

5.3.5 What kind of condition do you need to shift to summer vegetables?

1. Improved seeds, 2. Improved fertilizer, 3. Specific training, 4. Irrigation facilities, 5. Others ( )

5.4 Water Source for Agriculture

5.4.1 From where you take water for agriculture in summer?

a. Sunsari-Morang Irrigation System, b. River(s): Name: \_\_\_\_\_, c. Pond, d. Boring (Shallow Tube Well) e. Rain, f. Others: \_\_\_\_\_

5.4.2 From where you take water for agriculture in winter?

a. Sunsari-Morang Irrigation System, b. River(s): Name: \_\_\_\_\_  
c. Pond, d. Boring (Shallow Tube Well) e. Rain, f. Others: \_\_\_\_\_

5.4.3 Is the water for agriculture enough through the year? ( Yes / No )

5.4.4 If the answer of 5.4.3 is no, in what season the water will be short?

1. Winter, 2. Summer, 3. Both in winter and summer,

**In the case of SMIP**

5.4.5 Do you pay the water fee for SMIP? ( yes / No )

5.4.6 If the answer of 5.4.6 is yes, how much do you pay?

( ) Rs / ( time(s) / month / season / year / katha )

5.4.7 Has SMIP improved your production? ( Yes / No )

5.4.8 If the answer of 5.4.8 is yes, how much have the production increased?

1. 10-15 kg /katha, 2. 15-20 kg / katha, 3. 20-25 kg/ katha, 4. More than 25kg /katha

5.4.9 If the answer of 5.4.8 is no, what is the problem?

1. no water / insufficient comes in the canal, 2. O & M is not properly functioning, 3. Lack of proper water distribution, 4. Others ( )

5.5 About proposed-project

5.5.1 Do you agree with the proposed project? ( Yes / No )

5.5.2 If the answer is no, why you do not agree to the project?

1. I cannot pay ISF, 2. I am not sure about success of the project,  
3. Others :

5.5.3 If the answer of 5.5.1 is yes, are you ready to contribute in cash or kind? ( Yes / No )

5.5.4 If yes, what is the maximum ISF you are willing to pay? Rs \_\_\_\_\_ /Bigha

5.6 Agriculture Inputs

5.6.1 Seeds:

Crops	Item	Self supply (kg/katha)	Quantity of external supply (kg/katha)	Supplier			Total Amount (kg/ katha)	Unit Price (Rs/ kg)
				a. AIC, private Foreign(India) dealer, Others( )	b. Domestic private dealer, private dealer, d. Others( )	c. Foreign(India) private dealer, d. Others( )		
	Paddy(Monsoon)							
	Paddy (Spring)							
	Wheat							
	Potato							
	Pulse ( )							
	( )							

( )					
Oilseed					
( )					
Vegetables					
( )					
Jute					
Sugarcane					

5.6.2 Fertilizer and Chemicals

Items	Specify*	Crop1	Crop2	Crop3	Supplier a. AIC, b. Domestic private dealer, c. Indian private dealer, d. Others ( )	Unit Price (Rs /kg)
		( kg/katha ) or (Rs / katha)**	( kg/katha ) or (Rs / katha)**	( kg/kahta ) or (Rs / Katha)**		
a. Urea						
b. TSP						
c. DAP						
d. Potash						
e. Organic Manure						
f. Herbicide						
g. Insectide						
h. Others ( )						

Note \*: To be specified by interviewer, \*\* for chemicals

5.6.3 How many labour forces do you need for your farming? (per katha)

Items	Specify*	Crop1	Crop2	Crop3
		( )	( )	( )
(1) Family labours				
a. Land preparation		Days	days	days
b. sowing/ Transplanting				
c. Weeding		Days	days	days
d. Irrigation and fertilizer application				
e. Harvesting/Threshing		Days	days	days
f. Others ( )		Days	days	days
Sub total				
(2) Hired Labour Requirement (days hired)				
a. Land preparation		Days	days	days
b. sowing / Transplanting				
c. Weeding		Days	days	days

d. Irrigation and fertilizer application			
e. Harvesting/Threshing	Days	days	days
f. Others ( )	Days	days	days
Sub total			
Grand total			

Note\*: To be specified by interviewer

5.6.4 Average wage rate for hired labour:

Male: with meal: ( ) Rs/day, without meal: ( ) Rs/day
Female: with meal: ( ) Rs/day, without meal: ( ) Rs/day

5.7 Machinery and bullock use

	Machinery / Animal / Manual	Quantity (No. / hr/ day/ bigha /katha)	Owned or leased	Renting fee (No. / hr/ day/ bigha / katha)
<b>For Paddy</b>				
a. For Land preparation	a.4-wheel tractor b. Animal ( )			
b. For threshing	a. Thresher b. Animals			
c. Irrigation (if any)	a. Pump b. other ( )			
<b>Wheat</b>				
a. For Land preparation	a.4-wheel tractor b. Animal ( )			
b. For threshing	a. Thresher b. Animals			
c. Irrigation (if any)	a. pump b. other ( )			
<b>For other Vegetables (Potato, Sugarcane)</b>				
a. For Land preparation	a.4-wheel tractor b. Animal ( )			
c. Irrigation (if any)	a. pump b. other ( )			

\* The unit should be specified by surveyors.

5.8 Post-harvest, existing facilities, Storage, Processing, : (About Potato)

5.8.1 Do you store potato after harvest? ( yes / No )

5.8.2 If the answer of 5.8.1 is yes, what kind of storage do you use and where?

◆ Type of storage: ( Local technology / Cold storage )
◆ Manner of storing: ( private / communal )

5.8.3 Do you process your product? ( Yes / No )

5.8.4 If the answer of 5.8.3 is yes, what do you do and how?

◆ Method of processing:
◆ Manner of processing: Individual / Cooperative ( name of the org. )

5.9 Marketing

Item	Home	To Whom	Farm-gate Price

Crops	Consumption	Village Merchant	Local Assembler	Wholesaler	Others ( )	Min. (Rs/kg)	Max. (Rs/kg)
Paddy (Monsoon)	%	%	%	%	%		
Paddy (Spring)	%	%	%	%	%		
Wheat	%	%	%	%	%		
Potato	%	%	%	%	%		
Sugarcane	%	%	%	%	%		
Jute	%	%	%	%	%		
Pulse ( )	%	%	%	%	%		
( )	%	%	%	%	%		
( )							
Oilseed ( )	%	%	%	%	%		
( )	%	%	%	%	%		
Vegetables ( )	%	%	%	%	%		
( )	%	%	%	%	%		

5.10 Agroforestry System

5.10.1 Have you tried to cultivate vegetables mixed with trees? ( Yes / No )

5.10.2 If the answer of 5.10.1 is yes, which vegetables and trees have you planted in your farm?

--

5.11 What are the most serious problems on farming operation?

1. Major problems, 2. Lack of irrigation facilities, 3. Incidence of pests and diseases, 4. Lack of storage facilities, 5. Poor marketing facilities, 6. Lack of capital /credit, 7. Lack of availability of labour, 8. Others ( )

Problem Ranking (Choose the number what to be circled above) : 1. , 2. , 3.

6. LIVESTOCK RAISING

6.1 What kind and how many animals are you raising now and how much their farm gate price?

Livestock	Item	Number of kept (no. or unit)	No. or head of Sold (last year)	Unit Price (Rs/head)
Cow Calves				
Milking Cow				
Bullock				
Buff-Calves				
Buffalo (male)				
Buffalo (female)				
Goat				
Pig				
Poultry				

Duck			

6.2 Do you have milking animals? ( Yes / No )

6.3 If yes, how much?

	Amount produced (litter / day)	Litter Sold (last year)	Unit Price (Rs /litter)
Milk		Litter/day	

6.4 Do you poultry production? ( Yes / No )

6.5 If yes, how many ?

	Amount Produced (unit / day)	Litter Sold (last year)	Unit Price (Rs / Unit)
Egg		Unit/day	

6.6 Are there any problems for livestock rearing? ( Yes / No )

6.7 If the answer of 8.6 is yes, what are major problems?

1. Lack of fodder and grass,	2. Social problems such as theft, etc.	3. Incidence of diseases,	4. Poor marketing facility for production,	5. Others ( )
Problem Ranking (Choose the number what to be circled above) : 1. , 2. , 3.				

## 7. Fishery

7.1 Are you engaged in fishing as a major source of your livelihood? ( Yes / No )

7.2 If yes, where do you fish? (Please check)

1. Sunsari river,	2. Morija Dhar,	3. Budhi river,	4. Local ditch and ponds,	5. Koshi,
6. Others ( )				

7.3 How often do you go for fishing?

1. Daily,	2. ( ) days per week,
-----------	-----------------------

7.4 How many hours do you fish per day?

hours
-------

7.5 What is the amount of your total catch per day in kg?

1. In winter:
2. In summer

7.6 What do you do with your catch per day?

Self Consumption (kg)	Sell (kg)	Price (Rs/kg)

## 8. Extension Service

8.1 DO you receive any agriculture extension service? ( Yes / No )

8.2 If yes, from who and what kind of technical assistance do you receive?

Kind of technical assistant you receive	From whom
a. Dissemination of new variety	a. JT/JTA, b. NGOs ( ), c. Others ( )
b. Fertilisation	
c. Pest /disease control	

d. Storing	
e. Processing	
f. Marketing	
g. Agroforestry	
h. Livestock rearing	
i. Fish breeding	
j. Others	

\* Refer to the No. Family structure

8.2 If you receive any technical assistance from any agencies, how often do you receive them?

1. more than 1 time / week	2. 1 time / two weeks,	3. 1 time / month,	4. When you have necessity,
----------------------------	------------------------	--------------------	-----------------------------

## 9. Income and Expenditure

9.1 Major Staple food

9.1.1 Major meals

	Common menu for meals (If you do not take, write "no")
Breakfast	
Lunch	
Supper	

9.1.2 Do you cultivate something in your backyard for your home consumption? ( Yes / No )

9.1.3 If the answer of 9.1.2 is yes, what do you produce?

<input type="checkbox"/> Vegetable: Species ( )
<input type="checkbox"/> Fruits: Species ( )
<input type="checkbox"/> Domestic fowl and other small livestock:

9.2 Food consumption (monthly)

Items	Quantity (kg or number)	Buying	
		Quantity (kg/month)	Rs/kg
Rice			
Wheat flour			
Milk			
Meet & fish			
Potato			
Green Vegetables			
Egg			
Fruits			
Others			

9.3 Information on Income

Major source of Income	Annual Income (Rs)
a. Agriculture (by each crop)	
◆	
◆	
◆	
b. Livestock (by species / products)	
◆	
◆	
◆	
c. Selling fish	
d. Forestry products (wood, firewood, etc.)	
e. Farm labour	
f. Other paid work: ( )	
g. Business ( )	
h. Migrant work ( to where?: ) ( for how long? Months)	
i. Loan	
j. Others	
Total	

## 9.4 Information on Expenditure

Major expenses	Annual Expense (Rs)
a. Agriculture	
◆ Fertiliser	
◆ Chemicals	
◆ Seeds	
◆ Tools	
◆ Labour	
◆ Others	
b. Livestock	
◆ Care ( Pasture, Feeding, Transportation, etc.)	
c. Education	
d. Food	
e. Medication	
f. Tax etc.	
g. Energy	
h. Repayment for credit	
i. Social Activities (Religious event, marriage, etc.)	
j. Cloths, general goods for living life, etc.	
k. Water fee	
l. Others	
Total	

## 9.5 Information on Loan and Savings

9.5.1 Do you have saving? ( Yes / No )

9.5.2 If the answer of 9.3.1 is yes, how much saving do you have annually? \_\_\_\_\_ Rs

9.5.3 Have you applied for loan? ( Yes / No )

\* If the answer is yes, go to 9.5.3, and if the answer is no, go to 9.5.4

9.5.4 If the answer of 9.5.3 is no, what is the reason?

1. I do not need, 2. I do not know the process of getting loan, 3. I don't have anything to submit as mortgage, 4. Others ( )

9.5.5 If the answer of 9.5.3 is yes, how much loan do you have now? \_\_\_\_\_ Rs

9.5.6 What is the purpose of the loan?

1. For Agriculture production, 2. For live-stock raising, 3. Other income generating activities, 4. Others ( )

9.5.7 If you have loan, from what agency do you borrow?

1. ADBN, 2. SFDP, 3. Women Development Program, 4. Micro Enterprise Development Program (UNDP), 5. Rural Development Bank, 6. LTF, 7. Local money lender, 8. Others ( )

9.5.8 What is the interest?

% per ( week / month / year )

9.5.9 Are you able to repay? ( Yes / No )

9.5.10 If the answer is "no", what will you do?

1. I will take another loan to repay it, 2. I will forfeit my mortgage, 3. I will sell my land to repay it, 4. I will wait and atch, 5. Others ( )3.

## 10. Basic Infrastructure

10.1 where do you take water for domestic use?

1. water well ( Private / communal ), 2. Pipe, 3. Tube-well ( Private / Communal )  
4. River(s), 5. Others ( )

10.2 Do you have electricity? ( Yes / No )

10.3 What kind of fuel do you use?

a. LPG Gas, b. Bio-gas, c. Kerosene, d. Firewood, e. cow dom,

## 11. Gender

11.1 Division of roles from Gender aspect

Activities	Women (% of engagement)	Men (% of engagement)	Children (% of engagement)	
			Male C	Female C
a. Fetching Water				
b. Domestic work (cooking, washing, etc.)				
c. Education for kids • decision to go to school • helping children to study at home				
d. Farming • land preparation • sowing • transplant • weeding • irrigation • threshing • Processing • farming in the backyard • selling • others ( )				

e. Livestock rearing · caring cattle · caring small animals ( ) · milking · collecting eggs · others ( )				
f. Receiving extension service				
g. Decision making Selling · farm product · livestock product · product from garden · others				
h. Decision making on buying · farm inputs · food · general goods for living (such as soup, cloths, etc.)				
i. decision making on loan				
j. Work as farm labour				
k. Other paid work				
l. Social activities				
m. Others				

**12 Community organisation belonged**

12.1 Do you belong to any community organisation? ( Yes / No )

12.2 If the answer of 6.1 is yes, please fill in the following information

Name of the organisation belonged			
You position held			
What is your merit to belong to the organisation			
Are there any duty and responsibility for the member? (ex. Member fee, voluntary work, activities, participation in meeting, etc.)			

12.3 Do your family members belong to any community organisation? ( Yes / No )

12.4 If the answer of 6.1 is yes, please fill in the following information

Name of your family member(s)			
Name of the organisation belonged			
You position held			

What is your family member's merit to belong to the organisation			
Are there any duty and responsibility for the member? (ex. Member fee, voluntary work, activities, participation in meeting, etc.)			

12.5 Has there been any effort to organize WUA in your area? ( Yes / No )

12.6 If the answer of 12.5 is yes, is the WUA functioning well? ( Yes / No )

12.7 If the answer of 12.6 is yes, what are they doing?

1. Looking after O&M, 2. Collecting ISF, 3. Arranging for provision of extension services, 4. Others ( )

12.8 Are you willing to join to WUA or the proposed project? ( Yes / No )

**13 Recreation**

13.1 Do you / your family have time for recreation? ( Yes / No )

13.2 If yes, what do you do for your recreation?

**14. When do you feel happiness?**

Thank you very much for your cooperation.

Annex - 2

**Water Quality Analysis**

**His Majesty's Government of Nepal**

**Ministry of Water Resources**

**Department of Irrigation**

**SCOPING REPORT**

**and**

**TERMS OF REFERENCE**

**for**

**Environmental Impact Assessment**

**of the**

**SUNSARI RIVER IRRIGATION**

**PROJECT**

**Proponent**

**DEPARTMENT OF IRRIGATION**

**November, 2002**



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**Terms of Reference**

## ACRONYMS

APP	-	Agriculture Perspective Plan
CBD	-	Convention on Biological Diversity
CITES	-	Convention on International Trade of Wild Flora and Fauna
DOI	-	Department of Irrigation
EA	-	Environmental Assessment
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EPA	-	Environment Protection Act, 1996
EPR	-	Environment Protection Rules, 1997
FGD	-	Focus Group Discussion
HMG	-	His Majesty's Government of Nepal
IEE	-	Initial Environmental Examination
IPRSP	-	Interim Poverty Reduction Strategy Paper
MFSC	-	Ministry of Forests and Soil Conservation
MOAC	-	Ministry of Agriculture and Co-operatives
MOF	-	Ministry of Finance
MOPE	-	Ministry of Population and Environment
MOWR	-	Ministry of Water Resources
mt	-	Metric Tonne
MWDR	-	Mid-Western Development Region
NCA	-	Net Command Area
NPC	-	National Planning Commission
PRA	-	Participatory Rural Appraisal
SIP	-	Sikta Irrigation Project
TOR	-	Terms of Reference
UNCCD	-	United Nations Convention to Combat Desertification
UNFCCC	-	United Nations Framework Convention on Climate Change
VDC	-	Village Development Committee
WECS	-	Water and Energy Commission Secretariat
WUA	-	Water Users Association

CHAPTER

1

**PROJECT DESCRIPTION**

**1. PROJECT DESCRIPTION**

**1.1 Background**

The past development plans of His Majesty's Government of Nepal (HMGN) as well as Tenth Plan (2002-2007) have accorded high priority to alleviating poverty, increasing production and incomes, and creating employment, especially in rural areas. HMGN has adopted the Agricultural Prospective Plan (APP, 1994/95-2014/15) and places strong emphasis on increasing agricultural production through the development of irrigation facilities. The Tenth Plan (2002-2007) continues to support groundwater development as well as small and medium scale surface water developments.

Agriculture, which is largely rain fed, dominates the country's economy. It accounts for about 42% of GDP and provides employment to about 80% of the working population. Crop yields are generally low, but could be increased considerably with effective irrigation, the use of improved seeds, proper fertilizer and pesticides applications and improved farming methods.

HMG/N is also promoting the involvement of user groups in the development, rehabilitation and maintenance of irrigation schemes through the implementation of a new Irrigation Policy, the Irrigation Policy, 1992 (first amendment 1997).

The development projects including irrigation projects are needed for the economic growth of the country. But at times, such projects bring not only the desirable but also undesirable environmental impacts. The aim should be to make a project technically feasible, economically viable, socially acceptable and environment friendly.

Environment Protection Act (EPA), 1997 and Environment Protection Rules (EPR), 1998 are the specific acts and regulations directly related to the environmental study. The EPA was formulated taking into consideration that sustainable development could be achieved through creating a balance between the economic development and environment protection.

Also Environmental Impact Assessment Guidelines, as a tool to minimize environmental impact, has been enforced in formulation and implementation of the projects. This Guideline contains the steps, necessary to ensure that environmental considerations are incorporated in the project planning and implementation process and that environmental approach are adapted to the existing administrative, institutional and political system in Nepal.

The policy and practice of concerning environment and the formulation and implementation of programs that empower people have increased environmental awareness. The processes of expanding activities favorable to environment and the practice of EIA have been started. But still now adverse effects are seen on public health and tourism development due to degradation of environmental quality.

Integration of EIA process in development projects has further been reinforced with the enforcement of the EPA and EPR. The EPR includes a list of proposals requiring the level of initial Environment Examination (IEE) or Environmental Impact Assessment (EIA). The EPR also contains elaborate provisions on the process to be followed in the preparation and approval of projects requiring IEE and EIA, including the need for scoping report, terms of reference, and public consultation. The report should be prepared on the basis of approved Scoping Report and TOR.

The EPR, 1997 and environmental assessment guidelines currently used in Nepal provide the format for Scoping Report. The national EIA Guidelines, 1993 and other EIA guidelines provide directives about the issues to be included in the Scoping Report (HMG, 1993). The EIA guidelines proposes to identify the issues to be considered in the EIA report, determine the evaluation procedures, include aspects likely to be affected by the Project, and provide an opportunity for public involvement. The main objectives of the scoping exercise are to provide key issues that should be included in the Terms of Reference (TOR) for EIA study.

## 1.2 The Project

Sapta Koshi River, flowing along the eastern part of Nepal, is the biggest river in Nepal with a drainage area covering about one-third of the country. In 1964, Chatra main canal, which withdraws water from the Koshi River, was constructed with Indian assistance for irrigating southern parts of Sunsari and Morang districts in the Kosi zone of Nepal. The canal was supposed to supply irrigation water to farmlands covering 63,925 ha in the area. However, the design unit water requirement was not enough to cover the entire farmlands as planned owing to certain areas of very sandy soil.

A plan was then started to rehabilitate and modernize the System in a phase wise manner. The farmlands, the prospective irrigable area, was divided into three stages and a project titled Sunsari-Morang Irrigation Project was started, which included among others the construction of a new intake at Koshi River. Stage I was started in 1978, Stage II in 1986, and Stage III in 2000 and is still going on. Though the Sunsari-Morang irrigation system has been rehabilitated/renewed through those three stages of construction, the average intake discharge, for 9 years from 1990 to 1998, was just 35 m<sup>3</sup>/s against the design intake discharge of 60 m<sup>3</sup>/s. A measure to supplement the intake deficit is now being sought.

Several rivers are flowing from north to south of the extensive farmlands in Sunsari District, which lies in eastern part of Terai Plain. One of them, the Sunsari River flowing through the western side of the farmlands, is located at around mid way between two secondary canals from the Chatara main canal namely the Shankarpur Branch Canal and the Suksena Branch Canal. The Sunsari River is perennial; therefore, if a headwork could be constructed at a some suitable place in it, that could deliver by gravity the water to the both branch canals that have not been able to supply adequate water to their commands, it could result in the improvement of irrigation service in the area.

The command area of the proposed project, about 16,800 ha (total), is located in the middle and lower reaches of the Shankarpur Branch Canal and the Suksena Branch Canal in Sunsari District, Koshi Zone, Eastern Region. A location map of the project area is shown in Figure 1. The area is under the 63,925 ha. command area of Sunsari Morang Irrigation Project (SMIP). It has been observed that the tail portion of the command area of SMIP is suffering from severe water shortage. The study area consists of 13-village development committees (VDCs) inhabited by about 98,000 population. The gross command area and authenticated area (land revenue paid) within command of 13 VDCs are presented in Table 1.1. A map of the study area is presented in Figure 2.

Table 1.1: Command Area with the 13 VDCs.

Sl.	Name of VDCs	GCA (ha.)	Land revenue paid area (ha.)
1	Sahebgunj	1346.3	1242.6
2	Kaptangunj	1469.0	1362.4
3	Dewangunj	373.9	333.9
4	Ghuski	1450.3	1299.3
5	Rajgunj Sinuwari	1969.1	1852.7
6	Madhya Harsini	627.5	589.0
7	Basantpur	983.0	793.8
8	Harinagar	1089.9	988.8
9	Ramnagar Bhutaha	1317.0	877.0
10	Jaipapur	599.9	543.2
11	Narsinmha	3548.9	767.2
12	Gautampur	817.6	768.3
13	Babiya	1226.2	1112.2
	<b>Total</b>	<b>16818.8</b>	<b>12530.4</b>

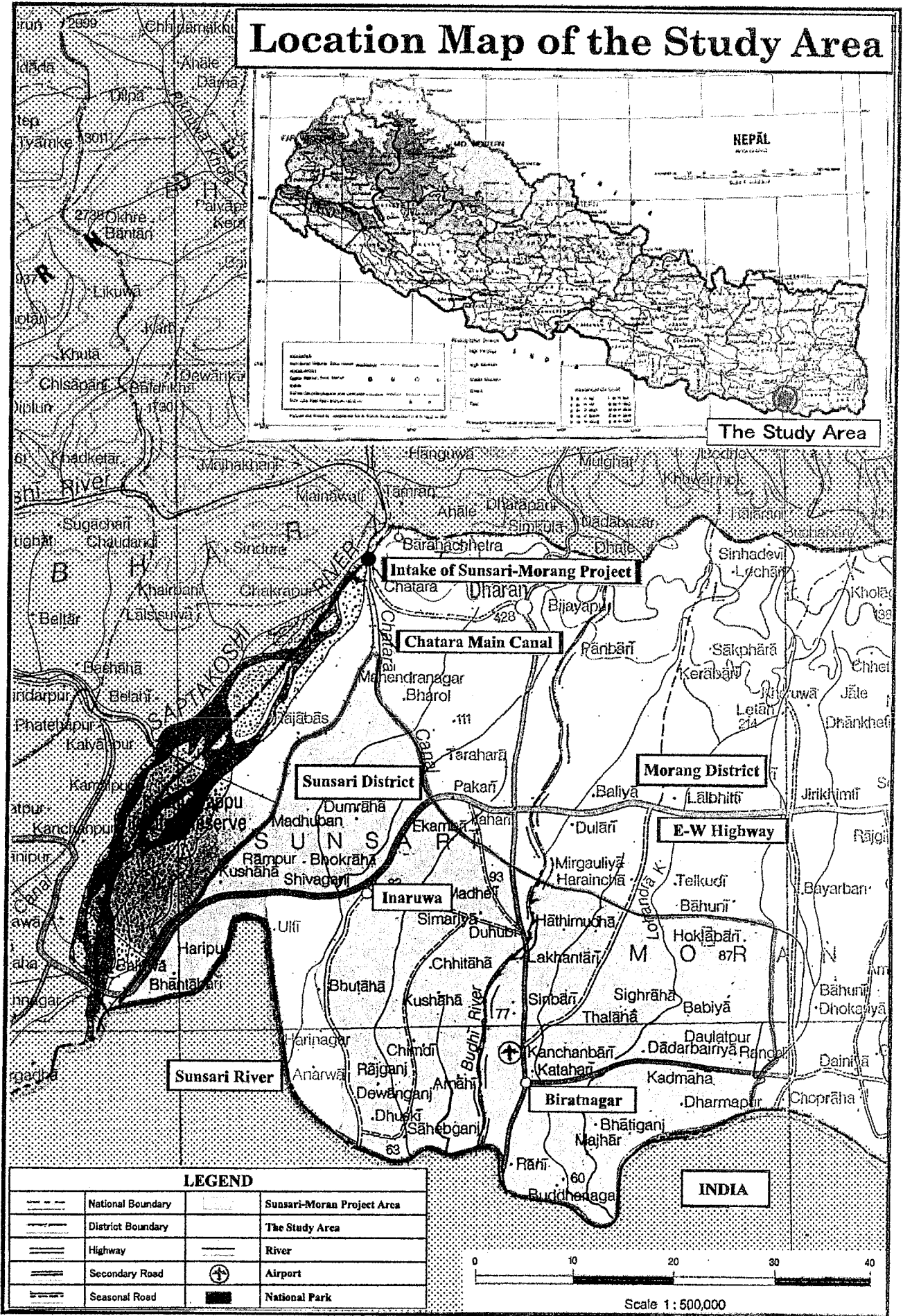
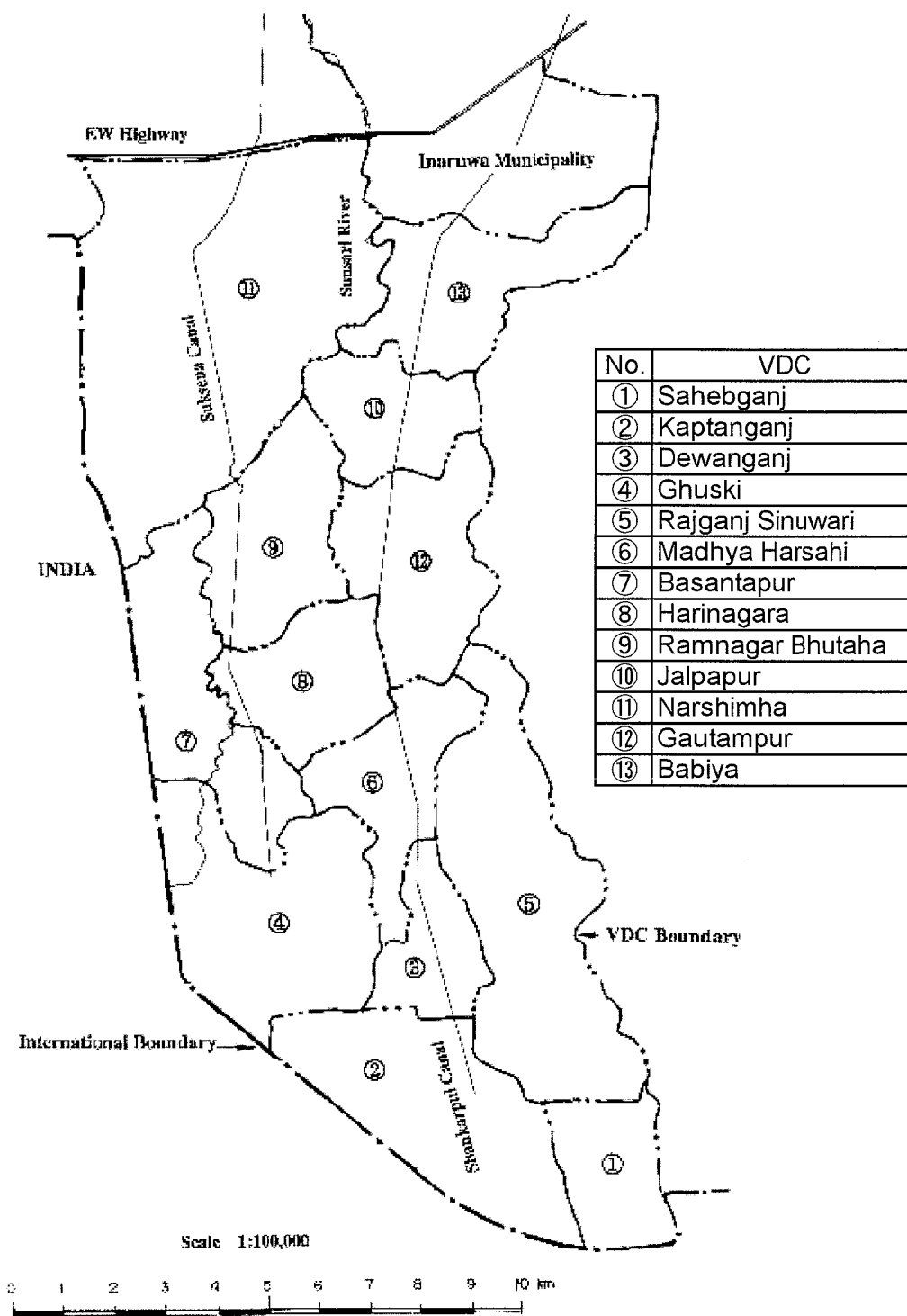


Figure 2 A Map of the Study Area



Construction of irrigation facilities such as headwork and conveyance canals linking Suksena and Shankarpur Canals can contribute to agriculture development and improvement of living condition in the area, where crop productivity is limited due to shortage of water. The salient features of the project are as follows :

Table 1.2 : Salient Features of the Project

<b>1. Name of the Project</b>	:	Sunsari River Irrigation Project (SRIP)	
<b>2. Study Area</b>			
Location	:	Latitude	260 24' N to 260 30' N
		Longitude	870 04' E to 870 12' E
Name of the Project	:	South western part of Sunsari District covering 13 VDCs	
Geographical Area	:	168.2 km <sup>2</sup>	
<b>3. Population</b>			
Study Area Population	:	98,000 (16% of Sunsari District)	
Population Density	:	583 people/ km <sup>2</sup>	
Annual Population Growth Rate	:	2.5 % (1991-2001) census period	
Average House Hold Size	:	6.1	
Literacy Rate	:	40 %	
<b>4. Land Use Pattern</b>			
Average Land Holding Size	:	1.5 ha	
Tenancy	:	29 % of total HH (Agri. census 91/92)	
Share Cropping	:	50 %	
Fixed Share	:	23 %	
Fixed Rate in Cash	:	7 %	
Others	:	7 %	
<b>5. Hydrology</b>			
Source	:	Sunsari River, perennial	
Headwork Axis at	:	600 m downstream of E-W Highway bridge	
Catchment Area	:	300 km <sup>2</sup>	
Average Annual Precipitation	:	2,072 mm	
Estimated Peak Flow at H/W	:	680 m <sup>3</sup> /s	
Mean Monthly Flow Minimum	:	2.745 m <sup>3</sup> / s in March (1/3)	
Mean Monthly Flow Maximum	:	40.308 m <sup>3</sup> / s in July (3/3)	
Total Annual Flow	:	420 Million m <sup>3</sup>	
<b>6. Proposed Cropping Pattern</b>	:	(Alt # C)	
Kari - Paddy	:	62 %	
Kari - Upland Crops	:	38 %	
Rabi – Wheat\	:	50 %	
Rabi – Others	:	50 %	
Cropping Intensity	:	200 %	
Existing Cropping Intensity	:	135 %	
<b>7. Irrigation Efficiency</b>	:	Paddy field	Upland field
Application Efficiency	:	90 %	85 %
Operation Efficiency	:	85 %	80 %
Conveyance Efficiency	:	85 %	75 %
Overall Efficiency	:	65 %	50 %
<b>8. Existing Yield (t/ha)</b>			
Wheat	:	1.5 to 2.4 (Ave. 1.95)t/ha	
Paddy	:	1.5 to 3.6 (Ave. 2.00)t/ha	



<b>9. Detail of Flood Affected Area</b>	(When River discharge reaches more than 250 m <sup>3</sup> /s, or Precipitation >150 to 200 mm/day)	
Narsimha VDC	:	380 ha, inundation period for 2-3 months, depth 0.3 to 0.8m
Basantpur	:	690 ha, inundation period for 4-7 days, depth 0.3 to 0.8m
Ghuski and Kaptangunj	:	880 ha, inundation period for 30 to 50 days, depth 0.3 to 0.8m
<b>10. Command Area</b>		
Total Command Area	:	16,820 ha
Total Cultivable Area	:	12,530 ha
Net Irrigable Area	:	10,147 ha
<b>11. Physical Facilities</b>		
Headworks	:	1 Barrage with both side off takes
Canal Details	:	Sukasena Sankarpur
Design Discharge at Intake (m <sup>3</sup> /s)	:	10.5 8.8
Main Canal Length (km)	:	21.2 20.8
Secondary Canal (km)	:	70 68
Tertiary Canal (km)	:	93
Minimum size of block (ha)	:	20
<b>12. Time Frame</b>		
Resources Mobilization	:	2 Years
Detailed Design	:	1 Year
Project Implementation	:	3 Years
<b>13 Total Cost (Tentative)</b>	:	18 M US \$
<b>14 EIRR</b>	:	15.6% (base case)

### 1.3 Environmental Setting-up relative to Irrigation Development

The project has planned to construct the headwork 600m downstream of E-W highway in Sunsari River and relevant structures and canal systems.

Integration of environmental aspects in development projects and programs was started in mid '80s following the donors' environmental guidelines. HMG/N in early '90s drafted the National EIA guidelines and endorsed it in 1993. This guideline prompted HMG/N to internalize Environmental Study in development planning as it contributed to identify adverse impacts of the development proposals on the environment. In the mid '90s, various sectoral agencies also started the development of sectoral EIA guidelines under the broad framework of the National EIA Guidelines.

The sectoral frameworks facilitated the implementation of the National Conservation Strategy for Nepal undertaken by the National Planning Commission in collaboration with the IUCN-The world Conservation Union. These environmental guidelines for the Water Resource Sector have been conceived and produced to form a complementary sequel required to the National EIA Guidelines.

The EPA prescribes preparation of IEE or EIA report by the proponent. The projects to be carried out IEE or EIA are mentioned in Schedule 1 and 2 in EPR. When a proponent plans to develop a irrigation project, whether IEE or EIA study is needed or not, depends on the scale and the location of the project as follows;

Table 1.3 : Categorization of Irrigation Projects for IEE or EIA Study

Project type	IEE	EIA
<b>New schemes</b>		
1. Terai Plain	25-2,000 ha	>2,000 ha
2. Hill valleys	15-500 ha	>500 ha
3. Hill slopes and mountains	15-2,000 ha	>200 ha
<b>Rehabilitation of existing schemes</b>		
1. Terai Plain	>500 ha	-
2. Hill valleys	>200 ha	-
3. Hill slopes and mountains	>100 ha	-

#### 1.4 Objectives of Environmental Scoping

The main objective of this Scoping Exercise is to identify major environmental issues for EIA study. Specifically, this Report attempts to:

- Review the existing environmental conditions of the project area and identify relevant environmental issues that should be considered during the preparation of the TOR and the EIA report.
- Provide the public an opportunity for involvement in determining the environmental aspects to be assessed during the EIA study, and
- Prioritize environmental issues that should be incorporated in the TOR for EIA study.

CHAPTER

**SCOPING METHODOLOGY**

**2**

**2. SCOPING METHODOLOGY**

In order to meet the objectives, outlined in Section 1.4, available literature has been reviewed and all issues and concerns have been thoroughly analyzed. As the feasibility study is going on, public consultations are being made. Literature review, public notice inviting suggestions, opinions and public consultations are the key approaches adopted in preparing this Scoping Report.

**2.1 Literature Review**

Relative information has been collected through extensive review of literature. Physical and biological information has been extracted based on field visits and survey. Socio-economic information, especially with respect to fishermen and fishing has been collected and analyzed.

Policy and legal information is based on the Ninth Plan (1997 – 2002), approach paper for Tenth Plan, irrigation policy, Environment Protection Act (EPA, 1996), and Environment Protect Rules (EPR, 1997). Other relevant legislation such as Water Resources Act, 1992, Forest Act 1993, Land Acquisition Act 1978 and Local Governance Act of 1999 have also been reviewed. Furthermore, the Environmental Impact Assessment Guidelines, particularly the National EIA guidelines, 1993 shall also be considered during the detailed EIA study.

**2.2 Public Notice**

In order to comply with the scoping provision for EIA study set forth in environmental legislation (EPA, 1996 and EPR, 1997), the Sunsari River Irrigation Project of the Department of Irrigation (DOI) published a notice in the national daily “Samachar Patra” on 10<sup>th</sup> of Shrawan 2059 (July 26, 2002). A copy of the public notice is presented in Annex 1. The aim was to inform the local people on the nature of the project and request them to solicit suggestions, opinions etc. regarding the likely adverse environmental impacts due to the project. Furthermore, people were asked to provide their concerns, about the natural system, cultural practices, social system, economic and human activities, and interrelationships of these environmental components. The study team also consulted with the local people in the command area to seek their concerns, opinion and suggestions on likely impacts of this project on the environment.

**2.3 Public Consultation**

EIA study team made a number of visits of the study area to inform the local people about the scope of work under the project and to solicit their opinions, to have a first-hand look of the canal system, and to observe the natural ecosystem, especially aquaculture condition. On such occasions discussions were made regarding the environmental issues related to the project and their opinions collected. Apart from this one district level and four farmer level consultation meetings were organized on 1<sup>st</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> of August 2002. For the farmer level meetings the 13 VDCs of the study area were divided in four groups as shown in the table below :

Table 2.1 : Schedule of Farmer Level Consultation Meetings

S. No.	Date	Venue	VDCs	No. of Participants
1	August 5, 2002	Primary Teachers' Training Centre, Inaruwa	Narsingh, Babiya and Jalpapur	56
2	August 7, 2002	Krishna Secondary School, Bhutaha	Ramnagar, Bhutaha, Gautampur and Basantpur	70
3	August 9, 2002	Harinahara Higher Secondary School	Harinagara, Madhya Harsahi and Rajganj Sinwari	71
4	August 11, 2002	Kaptanganj Higher Secondary School	Kaptanganj, Devanganj, Ghuski and Sahebganj	85

The details of the meetings are presented in Annex 2. The main opinions, suggestions and comments obtained during the consultation meetings are summarized below :

**Positive impacts:**

- silt carried by the canal water can act as fertilizer, increase in cropping intensity, increase in productivity and production, construction of access roads, more employment opportunities in agriculture sector etc. and in an overall sense betterment in the living conditions of the people.

**Negative impacts :**

- water quality down stream of the headwork needs attention especially in the context of reduced flow in the river during winter and spring season and release of effluents from the paper mills.
- existing downstream use (for lift irrigation, cattle watering etc.) may be impaired. When asked about the minimum release in the river for environmental considerations, a compromise between irrigation and ecology during lean period, they suggested 10-25% of the flow.
- Sunsari is not a good source of fish and fishing in it is not a major problem, fishermen can fish in canal and also act as farm labor. They can also fish in the u/s of headwork.
- compensatory fish culture in Mariya Dhar might be a better alternative if the ownership issue can be resolved.
- inundation is a problem in some part of the project area and might get worse.
- the erosion problem exists and might continue.

**Other comments:**

- VDCs would make some land available for making ponds for community fish culture.
- fishermen, these days, take private ponds in contract and are also engaged as middle men in fish trade.
- the river is fed by spring source. Some of the participants expressed doubts about the water from spring after construction of deep cutoffs in the headwork.
- some of them raised doubts about the possible development of Mariya Dhar as an alternate fishery option. They said that most of the land within the Dhar is private either registered in somebody's name or in the sense that people are using it and paying tax to VDC. In addition comments and suggestion of the VDCs for the project were also collected. They are presented in Annex 3.

CHAPTER

**EXISTING ENVIRONMENTAL CONDITIONS**

**3**

**3. EXISTING ENVIRONMENTAL CONDITIONS**

**3.1 Physical Environment**

**3.1.1 Project Area**

The Sunsari River Irrigation Project (SRIP) area is located in the south-western part of Sunsari District spanning between 26°24'N to 26°30'N in latitude and 87°04'E to 87°12'E in longitude. The elevation ranges from 64 meters to 80 meters above sea level. The study area is rectangular in shape with E-W width varying from 4 to 8 kilometers and N-S length about 22 kilometers. The western and southern borders of the project area are with India.

The terrain starts from foothills of the Siwalik range and slopes gently down to south with an inclination of 5 degrees on the average and is formed by alluvium of old and present rivers dominated by sandy soils having low to moderate water holding capacity.

There are two main rivers flowing through the study area in a direction parallel to the Koshi River. The Sunsari River, source river, flows southwest through the central part of the study area and the Budhi river flows towards south along the eastern border of the study area. Mariya Dhar, abandoned course of Sunsari River, is in the central part of the study area between Jalpapur and Kaptanganj.

The climate in the project area is sub-tropical. Temperatures are high between March and October, the hottest month being April, during which the mean daily maximum temperature is about 34°C. During the cool period from November to February, mean monthly temperatures are in the range of 16 – 22°C. The annual average rainfall from 1970 to 1993 is 1,867mm, raining intensively in monsoon period, from late May to September.

**3.1.2 Catchment Condition**

Most of the catchment area of the Sunsari River lies in the geologically fragile Siwalik Range that is characterized by weak geological formations and unstable and steep slopes, making it vulnerable to exogenous factors. Of these, the intense monsoon rainfall that occurs within a short span of time is an important cause of soil erosion. As a result of improper land use, deforestation and intense rainfall the Churia hills undergo degradation every rainy season. Consequently, flooding, sediment deposition and bank erosion affect the terai plains.

**3.1.3 Water Availability and Quality**

Sunsari River is the source of water for the project. The 80% reliable mean monthly flow of the river is given below:

Table 3.1 : 80% Reliable Mean Monthly Flows (middle 10 days) of Sunsari River in m<sup>3</sup>/s

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<u>3.337</u>	<u>3.009</u>	<u>2.746</u>	<u>3.467</u>	10.296	25.002	33.659	34.072	25.579	12.419	<u>3.816</u>	<u>3.359</u>

The flow in the river is less than irrigation requirements during winter and spring.

In order to collect general water quality data in the Command Area of the Project, to check whether surface water and ground water are suitable for irrigation or not, and to analyze the water pollution caused by the two paper mills near the proposed headwork site of the Project, water sampling and analysis were done. The parameters analyzed for six sampling points in the Command Area and the wastewater of two paper mills, Baba and Arvind are as follows; pH, Electric Conductivity (EC), Bacteriological test, Dissolved Oxygen (DO), T-C in TSS, Suspended Solids (SS), Total Nitrogen in Total Suspended Solids (T-N in TSS) Bicarbonate, Nitrate, Nitrite, Ammonia, Total Phosphate, Chloride, Sulfate, Calcium, Magnesium, Total Hardness, Iron, Sodium, Potassium, Arsenic, Manganese, PV value which equals to Dissolved Organic Carbon, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD).

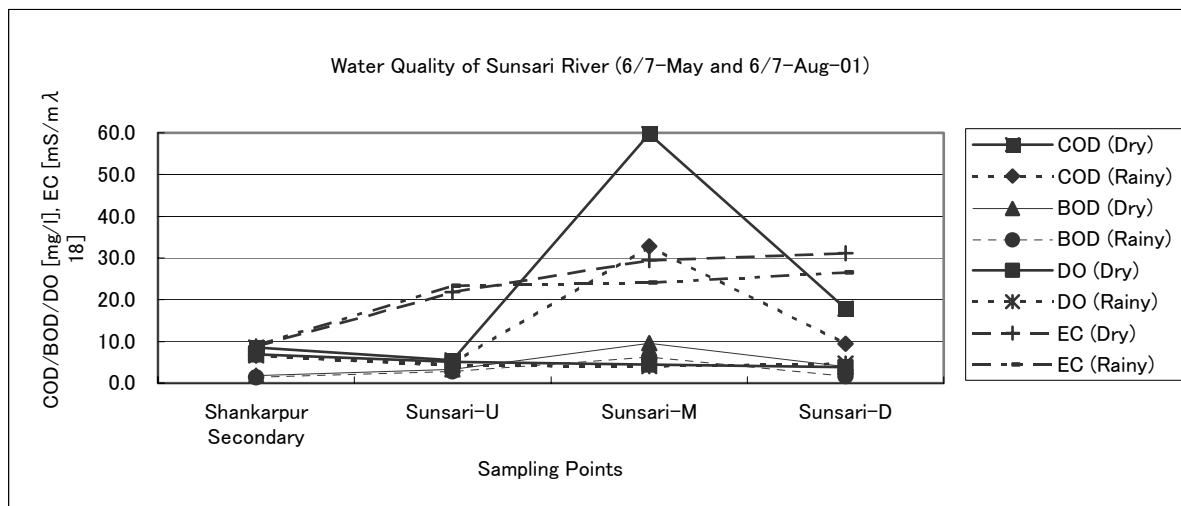


Figure 3 : Water Quality of Sunsari River in Dry and Rainy Seasons

Results of the analysis show that most of above parameters except COD, BOD, DO for Sunsari River water are within standard of FAO for irrigation water and recommendation maximum concentration of trace element in irrigation water in England. The standard for irrigation water in Japan also suggests that EC higher than 30mS/mλ<sup>18</sup> may have some impact on the yield of paddy and EC of Sunsari-D (downstream) is slightly over that value in dry season. Therefore, it can be concluded that water quality in surface water and ground water is suitable in the Project area as long as the headwork is constructed upstream of two paper mills, because high values of COD and BOD result from wastewater from two paper mills, which are located along Sunsari River near E-W Highway Bridge which is just downstream of the sampling point Sunsari-U (upstream).

Two paper mills, namely Baba Paper Mill which consumes approximately 4 million liters of water per day and Arvind Paper Mill which recycles paper and consumes approximately 150 thousand liters of water per day, are located near the proposed site for the headwork, which discharge wastewater directly into Sunsari River. The smell of the wastewater is especially strong along the channel and two reservoirs of Baba Paper Mill, and the residents who live downstream of the paper mills are complaining of smells, dying of fishes, skin rashes and funny taste of head part of the fishes caught at Sunsari River. They sometimes protest against the paper mills about the water pollution, and it has become a social problem cited in newspaper.

Table 3.2 : Wastewater Quality of Two Paper Mills

Parameters	Results (Aug-01)		NS*	German Standard 1)	Units
	ARVIND	BABA			
T. Suspended Solids	1,634.6	1,445.9	30 – 200	<20	mg/l
Ammonia (NH <sub>3</sub> )	1.64	133.00	< 50	–	mg/l as N
Chloride (Cl)	139.5	744	–	<350	mg/l
Lead (Pb)	0.06	0.17	< 0.1	–	mg/l
Chromium (Cr)	0.08	0.26	< 0.1	–	mg/l
Sodium (Na)	25	1,104	–	–	mg/l
COD	252	2,965	< 250	<85	mg/l
BOD	168	2,025	30 – 100	<25	mg/l

NS\* = Nepal Bureau of Standards and Metrology (Ne. Gu. Na. 229-2047).

Resource: 1) Galvonotechnic(1971, 62, No.12sss L'ultima acqua, A.Canuti, 1974, AFEE 2482/2)

Danish International Development Agency (DANIDA) is implementing Cleaner Production (CP) and Environment Sector Program Support (ESPS) in five industrial sectors including paper mills in Nepal, and construction of an effluent treatment plant jointly managed by Baba and Arvind Paper Mills is expected to start in December 2002.

## 3.2 Biological Environment

### 3.2.1 Vegetation

The Study Area was once covered with primary forest. However, the construction of the Koshi dike, the East-West Highway, and Sunsari Morang Irrigation Project caused the conversion of the forestland into agricultural, residential and industrial lands. At present most of the area is agricultural land. Even so, the forest area, especially catchment area of Sunsari River, has been decreasing gradually due to extraction of firewood and fodder by local people.

### 3.2.2 Fish Species and Population

Due to low botanical density, little mammalian wildlife are observed in Study Area. Main vertebrate in the area is fish, and the number of species surveyed in Sunsari River and Budhi River are 48. The Sunsari River supports biological diverse species like carps, catfishes, loaches and minnow. These collections represent from upstream to downstream of proposed and existing dam axis of Sunsari and Budhi rivers respectively. The principal fish species of Sunsari River are grouped as follows:

- Carps** : River carp (*Lebeo rohita*, *L. gonius*, *L. dero*, *L. pangusia*, *Catla-catla*, *Cirrhina mrigal*) and other species like *Crossocheilus latius*, *Chagunius chagunio*, etc.
- Cat fishes** : *Clupisoma garua*, *Mystus spp.*
- Loaches** : Stone loach (*Noemacheilus beavani*, *N. botia*, *Lepidvcephalichthys guntea*, *L. nepalensis*, *heteropneustes fossils*).
- Eels** : Swamp eel (*Amphipnous Cuchia*, *Mastacembelus pancalus*, *Macrognathus aculatus*) fresh water eel (*Anguilla bengalensis*).
- Barbs** : *Puntius sophore*, *P.ticto*, *P.titius*, *P.sarana*, *Chanda nama*, *Colisa patius*, *Sicamugil cascasia*.
- Minnows** : *Barilius shacra*, *B. barna*, *Essomus dandricus*, *Rasbora daniconius* etc.

## 3.3 Socio-economic Environment

### 3.3.1 General

Total population of the Study area according to year 2001 Census is 98,000 consisting of 50,700 and 47,300 of male and female respectively. The proportion of male and female is thus calculated 1.00 : 0.93. Total number of households is 16,200 and the average family member per household calculated is 6.1. Demographic features of the study area are presented in Table 3.3.

Table 3.3: Demographic Features of the Study Area

Sl.	Name of VDCs	No. of HH	Male	Female	Total	Ave. HH	Pop. density	Growth rate
1	Sahebgunj	641	1757	1643	3400	5.3	253	-2.9
2	Kaptangunj	1328	4331	3865	8196	6.2	558	3.0
3	Dewangunj	1101	3387	2992	6379	5.8	1706	3.9
4	Ghuski	1482	4823	4701	9524	6.4	657	1.8
5	Rajgunj Sinuwari	1435	4298	4184	8482	5.9	431	2.3
6	Madhya Harsini	824	2607	2323	4930	6.0	786	2.1
7	Basantpur	744	2420	2237	4657	6.3	474	-1.8
8	Harinagar	1142	3633	3391	7024	6.2	644	1.8
9	Ramnagar Bhutaha	1703	5692	5387	11079	6.5	841	3.3
10	Jaipapur	1093	3029	2781	5810	5.3	968	3.2
11	Narsinmha	2770	8908	8502	17410	6.3	491	5.2
12	Gautampur	700	2051	1846	3897	5.6	477	2.0
13	Babiya	1224	3755	3468	7223	5.9	589	2.7
	<b>Total</b>	<b>16187</b>	<b>50691</b>	<b>47320</b>	<b>98011</b>	<b>6.1</b>	<b>583</b>	<b>2.5</b>

The annual growth rate from 1991 to 2001 is 2.5%, slower growth to the district totally. Although the population growth of Sunsari district is relatively rapid due to migration from hilly area, as one of the factors, it seems that the migration movement has not reached influentially to the Study area located at the southern most part of the district. Indian migration to Nepal has not taken place for recent years.

According to the Household Survey Data, 70% of female, 51% of male and totally 60% of the people in the Study area are illiterate. Graduates of primary school and secondary school are 15% and 19% respectively. Disparity of education status by sex increases as the grade goes higher.

Most of the people in the Study area are engaged in agriculture. Those who earn from agriculture is categorized to land owner, tenant and farm labor. Women are mostly engaged in agricultural labor. Livestock rearing is also considerable income source. Fishery in rivers and fishponds is also a common occupation, especially for those who are landless.

The land holding size ranges from less than 0.5 ha to 18 to 20ha in the Study area, but the majority of the owners are small-scale farmers. The baseline survey in Kaptanganj shows that 63% of the households are either landless (42%) or own less than 0.5 ha (21%) and 86% of households fall in the category of less than 2 ha. Households who own more than 5 ha only occupy 3% of the total households in Kaptanganj. According to a series of field interviews with farmers, the situation in other VDC would be more or less same.

According to the household survey by Local Government Program (LGP) in 1998, 53% of households answered that they live with inadequate food for more than nine months. The areas much constrained with food supply are not always located in the downstream reaches of the Study area, where it is envisaged; the water shortage for agriculture should be much more than the upstream reaches. Like Babiya and Jalpapur VDCs, though they are located fairly upstream within the Study area, the data indicates the considerable shortfall of food supply to the households. As the Study area is located far downstream from Chatara main canal, it is indicative that water shortage for agriculture is prevailing all over the Study area. Also social structure relative to land holdings may be a concern on the food shortage.

### 3.3.2 Fishing Community

There are four fishing settlements in four different Village Development Committees in the Command Area of the Project and the total members of the fishermen households are 202 with approximately 1,250 population. The average family size of these fishermen is six. Most of them are very poor, landless or have small pieces of land for erecting their houses. The largest fishing settlement is Ward No.8 of Ramnagar Bhutaha VDC and almost every villager goes fishing everyday and few of them have other income sources. The fishermen of Ramnagar Bhutaha, Ghuski and Narsingh mainly catch fishes in Sunari River and Sunsari Mariya Dhar.



Table 3.4 : Fishing Community

Name of VDC	Fishermen Households	Total Members	Regular Fishermen
Ramnagar Bhutaha	100	600	100
Ghuski	60	400	50
Bhokraha	22	125	12
Narsingh	20	125	13

An interaction/consultation meeting was organized on August 14, 2002 with the fishermen of Ramnagar Bhutaha VDC ward no. 8 in their locality. 42 fishermen from the village took part in the discussion. The minutes of the meeting is presented in Annex 3. Their opinions, suggestions and comments were summarized here below:

- irrigation project, though essential, would be of no use to landless fishermen
- Sunsari River is a better source of fishes as compared to other rivers in the locality
- fish culture in community ponds as an alternative managed by their own organization
- those with some lands agreed to be benefited through irrigation by growing vegetables etc.
- most of them did not accept the idea of earning by working as farm labor
- fish population in Sunsari River was constantly decreasing after the paper mills started operating
- since many people claim the land within the Mariya Dhar as private, fishermen expressed doubts whether the land that people are claiming as private are really private
- fishermen said VDC cannot resolve the ownership problem and indicated towards some higher levels of HMG/N.

CHAPTER

**PRIORITY EIA ISSUES**

**4**

**4. PRIORITY EIA ISSUES**

EIA is generally carried out to identify the likely impacts, both the positive and adverse even a small actions may pose adverse impacts on the environment. All issues raised may not be equally important for assessment, because some of them may be outside the scope of the nature of the project. In this context, it is very important to select the issues that should be looked into the EIA study. Hence, the Scoping exercise should focus on sorting the issues, which are directly related to the project.

As this is an irrigation project and is planned for construction to provide irrigation facility in the command area, the following issues are considered important which effect the environmental resources even if little damage is done to it at any stage of construction or operation.

Table 4.1 Summary of Activities and Adverse Impacts

Project Stage	Activities	Likely Adverse Impacts	Elements of Environment								
			Physical				Biological		Socio-economic		
			Water quality	Ground water	Water volume	Land	Fishes	Vegetation	Health	Economic	Social cultural
Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent	Magnitude Extent		
Construction Stage	Migration of labors during construction	Loss of woods, sanitation						□ □	□ □		
Operation Stage	Reducing flow in the river	To make water quality worse	● ●				● ●	● ●	○ ○	● ●	□ □
		To make less habitat area					● ❖			● ○	
		Lowering velocity of the flow					○ ○				
		Less quantity of water available			○ ❖			○ ○		○ ❖	
	Lowering ground water table along the river			□ ○						□ ○	
	Reducing sediment load of the flow	Downstream erosion at the initial stage				❖❖					
	Headwork construction									○ ○	
	Canal operation					○ ○				○ ○	
Stagnation of water								□ □			

Note

- = very high or large
- ❖ = high or large
- = medium
- = low or small

## **4.1 Physical Issues**

The physical resources should be least damaged during the construction and operational period of the Project. The EIA study should emphasize impact assessment on the following issues for both of construction, operation and maintenance stages.

### **4.1.1 Operational Stage**

- Worsening of water quality of the river by reducing flow in the river relative to the load of pollutants from the paper mills,
- Less quantity of water available downstream by reducing flow in the river,
- Lowering ground water table along the river by reducing flow in the river,
- Downstream erosion at the initial stage by reducing sediment load of the flow,
- Sedimentation in the canal by operation.

## **4.2 Biological Issues**

### **4.2.1 Construction Stage**

- Loss of woods used for cooking by labors during construction.

### **4.2.2 Operational Stage**

- Less habitat area for fishes by reducing flow in the river,
- Likely impact on fishes by lowering velocity of the flow
- Less vegetation by reducing flow in the river,
- Likely impact on vegetation by less quantity of water in the river.

## **4.3 Socio-economic and Cultural Issues**

### **4.3.1 Construction Stage**

- Sanitation problem by migration of labors during construction.

### **4.3.2 Operational Stage**

- Likely impact on human health caused by worsening water quality,
- Vector-borne disease caused by stagnation of water,
- Likely impact on economic, social and cultural environment by worsening the water quality in the river,
- Less feeding grasses for cattle by reducing flow in the river,
- Increased cost for pumping irrigation by less quantity of water in the river,
- Increased cost for using ground water by lowering ground water table along the river,
- Increased cost for headwork maintenance due to sedimentation,
- Increased cost for canal maintenance due to sedimentation.

## **4.4 Management Issues**

- Proper management of solid waste and timing of releasing effluent by paper mills
- Catchment improvement in long-term
- Proper disposal of excavated soil
- EIA Study should address and recommend the ways for better management of environmental issues

CHAPTER

**WORK SCHEDULE**

5

**5. WORK SCHEDULE**

In order to comply with the environmental legislation the proponent will mobilize a multi-disciplinary study team of relevant environmental specialists, to the earliest possible, once the Ministry of Population and Environment approves this Scoping Report and the TOR in accordance with the environmental legislation. The work schedule for the EIA Study is presented in Figure 4.

**TENTATIVE WORK SCHEDULE**  
*For*  
**EIA STUDY OF SUNSARI RIVER IRRIGATION**

S.N	Description	2002						2003		
		July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March
1	Scoping Report									
	• Public Notice	■								
	• Preparation of the Scoping Report and Terms of Reference		■	■	■					
	• Submission of the Scoping Report and Terms of Reference				■					
	• Approval of the Scoping Report and the ToR for EIA Study				■	■				
2	Team Mobilization					■				
3	Literature Review					■				
4	Field Study					■	■			
5	Data compilation						■			
6	Report preparation						■	■		
7	Preparation of material for Public hearing							■		
8	Report Submission							■	■	
9	Approval of EIA Report									■

Figure : 4

*ANNEX - 1*

**Public Notice**

# नेपाल समाचारपत्र

काठमाडौं र विराटनगरबाट एकसाथ प्रकाशित पहिलो राष्ट्रिय दैनिक

श्री ५ को सरकार

जलश्रोत मन्त्रालय

सिंचाई विभाग

## सुनसरी नदी सिंचाई आयोजना, सुनसरी सार्वजनिक सूचना

(प्रथम पटक प्रकाशित मिति : २०५९/४/१०)

सुनसरी जिल्लास्थित प्रस्तावित सुनसरी नदी सिंचाई आयोजनाको हाल संभाव्यता अध्ययन भईरहेको छ र उक्त आयोजनाको वातावरणीय प्रभाव मूल्यांकन (EIA) पनि निकट भविष्यमा गरिदै छ। यस सिलसिलामा वातावरण संरक्षण नियमावली, २०५४ बमोजिम अध्ययन क्षेत्र निर्धारण (Scoping) गर्नको लागि यो सूचना सबैको जानकारीको लागि प्रकाशित गरिएको छ।

**वातावरणीय प्रभाव पर्न सक्ने सुनसरी जिल्लाका सम्बन्धित गाउँ विकास समितिहरू :**

- |                    |                 |             |             |
|--------------------|-----------------|-------------|-------------|
| १. साहेवगंज        | २. कप्तानगंज    | ३. देवानगंज | ४. घुस्की   |
| ५. राजगंज सिनुवारी | ६. मध्य हर्पाही | ७. वसन्तपुर | ८. हरिनगरा  |
| ९. रामनगर भूताहा   | १०. जलपापुर     | ११. नरसिंह  | १२. गौतमपुर |
| १३. वाविया         |                 |             |             |

उपरोक्त गा.वि.स.हरू सम्मिलित आयोजना क्षेत्रका कृषक समुदाय, गा.वि.स.हरू, विद्यालय, महाविद्यालय, अस्पताल, स्वास्थ्य चौकी तथा अन्य सबै सरोकारवाला व्यक्ति वा संघ संस्थाहरूलाई आयोजनाको बारेमा जानकारी दिने उद्देश्यले हाल संभाव्यता अध्ययनमा संलग्न टोलीले आयोजना क्षेत्रका विभिन्न स्थानमा बढी २०५९ साल श्रावण २६ गतेदेखि छलफल कार्यक्रम आयोजना गर्ने भएको छ। छलफल कार्यक्रमको मिति, समय, तथा स्थानको जानकारी सम्बन्धित गा.वि.स.हरू मार्फत गराइने छ। त्यस बाहेक आयोजना सम्बन्धि आवश्यक जानकारी सिंचाई डिभिजन कार्यालय (साविक सुनसरी जिल्ला सिंचाई कार्यालय), इनरुवाबाट पनि प्राप्त गर्न सकिने छ।

प्रस्तावित सुनसरी नदी सिंचाई आयोजनाबाट त्यस क्षेत्रका भौतिक, जैविक, सामाजिक र सांस्कृतिक प्रणाली तथा आर्थिक वातावरणमा पर्न सक्ने प्रभावको सम्बन्धमा लिखित सुझाव यस सूचना प्रथम पटक प्रकाशित भएको मितिले १५ (पन्ध्र) दिनभित्र सिंचाई डिभिजन कार्यालय (साविक सुनसरी जिल्ला सिंचाई कार्यालय), इनरुवामा पठाईदिनु हुन अनुरोध छ। त्यस्ता राय सुझावको प्रतिनिधि सम्बन्धित मन्त्रालय वा विभागमा सनेत पठाउन सकिने छ।

प्रस्तावकको नाम तथा ठेगाना :

सिंचाई विभाग, जावलाखेल, ललितपुर

His Majesty's Government  
**Ministry of Water Resources**  
Department of Irrigation  
**Sunsari River Irrigation Project, Sunsari**

**Public Notice**

**Date of First Publication : (July 26, 2002)**

The feasibility study of the proposed Sunsari River Irrigation Project in Sunsari district is being conducted. An EIA study of the said project will be done in the near future. In this regard this notice has been published, for the information of all concerned, for the purpose of Scoping in accordance with the Environment Protection Rules, 2054.

**Village Development Committees likely to have environmental impacts:**

**1. Sahebganj 2. Kaptanganj 3. Dewanganj 4. Ghuski 5. Rajganj Sinuwari 6. Madhya Harsahi  
7. Basantapur 8. Harinagara 9. Ramnagar Bhutaha 10. Jalpur 11. Narsimha 12. Gautampur  
and 13. Babiya**

The feasibility study team will conduct consultation meetings from August 11, 2002 onward in different places within the Project area with a view to disseminate information about the Project to the farmers community, VDCs, Schools, Colleges, Hospitals, Health Posts as well as all other concerned individuals or institutions of the Project area. The schedules of such consultation meetings will be notified through the VDCs. Apart from this necessary information about the Project can be obtained from District Irrigation Office (DIO), Inaruwa.

Written opinions and suggestions regarding the likely environmental impacts on Physical, Biological, Social and Cultural system as well as economic aspects are requested to be sent to DIO, Inaruwa within 15 days from the date of first publication of this notice. The copies of the opinions and suggestions can be sent to the concerned department and Ministry.

**Name and Address of the Proponent** : ***Department of Irrigation  
Jawalakhel, Lalitpur***



*ANNEX - 2*

**Comments and Suggestion from VDCs**



श्री ५ को सरकार  
स्थानीय विकास मन्त्रालय

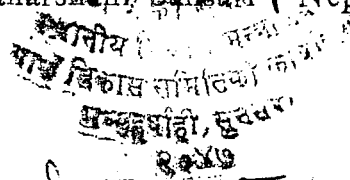
# गाउँ विकास समितिको कार्यालय

मध्यहर्षाही, सुनसरी (नेपाल)

## Office of Village Development Committee

Madhyaharsahi, Sunasari (Nepal)

पत्र संख्या :- ०४९५०  
चलानी नम्बर ३४



मिति:- २०७१/३/१८

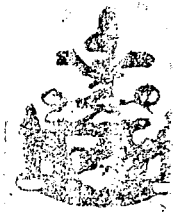
विषय:- याेजना कार्यालयको लक्षणापत्र ।

यो नो लागू सम्वन्धित छ

उपरोक्त लक्षणापत्रमा शुक्रवादी सिंचाई योजना लक्षणा-  
मा मिति २०७१/३/१८ गतेका दिन यस गाउँको एउटा निर्वातमान पडाशिकी  
हउ स्थानिय राजनीतिक पार्टी प्रतिनिधिहरु र केहि कृषकहरु समेतको  
यस योजनाको केन्द्र हरिनाथमा लक्षणा लक्षणा शुक्रवादी सिंचाई कार्यालयको  
कार्यालय जाइदा कष्टययन टोली लागू व्यापक फैलपुल हुँदा यो कार्यालय  
को अर्थगतित्व बाँकिरहल गर्दै प्रस्तावित कार्यालय संचालन गर्न यस क्षेत्र  
का कृषकहरुको व्यापक मार्गदर्शिकाल यो कार्यालय अद्यावधि संचालन  
गरी दिनु हुन सिफारिस साथ कर्नुपर्दा छी

(सुनसरी)  
२०७१/३/१८  
अध्यक्ष

गा.वि.स. कार्य संचालन समिति



# गाउँ विकास समितिको कार्यालय

(सुनसरी)

पत्र संख्या :-

चलानी नम्बर ३१

सुनसरी

दिनांक २०२१/१८

विषय: यो जो लंग लान्छर्छ

x

उपरोक्त लान्छमा मिति २०२१/१२० का दिन  
शिक्षा तालिम केन्द्रमा हुने गरी विभिन्न कामकाज  
थले जाइरहेको का निवर्तमान प्रतिनिधि, पारि  
प्रतिनिधि, विज्ञान प्रतिनिधि-६५ ~~सुनसरी~~  
- सुनसरी र सुनसरी सिचाई लान्छ जोडा-  
अध्ययन टोली लिच व्यापक दलकल गर्दै उक्त  
सुनसरी सिचाई योजना कार्यालय गर्न अर्ह  
आवश्यक छैर गरिने हुंदा यो योजना  
शिक्षा कार्यालय तर्फ सिधारीस लाभ अनुरोध  
छैर

२०२१/१८  
सुनसरी  
डा. वि. स. बस्नेत



गाउँ विकास समितिको कार्यालय

घुस्की, सुनसरी

OFFICE OF VILLAGE DEVELOPMENT COMMITTEE

GHUSKI, SUNSARI

प. सं. १-  
च. सं. १

०८६६/६०

मिति ०८६६/६०

स्थानीय विकास समिति  
घुस्की, सुनसरी

विषय - योजनाको ~~सुझाव~~ (सुझावको)

उपरोक्त सम्बन्धमा मिति ०८६६/२६ का दिन श्री-  
वृषभा शाह वि. कृष्णराज के. सुब्बा कुमर शाह-वि. वि. वि.  
को साथै यश शाह, कि. सु. दा. नि. व. त. शाह प्रतिनिधी  
पार्टी प्रतिनिधी वि. शा. शा. प्रतिनिधी एन. र. सुब्बा  
सिन्हा सम्बन्धि आइका अन्वयनको योजना  
कोच तथा पत्र देखाफात गर्दै उक्त सुब्बा सिन्हा  
योजनाको कार्यान्वयन गर्न कति अनुभव तथा  
वैशेषिकताहरू यस योजना शीघ्र कार्यान्वयन तर्फ  
सिन्हाको साथै उपरोक्त अनुभवको

*(Handwritten signature and text)*  
०८६६/६०  
सुनसरी  
०८६६/६०



श्री ५ को सरकार  
स्थानीय विकास मन्त्रालय

# गाउँ विकास समितिको कार्यालय

गौतमपुर; सुनसरी

मिति २०७३/३/८

पं.सं. :- ०२९/३०

च.वं. :- १०

स्थानीय विकास मन्त्रालय  
गाउँ विकास समितिको कार्यालय  
गौतमपुर, सुनसरी

**विषय :-** योजना कार्यान्वयन सम्बन्धमा ।

योजना सँग सम्बन्धित छ ।

उपर्युक्त सम्बन्धमा सुनसरी जिल्लाको सिन्धुपाल्चोक योजना

का लागि मिति २०७३/११/२२ मा बालकृष्णमाठ कि जुटाएमा ४४४  
गाउँ विकास समितिको साथ यस गाउँ कि १०० युमेलका निर्वाहमा  
प्रतिनिधिहरू, जारी प्रतिनिधिहरू र कृषकहरूको संलग्नतामा आएका  
कृषकहरूको बीच व्यापक कलकत्रिया र इलपल हुँदा यो योजना  
कार्यान्वयन गर्न व्यापक मात्राको कलकत्रिया उपर सुनसरी सिन्धुपाल्चोक  
योजनाको कार्यान्वयन गरी दिनु हुन सिन्धुपाल्चोक साथ कुरा गरिने छ ।

(सुनसरी प्रसाद महताे)  
गाउँ विकास समितिको सचिव  
सुनसरी अञ्चल



श्री १ को सरकार  
स्थानिय विकास मन्त्रालय

# गाउँ विकास समितिको कार्यालय

## राजगंजसिनुवारी सुनसरी

पत्र संख्या :- डि.वि.सं. २०२९/६०  
पत्रांकी नम्बर :- ३३

मिति २०२९/१/८

श्री १ को सरकार  
स्थानिय विकास मन्त्रालय  
गाउँ विकास समितिको कार्यालय  
राजगंजसिनुवारी, सुनसरी

विषय :- सिफारिस बाहिरको कोडा

यो हस्तोस्त्रो लम्बोचित हो।

उपरोक्त कोडा सुनसरी सिन्धुवा योजना लम्बोचिता प्रिति  
२०२९/१/१२४ गते का दिन आफु जार कि कडा सिफारिस  
पढाफिकाई हक सुनसरी जारनाई जारी जमिनी हक  
र कडा हक जमिनी हक आफु जार हो कडा हक  
जगतमा मा कडा हक मा सुनसरी सिन्धुवा  
आपोजना का आपोजना जायका आपोजना  
शेरी हक हक हक हक हक हक आपोजना  
को उपरोक्त को आपोजना हक पढाफिकाई  
आपोजना संस्थान गते शुरु होव का हक  
हक को आपोजना आपोजना हक हक हक हक हक  
ले आपोजना आपोजना लेखा गते हक हक  
सिफारिस हक हक हक हक हक

२०२९/१/८  
उपरोक्त  
स्थानिय विकास मन्त्रालय  
राजगंजसिनुवारी सुनसरी



# गाउँ विकास समितिको कार्यालय

देवानगंज, सुनसरी

सं. सं. -  
सं. सं. -

०२५/६६,



मिति २०२५/६६

विषय : यो जो जस खा सम्बन्ध,

X

प्रस्तुत विषयमा यस जिल्लाको हामी  
 इलाका मा सुनसरी सिचाई योजना को लागि  
 मिति २०२५/६६ गते हुणा मा की कृषान  
 गन्धमा मूल फल हुदा सो छल फल मा उपस्थित  
 निवतमान क्षया र दुपाय र सक्छ अप्पु र  
 उपस्थित कुषक हु वर सुनसरी सिचाई वर  
 योजना संचालन गर्ने को लागि क्षार्षि उपाय  
 हते का अप सहयोग दिने संचालन गर्ने  
 मदा माछो हुदा उपरोक्त योजना संचालन  
 गरि छि हुन विफारीस साथ (पुरोपेक्ष)

दिवसि नारायण  
 गाउँ विकास समिति  
 (देवानगंज)



श्री १०१ नरकार

स्थानीय विकास मन्त्रालय

# गाउँ विकास समितिको कार्यालय

रामनगरभुटाहा, सुनसरी

OFFICE OF VILLAGE DEVELOPMENT COMMITTEE

Ramnagar Bhutaha

प० सं० :- ०२९/६०

च० नं० :-

मिति :- २०२९/६/१९

विषय :- आँजार संग सन्बन्ध राख्नुको लागि ।

उपर्युक्त विषयमा यस जिल्लाको दक्षिणी क्षेत्रमा सुनसरी जिल्लाको सिन्धुवा उपलब्ध गाउँ सन्बन्धमा आपाती अध्ययन रिपोर्टमा को ले ०२९/६०मा अन्य गाउँ विषयमा खाति यस गाउँ विषयमा गाउँ विषयको निवर्तमान पदाधिकारीहरू, राजनीतिक पार्टीका प्रतिनिधिहरू र किसानहरूको योजनाको सम्मान व्यता र आवश्यकता सम्बन्धमा व्यापक छलफल र अन्तरक्रिया गर्दा उक्त योजनाको पक्षमा व्यापक समर्थन र साथमा आँजोमिमा र्ग कार्यक्रम शिष्ट कार्यान्वयनको लागि पहल गरिनेछुन सम्बन्धित निकायमा सिफारिस साथ आँजोमिमा गरिनेछ ।

गाउँ विकास समिति  
 रामनगरभुटाहा, सुनसरी





श्री ५ को सरकार

स्थानीय विकास मन्त्रालय

# गाउँ विकास समितिको कार्यालय

बसन्तपुर, सुनसरी

Office of the Village Development Committee

BASANTPUR, SUNSARI

पं० सं० :- ०५९/०६०

व० नं० :- ३९

मिति ०५/१६/९५

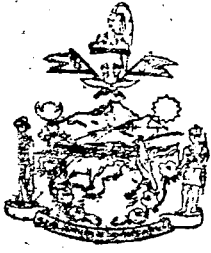
विषय :-

श्री गौरीबिक्रम शर्मा  
बसन्तपुर सुनसरी

श्री

प्रस्तुत सम्बन्धमा यस जिल्लाको दक्षिणी क्षेत्रमा सुनसरी नदिको सिंचाइ उपलब्ध गराउने सम्बन्धमा जाइका जपानी अध्ययन रिपोर्ट ०५/१६/९५मा यसको आधारमा वि.स.का साथै परगाविका सका निवर्तमान पदाधिकारीहरू, राजनैतिक पार्टीका स्थानीय प्रतिनिधीहरू र किसानहरूको योजनाको सम्भाव्यता र आवश्यकता सम्बन्धमा व्यापक फल र सुझावहरू प्राप्त भएका छन्। उक्त योजनाको परिणामकारक सम्पन्न गर्न माग गरिएको निर्माण कार्यहरूमा निम्न-कार्यान्वयन गर्न पहल गरी दिनु हुन सम्बन्धित अधिकारीसँग साभू अनुरोध गरिन्छ।

०५/१६/९५  
वि.स.का



श्री २ को सरकार  
स्थानिय विकास मन्त्रालय

# गाउँ विकास समितिको कार्यालय

हरिनगरा, सुनसरी

OFFICE OF VILLAGE DEVELOPMENT COMMITTEE

HARINAGARA, SUNSARI

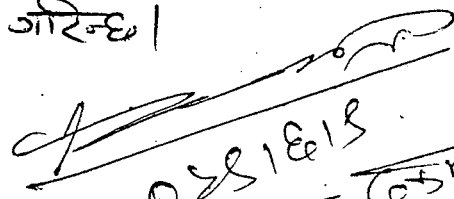
प. नं. ४४  
प. सं. ०४९/०६०

हरिनगरा, सुनसरी  
स्था. २३४७

मिति २०२१.६.१९

विषय - जो जससँग सम्बन्ध छ।

प्रस्तुत सम्बन्धमा यस जिल्लाको दक्षिणी क्षेत्रमा सुनसरी नदिबाट सिँचाई उपलब्ध गराउने सम्बन्धमा जाइका अध्ययन रिपोर्टले २०५९।४।२४ मा हरिनगरामा अन्य गा.वि.स.का साथै यस गाविसका निवर्तमान पदाधिकारीहरू, राजनैतिक पार्टीका स्थानीय प्रतिनिधिहरू र क्लियरिङसँग योजनाको सम्भाव्यता र आवश्यकता सम्बन्धमा व्यापक छलफल र अन्तर्क्रिया गर्दा उक्त योजनाको पझमा व्यापक लभ्यन र माग भए प्रमोजिम सो कार्यक्रम सिधै कार्यान्वयनतर्फ पहल गरिदनु हुन सिफारिस साथ अनुरोध गरिन्छ।

  
०४९/०६१९  
बलराम लकल

गा.वि.स. सचिव  
(समितिको अध्यक्ष)

*ANNEX - 3*

**Proceedings for Public Hearing**

## Proceedings of Farmer Level Consultation Workshop<sup>1</sup>

Venue : Training Centre for Primary Teachers, Inaruwa

Date : August 5, 2002

Time : 9.00 – 17.00 hrs.

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**Objectives** : 1. to present and discuss the preliminary development plan of SRIP.  
2. to solicit opinions, suggestions from the beneficiary participants.  
3. to discuss the institutional, social, environmental and agricultural aspects of the Project as well as collect relevant data and information.

**Chairman** :

**Participants** : 56 participants from Babiya, Narsingh and Jalpapur VDCs as per attached list

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The meeting began at 10.00 a.m. and was facilitated by Mr. L. Bhattarai. At the outset there was an exchange of introduction, each participant (study team members as well as the invitees) introducing oneself. The facilitator then explained in brief the various topics to be discussed through out the day. He then invited Mr. Kosei Hashiguchi, team leader of the study team for an introductory address.

**Team leader's address:** The team leader presented the background and present status of the feasibility study of SRIP. In this connection he said that due to long lengths of Suksena and Shankarpur canals and sandy soil having very high percolation rate, as high as ten times the value considered for calculating water requirement in SMIP, in their command, SMIP was unable to provide irrigation facility in the present study area. Due to this HMGN requested, 3 years back, to the Govt. of Japan for feasibility study of SRIP that was entrusted to us.

He informed that the team started its work since last April with the discharge measurements of Sunsari river for ascertaining the potential command area and study of social and agricultural aspects. Based on the study so far a preliminary development plan of the Project has been prepared that will be discussed during the workshop and requested the participants for their suggestions and opinions. He said that the outcome of the workshop would be reflected in the final development plan (FDP). Another aspect is the implementation of the Project. The team at present is entrusted the task of feasibility study and preparation of FDP. HMGN would then look for funds required for the implementation that can be met from national treasury and/or through donors. Japan might be one of the donors.

He stressed that other issues to be considered for the success of the project are ISF, fund required for O,M &M and the beneficiaries commitment for contribution during construction. He requested the participants to discuss about these issues as well and provide their valuable suggestions.

Next, the facilitator requested Mr. R. Koirala to present the technical aspects of the Project.

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<sup>1</sup> Recorded by Tanka Kafle

He started by explaining about the river morphology along different reaches and the history of change in the course of the river in the past.

**Technical aspects:**

Other technical issues discussed were:

- reasons behind the selection of headwork site
- planning of canal networks, with due consideration to utilizing the existing canal networks of SMIP to the extent possible
- SMIP's inability to deliver water to the present study area with emphasis on high percolation rate than adopted in project design
- different stages of command area development in SMIP
- SRIP can provide irrigation water to 60% of the proposed command for paddy at 80% system reliability
- approximately a highland area of about 500 ha. in Kaptanganj VDC will not be irrigated by SRIP
- main canals and major SCs will be graveled
- project to be managed under joint management

**Issues raised by the participants:**

- part of Narsingh VDC north of western main canal of SRIP deprived of irrigation
- area on the other side of Geruwa Khola irrigated neither by SMIP nor by SRIP. Study team agreed to make field inspection.
- location where the eastern conveyance canal will meet Shankarpur distributary?
- provision of flood control and drainage improvement in the scope of the project, if not, even the irrigation infrastructures might get damaged.
- what about having covered conveyance system? that might save land.

**Clarifications from Study team:**

- areas not irrigated by SRIP are expected to be irrigated from SMIP.
- flood control and drainage improvements not considered so far in the scope of works.
- covered canal will lead to high cost and O & M difficulties.

There after the discussions about institutional plans were started by Mr. Ehera mentioning that a good start, continued discussion would lead to many agreements and the most needed participation of all.

**Institutional aspects** (facilitated by Mr. Ehera and Mr. Bhattarai) - main points discussed:

- large irrigated area → great number of beneficiaries → many problems requiring strong institution to solve them.
- institution also needed for making rules governing water distribution.
- no religious, no political but irrigators' organization.
- the organization to be bottom up.
- a watercourse for a block of 20 ha.(about 30 farmers).
- the proposed WUA structure starting from watercourse and higher up to system level was discussed.
- the WUA to be a democratic and disciplined organization.

- different stages and aspects of decision-making and execution were explained using flip charts.
- the role of board of directors and formation of various committees was discussed.

**Participants' reaction:**

- the farmers' agreed to the need of an organization and also to the proposed model of WUA

After this a one-page questionnaire about socio-institutional aspect was distributed to the participants. The study team helped in filling it. After the participants finished filling the format, Mr. Ihera resumed the session again. He explained about three important aspects relating to implementation and post construction phase viz;

- beneficiaries role in O & M, headworks and main canal to be managed by agency rest by farmers. The participants agreed to this arrangement.
- construction contribution, especially construction of watercourses and partial contribution in the cost of tertiary canal.
- Rate and payment of ISF.

**Participants' response:**

Mostly participants were of the opinion that owing to the poor condition of the farmers they are not in a position to contribute to construction cost. If constructed they can operate and maintain the lower level canals. Regarding ISF, they agreed to pay as per the prevailing SMIP rate or even higher than that provided that the irrigation service would be reliable.

Upon further perusal by the presentator, there was a mixed reaction towards contribution during construction

**Other issues raised by participants:**

- what if someone does not give land for watercourse?
- study team should try to further lower down the command of one watercourse.
- Watercourses should be planned in consultation with farmers.
- project needed but unable to contribute during construction due to poor economic condition.

Facilitator - "O.K. no cash. But you can contribute in labour"

**Participants:**

- ISF @ Rs. 200 per bigha o.k. but should be supported by AESS, so that we can be benefited by irrigation. Labour contribution only for a day or two.

Facilitator – “But the basis should be the O & M cost.”

After this the participants were divided in three groups VDCwise i.e Narsingha, Babiya and Jalpapur and discussions about agricultural, social and environmental aspects were made separately with different teams in a merry go round style. The aim was to collect information, solicit their opinions and discuss about possible impacts of the project from the participants point of view. The main findings were as follows:

**Social aspect** (facilitated by Ms. Okata and Ms. Sharma): some informations regarding the following were gathered.

- wardwise cast distribution distribution
- land holdings
- problem ranking
- village roads
- existing organizations in the villages e.g. NGOs etc.

**Agricultural aspect** (facilitated by Mr. Miki and Mr. Mishra):

- the participants agreed to the cropping pattern proposed by the study team.
- at present in Babiya VDC 90% paddy. 60 – 70% being irrigated by SMIP.
- Narsingh and Jalpapur VDC- only 15 – 20% are being irrigated by SMIP.
- constraints to irrigated agriculture: timely and reliable irrigation, market, non-availability of inputs and AESS.

**Environmental Issues** (facilitated by Mr. Shimazu and Mr. Kafle):

- EIA process and publication of notice for scoping was explained. Participants were asked to give their opinion about the possible impacts. Their response was as given below:

Positive impacts – silt can act as fertilizer, increase in productivity and production, construction of access roads, increase in cropping intensity etc. and in an overall sense betterment in the living conditions of the people.

Negative impacts – water quality down stream of the headwork needs attention especially in the context of reduced flow in the river during winter and spring season and release of effluents from the paper mills.

- inundation problem though not directly associated with the project.
- existing downstream use (for lift irrigation, cattle watering etc.) may be impaired.

**Other comments:**

- they were of the opinion that fishing in Sunsari river is not a major problem. One of the participants suggested that the fishermen can fish in the canals.
- the IP Chairman of Jalpapur VDC raised doubts about the possible development of Mariya Dhar as an alternate fishery option. He said that most of the land within the Dhar is private in the sense that people are using it and paying tax to VDC. But few other participants (in low tone) objected to this.
- when asked about the minimum release in the river for environmental considerations, a compromise between irrigation and ecology during lean period, they suggested 25% of the flow.
- Sunsari river is fed by spring source.

After the group discussion the facilitator summarized the findings of the daylong proceedings in brief which are mentioned above under different sections. The issue of contribution and ISF as said to be understood by the project was conveyed to the participants for reconfirmation as follows:

- O & M below main canal by beneficiaries.
- beneficiaries agree to contribute as much as they can.

After this one participant from each VDC was given some time to express the views on behalf of his VDC.

Their opinion is given below.

**Opinion of representatives from among signatories:**

**Immediate Past Chairman, Babiya VDC:** Quote “SRIP will be boon to the 13 VDCs that are deprived of irrigation facilities at present. At the same time we have bitter experiences of some very good projects not being implemented in the past. But I hope this will be implemented.

Thanks to all.” Unquote

**Immediate Past Chairman, Jlpapur VDC:** Quote “People will be greatly benefited by this project.

Thanks.” Unquote

**Ex-VDC Chairman, Narsingh VDC:** Quote “We are glad that SRIP, for which we were trying for ever is being studied. We will help our best for the successful implementation of this project.

Thanks ” Unquote

Finally the daylong proceedings ended with a vote of thanks by the facilitator on behalf of the study team, especially, the team leader.



## **Consultation/Interaction with Fishermen of Ramnagar Bhutaha VDC Ward no 8**

**Venue** : Open field in the fishermen's settlement  
**Date** : August 14, 2002  
**Time** : 7.15 a.m. – 9.00 a.m.

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**Objectives** : 1) to inform the participants briefly about the preliminary development plan of SRIP.  
2) to solicit opinions, suggestions from them, especially, regarding the likely adverse impact on fishing in Sunsari river in the post project phase (PPP).  
3) to collect relevant data and information.

**Participants** : 1) Mr. H. Shimazu, Mr. M. Miki, Ms. I. Okata, Ms. M. Sharma, Mr. R. Mishra and Mr. T. Kafle from the study team  
2) 42 participants from the village, all belonging to Mallah (fishermen) cast

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The discussion began at 7.15 a.m. and was facilitated by Mr. Mishra and Mr. Kafle. The participants were informed about the background as well as the preliminary development plan of Sunsari River Irrigation Project (SRIP) prepared so far. It was made clear to them that the study team at present is entrusted the task of feasibility study and preparation of final development plan (FDP). HMG/N would then look for funds required for the implementation. EIA process and publication of notice for scoping was explained in brief. Participants (the fishermen) were then asked to take part in the discussion and give their opinion, suggestions, alternatives etc. about the likely impact on fishing in Sunsari river, especially, in the context of the possibility of having quite low discharge in the river during lean period in the post project phase as compared to the present situation.

The participants actively took part in discussion. Their opinions, suggestions and comments were found to be as follows:

1. Most of them were of the opinion that Irrigation project, though essential, would be beneficial for farmers but would be of no use to landless fishermen.
2. They emphasized that their main occupation is fishing.
3. "Irrigate the proposed study area of SRIP from SMIP and do not disturb Sunsari river".
4. In contrary to the statement of most of the participants of Farmer Level Consultation Workshop some of them said that Sunsari river is a better source of fishes as compared to other rivers in the locality.
5. They suggested fish culture in community ponds as an alternative managed by their own organization. When asked about their contribution in making these ponds they said that they would contribute to the extent possible.
6. One of the participants opposed the idea of community ponds. He preferred an un dammed river.

7. Those with some lands agreed that they would be benefited through irrigation by growing vegetables etc.
8. They were of the opinion that downstream releases of the order of 10-20% during lean period are not likely to work due to low velocity and consequently no upward migration of the fishes.
9. Most of them did not accept the idea of earning by working as farm labor, simply by saying that they are not used to it. They preferred to go for fishing irrespective of getting good catch or not.
10. They said that fish population in Sunsari river was constantly decreasing after the paper mills started operating. They were of the opinion that the mills should not be allowed to release the untreated effluents in the river.
11. Regarding fishing in Mariya Dhar, at present many people claim the land within the Dhar as private. They expressed doubts whether the land that people are claiming as private are really private. Quite often there are conflicts that are generally settled by giving half of the catch. In their opinion resolution of the ownership problem and a weir/bund for ponding about one meter depth of water in it (Dhar) would be the most appropriate alternative to them. When asked whether VDC can resolve the ownership issue they answered in negative and indicated towards some higher levels of HMG/N.

The study team clarified that the main issues considered by them (the team) so far were the release of effluents from the paper mills affecting the water quality and fishing in Sunsari river.

Thereafter the participants were given a questionnaire related to fishing. 20 of them were returned to the study team duly filled. Their answers are categorized under different sections as below:

**Major source of income**

- fishing – 100%
- fishing as well as farming – 20%
- fishing as well as working as farm labor – 20%

**Fishing time (months/year)**

- year round – 35%
- 9 – 11 months – 10%
- 6 – 9 months – 35%
- less than 6 months – 10%

**Family members working partly as farm labor** – 50 % of the respondents have mentioned that some of their family members work as farm labor.

**River mostly used for fishing**

- Sunsari only – 70%
- Sunsari and Mariya Dhar – 25%
- Sunsari, Kosi and Mariya Dhar – 10%

**Maximum catch on an average** – 6 kg/day during October – December

**Minimum catch on an average** – 1/2 kg/day during July – August

**Conflicts with the people during fishing who claim that they have land inside the Mariya Dhar**

usually – 55%  
sometimes – 45%  
never – 0%

**Is it necessary to implement SRIP?**

yes – 30%  
no – 55%

**To what extent fish catches in Sunsari river will be adversely affected by SRIP?**

no effect – 10%  
decrease in catch by half - 20%  
decrease in catch by more than half - 40%

**After SRIP can you fish in the canals instead of in Sunsari river?**

yes – 5%  
no – 75%  
yes but less fish in the canal than in the river – 20%

## Environmental Issues

EIA process, prevailing regulatory provisions of HMG/N, its significance and publication of notice for scoping were explained in brief. The participants were also informed about the findings of the study team so far. Thereafter they were asked to give their opinion, suggestions about the possible impacts, especially the likely negative impacts due to the implementation of SRIP. Their response is given below.

### Positive impacts

- silt carried by the canal water can act as fertilizer, increase in cropping intensity, increase in productivity and production, construction of access roads, more employment opportunities in agriculture sector etc. and in an overall sense betterment in the living conditions of the people.

### Negative impacts (VDCwise)

#### Rajganj Sinwari VDC

- maintaining acceptable water quality down stream of the headwork needs attention especially in the context of reduced flow in the river during winter and spring season and release of effluents from the paper mills.
- inundation problem though not directly associated with the project.
- existing downstream use (for lift irrigation, cattle watering etc.) may be impaired. The river is fed by spring source. In their opinion release of about 12% of the flow at that time would be reasonable.
- fishing not a major problem, fishermen can fish in canal and act as farm labour.

#### Harinagara VDC

- fishing not a major problem, Sunsari river not a good source of fish.
- maintaining acceptable water quality down stream of the headwork needs attention especially in the context of reduced flow in the river during winter and spring season and release of effluents from the paper mills.
- existing downstream use (for lift irrigation, cattle watering etc.) may be impaired. The river though fed by spring source, at least about 15% of the flow need to be released d/s.

#### Madhya Harsahi VDC

- fishing not a major problem, fishermen can fish in canal and also act as farm labour. They can also fish in the u/s of headwork.
- compensatory fish culture in Mariya Dhar might be a better alternative.
- water quality may get deteriorated down stream of the headwork.
- existing downstream use (for lift irrigation, cattle watering etc.) may be impaired. At least about 10% of the flow needs to be released d/s.

## Proceedings of 2<sup>nd</sup> Farmers' Level consultation Workshop<sup>1</sup>

**Venue:** Balkrishna Higher Secondary School, Ramnagar, Bhutaha  
**Participated VDCs:** Ramnagar Bhutaha, Basantpur and Gautampur  
**Date:** August 8, 2002

Registration started from 9:00 AM onwards. Mr. Janak Timalsina was responsible for registration work. The total numbers of participants were seventy one (as per the register).

10.00 AM Plenary session started. All participants, Members of Study Team and Counterparts gave their introduction by themselves. Mr Lok P. Bhattarai opened the session as facilitator.

10:15 AM Kosei Hasiguchi (Team Leader)

T/L expressed gratitude to all participants and explained background of the study. About three and half years ago, HMG/N requested to the Govt. of Japan, to carryout Feasibility Survey of Sunsari River Irrigation Project (SRIP). Sunsari Morang Irrigation Project (SMIP) felt difficulty to convey enough water to the downstream area of Suksena and Sankarpur Canal. This may be because of long length of canals and sandy type of soil available in the command area. Japan Government entrusted to the study team to carryout the Feasibility Study. When the study team arrived here for the first time (April 2001), it immediately started taking discharge measurement at various points of Sunsari River. Several other activities in fields like agriculture, environment, institutions etc also started side by side. Today the study team wanted to present the findings of that preliminary study report among the participants.

The objectives of the meeting were

1. to present preliminary irrigation plan
2. to solicit ideas/opinions/ suggestions etc from you , and
3. to identify any positive or negative impacts in the future

The T/L informed that the outcome of the meeting will be incorporated in the final report. He also narrated that irrigation facility will increase the agriculture production, in the case of SRIP, for example, the paddy production may go up to 80 mounds per bigha (from 40 mounds at present) i.e. an increase in yields by two times.

The T/L also highlighted regarding the importance of Irrigation Service Fee (ISF) collection. The ISF rate (Rupees per bigha per year) should be decided in such a way that the collected amount could well cover the operation and maintenance cost of the project. The present SMIP Rate of ISF (i.e. Rs 135/bigha/year) is not

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<sup>1</sup> Recorded by R P Koirala

sufficient for operation and maintenance of the system. HMG/N is giving a lot of subsidy to the project, which means HMG/N will face bankruptcy in the future. He also informed that as per the preliminary calculation, an ISF of Rs. 550 to 600 per bigha per year seems sufficient to run the project (i.e. SRIP) smoothly.

The T/L also wanted to know, aside from ISF, to what extent or how much contribution farmers are willing to bear regarding initial investment cost.

Finally, the Team Leader informed that the Study Team is responsible for design and planning and not responsible for the implementation. Upon the completion of the study work, HMG/N is responsible for implementation of the project. Some part of the fund that is needed for the project implementation should be borne by HMG/N from its national treasury and the remaining part may be managed by other agencies. One of such agency may be the Government of Japan. But, a concrete and detailed plan is necessary prior to ask assistance from such agency. He also hoped that this discussion may play a good role in making a concrete and detailed plan of the project.

#### 10:30 Technical Issues (Presentation by R P Koirala)

Sunsari River (with the help of Map)

Originates at hilly area near Dharan

U/s catchment, high erosion because of deforestation, weathering and agriculture practices. Total catchment area 294 km<sup>2</sup> at E/W Highway Bridge. Up stream reach, agradation (bed rising) problem, while at down stream reach, meandering problem. Inundation problem in Study area (particularly, Narsimha, Basantpur, Ghuski and Kaptangunj VDCs). Maria Dhar remained active during 1962 – 78. Average monthly discharge at E/W highway crossing, minimum 2.746 cumecs, maximum 40.21 cumec, and Total annual volume is 420 million cu m. During lean period, a significant contribution from SMIP join this river as seepage water.

Sunsari Morang Irrigation Project (SMIP), (with Map)

Total command area in Sunsari and Morang districts is about 73,000 ha. SMIP is being implemented under different phases of different stages. Suksena and Sankarpur were developed under first stage. Suksena and Sankarpur canals are long canals. The type of command area under these canals is sandy soils. Average percolation loss considered for entire SMIP command area was 2 to 3 mm per day, while, the average percolation loss in SRIP command area was observed as much as 15 to 20 mm/day. Therefore, a shortage of water is felt in this area.

Sunsari River is flowing without being harvested, and the area nearby (SRIP) is thirsty. Therefore, it may be a good decision to consider the use of Sunsari River water for irrigation purpose.

Some of Technical Features of SRIP

Total Area	16818.8 ha
Gross Command Area	11338 ha
Net Command Area	10147 ha

	Sukasena	Sankarpur
Net Command Area (ha)	5529	4618.8
Main Canal Length (km)	21.20	20.80
Design Discharge (m <sup>3</sup> /s)	10.50	8.80
Long slope	1/5000 to 1/2600	1/5000 to 1/2500
Bed Width (m)	5.80 to 1.60	5.50 to 1.50
Secondary Canal Length (km)	70.00	68.00
Tertiary Canal Length (km)		93.100
Total Nr of Structures		778

Some rearrangement of secondary canal layout could be done (or adjusted) whenever felt necessary from the viewpoint of manageability.

#### Cropping Pattern

Several alternatives of cropping patterns were critically reviewed. If we consider 80% system reliability (i.e. one out of every five year is supposed to be drought) then a suitable cropping pattern for summer may be 60% land covered by paddy and 40 % others crop like vegetables, jutes etc. Similarly, if we consider 50% system reliability, in such case, 80% land can be covered by paddy and remaining 20% with other crops like vegetables or jutes.

The appropriate cropping pattern during winter season depends very much upon the quantity of assured water that we can divert from the head work. A minimum amount of water should be released downstream from the viewpoint of environment and other biological needs. But this quantity is not decided yet. If we consider this quantity as 10% of available flow minimum, the 90% area can be brought under irrigation with 50% wheat and 50 % vegetables. But, if the minimum discharge be 50% of available flow, then the coverage may be approximately 50% of the total land. In such cases, we have to introduce rotation supply system.

And conjunctive use of STW may be a reasonable solution.

#### Road Network

When assured irrigation is available, the production starts increasing. That requires good road network. Project facilitates canal service roads along main canal, selected secondary canals. Other agencies like DDC and DOR are also involved in making roads in that area. So, a good coordination among all agencies is felt necessary to decide additional service road network.

WUA

Establishment of WUA for project implementation phase as well as for operation and maintenance. A joint management between Government and Water Users will be established to operate and maintain the project. Government will take care of Barrage, main canals and selected secondary canals. Remaining part will be taken care by the WUAs.

Raised questions during discussion

- Flood problem is more pronounced than irrigation
- Some extra water should be diverted to Maria dhar (particularly, during flash flood)
- SMIP canal network is obstructing the natural drainage of the area, this project may still worsen the problem (12 rivers)
- Is it possible to use (and reuse) of local small rivers for irrigation purpose?
- River courses are being encroached, whether there is any plan to take action or not?

11:30AM Institutional Development (Ted Ehera and L Bhattarai)

Ted Ehera described about the importance of water users group. As the project increases in size, difficulty also increases in running various canals like main, secondary, tertiary, water courses and field channels. He also mentioned that the main task is to supply smooth water to the fields of nearly 16000 farmers. A water course is proposed to cover 20 ha of field. So the group of nearly 30 farmers within this 20 ha land is called WUG. Government is planning to construct various facilities up to tertiary canal turn outs by spending US \$ 15 Million. At the same time, Government expects WUGs to make water courses and field channels within the 20 ha land. Mr Ehera asked to the participants whether they are ready to participate or not? Some clarifications were given to the participants regarding the tentative size of water courses. The Team Leader intervened with some example of Egypt and Philippines. With some reluctance, farmers nodded their head in the favor of YES. Some raised issues (by participants) were

- make firm law and enforce effectively
- what is the demarcation (to what level, the agency can go) limit
- contribution made by farmers may develop some sentimental attachment with the project

Mr Ehera added that to make the project everlasting, four basic points (objectives) are important

- Sharing of water among farmers
- Operation and protection of facilities
- Maintenance
- ISF

To fulfill these points what we need are

- An effective WUA
- Handing over all facilities after completion



- Joint Management (Irrigation Office and WUA)

Mr Ehera also presented the proposed WUA structures from WUGs to WUCC and highlighted the nature of work to be executed under each level. He also mentioned the role of discipline in democracy as well as in WUA.

Finally, Ted Ehera raised the issue of ISF. He tried to solicit the opinion of farmers into this matter. There was distinct division in respect of the amount. Few farmers said that we should follow the SMIP practice. But most of them have realized that it is too low. They offered higher ISF. Someone even suggested that considering the operating cost of STW, they can pay up to Rs 600 per year per bigha. But the consensus among the farmers was that they decided to pay about 270 to 300 Rs per annum per bigha at the beginning, later as per the reliability, the WUA can review the ISF and increase. Later on the Team Leader intervened and mentioned that the decision on ISF is still open and can be again discussed later on as per the progress.

### **Group Session**

Agricultural Aspects (Masaki Miki, Rakesh Mishra)  
Discussion reports are attached herewith.

### **Social Aspects (Izumi Okata, Manju Sharma)**

A brief introduction of Social Aspects was given in each VDC group. Ward wise information regarding social structures (caste wise), land holding size were collected in a tabular format. Apart from these information, some other problems, the farmers are suffering, were also collected with ranking (importance). Also information regarding active NGOs working within VDCs was also sought with their rank. A brief summery is presented below.

#### **Basantpur VDCs**

The problems identified were irrigation, sanitation, School, cattle stealing, security etc. The rank of the problems, as they have mentioned, are

1. Irrigation
2. Cattle stealing
3. Road network
4. Education
5. Sanitation etc

#### **Ramnagar Bhutaha**

Among 5 NGOs active in this VDCs, " Eillet millet community" stood first based on the activities. Rural Development Bank's activities also lauded.

#### **Basantpur**

Farmers of this VDC seemed united to run commercial resources (a commercial land of 250 bigha). Some of the land has been given to the landless farmers under lease. The management without the farm is not found encouraging.

### **Environmental Aspects (Idaho Shimaju, Janak Timalcina, R Koirala)**

A discussion regarding the environmental issues were conducted among the farmers of each VDCs. Team tried to disseminate knowledge among farmers about the need of environmental study for large development activities. The team also described the procedure in each step and solicited the opinion from the farmers regarding the positive as well as negative impacts that would arise in the future after the implementation. All participants spoke that they do not identify any negative impacts of the project, however following existing problems were mentioned which the study team must consider to mitigate/ remove during further stage of study in the future.

#### **Ramnagar Bhutaha**

- Effluent from paper mill is directly affected to the cattle and agriculture yield. Farmers are seriously angry with the mill
- We can not use Mariadhar to divert flash flood at Sunsari River
- Sediment diverted from river may damage agriculture land

#### **Basantpur**

- Paper Mill effluent problem
- We can not use Mariadhar to divert flash flood at Sunsari River
- No significant impact to fishermen community

#### **Gautampur**

- There may be some erosion problem
- may affect the health of cattle/ human beings (because of increased dampness)
- No significant impact to fishermen community
- Suggest that the effluent color and river water color should be same (eye judgment)

4:30 PM

The meeting again assembled to the plenary session. Some important participants were requested to address the session on behalf of the farmers.

Momd. Allauddin, Ex chairman of Ramnagar Bhutaha.

Requested to the Study Team to convey their plight up to the central government and thanked to the team

Sikamlal Yadav, Ex Chairman of Basantpur

Welcomed to all of JICA Team and DIO, Irrigation is very important, Road network is also important and thanked to everybody

Duriklal Shah Ex chairman of Gautampur VDC

Welcome to everybody. SMIP did not consult with farmers at early stage that is why it has so many problems. So this is a good practice to solicit farmers' suggestions which may be a key to the success.

The Facilitator Mr Bhattarai thanked to all and closed the Session.

## **TERMS OF REFERENCE**

# Terms of Reference for EIA Study of Sunsari River Irrigation Project

## 1. NAME AND ADDRESS OF THE PROPONENT

Department of Irrigation  
Jawalakhel, Lalitpur  
Nepal

## 2. BRIEF DESCRIPTION OF THE PROPOSAL

In 1964, Chatra main canal, which withdraws water from the Koshi River, was constructed with Indian assistance for irrigating southern parts of Sunsari and Morang districts in the Kosi zone of Nepal. The canal was supposed to supply irrigation water to farmlands covering 63,925 ha in the area. However, the design unit water requirement was not enough to cover the entire farmlands as planned owing to certain areas of very sandy soil.

A plan was then started to rehabilitate and modernize the System in a phase wise manner. The farmlands, the prospective irrigable area, was divided into three stages and a project titled Sunsari-Morang Irrigation Project was started, which included among others the construction of a new intake at Koshi River. Stage I was started in 1978, Stage II in 1986, and Stage III in 2000 and is still going on. Though the Sunsari-Morang irrigation system has been rehabilitated/renewed through those three stages of construction, the average intake discharge, for 9 years from 1990 to 1998, was just 35 m<sup>3</sup>/s against the design intake discharge of 60 m<sup>3</sup>/s. A measure to supplement the intake deficit is now being sought.

Several rivers are flowing from north to south of the extensive farmlands in Sunsari District, which lies in eastern part of Terai Plain. One of them, the Sunsari River flowing through the western side of the farmlands, is located at around mid way between two secondary canals from the Chatara main canal namely the Shankarpur Branch Canal and the Suksena Branch Canal. The Sunsari River is perennial; therefore, if a headwork could be constructed at a some suitable place in it, that could deliver by gravity the water to the both branch canals that have not been able to supply adequate water to their commands, it could result in the improvement of irrigation service in the area.

The command area of the proposed project, about 16,800 ha (total), is located in the middle and lower reaches of the Shankarpur Branch Canal and the Suksena Branch Canal in Sunsari District, Koshi Zone, Eastern Region (see Location Map). The area is under the 63,925 ha. command area of Sunsari Morang Irrigation Project (SMIP). It has been observed that the tail portion of the command area of SMIP is suffering from severe water shortage. The study area consists of 13-village development committees (VDCs) inhabited by about 98,000 population.

Construction of irrigation facilities such as headwork and conveyance canals linking Suksena and Shankarpur Canals can contribute to agriculture development and improvement of living condition in the area, where crop productivity is limited due to shortage of water.

## 3. OBJECTIVES OF THE EIA STUDY

Environment Protection Act (EPR) defines the word "Environment" as interaction and inter-relationships among the components of natural, cultural and social systems, economic and human activities and their components. The main objectives of the EIA study are to assess the impacts of this irrigation project on the "environment" and contribute to minimize the adverse impacts and maximize the project benefits.

## 4. STUDY AREA

The study area is Sunsari River Irrigation Project (SRIP) area located in the south-western part of Sunsari District spanning between 26°24'N to 26°30'N in latitude and 87°04'E to 87°12'E in longitude. The elevation ranges from 64 meters to 80 meters above sea level. The study area is rectangular in shape with E-W width varying from 4 to 8 kilometers and N-S length about 22 kilometers. The western and southern borders of the study area are with India.

The terrain starts from foothills of the Siwalik range and slopes gently down to south with an inclination of 5 degrees on the average and is formed by alluvium of old and present rivers dominated by sandy soils having low to moderate water holding capacity.

There are two main rivers flowing through the study area in a direction parallel to the Koshi River. The Sunsari River, source river, flows southwest through the central part of the study area and the Budhi river flows towards south along the eastern border of the study area. Mariya Dhar, abandoned course of Sunsari River, is in the central part of the study area between Jalpapur and Kaptanganj.

The climate in the project area is sub-tropical. Temperatures are high between March and October, the hottest month being April, during which the mean daily maximum temperature is about 34°C. During the cool period from November to February, mean monthly temperatures are in the range of 16 – 22°C. The annual average rainfall from 1970 to 1993 is 1,867mm, raining intensively in monsoon period, from late May to September.

## 5. METHODOLOGY FOR INFORMATION COLLECTION

Secondary and primary level of information on physical, biological and socio-economic patterns and cultural aspects within Study Area should be collected and assessed. And also, the proponent shall focus the information collection on local physiography, geology, watershed condition and environmental pollution as major elements of physical environment for both construction and operational stages of the project.

Several methods can be used to generate the required information in order to meet the above objectives. Secondary information can be collected through published and unpublished reports, and interpretation of maps and photographs. The field level information shall be collected through questionnaires, checklists, data sheets, observation, and interview with local people in various levels such as community groups, officers of districts and VDCs.

Possible loss of vegetation, infrastructure and damage to community services shall be collected employing the standard methods as also included in the EIA guidelines currently implemented in Nepal. These data should be included at appropriate places in the EIA report.

## 6. POLICIES, LEGISLATION AND GUIDELINES BASED ON EIA

The following policies, legislation and guidelines should be reviewed and appropriate information should be incorporated in the EIA report, namely,

Tenth Plan policies with emphasis on environment water resources development and irrigation facilities

- Ninth Plan policies and strategies, including concept paper of the Tenth Plan and Poverty Reduction Strategy Paper with emphasis on environment and irrigation sector
- Irrigation policy
- Irrigation Regulation, 1998
- Environment Protection Act, 1996 and its Rules, 1997 (amendment 1999)
- Water Resources Act, 1992 and its rules 1993 including irrigation rules
- Forest Act, 1993 and its Rules 1995
- Land Acquisition Act, 1978
- Local Self Governance Act, 1999 and its Rules 2000
- National EIA Guidelines, 1993
- EIA Guidelines for Forestry Sector, 1995
- Draft EIA Guidelines for Water Resources Sector, 1997
- Environmental monitoring and auditing guidelines, published by the Water and Energy

Commission Secretariat

- Forest Products (timber/firewood) Collection, Sale and Distribution Guideline, 2000
- Guidelines for inventory of Community Forests 2000, if necessary

## 7. TIME, BUDGET AND STUDY TEAM

### 7.1. Time

Although the project schedule to start construction is not fixed yet, it is required to comply with the schedule for EIA report preparation in the Scoping Report. The tentative estimated time period is as follows.

Activities	Tentative time	Remarks
Team mobilization	Second week of November 2002	
Literature review Field Survey	Second week of November 2002 Third and fourth week of November, 2002	One week Two weeks
Data compilation	First week of December 2002	One weeks
Draft report preparation	December, 2002	Four weeks
Materials preparation and public hearing	Second week of January, 2003	
Report submission	January, 2003	

### 7.2. Budget

A budget of NRs. 2,000,000.00 has been allocated for the EIA study. The project will provide the logistic support and all the relevant data from the socio-economic base line study.

### 7.3. Team

A multi-disciplinary EIA study team composed of following professional from DOI including irrigation engineer, environmental specialist and sociologist shall be mobilized to complete this EIA study.

- Environmental Specialist (Team Leader)
- Irrigation Engineer
- Socio-Economist
- Sociologist and/or Environmental Management Specialist
- Hydrologist
- Aquatic Expert
- Soil Scientist
- Others

The Proponent shall employ necessary field assistant(s) to collect field data and verify the secondary information and process them for EIA report.

## **8. SCOPE OF WORK**

The Proponent shall assess and evaluate the likely impacts of the proposed irrigation proposal on physical, biological, socio-economic and cultural aspects for pre-construction, construction, operation and maintenance periods in the following areas:

### **8.1 Physical and Chemical Issues**

#### **8.1.1 Activities in the Pre-Construction Stage**

This SIP follows the gravitational flow system and/or the water will be diverted from the Sunsari River through the construction of a diversion weir. The EIA study will give priority attention to select activities and alternatives in order to increase irrigation facilities during the following pre-construction stage.

- Survey and site investigation;
- Land acquisition for canal, if necessary;
- Land leasing; and
- Identification of work camp area, quarry and spoil disposal site(s).

#### **8.1.2 Construction Stage**

With the objectives of least damaging the physical resources, the EIA study should emphasize the following issues during impact assessment. They are:

- Site-specific disturbance to landscape, land use, drainage along the canal system and the net command area of the project;
- Construction related impacts such as possible change in air and water quality and noise level;
- Work camp and labour camp(s) operations and impacts of stockpiling of construction materials;
- Possible impacts through quarry operation and disposal of spoils; and
- Possible changes in water regime of the sources of irrigation water and streams in the command area.

#### **8.1.3 Operational and Maintenance Stage**

The EIA study will assess the environmental impacts during this stage in the following areas.

- Downstream effect on the water quality and other water users due the diversion of water,
- Reduction in the assimilative capacity of the river due to reduced flow, thereby effect on the waste load from the paper mills at downstream ,
- Lowering groundwater table along the river by reducing flow in the river
- Possible sedimentation and siltation in main canal, feeder, secondary and tertiary canals and command area and possible loss of crop production;
- Possible change in the soil characteristics of the command area, problems of water-logging and salinity and change in crop production; and
- Potential use of agro-chemicals and change in crop production.

### **8.2 Biological Issues**

#### **8.2.1 Pre-Construction Stage**

No biological impact has been foreseen at pre-construction stage.

### 8.2.2 Construction Stage

The following issues will be duly considered during impact assessment.

- Impact of fish species due to the construction activities at the river bed and
- Likely encroachment on all categories of forests in the project area vicinity by the work force and temporary market settler; and

### 8.2.3 Operational and Maintenance Stage

The following issues will be assessed during the EIA study.

- Less habitat area for fishes by reducing flow in the river;
- Likely impact on fishes by lowering velocity of the flow;
- Less vegetation by reducing flow in the river and
- Likely impact on vegetation by less quantity of water in the river.

## 8.3 Socio-economic and Cultural Issues

With regard to socio-economic and cultural aspects, the priority issues that should be assessed include:

### 8.3.1 Pre-Construction Stage

Estimated loss of cultivated land and possible change in canal alignment, land acquisition, compensation and resettlement if any issues will be considered during this stage.

### 8.3.2 Construction Stage

Detail level of information will be generated and impacts assessed in the following areas.

- Permanent and temporary loss of land including farmland due to canal system;
- Loss of private and public properties;
- Influx of workforce and pressure on social service facilities such as health, sanitation, drinking water, and education;
- Occupational health and safety (of the workers);
- Change in food price and cereal production;
- Employment opportunities and availability of local labour force;
- Change in economic structure and/or increase or decrease in per capita income of the local people;
- Gender issues;
- Child Labour;

### 8.3.3 Operational and Maintenance Construction Stage

The following issues will be assessed in this stage.

- Increased in crop production;
- Use of agro-chemicals such as pesticides and chemical fertilizers;
- Potential change in cropping pattern and cropping intensity, crop diversification and crop production;
- Possible water logging, salinity and change in crop production;
- Expansion of agro-based industries and other income generating activities;
- Permanent and seasonal employment opportunities;
- Gender's participation in water management, and role of Water User's Association;
- Health and sanitation and possible spread of water-borne diseases due to deteriorating water quality and stagnation of water;
- Less feeding grasses for cattle due to reducing flow in the river;
- Increased cost for pumping irrigation by less quantity of water in the river;
- Increased cost for using ground water by lowering ground water table along the river;
- Increased cost for headworks maintenance due to sedimentation;
- Increased cost for canal maintenance due to sedimentation;
- Possible economic activities, economic status of the local people and quality of life;



- Possible change in cultural aspects;
- Future development potential and likely impacts on the environment;

#### **8.4 Management Issues**

Following management Issues have been identified in the priority:

- Proper management of solid wastes and timing of releasing effluent by paper mills;
- Catchments improvement in long-term;
- Proper disposal of excavated soil;

In addition, an irrigation project aims to increase the per unit area production of crops and cumulative increase in crop production through cropping intensity. Besides, the above issues that should be assessed by the EIA study, the study will also take into consideration the ways and means for the implementation of the environmental mitigation measures and the Environmental Management Plan (EMP). The EIA report will propose for environmental monitoring and auditing aspects, and budget allocation and execution issues. The study will also take into consideration the reinstatement of public services likely to be damaged by the project during its construction.

**Public awareness and involvement of key stakeholders will be dealt with in the EIA report for the effective implementation of the proposed environmental protection measures.**

### **9. IMPACTS PREDICTION AND IMPACT RANKING**

Prediction of environmental impacts shall be implemented by the estimation of to some extent, quantifiable data shall be used for estimation of impacts as much as possible. If it is impossible to describe the amount like numbers of affected people, impact ranking or scoping of the magnitude, extent and duration of identified environmental impacts shall be presented. In this way comparison of project alternatives on environmental factors can be examined.

### **10. ALTERNATIVE ANALYSIS**

The EIA report should describe and discuss possible alternatives with due consideration on design, Study area, technology and construction method (including schedule and row material), existing environmental management system, acceptability of risks likely to emerge while implementing the proposal and other issues of topical interest. Likely impacts of each alternative should be analyzed and compared in terms of environmental impacts, justice and benefits etc. and the best alternative should be recommended.

### **11. FORMATION OF MITIGATION MEASURES**

Feasible and cost-effective mitigation measures should be examined and recommended to reduce or prevent significant adverse environmental impacts during Pre- Construction/Design, the Construction and Post Construction phases. The following measures needs to be considered.

- Compensation measures
- Corrective measures
- Preventive measures
- Mitigation measures

### **12. COSTS AND BENEFITS OF THE PROJECT**

The EIA study should include the cost of mitigation measures to the extent possible and qualify the benefits of the project, for example cost of compensation for fishermen, monitoring activities of the paper factories, located upstream of the proposed headwork site. Information on cost and benefit should be included in the main EIA report.

### 13. MONITORING AND AUDITING REQUIREMENT

As the effectiveness of the mitigation measures shall be qualified in the environmental auditing study, the EIA report should include practical and cost effective monitoring parameters, schedule of monitoring and responsible agency for monitoring. Particulars of activities to be carried out are follows;

Description of environmental parameters

Preparation of a plan to monitor the implementation of mitigation measures and the impacts of the project during the Construction and Operation and Management phases

Indication of the responsible monitoring agencies

Indication of the period of monitoring

Estimation the costs of monitoring

Description of other inputs if necessary such as training and institutional strengthening

Description of the mechanism for reporting with reference to the supervisory agencies

### 14. THE REPORT FORMAT

In order to guide the proponent and the study team, the EIA report format is included in clause 6 of the EPR, 1997. With due consideration on Schedule 6, the EIA report should be accommodate potential issues as discussed above. However, the environmental information can be rearranged to prepare the report in the following format. In any case, the EIA report should not omit any components of the EIA as mentioned in this TOR.

Executive Summary (If the report is prepared in English, the executive summary should also be included in the Nepali language and vice versa)

Table of Contents

Acronyms

Chapter I	:	Introduction (background, study objectives, methodology, and limitation)
Chapter II	:	Project Description (Project highlights can be included in this chapter)
Chapter III	:	Policies, Laws, Guidelines and Institutions
Chapter IV	:	Existing Environmental Conditions
Chapter V	:	Alternative Analysis
Chapter VI	:	Impacts Identification and Mitigation Measures
Chapter VII	:	Environmental Management Plan (The Plan may include cost for mitigation measures, monitoring requirements, framework for environmental auditing, and institutional arrangement for the implementation of EMP)
Chapter VIII	:	Conclusion and Recommendation
References		
Appendices		
Maps		
Tables		

**Note:** Details of concerns and opinions of the public hearing shall be included in the annex of the final EIA report.

As per Rules 10 of the EPR 1997, a recommendation letter of the VDC(s) or a Municipality where the proposal shall be implemented, and the approved Scoping Report and the Terms of Reference shall be included in the annexes.

### 15. DELIVERABLE

The proponent should submit ten copies of the final EIA report to the MOPE in accordance with Rules 11 (1) of the EPR.