5 DATA ANALYSIS AND IMPACT ASSESSMENT

Many hydro-power generation activities have come up and many are proposed on Satluj River. This starts right up from the upper reaches with projects like Khab, then Karcham Wangtoo HEP, 300 MW Baspa HEP on Baspa river, 120 MW Sanjay Vidyut Pariyojana on Bhaba river, a right bank tributary of Satluj, Ghanvi HEP, Sorang HEP. The 1500 MW Nathpa Jhakri HEP is in stage of operation. Most celebrated dam on the river is the Bhakra dam completed in 1963. Downstream of Bhakra too there are structures on the river, including the Nangal diversion dam and Ropar barrage. The cumulative impact of number of dams on a river is not simple addition of impacts of individual dams. A study should be carried out with a wider perspective.

Though dams are have been constructed to harness energy for industry and commerce, to help secure a reliable source of water for domestic, industrial and/or agricultural use, to reduce risks associated with flood hazards, there are certain ill-effects associated with them too. These structures transform river ecosystems over a range of spatial and temporal scales. Through impoundment and increased residency times, dams alter water temperatures and chemistry, which in turn influences rates of biological and chemical processes. Dams create barriers to the upstream-downstream movement of nutrients and organisms, thereby affecting physical and biological exchange processes. They also alter the timing and magnitude of downstream fluxes of water, sediment, and ice, which modify biogeochemical cycles and the resulting structure and function of aquatic and riparian habitat. As dams occasionally collapse, they also present a risk to the built environment and downstream ecology.

The Chapter presents an appraisal of the anticipated positive as well as negative environmental and the socio-economic impacts which would surface after the commissioning of the proposed Hydroelectric projects along with the already operating projects in the area.

5.1 Environmental impacts

5.1.1 Change in hydraulic regime

Due to construction of dams at several places on river, change in the hydraulic system is bound to occur. The actual river path gets altered due to the diversion of flow at several places all along it course. With the construction of a reservoir, generally two major hydraulic changes occur. First, the water area above the dam changes from lotic (i.e., running water) to lentic (i.e., standing water) in nature, with associated changes in hydrologic and ecological processes. Second, diurnal and seasonal variations in the demand for water or power cause short- and long-term variations in discharge quite different from those seen in an undammed/ unblocked river. On large rivers, the physical and ecological effects of flow regulation can be experienced several hundreds of kilometres downstream, with compounding effects occurring on systems with series of dams.

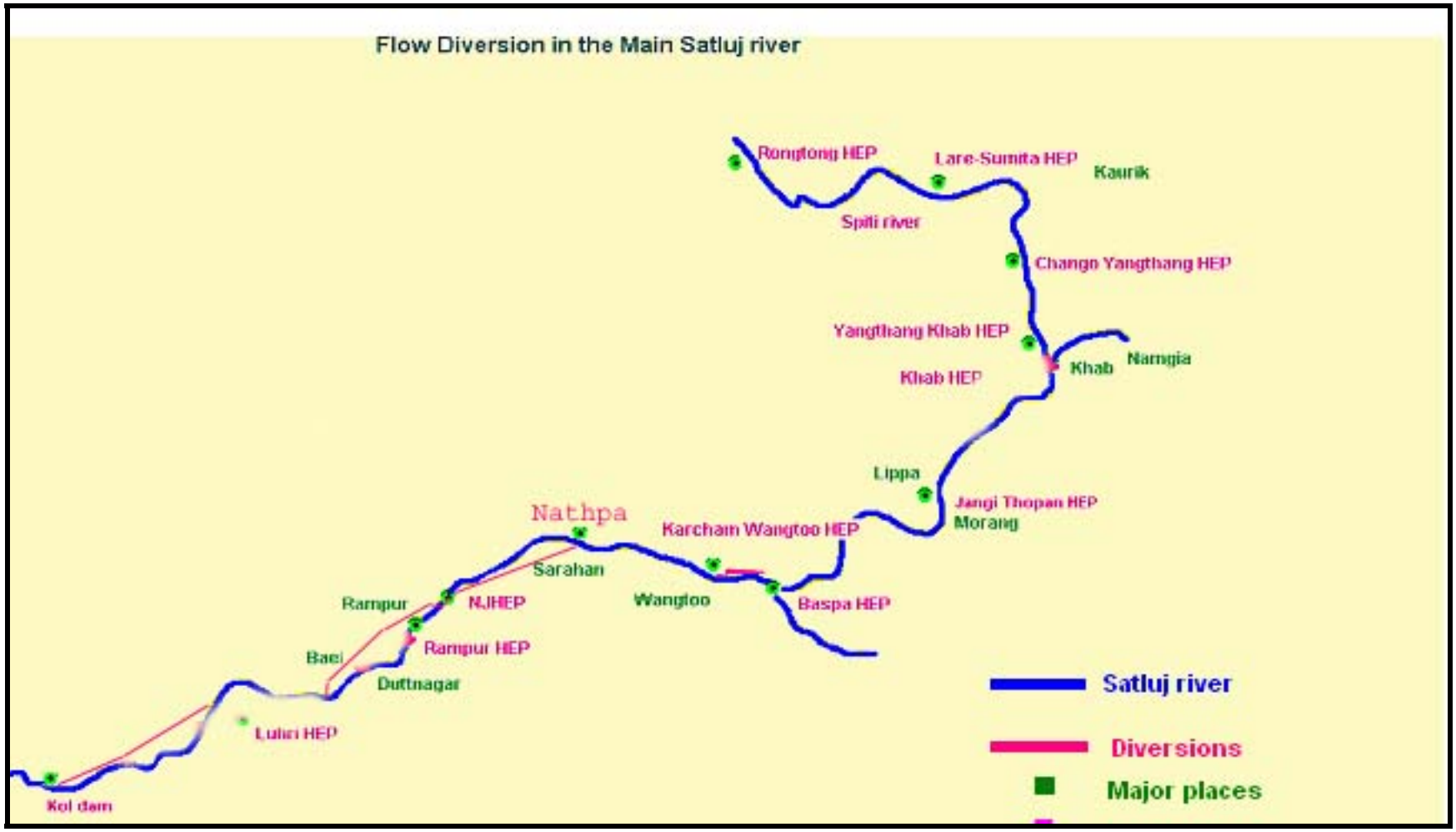


Fig 5.1: Flow diversions in Main Satluj River and various hydroelectric projects planned on the river

Water Storage in the Basin

There are two main categories of large dams viz,

- the reservoir-type storage projects
- and the run-of-river dams

The former category includes impoundment of water behind the dam for seasonal, annual and, in some cases, multi-annual storage and regulation of the river, whereas the run-of-river dams (weirs and barrages, and run-of-river diversion) have no storage reservoir and may have limited daily pondage. These create a hydraulic head in the river to divert some portion of the river flows to a canal or power station.

Typically, the reservoir has two purposes: to increase the hydraulic head or difference in water level across the plant, and to provide storage for periods of low inflow from upstream. Run-of the river projects are common additions downstream of large reservoirs. They require only sufficient upstream storage to balance flows and to develop the necessary head across the plant.

For the Khab HEP, a 69 m high straight gravity dam across river Satluj to provide a live storage of about 36.38 Mm^3 with Full reservoir level (FRL) at El. 2592m and Minimum Draw down Level (MDDL) at El. 2568m. The dam has a provision of passing about 5600 cumecs of 10,000 years flood. The Karcham Wangtoo HEP envisages construction of a concrete gravity dam about 90m high (from deepest foundation) at Karcham. The Nathpa Jhakri Hydro-Electric Project originally envisaged the construction of a 60.5 m high diversion dam at Nathpa on river Satluj. The FRL of the dam is El. 1488.50 m. and MDDL is at El. 1474.00 m. The pondage available is 205.18 ha m. The Luhri project envisages construction of a 60M high (above sea bed) concrete gravity dam on the river near the village Nathan for diversion of a design discharge of 477 cumecs.

Other major projects such as Baspa HEP, Bhaba HEP, Sorang HEP, Ganvi HEP, and Rampur HEP are run-of-the-river type of projects. Hence they do not include the construction of a reservoir/ dam. These are weir- or barrage- or tailrace developments. As has been reported in past studies, majority of the silt carried by the river comes mainly from Spiti River, where due to degraded status of the catchment, high soil erosion rates are observed. The same could also be referred through Map Soil Erosion Map prepared for entire Catchment area (fig 5.2), which shows high erosion intensity at upper reaches.

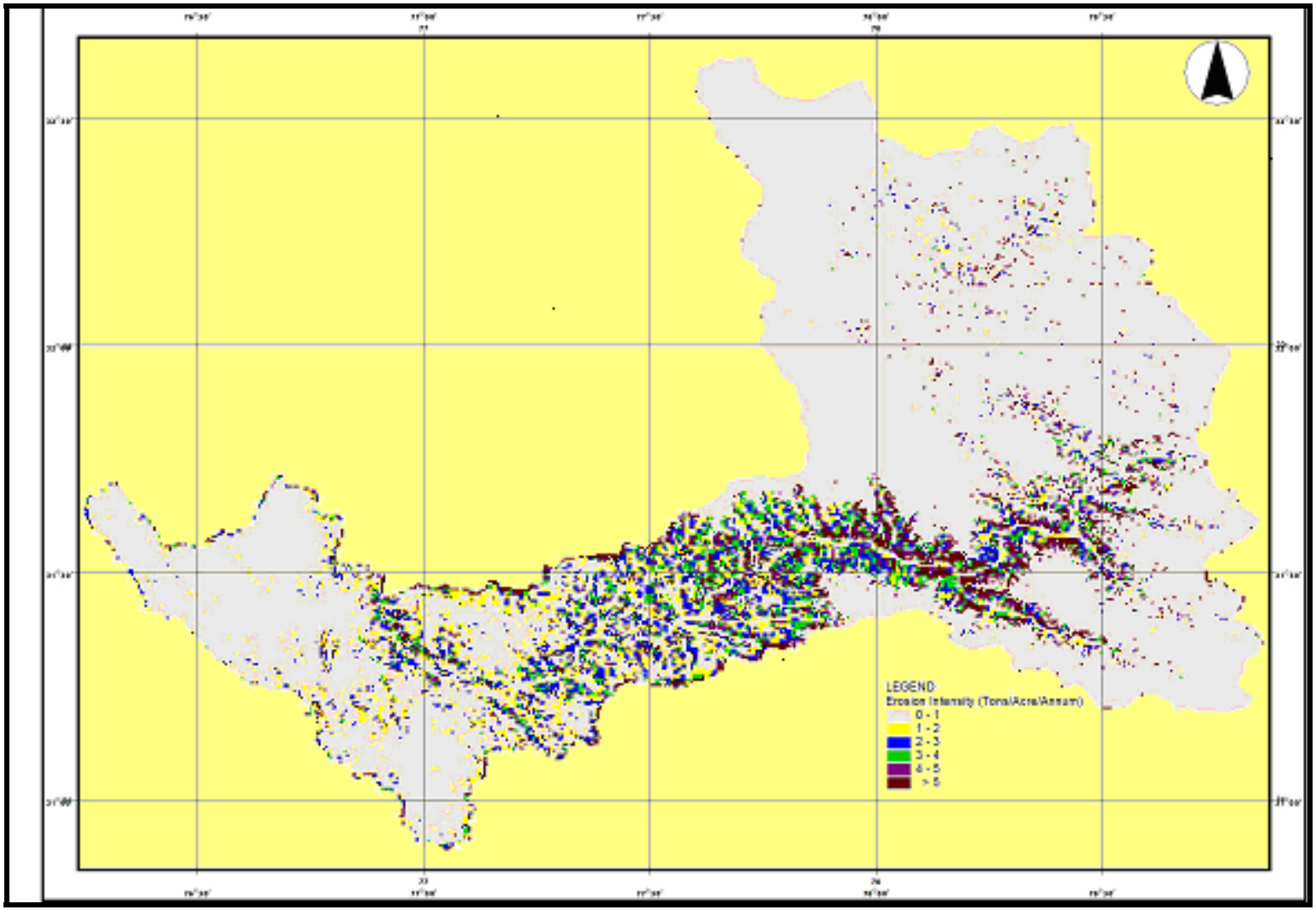


Fig 5.2 *Soil Erosion Map of Satluj Basin in Himachal Pradesh*

Significance of the Khab Project

The upstream Khab project was specifically designed with the objective of protecting the downstream hydroelectric projects from damage due to excessive silt and floods. Initially, two separate projects, Khab-I and Khab-II, with a combined generation capacity of about 1,100 MW, were planned but the problem of excessive silt, which led to repeated shutdown of the 1,500 MW Nathpa Jhakri project, forced the engineers to go for a storage project upstream. The three de-silting chamber would remove silt particles of size 0.2 mm and above.

Past studies conducted by the Satluj Jal Vidyut Nigam (SJVN) indicated that a high dam is required to arrest the 12 million cubic metres (MCM) of silt which the snow-fed Satluj and Spiti, its main tributary, bring down annually. Accordingly, it has proposed a 275 m dam with a storage capacity of 95 million cubic metres and life span of 28 years. It will be the second highest concrete gravity dam of the world after the 285 m high Grand Dixiens Dam in Switzerland. At present the 261 m Tehri dam is the highest in the country, followed by 225 m Bhakra Dam. It has been calculated during many studies that the life of the Bhakra reservoir will be increased by nine years and that of Kol Dam reservoir by 14 years. Further, two more dams are proposed upstream on the Spiti River at Rangrik and Pooh to enhance the life of the Khab Dam reservoir.

This would reduce the sediment load of the river upstream which comes down to feed the requirement of .projects downstream.

River diversion works at various Project sites

The Nathpa Jhakri Hydro-Electric Project originally envisaged the construction of a 57.5 m high diversion dam at Nathpa on river Satluj. Later on it was proposed to increase the dam height by 5 m i.e. from 57.5 m to 62.5 m. The headrace tunnel is lined along the left bank of the river Satluj. The tunnel traverses below the bed of Manglad Khad in the shape of a Syphon aqueduct. The flow in Shoulding khad is diverted fully through a trench weir which is dropped into the HRT through drop shaft. Tailrace tunnel conveys the tail race discharge from the power house back into river Satluj. With the increase in the dam height by 5 m, the storage capacity of the dam will increase from 165.07 ha.m to 343.39 ha.m. The flow in river Satluj downstream of the dam site will reduced significant upto the point of disposal tail race discharge at Jhakri for a stretch of about 40 km. The only flow in this stretch will be the contribution of flow from various small streams and khads meeting river Satluj (refer Table 4.7 of Chapter 4).

The **Rampur project** is designed to divert 405 cumecs of de-silted water of the Satluj from the tailrace pool of NJHEP through 15 km headrace tunnel to a surface power station near Bael on the right bank of the river. The length of HRT on left bank is 484 m before it crosses the river Satluj with a 43.2 m long Cut and Cover Conduit. The water will then be returned to the river Satluj at Bael.

For the **Luhri project**, the proposed river diversion is to be done through a tunnel located on the left bank, capable of carrying non-monsoon flood of about 1,267 cumecs.

For **Kol Dam**, the river water will be diverted to the powerhouse. The powerhouse will be constructed upstream of the Dehar project and the tail race water will be again diverted into the river through an open channel.

5.1.2 Impact on Water Availability and Quality

Water Availability: As mentioned earlier, the river Satluj is not the main source of water in the area. The natural springs and 'chashme' are the key sources of water for people living in the area for their own domestic consumption, livestock use and irrigation purposes. In most of the villages except those situated on high hills, IPH Department has laid down the pipelines to connect the natural springs (at upper reaches) to the households through storage tanks for water supply after providing primary treatment. The villages those are located on higher reaches depend directly on natural springs or khads flowing in vicinity.

Hence, massive hydropower development in the area, which is causing diversion of flow from river for power generation, will not directly put an impact on availability of water for consumption purpose for village population.

However, complete drying of natural springs (at its original location) has been reported by the villagers due to construction and blasting activities. It has been reported that more than 30 chashme have dried up in Yangpa village due to the construction works for Sanjay Vidyut Pariyojna. Also, it was found out during primary surveys conducted for the study that more than 8-12 chashme have dried up in Nathpa-Jhakri areas due to NJHEP project. Considering a post project measure, SJVNL has conducted a monitoring campaign for examining the flow of springs. It was established that blasting/digging activities can cause building up of excessive water pressure at particular location, which may lead to shift in the position of a spring or reduction in the flow rate of spring, but complete drying of springs is not likely.

Due to construction of NJHEP, the IPH water supply scheme was badly affected in following villages:

Table No 5.1 Affected Water Supply of IPH due to NJHEP project.

S. No.	Name of Scheme	Name of Habitation	Present Population
1.	WSS Maghara Majholi Koshgar	Majhewali Koshgar	490 130
2.	WSS Kartot Chandpur	Kartot Chandpur	437 138
3.	WSS Khasha Shah Jaleend	Gaso Shah	622 326
4.	WSS Sharn Rattanpur	Rattanpur Rattanpur II	151 50

		Basara Sanarsa Halti	329 282 229
5.	WSS Jhakri	Jhakri	4980
	Total	**12 habitation**	**8164**

Source: IPH Department, Rampur

Presently, restoration of these schemes is going on and SJVNL is providing financial support to IPH department for restoration of these schemes. SJVNL has kept a budget provision of 5 crore for renewal of water provision in areas where the water resources have been dried up. Immediate measure under the scheme will be lifting of water directly from river Satluj to the affected villages to maintain the minimum water supply to the affected areas.

Under the proposed Rampur Hydroelectric project, SJVNL is taking pre-project measurement and started monitoring the flow of existing natural springs in the influence area.

Water quality can be significantly affected by impoundment. Physical, biogeochemical, and biological processes occurring within a reservoir can affect the temperature and chemical composition of the water leaving the system to an extent that its quality upon release no longer resembles that of the inflows. The degree to which water quality is affected on a diel, seasonal and/or annual basis depends on factors such as surface to volume ratio and depth of the reservoir; geology and soil geochemistry of the surrounding catchment; latitude of the reservoir; rates and magnitude of sedimentation; magnitude and timing of incoming flows and their residency time; and level of biological productivity in the reservoir.

Chemical changes in water quality are less predictable due to the complexity of interrelated physical, biological, and chemical processes occurring in the reservoir, both in the open-water season as well as under-ice in the winter. Chemical changes include altered nutrient levels and dynamics, modified water-column and sediment oxygen regimes, nitrogen super saturation in downstream waters, and increased mobilization of certain metals. In newly formed reservoirs, water quality is often also affected by a trophic upsurge due to release of materials from the newly flooded area, which can be of short duration or last several years in the largest impoundments. One of the more predictable water-quality effects of impoundment is release of mercury from flooded sediments. Bacteria present in decaying vegetation can also change mercury, present in rocks underlying a reservoir, into a form which is soluble in water. This mercury in its methylated form enters the food chain and is bio-concentrated, with highest concentrations occurring in piscivorous fish and birds. These elevated tissue levels can often exceed those recommended for human consumption (particularly in older biota), thereby creating associated human and environmental health risks.

The water quality of river Satluj, in general, is designated as good (ref. Table 4.37 a-b of Chapter 4). There are no major sources of domestic or industrial pollution, hence the DO levels are found to be good, and BOD and COD values of the river are found to be low.

However, as such there is no direct disposal of domestic sewage into the river but due to open defecation; human/animal waste finds its way to Satluj through seasonal and perennial streams due to natural slope of area. Further, due to less population density and sparse location of human settlements, the impact on river quality gets insignificant due to dilution of sewage.

The use of agro-chemicals in the area is low but it has been seen (and confirmed during the village level survey conducted especially for the study) that over the last few years the rate of consumption has increased. This can be one of the sources of water pollution; it can also lead to production of excessive organic matter, which would further deplete the DO content of the river.

The river water quality at Rampur has been designated as Class A, which indicates that water can be used for drinking purpose after disinfection without conventional treatment. However, as per the monitoring carried out by the Consultant, DO observed was in the range of 8.0 to 8.5 (mg/l) between Jhakri to Bael. The pH value as observed was 7.88 and 8.1 at Jhakri and Bael respectively. The level of Biochemical Oxygen Demand (BOD) observed in the river was about 1.0 mg/l and value observed at Rampur d/s was 1.2 mg/l. Water Quality in terms of pathogenic bacteria appears to be fine except at Rampur d/s. The value detected for faecal coliform at Rampur d/s was 4 MPN and total coliform was 14. Iron and Zinc levels were found to be < 0.05 at Jhakri outfall and at Bael but value of Mercury was observed on higher side. Mercury was found 7.11 at Jhakri outfall.

5.1.3 Ecological Impacts

5.1.3.1 Change & loss of forest

Khab The forest in the study area falls under the jurisdiction of Pooh forest range of Kinnaur forest division. The forest existing in the this region is designated as a protected forest and not a reserve forest, which means although the human disturbance is allowed, but activities like burning, new agriculture (no expansion of existing) etc should not take place without permission from the forest department. However, in the Khab-I and Khab II project areas, no forest stands or sufficient crowns are present, therefore no significant impact on forestry would be anticipated in this region.

The **NJHEP** entails a total loss of 147.50 ha of forestland[1] due to various project appurtenances. The entire land belonged to HP Forest Department. The land was generally degraded and barren and did not support any vegetation. No rare or endangered species were observed in this area. Likewise no medicinal plants or species of economic importance were observed in this acquired land.

[1] *EIA for NJHEP, Year 1998*

The proposed **Rampur HEP** project entails acquisition of 50 ha of land. The tree density in the forest to be acquired for the project is low. It is reported to be only around 128-184 trees/ ha (refer table 5.2), whereas in a good forest, the tree density is of the order of 1000-1100 trees/ ha. No rare or endangered species were observed in this area. Likewise no medicinal plants or species of economic importance were observed in this acquired land. Thus, no significant impacts on account of acquisition of forest land are anticipated.

Table 5.2 Density of trees in the Rampur forest area

Location	Density (No./ ha)
Nogli (Left bank)	128
Bael (Right bank)	184
Duttnagar (Left bank)	133

Source: EIA Study Rampur HEP, H.P

Mitigation measures

Afforestation programmes are undertaken for the loss of forests. This includes; tree plantations, silvipasture development and vegetative shrubs. Some of the mitigation measure guidelines could be:

- Large areas of pasture lands, grazing lands should not be taken up for afforestation.
- Exotic species should be avoided but if introduced, they should be carefully monitored for their spread.
- Dry deciduous specious should be avoided. Ever green species should be preferred as they do not become flammable during dry summers.
- Local community should be involved in selection of area process.
- Participatory management practices for conservation of natural resources should be encouraged.

5.1.3.2 Change & loss of bio-diversity

Terrestrial Flora and Fauna

The proposed Rampur Hydroelectric Project neither involves construction of dam nor submergence of forest. Hence, any adverse impacts on existing forest in terms of reduction of either forest cover or loss of forest flora is not anticipated.

One of the major factors, which have an impact on flora, in and around the project area, is the increased level of human interferences. The workers/ labours working on the project, cut trees to meet their requirements for construction of houses and other needs like fuel. Thus, if proper measures are not undertaken, adverse impacts on terrestrial flora is anticipated.

Various reports[2] have been referred to for studying the impact of these envisaged projects on bio-diversity. They all indicate that no major wild fauna is observed in the neighbouring areas of these projects. It is also stated that the wild animals do not come below an altitude of 2000m in the project area because of low density of forest and lack of proper habitat in the region. Hence, impacts on terrestrial fauna are not expected to be significant. The NJHEP area has very low density of forest and lack of a proper habitat in the submergence and surrounding area of NJHEP, no major wildlife is reported in the region. However, about 8 ha of submergence lie in Rubi-Bhaba sanctuary (i.e. about 0.06 % of the total sanctuary). Since this area is small and it does not support a good habitat for wildlife, the impact on reduction of wildlife habitat may be considered as insignificant.

However, there are only a few factors, which may affect the fauna:

- During construction phase, large number of machinery and construction labour are mobilized to the area. The operation of various construction equipment and blasting is likely to generate noise. These activities can lead to some disturbance to wildlife population. Likewise, siting of construction equipment, godowns, stores, labour camps, etc. can lead to adverse impacts on fauna in the area.

- The increased accessibility to the area due to human interferences could have some adverse impact on the fauna of the area like migratory birds etc.

None of the wildlife[3] was either observed during survey of the area or has been reported by forest department. These area no records of any endangered, rare, threatened or endemic species from the project area. The project activities affecting directly to animals present in the project area are not envisaged, in terms of direct loss of any animal due to any proposed project activity.

Likewise, it has also been reported that all these regions do not appear to be on the migratory route of animals. Therefore, the construction of these projects does not have much significant effect on migration of animals as well.

Indirect impact on Flora

Traditional Timber Rights

Himachal Pradesh has the highest percentage of rural population (90.21%) in the country residing in more than 20000 villages across the state. The predominantly rural population is primarily dependent on agriculture base economy for livelihood. The natural forest in the area provides wood for building of houses, bridges, furniture, and agricultural implements, in addition to providing much needed fuel wood. People are also dependent upon

[2] *PFR Khab HEP, EIA study for Updation of NJHEP, EIA for RHEP, PFR Luhri*

[3] *Also re-checked with CES, Biodiversity report, 2006*

the native land races of livestock for agricultural purposes and their daily needs of milk, meat, wool and hide. A large proportion of this livestock feeds on grasses and leaves obtained from forest. Overall the dependency of local people on naturally available resources of forest is very high.

The forest of Himachal Pradesh have an estimated growing stock of 10.26 crore m^3 and more than 4.5 lakh m^3 of timber is harvested every year in the form of salvage and to meet the demand of right holders. As per one estimate timber worth Rs. 60 crore is allocated to the right holders at nominal coast every year (HPFSR, 2000). The forests also contribute an estimated annual income of Rs 25 crore to the rural communities in the form of minor forest produce.

The right to the timber is admitted under section 28 of Indian Forest Act (1927). People have a right to get timber at nominal rates for construction/repair of houses/dwellings. The right holders must be bonafide native agriculturist, holding land in settlements in forest areas. A right to the timber is for building & repair of households, construction of temple arch, cremation of dead bodies etc.

As regards the timber rights of project influence area total forest cover of Rampur division is 40372 ha and there are 250 villages under 48 Panchayats as right holders. The local villagers have rights to get timber for construction of house/ cattle sheds. It is estimated that nearly 800 trees are cut/felled to fulfill the demand of local people. The data on timber rights for five years i.e. 1987-92, has been collected from Rampur Div. A total of 8695 trees were felled/ cut to meet timber demand. Important timber trees are Pinus roxburghii(Chir), Pinus wallichiana (Kail), Cedrus deodara(Devdar) and Picea smithiana (Rai). The maximum number of 5743 trees of Kail was felled followed by 2018 of Deodar, 717 of Rai and 217 of Chir. The year wise details of species felled along with number & volume of trees is given below.

S.N	Year	Deodar		Kail		Rai		Chir	
		No	Volume	No	Volume	No	Volume	No	Volume
1	1987 – 88	533	1646.71	1058	4291.62	277	941.68	58	35.70
2	1988– 89	408	1085.58	955	2597.34	53	786.79	70	99.36
3	1989 – 90	109	543.04	655	2397.98	236	1118.43	23	26.99
4	1990 – 91	344	1773.625	1414	378.85	86	363.99	25	58.63
5	1991 – 92	624	2448.14	1661	6694.68	65	996.29	41	116.45

Source : Working Plan for Rampur Forest Division

The right holders have rights to remove all Chir & Kail trees uprooted by natural process such as rain, wind & snow. Deodar trees normally granted for door & windows only, but it is seen that, right holders manage to get Deodar for whole of the building. Besides this, right holders get timber at very nominal rate which are decided at the time of settlement i.e. Zamindari rate. The Zamindari rate or concession rates at which a right holder get timber is given below.

S.N.	Girth Size	Class	Deodar	Kail	Fir	Chir
1	90 – 120	ID	5.0	1.0	0.25	0.50
2		IC	4.0	1.0	0.25	0.50
3		IB	4.0	1.0	0.25	0.50
4		IA	3.0	1.0	0.25	0.50
5	60 – 90	IIB	2.0	0.75	0.19	0.37
6		IIA	1.5	0.50	0.19	0.28
7	30- 60	III	0.75	0.25	0.12	0.12
8	> 30	IV	0.19	0.12	006	0.06

Source: Working Plan , Outer Seraj, Kullu District

It revealed that, the rates for high quality timber Deodar is sold at the rate of Rs 0.19 to 5.0 depending on class of timber followed by Kail Rs 0.12 to 1, Fir Rs 0.06-0.25 and Chir Rs 0.06-0.50. This concession has resulted in considerable depletion of forest near habitats/settlements as demand of timber is growing day by day. The prices for non-right holder are decided by Himachal Pradesh Forest Corporation (1978). The average sale price/cubic centimeter timber in the depots of Forest Corporation is given below.

TABLE 5.3 Timber Rates for Non-right Holders

S.N.	**Name of Species**	**Size(cm3)**	**Grade**		**Rate**
			I	II	
1	Deodar	305x25x13	20,744	18,372	14,048
	Kail	- do -	14,978	12,226	10’262
	Fir	- do -	7,288	6,455	5,381
	Chir	- do -	6,876	6,089	4,690
2	Deodar	240x21x10	14,112	12,497	11,874
	Kail	- do -	13,401	11,869	9,183
	Fir	- do -	6,728	5,960	4,968
	Chir	- do -	5,991	5,305	4,087
3	Deodar	240x16x16	14,112	12,497	9,557
	Kail	- do -	10,765	9,537	7,378
	Fir	- do -	6,294	5,574	4,647
	Chir	- do -	5,821	5,156	3,971

Source: Working Plan , Outer Seraj, Kullu District

The rate of best quality swan timber is Rs 1,421, for Deodar, Rs 900 for Kail, Rs 798 for & 743 m3. It seems that rates of timber allotted to right holders are 1000 time less than prevailing market rate. Leading to increase of timber demand by local people.

Increase in timber demand attributed to increase in population of right holders, as well as partition in the family, all round development of the people in their financial position

& good return of horticultural crops/activities and most importantly the low rates (two to four rupees/tree) at which trees are granted to right holders as compare to the prevailing market rate. It is also observed that, local right holders misuse rights by selling timber obtained in confessional rates to non-right holders & city dwellers of nearby town. The concession with respect to rights to the timber has been reduced due to non-availability of trees in Rampur Forest Division.

Thus it revealed that major impact on project influence area is due to various rights given to villagers residing in forests. The necessary steps should be taken to reduce the extraction of timber from the forest.

Aquatic flora and fauna

Changes in the physical and chemical characteristics of water from impoundment inevitably affect distribution and abundance of aquatic biota and resulting community structure. Within new reservoirs, fish populations are often quite large during the first few years, largely because of increased nutrients leached from flooded soils and vegetation, enhanced productivity throughout the food chain, and provision of secure sites for spawning and predator protection. Once established, the new physical/ chemical characteristics of a reservoir can pose challenges to biota, primarily because they are not in synchrony with natural cycles. Disturbance to spawning resulting from the drawdown/ raising of water levels, changes in seasonal temperature cycles, and blocked migration for fish are some major examples.

Similarly, downstream biota are exposed to a new disturbance regime (e.g., diel and/or seasonal alterations in discharge and thermal regimes), the degree of disturbance depending on the severity of the change and the distance downstream of the dam. For instance, lotic fish species select their preferred habitats by depth, water velocity, and type of substrate. If these change rapidly, as they would immediately downstream from a peaking hydroelectric station, the area would likely be abandoned by these species. In general, damaged communities of colonizers, tolerant species and temporary residents established nearest to the dams are replaced by more natural communities downstream as conditions ameliorate and tributaries and groundwater exchanges return the river to a more natural regime.

Dams, designed to meet daily to weekly hydroelectric demands, have more variable water levels and flow regimes than large storage reservoirs. Consequently, they can produce higher disturbance effects on in-channel and riparian processes and related biota. Hence, regulated discharges are often directly responsible for reduced habitat diversity and biodiversity in downstream reaches. Although most responses to flow regulation are site-specific, general patterns of large-scale downstream effects are being observed worldwide and a synthesis of these is emerging.

The labour may resort to fishing in river Satluj and its tributaries, using low level dynamites, etc. Although this technique leads to the death of only a few fishes, but it de-

stroys a large habitat specially the floral species on which the fishes feed. However, such impacts are not expected to be significant in view of the magnitude of the riverine system.

During lean season, the downstream flow in the river is contributed by the perenial khads between Dam & Power house. Due to reduction of flow and increase turbidity between river stretch from dam to power house, several groups of micro-benthic organisms especially diatoms could be adversely affected.

Dredging operations often have deleterious affects on the aquatic fauna of the area:

1. It has been proposed to extract fine aggregates from the shoals deposited on the right bank of river Satluj from Tapri towards Karcham and Morang. The areas from where construction material is excavated, benthic fauna get destroyed in such areas. Although in due course of time the area gets recolonized, but the density and diversity of benthic fauna, is much lesser as compared to the pre-dredging levels.

2. The second important impact is on the spawning areas of cold water fisheries. Almost all the cold water fish breed in the flowing waters. The spawning areas of these fish species are found amongst pebbles, gravel, sand etc. The eggs are sticky in nature and remain embedded in the gravel and subsequently hatch. Any disturbance of stream bottom will result in adverse impacts on fish eggs. Even increase in fine solids beyond 25 ppm will result in deposition of silt over the eggs, which would result in asphyxiation of developing embryo and also choking of gills of young newly emerged fry. Thus, adequate precautions during dredging operations need to be undertaken.

Impacts on fish growth due to disruption of hydrologic regime

The ecological changes brought by the any hydro-electric project may affect the fish fauna in the river. Consequent to dam construction and reservoir formation substantial morpho-ecological changes occur in the river both upstream and downstream of the dam site. These include radical transformation of long established and inter-relationship between organisms, some species shift to new spawning and migration ranges; intra-specific biological differentiation of fish occurs and egg laying substrata undergoes changes. Other changes that could occur include inundation of spawning grounds; fluctuation in water levels, alteration in the physio-chemical conditions of spawning area in the upper reaches; disappearance of feeding ground of fishes.

The construction of a dam on river Satluj at **Nathpa** and therefore, reduction of flow has already affected the riverine ecology by converting lentic system to a lacustrine system. As reported in the EIA study for Updation for NJHEP, the ecology in the lacustrine system has already developed over an area of 16.5 ha. As a result of reduction in flow, downstream of the dam i.e. from Nathpa-Jhakri-Bael, the fish stock would be affected adversely. *But since this stretch already has negligible fish population and the fish predominance is more in the side streams/ tributaries, not much impact is envisaged.*

Impacts on migratory fish species

As mentioned earlier, Schizothorax richardsonii is the only commercial species of river Satluj in the project area. When the temperatures start rising above 22 ^{o}C to 25 ^{o}C, sometimes during Feb-March, *S. richardsonni* species in Satluj starts migrating upstream to colder reaches of the river from downstream. But there again they experience an unfavourable low temperature of 8-9.5 ^{o} C, due of the influx of snow-melt water, which is not conducive for the ripe fish to spawn. Hence, these trouts enter the side streams of the river, which receive warm ground waters (17.5-21.5^{o}C) and spawn profusely (density of fertilized eggs 20-23 per sq. m and hatchlings 37-40 sqm) (Ref D Sc dissertation Dr. K. L. Sehgal).

Mahseer is migratory fish and its migration is affected by construction of Bhakra dam on the Satluj. Its availability in project area is a remote possibility due to low water temperature.

5.1.4 Impacts on Soil Erosion and Muck Disposal

5.1.4.1 Increased Soil Erosion

River regulation can modify the sediment regime of a river through retention of material within the reservoir and through modifications of downstream erosion and deposition processes. Short reservoir life expectancies are associated with small-scale dams that impound rivers with high levels of sediment influx. Continued reduction in storage capacity of such reservoirs through sediment accumulation results in a decreased water-retention capacity, and may lead to an inability to retard the passage of floodwater downstream.

Changes in the flow and flood regime have implications relative to the competence of the channel to carry sediment and to the ability of the system to flush sediment deposited during low-flow events.

In downstream, where tributaries add more material to the river, aggradations may be more common than degradation. Lower regulated flows, especially without the natural freshet peaks, do not have the conveyance power to carry material produced by upstream degradation as well as that contributed by the tributary flow. Where aggradation occurs, the nature of the morphological response depends on the character of the alluvial deposits. Typical responses may include lateral scour, channel widening, braiding, and a reduced mean flow depth. Successive species advance of vegetation down the banks onto abandoned floodplains, however, can lead to an adjustment in the overall flow pattern and, ultimately, to a narrower channel. The river downstream of the dam is also deprived of silt, which fertilizes the river's flood plain during high water periods.

One critical aspect of changes to a river-sediment regime is time scale. Although some dramatic changes can be observed in the first few years after regulation, the time required for a system to achieve a new equilibrium depends on manner of regulation, form and composition of the channel and rate at which vegetation becomes established. Because of the huge volumes of sediment involved on large rivers and the associated slow rate of vegetation change, the time scale for adjustments can be in the order of centuries.

In general, the runoff from the unprotected excavated borrow pits and muck disposal sites lead to increased soil erosion and therefore, increased sedimentation rate downstream of the area. The erosion rates are generally significant during construction phase. This results in the increased sediment concentration in receiving water bodies, downstream of the construction site.

High turbidity levels in the Satluj river water due to sediments reduce the light penetration, which reduces the photosynthetic activity and therefore the primary productivity as well. It should be noticed that Satluj River, during its course of travel from its origin in Tibet, flows through a large tract of terrain having very little or loose vegetation. This type of vegetation does not hold the soil tightly and which further enhances the rate of erosion (Refer Figure 5.2). Most of this loose soil is flushed into the river. As a result, suspended solid content of the river is rather high and the river remains turbid for a significant part of the year.

Effective implementation of CAT plan and construction of storage dam upstream can greatly solve the problem of erosion in Satluj Basin.

5.1.4.2 Impacts due to quarrying and muck disposal

During the construction work of NJHEP, the Central Soils and Materials Research Station (CSMRS) had conducted the survey for the availability of the construction material during construction of main dam. The construction material was procured from quarrying sits at Pashada, Tapri and Morang. Based on the findings of survey, quarry near Pashada was used for extracting quartzite. The gravel and boulders were extracted from the shoals deposited along the right bank of river Satluj, 5 km from Tapri towards Karcham and Morang. The fine aggregates for the construction works were excavated from the shoals deposited on the right bank of Satluj from Tapri towards Karcham and Morang. It is proposed to use the same sources for extraction of required material for construction of the proposed increase in dam height and other project appurtenances.

The Rampur project requires a significant amount of construction material, coarse aggregates of the order of 2.72-lac m^3 and fine aggregate requirement of the order of 1.38 lac m3. The excavated material of the Headrace tunnel (between Kajo and Kunni khads) is proposed to be used as coarse aggregates as the geology is similar to that of the Pashada Quarry, used for NJHEP. The remaining requirements of coarse and fine aggregates will be excavated from the Koel Quarry, located near Bael powerhouse site.

The impacts of excavation of construction materials such as clay, rock and sand for construction of hydroelectric projects on environment depend on excavation process, local hydrological conditions, climate, rock types, size and type of operations and topography. Impacts also vary with stages of development at quarry sites e.g. development of working platforms has a less impact compared to the excavation of aggregates and sand. Physical changes in the soil, water and air associated with excavation activity affect the biological environment directly or indirectly. The major environmental impacts would be due to excavation and degradation of land around the quarry and the biotic life on it.

For the NJHEP, the total quantity of muck generated was of the order of 6003250 m3 and it was disposed at 10 dumping sites viz. two at Jhakri, one each at Koshgarh, Kotla, Dharali, Negulsari, Plingi, Sakichran, Punspa, Linge. The capacities of these sites were:

Table 5.4 Muck Disposal sites and respective capacities under NJHEP project

Site	Capacity (in cum)
Jhakri-I, Jhakri-II	14,16,530
Koshgarh	2,50,000
Kotla	4,10,000
Dharali	7,20,000
Negulsari	5,78,000
Plingi	5,92,000
Sakiaharan, Punspa	20,15,000
Linge	21,721

Source: EIA Study NJHEP, Year 1998

The dumping site at Sakicharan was used to dispose the muck generated due to the construction of the main dam. Later, when the dam height was increased by 5 m, as a compensatory measure, an alternate Tail Race Tunnel was provided to the Bhaba Power House because with increase in the dam height, the tailrace of Sanjay Vidyuit Pariyojna (SVP) Bhaba came in the submergence zone. The construction of this compensatory TRT generated about 2170 m3 of muck. This muck was disposed over the previously disposed material in the existing dump yards at Sakicharan.

The proposed project at Rampur is expected to generate approx. 2.72-lac m^3 of muck, which is propsed to be disposed at the following designated sites:

- Dumping area near Kajo adit (Tehsil Nermand, Fatti/ Tunan, Kothi 15/20)
- Dumping area near Kunni adit (Tehsil Nermand, Fatti/ Tunan, Kothi 15/20)
- Dumping area, Tehsil Nermand , Fatti Nermand.
- Dumping area in Bael

These sites have been identified at right bank of the river, close to four edits of proposed tunnel so as to minimise the risks involved in terms of affecting human settlements due to blow of dust and frequent movement of heavy vehicles. The sites need attention in terms of surface preparation and fencing of boundaries to avoid environmental risks i.e.

land sliding, sedimentation of river, air pollution etc. SJVNL is already taking care of this aspect with great care. The measures include construction of retaining wall before actually dumping the material. So this aspect doesn't seem to pose any such threat.

At Luhri, the volume of muck to be disposed off has been estimated to be about 35-40 lakh M^3 (Luhri HEP PFR). It is expected that about 25 % of this will be used for making aggregates. The rest will be disposed of in a planned manner. It is intended that suitable dumping locations will be identified. Retaining walls will be constructed. Rehabilitation of the site will also be done after the site is filled. Plantations, wherever possible, will also be done on these sites so that these get stabilized over the time. Despite the provision of establishment of embankments down the slope to stabilize the deposited muck, the likelihood of the muck entering the Satluj is high thus reducing the depth of the river at these sites and downstream of these sites. This would result in increased turbidity of the water in the river stretch making it less usable and aesthetically appealing. The problem is going to be more pronounced in the lean period where the flow is even less than normal.

Dump sites identified by SJVNL

Site 1-Kajo Adit

Site 2-Kunni Adit

Site 3-Near Nermand

Site 4-Near Bael

Making available a suitable muck dumping area and then a well planned dumping schedule before the start of construction activities is a very important aspect in addressing this issue in Satluj basin.

5.1.5 Impact of Blasting on Agricultural & Horticultural Yield

Simla is one of the biggest apple growing districts in HP. Half[4] of the State apple crop is produced in the district. But for consecutive 5-6 years from 1992-93 to 1997-98 the apple crop was very poor due to continuous rains and widely fluctutating temperatures (maximum and minimum) at the time of flowering during March- April. In 2001-02, there was virtually no crop in apple growing areas situated at elevations below 6500 ft msl. (Refer table 5.5).

Table 5.5 Production of Apple in Himachal Pradesh

Year	Apple Production ('000 tonnes)
1980-1981	118.01
1981-1982	306.79
1982-1983	139.08
1983-1984	257.91
1984-1985	170.62
1985-1986	174.61
1986-1987	359.32
1987-1988	259.27
1988-1989	165.15
1989-1990	394.86
1990-1991	342.07
1991-1992	301.73
1992-1993	279.05
1993-1994	294.73
1994-1995	122.78
1995-1996	276.68
1996-1997	288.54
1997-1998	234.25
1998-1999	393.65
1999-2000	491.3
2000-2001	376.73
2001-2002	180.53

[4] *District census handbook 1991Series 9 part XII, Simla*

2002-2003	348.26
2003-2004	459.49

Source: HP, Statistical outline of Himachal Pradesh, 2003-04, Department of Economics and Statistics (Horticulture Department data)

This kind of reduction in apple production was attributed to dust pollution caused by various hydropower project-related activities in Satluj Basin. Projects of these kind include activities like blasting for various construction purposes like excavation of underground tunnels for channelising the waters of river, open blasting for mining operations and other works of the project. A committee was formed by Horticultural Department, HP to inspect the case. The following areas were surveyed by the experts[5], to inspect the level of air pollution and to study whether the particulate air pollutants emitted from blasting operations were causing any adverse effects on the production of apple and other fruit crop:

a) Project sites at:
- Nathpa;
- Jhakri;
- Pashada quarry;
- Mini hydroelectric project at Kafnu/ Katgaon ;
- Piwa crusher plant at Tapri.

b) Orchards near project/ quarry sites at:
- Pachchada and Dhar Gaura
- Ponda and adjoining areas
- Katgaon/ kafnu
- Kacksthal
- Tapri

Although atmospheric pollutants adversely effect the plants in various ways, such as causing closure of leaf stomata, growth retardation, injury to leaves, plasmolysis, other physiological effects like reduced photosynthesis etc, in this particular case, the findings of experts are given below:

- No evidence of dust pollution were recorded being responsible for the low and declining yield of apple in Shimla and Kinnaur areas falling within the boundaries of SJVNL projects.

- Though dust deposition on flowers may reduce the period of stigma receptivity or may hinder pollen dehiscence and pollination, or may affect pollen germination but for all these effects to show up, the dust pollution must be very high so as to form a sufficient thick layer of dust particles on the flower parts. But it was found that the

[5] *Sh TCP negi, Joint Director, Horticulture, Dr. SA Ananda, Professor of Pomology and Dr. PS Chauhan, Horticulturist*

level of dust on the plants in the adjoining area of Jhakri, Pashada and Dhar Gaura villages were not high enough to cause such adverse effects on flowers of fruit plants, including apple.

- No such dust deposition was noticed at orchards/ sites at Ponda, Nichar area, Katgaon, Kafnu and Kacksthal. The SPM at a site near Jhakri at a distance 250 m from Pashada quarry as recorded during the time of inspection was around 350 μg/ m^3, which was much lower than the threshold admissible limit of 500 μg/ m^3 for industrial areas.

- At the Pashada Quarry, although open blasting was being carried out, the levels of dust pollution caused by blasting appeared to be low because these operations were carried out entirely on solid stone rocks. Also, most of the components of NJHE project work were carried underground; hence underground blasting could not cause such serious pollution problems. Similarly, no pollution could have been caused by dumping of excavated sites as these sites were away from fruit plantation.

- Similarly in villages of Jhakri, which is located just near Pashada quarry and Snarsa and Shah, which are located on Kacha approach road to surge shaft and in the villages of Ropru, Pashada, Dhar Gaura, Dobi and Gopalpur, it was found that the although the fruit set for stone fruits like apricot, plum and almond was good, the fruit set in apple in Shah, Pashada and Dhar Gaura areas was average. It was concluded that had dust pollution been responsible for poor fruit set in apple, it should have played a similar adverse role in fruit set in stone.

CONCLUSION

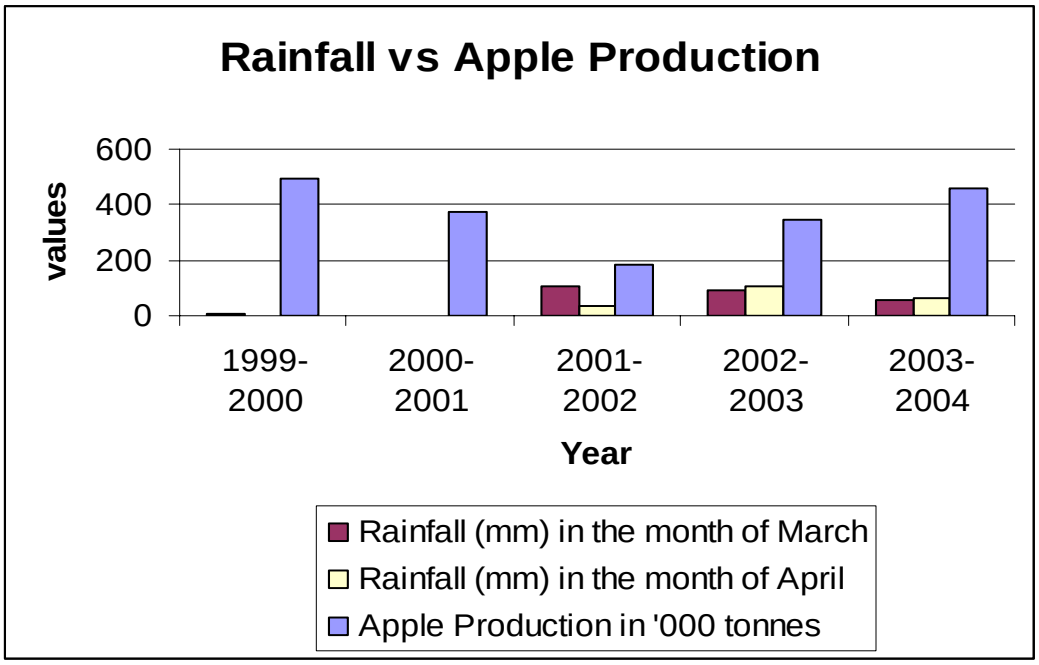
It was observed that the extent of fruit set in apple in above-mentioned areas was low, but it is due to some other factors. The main causes might be:

1. Continuous rains and low temperature during the time of flowering (March April) results in poor bee activity, inadequate cross pollination and poor fruit set. An attempt was made to correlate the rainfall with fruit production. Table 5.4 shows drastic reduction in the production of apple in the year 2001-2002. The rainfall data (table 4.8, produced below again) shows that in this particular year, there was continuous rainfall in the months of March-April.

Historical monthly Rainfall (in mm) Data for Rampur

Year	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
1999	*78.9*	*19.9*	*5.4*	*0*	*31.4*	*19.6*	*185*	*60.9*	*18.5*	*0*	*0*	*5.2*	*424.8*
2000	*0*	*0*	*0*	*0*	*0*	*244.9*	*337.9*	*21.3*	*12.1*	*0*	*0*	*0*	*616.2*
2001	*20*	*40*	***105***	***34***	*103*	*113.9*	*60*	*123.1*	*60*	*0*	*16*	*41*	*716*
2002	*61.5*	*142*	***93***	***104***	*13*	*45*	*10*	*152*	*104*	*0*	*0*	*1*	*725.5*
2003	*55*	*110*	*60*	*61*	*11*	*41.5*	*264*	*132*	*107*	*0*	*4*	*41*	*886.5*
2004	*67*	*4*	*0*	*69*	*57*	*114*	*93*	*244.5*	*24*	*81*	*2*	*6*	*761.5*

However, the areas located at higher elevations i.e. above 6500 ft msl had good crop because in such area flowering took place a little later which escaped the adverse effects of rain and low temperatures.



2. It may be due to lesser number of pollinizer trees in the orchards[6]. It was observed that the fruit was very good in pollinizer trees of Golden Delicious variety and adjoining trees of Royal Delicious variety, but was poor in trees away from pollinizer's trees. Hence, the reason of lesser extent of apple could be due to the inadequate and improper placement of trees of pollinising varieties in orchards.

5.1.6 Impacts on the frequency of Disasters

5.1.6.1 Earthquake

Earthquake in seismically active areas, a reservoir may advance the occurrence of earth tremors (possibly resulting in more frequent but smaller magnitude events). This is due to either a change in stress because of the weight of water, or more commonly due to weakening of fractures and faults under the reservoir by increased water pore pressure. The energy released in a reservoir-induced earthquake is normal tectonic strain energy, released prematurely. It may be put that the reservoirs may induce increased seismic activity through:

[6] *Survey report on the effect of Blasting operations on Fruit production in NJ HEP areas, by Dr. SA Ananda, Professor and Head, Department of Pomology, Dr. PS Chauhan, Senior Horticulturist, RHRS and Dr. KN Ojha, SMS, Deptt of Horticulture, Simla*

- change in the normal effective stresses in the underlying rock due to increased pore pressures
- transmitting hydrostatic pressure through discontinuities in the underlying rock

General characteristics of induced earthquakes are:

- occurrence within the vicinity of the reservoir;
- small focal depths;
- the frequency of small earthquakes is higher than that of large earthquakes;
- high chance of occurrence in an area of normal or lateral faults.

Medium sized earthquakes tend to occur in situations where:

- the generating head is large (typically over 100 m);
- the impounded water volume is considerable (typically over 1 km3)
- there are many fissures and faults in the crust.

Satluj Basin largely falls in Seismic zone IV and V. Refer to the sections 4.1.5 and 4.1.7 of Chapter 4 for details.

5.1.6.2 Floods

The most obvious impact of hydro-electric dams is the flooding of vast areas of land, much of it previously forested or used for agriculture. The size of reservoirs created can be extremely large. Reservoirs can be used for ensuring adequate water supplies, providing irrigation, and recreation; but in several cases they have flooded the homelands of native peoples, whose way of life has then been destroyed. Many rare ecosystems are also threatened by hydro-electric development.

Catastrophic flash flooding occur when a dam fails and the impounded water escapes through the breach into the downstream valley. Usually the response time for warning is much shorter than for natural floods. Numerical simulation models are powerful tools to assess the impacts of floods due to dam failure events

Refer section 4.1.7 of Chapter 4.

5.1.6.3 Landslide

Landslides are another common geological hazard in the area. The vulnerability of the geologically young, unstable and fragile rocks of the state has increased many times in the recent past due to various unscientific developmental activities. Deforestation, unscientific road construction, terracing and water intensive agricultural practices, encroachment on steep hill slopes are the activities that have increased the intensity and frequency of landslides.

Also, landslides are often triggered due to road construction because of the loosening of rocks by water trickling from various streams. Steeply sloping banks are liable to landslides, which can largely be controlled by provision of suitable drainage. The basic principle is to intercept and divert as much water as possible, before it arrives at a point, where it becomes a nuisance. The construction of road is one of the leading causes of increased landslide occurrence in the study area. The quantum of damage by unscientific road construction can be judged by scientific research, which states that, one kilometre of road construction in the Himalayas needs 60,000 cubic meters of debris. The construction of roads in the recent past has been extensive with the development of various hydropower projects in the study area, as has been the increase in the incidence of landslides due to this and other reasons, especially during the rainy season.

The other erosion hazard is that of surface erosion of the bank, which is best controlled by vegetation. However, in a steeply sloping terrain, difficulty lies in growing vegetation on steeply sloping banks. Engineering solutions such as surface drainage, sub-surface drainage, toe protection and rock bolting can be used. Landslides can be stabilized by several methods-engineering or bio-engineering measures alone or a combination of these. The cost required for implementation of various measures has already been incorporated in the overall budget earmarked for construction of roads.

Also refer Section 4.1.7 of Chapter 4.

5.1.7 Extreme events and Climate Change risks

The river Satluj carries the maximum amount of silt among the Indian rivers. The river has been affected by three floods which submerged the entire Satluj basin in 1997, 2000 and 2005. It not only led to damages but the entire topography has been reported to have changed along with the catchment areas. The riverbanks eroded badly. The original plans that were made when the project was envisaged regarding silt contents (5,000 parts per million) had to be changed and are in the process of revision.

Last year in June 2005, there was a sudden breach in the artificial lake on river Pareechu, in Tibet (China) which led to an unprecedented rise in the water level of river Satluj and caused flash floods in five districts of Himachal Pradesh. Due to a timely alert sounded by the ITBP post at Lepcha and prompt action initiated by the State Government and Government of India for evacuation of people residing on the bank of rivers Spiti and Satluj, that lives of villagers in Indian region, were saved. Three hydro-electric power projects in the State viz. Naptha Jakhri, Chamera II and Baspa, had to be temporarily shut down due to heavy siltation caused by the flash floods. The flash floods caused extensive damage to roads, bridges, agricultural crops, Government & private properties and other infrastructure.

However, no loss of life was reported from anywhere in the state after more than 40 to 50 feet high water breached the banks of the river and caused an estimated loss of property, worth Rs 100 crore in Kinnaur district alone. Large parts of the Kinnaur district are cut

off from the rest of the country as all communication links were snapped with the Indo-Tibetan road breached at several places. The water level, which was 12 to 13 feet last night, at Tatapani town in Mandi district, has steadily come down and there was no flood threat in the low lying areas downstream. Water entered the Powari village of the district and submerged three shops and washed away a silt monitoring station at Khab. Twenty houses besides a primary school and a Mahila Mandal building were washed away at Leo village in the district.

Five bridges on Satluj River at Khab, Karcham, Leo, Akpa and Kharo had been washed away. Other bridges at Morang, Kaanam and Apka appear safe but have sustained some damage and would require reconstruction. A bridge at Shlkar had been damaged, while two orchards and two houses at Chango were washed away by the Satluj waters. Two bridges of Jagatkhana and Bajja Bowri at Brau area of Rampur and two bridges of Nathpa Jhakri power project have been washed away.

About 500 metres road of the National Highway no 22 was washed away at Leo village besides Tangling, Tanlik, Powari and Choling areas of the district.

Also refer Section 4.1.7 of Chapter 4.

5.2 Socio-Economic Impacts

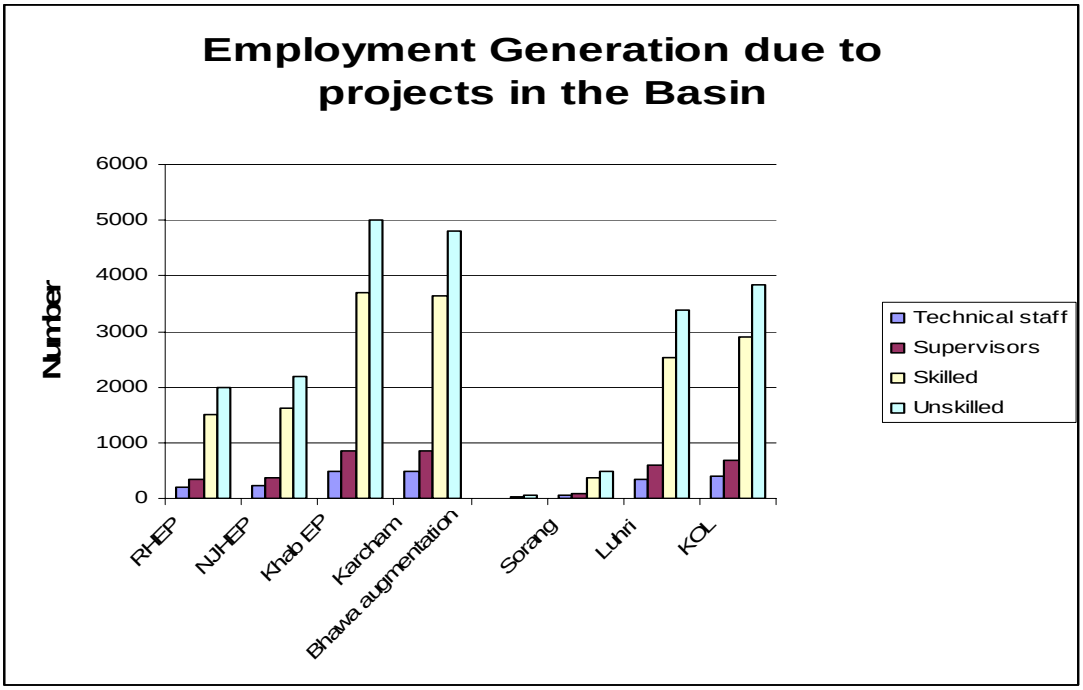
5.2.1 Employment benefits

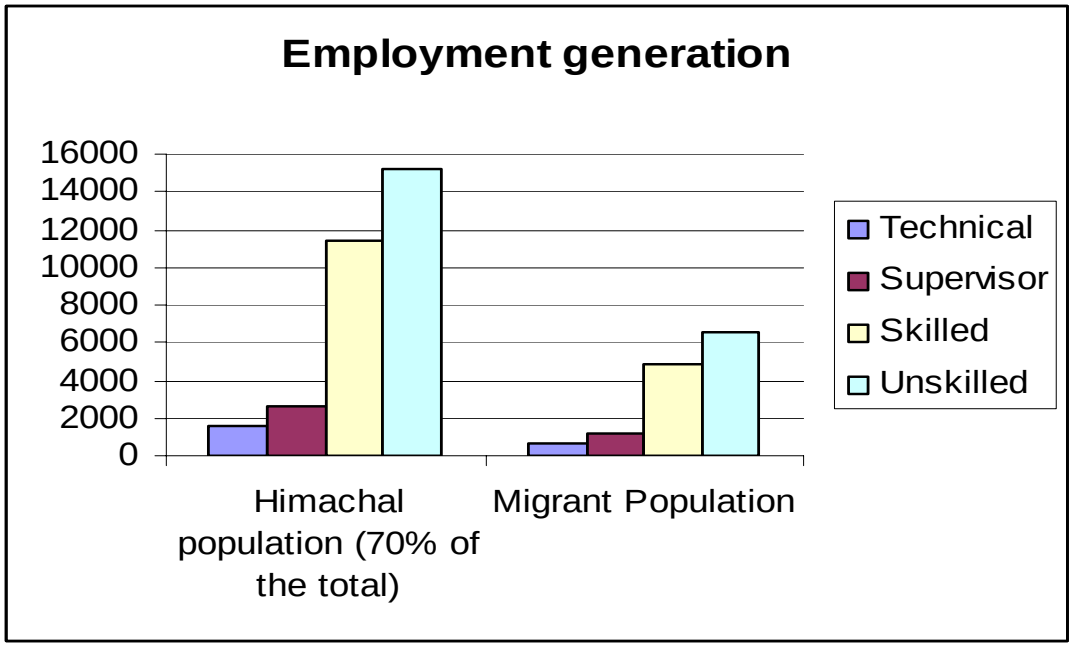
A large number of hydro projects are planned in the entire Satluj basin. The development of these over the time would generate many employment opportunities in the basin directly as well as indirectly in the form of various service providers. A tentative estimate of potential employment opportunities have been worked out on the basis of hydro generation capacity. As per MOU signed by government of Himachal Pradesh with all hydro developers, 70% is to be engaged from the state. Hence around 30000 staff is expected to be employed from the state. Rest of the staff would contribute as migrant population. The migrants will also bring their families along with them and thus the migrant population will be around 38000. It is also expected that 2 % of the migrant population will start some petty business or business establishments for their daily needs.

Table 5.6 Employment generation

Project	Capacity	Staff expected to be employed				
		Technical	Supervisor	Skilled	Unskilled	Total
RHEP	412	200	350	1500	2000	4050
NJHEP	1500	215	378	1628	2200	4421
Khab EP	1020	490	860	3700	5000	10050
Karcham	1000	480	842	3626	4802	9750
Bhawa augmentation	4.5	5	9	37	49	100
Sorang	100	48	84	362	480	974
Luhri	700	337	591	2545	3371	6844
Kol	800	385	675	2908	3851	7819

TOTAL	**5536**	**2160**	**3789**	**16306**	**21753**	44008





In absence of time series data (before and after) for all hydroelectric project sites that are in operation or proposed, change in employment pattern and employment benefits has been assessed and quantified only for NJHEP and RHEP influence areas which would be helpful to understand the kind of scenario which could be foreseen for the region, once all proposed hydro power projects get started

There is clear indication of shift of type of economic activities from agriculture to business due to massive hydropower development projects in the region. The statement has been substantiated with the help of following:

Table 5.7 Occupational Activities (%) in NJHEP project.

Occupational Activities	Areas, which are not directly affected	Project affected areas	
		Pre Project	Post Project
Cultivators	51.89	49.39	40.07
Agri-Labour	0.84	1.70	2.13
Daily Wages	1.68	13.59	18.29
Service	29.95	20.15	24.35
Others	7.17	20.15	20.15
Business	8.43	11.65	12.79
Pensioners	0.84	-	-
Non-working	74.78	76.10	74.15

Source: EIA for Updation of NJHEP, Year 2003

A comparison of pre and post project employment scenario as given above and as already discussed in Chapter 4 for NJHEP, reveals the following:

- Average annual employment of those households who were given land for land has increased from 393 days to 550 days per household. The average annual income has increased from Rs.45, 222 to 1,07,422. However, the share of agriculture in the household income has declined because of reduction in the size of their land holdings. But their income from wage labour and services has more than doubled as compared to there past income six years ago.

- The average income of those households who got compensation for house construction has increased from 28,333 to Rs. 50,933. The employment and income from regular jobs have increased in the group.

- In the case of those households who were allotted alternative shop plot average annual income was Rs. 79,867/- in 1996, which increase4d to Rs. 1,81,107 in year 2002. This change has been mainly due to increase in pretty business/trading activities, which have increased due to increase increased demand for daily need items from residents of new NJPC colony and also due to increased purchasing power of project affected families. Average income of those families who have been provided employment in the NJPC has increased from Rs. 68,874 to Rs. 1,41,759 per annum. The

increase in household income has been mainly due to increase in employment in non-farm activities.

- Those households who were provided cash compensation only have also improved their economics position. Average annual employment of these families was 350 days in 1996, which has now increased to 401 days. Similarly the average annual household income has increased from Rs. 77,677 to Rs. 98,721 in year 2002.

- Out of 62 families of project affected areas and who are rendered landless under the project, one person each from the 51 families has already been provided a regular employment in the NJPC, and it is to be noted that 29% of employed persons are women.

Further, in case of RHEP, apart from students, the largest number of males is engaged in service and females have agriculture as a main activity. The analysis indicates that annual income of the sampled households from different sources, at overall level was Rs.1,07,408 per annum, which was Rs. 77,351/- for SC/ST and 1,32,748 for general category. The largest share of the total income was generated from employment including service and wage labour. This was followed by agriculture; accounting for 18.61% and other sources, 17.71 %. Business was observed to be last in this respect and generated only 0.98% of total household income at overall terms.

It is foreseen that after operation of RHEP project, the business activities will definitely have some impact and this would flourish due to increase in influx of the people resulting in demand for all daily-need products.

A similar trend is predicted for the whole Satluj basin when construction of the envisaged hydropower projects will start. Business establishments like vegetable shops, grocery shops etc, taxis, auto rickshaw etc will come up in respective regions. Hence, the development of the basin, in-general, would improve the living conditions of the local population by generating employment.

5.2.2 Accessibility to Basic Infrastructure

Infrastructure is a key facilitator of economic development. With the hydropower development in the region, improvement in basic infrastructural amenities i.e. roads, highways, public health institutes, telecommunications, water supply, electrification and hence, the economic development of the area is bound to happen.

For the various projects envisaged along the Satluj basin, from upstream Khab to downstream, which comprise the extreme boundaries of our study stretch, various infrastructural developments have occurred due to the progress of hydro power projects. These developments would, in the long run, i.e. even after when the projects are well-commissioned, be of great use to the inhabitant population.

However, the villages falling under influence areas had already had accessibility to basic infrastructural amenities like motor-able roads i.e. highways, access/approach roads, electricity, piped water supply, health centers, primary schools, Banks/post offices and Canals (khuls) for irrigation but due to hydropower project development, there has been improvement in road facilities. At various places pathways have been made, bridges have been constructed across nullahas and rivulets, which has significantly reduced the travel time and distance of the villages with nearby towns and also among villages of the area.

Generally, for the area, infrastructure building could be discussed under two different heads, one is building up of these facilities which are directly must for hydro power project development during construction stages, it could be of use of local people as well. Second category is these infrastructure facilities, which have been built up or proposed by the implementing agencies for the project-affected areas or indirectly catering to those areas as well, which are not directly affected by the projects. Below is the complied information on infrastructure amenities that have been built up under different hydropower projects:

Infrastructure building to cater the needs during project construction:

- For the movement of heavy trailer/ machinery up to Karcham, for execution of NJHEP and Baspa HEP –II, the highway has been widened with the quality improvement of road surface as well.
- For movement of heavy machinery during construction of NJHEP project, 15 m wide road has been constructed at right bank of the river up to Jhakri along with the connecting bridges, which has helped in connecting the local villages to the highway and hence, in improving their quality of life.
- From Karcham up to Khab, the widening of the road and strengthening of bridges (five in number from Jhangi to Khab) has been kept in the purview under Khab project.
- At Luhri, the existing High way from Shimla to power house site/ dam site will be suitably widened/ improved to 7-10 m wide specifications in about 80 km length to serve as approach road to the project site for construction. In addition, NH way will be re-aligned at some stretches where blind curved exist. Also a 70R bridge for crossing over to the right bank of river Satluj will be constructed near dam.
- Under proposed Luhri project, it has been proposed that schools and college education institutes, hospitals, market, recreational facilities at Nathan and Suni would be constructed for the staff posted on the project, which would also cater to the local village population.

Infrastructure building taken place during operation of projects also cater the needs of local village people:

- Under the NJHEP project, infrastructure has been created for nearby rural areas which, helped farmers in switching from the traditional subsistence farm production system to the high value cash crops in the area, which would ultimately helped in increasing the employment opportunities.
- A mobile Health Unit has been started under NJHEP project, which is functioning since January 2000. The unit makes four visits per week to nearby villages that include two in project-affected villages of Kinnaur district and two Shimla district. Through this, doctors of the team are also helpful in making the local people aware about common health diseases and ailments.
- A project hospital in NJPC colony at Jhakri at the cost of Rs.13.22 million has also been established under NJHEP project, which is also serving local people of villages.
- A 200-bed hospital has been constricted at Khaneri, Rampur by the State Government with the financial assistance of Rs. 80 million from the NJPC.
- A school has been established at Jhakri with a grant of Rs. 20 million from NJPC for the children of the staff. It is also providing quality educational facility to the local people and helping other schools to improve their existing level of infrastructure and quality of education. The project affected area villages have to pay subsidized fees for their children in this school, which is otherwise a very costly affair for them as compared to any other government school.
- NJPC also helping in building up of new infrastructure facilities or in improving the existing ones in government schools of the area in terms of construction of classrooms, play grounds etc. A sum of Rs. 70 lacs has already been spent on school building and playgrounds by the ER&R department of the NJPC. The school at Sansara village has been provided playground with the financial assistance from NJPC. Financial assistance has been provided for construction of school building at Shah village.
- The displaced shopkeepers were provided alternative shop plots in the market complex. NJPC has provided water supply, sewerage system, streetlight and other amenities in the market complex. All shops in the new market complex are of permanent type, unlike the old shops, which were kuccha structures.
- All the project-affected villages have been electrified and have provision of piped water supply.
- IPH has various schemes for renovation of water supply schemes for the local village people and the places where water sources have been dried up, alternate sources would be provided. NJPC is providing financial support to IPH for such schemes.

Similar provisions are expected to be provided by various project proponents of the various envisaged hydropower projects in the Basin. The living standards, access to infra-

structure, education and health and hygiene will improve considerably. The State Development Plan of the Government may incorporate such changes in anticipation.

5.2.3 Power Generation and Transmission Benefits

There is a broad consensus in the government to expand power generation by developing the country's hydropower potential, of which only 30 percent has been harnessed so far. The government has set the target for India's optimum power system mix at 40 percent from hydropower and 60 percent from thermal/nuclear power. The present ratio – at 25:75 – falls far short of this optimum, causing severe power shortages particularly during peak periods and technical and economic problems in grid operations. The country, therefore, plans to increase hydropower's share in power generation to 28 percent by fiscal 2007, and to reach the target of 40 percent over the longer term.

The following table shows the major hydropower projects along river Satluj, their generation capacities and transmission benefits:

Table: 5.8 Power capacity and Transmission aspects for various HEP in basin

S.No.	Hydropower Project	Power Benefits/ capacity	Power Transmission
1.	Khab	Capacity: 1020 MW	The proposed evacuation plan is under review as suggested by CEA in view of the various upcoming projects in Satluj basin.
2.	Baspa II*	Capacity: 300 MW (100 MW x 3) Generation: 90% dependable year: 1213 MU 50% dependable year: 1391.61 MU	A 400 KV D/C transmission line between BASPA-II to Jhakri.
3.	Karcham Wangtoo	Capacity: 1000 MW (250 MW x 4) Generation: 90% dependable year: 4463.88 GWh 50% dependable year: 4810.56 GWh	Evacuation system planned by Himachal Pradesh State Electricity Board.
4.	Nathpa Jhakri*	Capacity: 1500MW (250 MW x 6) Generation: 90% dependable year: 6684 MU 50% dependable year: 7425 MU	About 12% of the energy at Bus Bar is to be supplied to the State free of cost and about 25% of the remaining 88% will be supplied at bus bar rates to Himachal Pradesh.
5.	Rampur	Capacity: 434 MW (144.67 MW x 3) Generation: 90% dependable year: 1946 MU 50% dependable year: 2206 MU	Power will be evacuated by LILO of 400 KV Jhakri-Nalagarh D/C line at Duttnagar.

6.	Luhri	Capacity: 465 MW (155 MW x 3) Generation: 90% dependable year: 2037.15 MU 50% dependable year: 2260.50 MU	Evacuation system planned by Himachal Pradesh State Electricity Board.
7.	Koldam	Capacity: 800 MW (200 MW x 4)	Evacuation system planned by Himachal Pradesh State Electricity Board.

Source: *PFR Khab, Year 2004; PFR Luhri HEP, Year 2004; EIA for Rampur HEP, Year 2005; EIA for NJHEP, Year 1998*

* Operational projects

The Himachal Pradesh State Electricity Board is planning the evacuation system in totality in view of the multiple hydropower projects in the State.

The power generation will improve the quality of electrical supply to existing consumers, especially at peak times, and also benefit farmers and other consumers in the northern Indian states who currently have either no access or constrained access to electricity. While the benefits from the additional power generated are indisputable, the financial benefits from the projects are also immense for the Government of Himachal Pradesh as the state is entitled to get 12% free power generated from the projects and there would also be additional revenue earnings by way of direct & indirect taxes by the sale of electricity.

Coordination among different projects for peaking power generation: An analysis has been carried out for peaking power generation synchronization among various projects. For this assessment, the following projects have been considered:

- Khab H.E Proejct
- Karchham-Wangtoo H.E Proejct
- Nathpa-Jhakri H.E Proejct
- Luhri H.E Proejct &
- Kol Dam H.E Proejct

The distances between Khab to Karchham, Karchham to Nathpa, Nathpa to Luhri and Luhri to Kol along with the river bed levels at all the above locations have been given in Table below. The travel time of the releases for peaking generation during the lean discharges as well as maximum discharges have also been calculated and given below:

Project	**Distance in km**	**River bed level in m**	**Travel time at max flow in hrs**	**Travel time at lean flow in hrs**
Khab	0	2550	0	0
Karchham	100	1700	3.0	5.0
Nathpa	125	1450	3.75	6.0
Luhri	200	710	6.00	10.0
Kol	295	600	11.0	18.0

Synchronization of peaking power generation has to be undertaken accordingly as per requirement and can be coordinated by a single agency as has been suggested in the later part of the report.

Environmental and Social issues in transmission projects

Construction and operation of transmission lines and substations may involve environmental and social concerns that are distinct from each other in terms of their nature of impacts. Some of the environmental and social issues that could arise from its projects are unavoidable, and the endeavour should be to seek to address them through its management processes outlined as below.

The environmental and social issues typically associated with its projects are identified as below.

Environmental issues

- Lopping of Trees within Right of Way
- Clearing of Ground vegetation for movement of Machinery
- Clearing of Ground vegetation for substations
- Used transformer oil

Social issues

- Loss of livelihood due to acquisition of private agricultural land
- Loss of homestead
- Loss of common property resources due to acquisition of revenue land
- Loss to standing crop
- Change in land prices.
- Temporary loss of access to Common Property Resources

It should be endeavoured to avoid orchards, plantations, and forests in line routing through studies of alternative routes. If inevitable, care is to be taken to route the line through a path of least disturbance. The following points while routing its transmission lines should be considered:

- the route does not involve any human habitation;
- the route does not affect any monument of cultural or historical importance;
- the proposed route does not threaten the survival of any community, especially tribal communities
- the proposed route does not affect any public utility services like play-grounds, school
- and other establishments, etc.; and
- the line route does not pass through any sanctuaries, National park, or similar ecologically fragile areas etc

These issues are required to be addressed effectively for the complete Satluj Basin in view of large scale proposed hydropower projects in the basin and planning of evacuation thereof.

5.2.4 Social and Resettlement Impacts

For resettlement and rehabilitation (R&R) of project-affected persons, the important parameters are water quality, soils, land use, erosion and siltation, afforestation, health aspects and water pollution.. The Environment & Rehabilitation & Resettlement (ER&R) Cell in SJVNL monitors some parameters related to Rehabilitation & Resettlement itself. The other aspects of water, air and soil quality are being regularly monitored by Himachal Pradesh Pollution Control Board. An amount of Rs.7.04 lakhs/year has been earmarked by SJVNL to fund these studies.

Under Nathpa –Jhakri project, the NJPC has acquired a total land of 386.10 ha to create facilities, infrastructure and to resettle the displaced families. The private land acquired as a part of the total land acquisition is 239.50 hectares and that affected around 480 families in 22 villages. The number of affected families include 54 families, whose houses have been acquired, 87 are those whose shops have been acquired and 52 are those families who have been rendered homeless i.e. those who were left with less than 5 bighas (0.402 ha) of land after acquisition.

However, in year 1994, the rehabilitation plan was prepared by NJPC which includes provision of developed agriculture land to project affected rendered families so that each family has 5 bighas of land, provision of a house with plinth area of 45 sq mt, allotment of plots for shops at Jhakri market complex for displaced shopkeepers and provision of suitable employment to one member of each landless family subject to availability. As per the planned schemes in place, several actions have been taken by NJPC in this direction.

For Rampur project, a total of 80 ha land is to be acquired. Location and alignment of many projects appurtenances pass through private property i.e. agricultural fields, other private land. 32 ha of private land that is proposed to be acquired for various project appurtenances, lies in 3 villges, viz, Nermand, Dutt nagar and Bael. A Memorandum of Understanding has been signed between Govt. of Himachal Pradesh, and SJVNL to protect the interest of (Project Affected family) PAFs. The PAF, which is rendered landless on account of acquisition of land, shall be eligible for rehabilitation grant and cash compensation as per the norms of Land Acquisition Act.

R & R Implementation Plan of RHEP

The Environment and R&R Policy of SJVNL believes in “sustainable development within the carrying capacity of supporting ecosystems and caters to human needs so as to improve the quality of life”.

Involuntary displacement is unavoidable in the execution of hydro electric projects. The land required for setting up the project will be acquired under the Land Acquisition Act 1894 the State Governments after paying the compensation to the landowners. That such compensation will not restore the landowners the equivalent land or benefits is a known hard fact. Further, where the dependence of population is more on land for livelihood, the involuntary displacement results in loss of livelihood at least in the initial stage of displacement. To mitigate all these to the maximum possible extent, a Resettlement and Rehabilitation Scheme has been made an integral part of the MOU signed between the State Govt. and SJVNL Management on 20.10.04. The basic objective of this policy is to improve or at least to restore the standard of living of the affected population and also to improve Community and Area Development:

- To compensate families whose land or other assets are acquired for the construction of the project;
- To create better living conditions and to improve by and large the quality of life of people residing in the project area;
- To contribute to the overall development of the project affected areas.
- To create good rapport with the local people for long term relationship and mutual benefits.

Basic issues and need for R&R Action Plan

Acquisition of land generally induces change in land use pattern and can destroy the economic base. The R&R Action Plan is therefore formulated with an objective to resettle the oustees whose land/house/shop is acquired and to rehabilitate them in such a manner that they improve or at least regain their previous standard of living, earning capacity and production level. Besides, it is imperative that the transition gap is to be reduced to the minimum possible extent.

With proper resettlement and rehabilitation plan, an amicable relationship with PAPs can be maintained which is essential for efficient operation of the project. It is generally seen that the displacement during acquisition of land is involuntary and the PAPs have to face a new social set up. During such transition period, the rural economic environment is generally transformed into higher cost of living and reduction in traditional sources of income. In general, PAPs face difficulty to cope with the new environmental set up.

Domestic changes in the land use patterns substantially alter the agro based rural economy and life style of affected families.

Stakeholders

The project is for the benefit of entire nation and particularly for the region. The project involves various stakeholders. On one side we have Government of India , Government

of Himachal Pradesh and beneficiary states as stakeholders; and on the other side we have local population consisting of following ;

- Project affected population;
- Residents who own land in the project area but the same has not been acquired;
- Residents who do not own land and work as laborers / shopkeepers / other wage earners in the affected area;
- People pursuing own occupations or partially depending on forest, land or common land which they do not own but is like common property resource / land, which is being acquired or effected by the project;
- Institutions like school/ hospitals / dispensaries etc.
- Local organized groups like Mahila Mandals, Youth Clubs etc.

Relief Rehabilitation Strategies

- Each project affected family will be suitably compensated by the benefits such as monitory compensation for land, house and for both etc.
- General population other than the project affected persons or land owners will be offered various facilities to improve their living conditions so as to enhance their standard of living;
- The local population will be provided suitable guidance in the sphere of better technology and better knowledge base for better living conditions and better livelihood.
- Confidence building measures amongst the local population and project affected persons in particular to induce a sense of feeling of being cared and heard.
- General Development of the project area such as roads, foot paths, foot bridges and community development works etc.
- SJVN will provide guidance to the Project Affected Families for utilizing the compensation amount in such a way so as to sustain their livelihood. A team of executives including R&R Personnel will be formed, who will meet the PAFs collectively and individually for proper guidance and utilization of compensation amount for a sustainable future.
- Each PAFs shall be issued an Identity Card. This card will be issued by Project Authorities which will facilitate PAFs entry and project offices and also for the purpose of association in various activities of the project.
- Wards of PAFs will be considered for admission in the project schools, and the fee will be charged same as being charged from the wards of the SJVN employees as decided from time to time.
- PAFs would be invited to attend various functions organized by SJVN like 26th Jan/15th Aug/Raising Day etc.
- A Public information Centre (PIC) will be opened in the project area which will contain necessary information/details regarding project components and information pertaining to R&R for the benefits of the PAFs and local people. The PIC will remain operative for a period of one year after completion of the project.

Rehabilitation Action Plan: Specific Interventions

Compensation for Property Acquired:

a) **Direct Compensation**: The property acquired from the affected families shall be suitably compensated under Land Acquisition Act 1894 immediately after notification to this effect is made by Government of H.P.

b) **Other Benefits for Acquisition**:
In addition to above-mentioned direct benefits, other specific benefits will be provided by SJVN as part of their R&R scheme. These are as under :

Resettlement plan:

- For the purpose of the RHEP, about twenty project-affected families will be rendered houseless/ displaced families whose dwelling houses are being acquired. This will be certified by the Deputy Commissioner concerned. The resettlement measures for the project affected families rendered houseless under the R&R Scheme of RHEP include:

- Each project affected family which is rendered landless as well as houseless (both) or houseless will be provided an independent house with a built up plinth area of 60 sqm. Alternatively PAF can also be offered a plot of land which allows construction of built-up houses of 60 sqm. Plinth area plus construction cost of the house @ Rs. 3000/ per sq. m.

- A family which does not opt for house / plot but wants to construct house at own cost with a plinth area of 60 sq. m. or more(upto 50%) shal be paid the construction cost of the house @ Rs. 3500/per sq.m. Options from such families will be asked at an appropriate time . In case any such family constructs house of less than 60 sqm. Plinth area on own plot or plot offered by the Nigam, then the amount to be given will be worked out on pro rata basis.

- Resettlement cost includes resettlement grant for project affected families, built up houses for houseless families, physical mobilization cost/ stamp duty etc, financial assistance for acquired cattle sheds, transit plan /temporary arrangement for resettling the houseless families etc.

- Keeping in view the enumeration done as above, the PAFs in the context of R&R Plan are classified under the following categories as per the scheme for R&R approved by State Govt. as well as SJVNL. The category-wise number of PAFs, their entitlements as per R&R scheme and options offered for rehabilitation are given in the table below:

S.No.	Description	Entitlement
	Family whose land before acquisition was more than 5 bighas and is left with 1 biswa or no agricultural land after acquisition.	Rs.65000/- as a Resettlement Grant
B	Family whose land before acquisition was less than 5 bighas and is left with 1 biswa or no agricultural land after acquisition.	Rs.55000/-
C	Family whose land holding is left with more than 1 biswa and less than 5 bighas of land after acquisition.	Rs.45000/-
D	Family whose cattle shed is acquired.	Rs.5000/-
E	Landless as well as houseless family or house less/displaced shopkeepers.	Landless grant & house to be provided as per R&R plan.
G	Project affected families who are covered under the definition of "Project affected family".	1 Merit scholarship scheme for the wards of PAPs . 2 Petty contracts to the cooperatives of eligible families under self employment scheme 3 Support services to PAPs. 4.Income Generating Schemes,etc.
H	Displaced shopkeepers	i) Shops will be allotted in the market complex of Project township. ii) Displacement grant of Rs.10,000/- (one time). In case SJVNL is unable to allot shops then financial assistance of Rs.40,000/- will be provided to displaced shopkeepers.

- Infrastructural facilities at Resettlement Colony:

Several infrastructural facilities will be funded by SJVNL in the resettlement colony as detailed below. The exact quantum of work involved and the time period/duration required in each item will be worked out at the time of preparing the layout/details in Resettlement Colony.

i) A main road connecting the resettlement colony.

ii) Internal roads/paths linking all the dwelling units.

iii) Drainage facilities.

iv) Tree plantation on either side of the roads and other vacant areas will be taken up in association with villagers.

v) Electrification in the Resettlement colony.

vi) Drinking water facility for the occupants of the resettlement colony.

vii) Other facilities like community hall, playground in the resettlement colony depending upon the requirement of the occupants of Resettlement colony

Rehabilitation Measures:

Satluj Jal Vidyut Nigam Limited is a well established Corporation. Because of very limited manpower in Hydro Power Project, employment in SJVNL has not been kept as Rehabilitation option. However, some other options have been kept under Rehabilitation measures i.e. Income Generation Scheme, Merit Scholarship Scheme for the wards of PAFs, Awards of Petty Contracts, to PAFs, Jobs with Contractors etc.

Transit plan for Resettlement of the Houseless Families:

A Transit plan has been for resettlement of the houseless families during the transition period i.e. the period compensation payment and allotment of new dwelling house. After the receipt of compensation, houseless families will have to vacate their houses and this period is traumatic to arrange new accommodation on their own. The following provisions have been kept under this temporary arrangement for houseless families:-

1. To provide financial assistance of Rs. 2000/- per month for 18 months or till the allotment of constructed houses in resettlement colony.

or

2 To provide leased accommodation of two rooms (area upto 60 Sq. mtr.) by SJVN tohouseless families till the allotment of constructed houses in resettlement colony.

This financial assistance or leased accommodation will be provided by SJVNL to the head of the houseless family untill the allotment of constructed house in resettlement colony. After the allotment of the constructed houses, the leased accommodation would be vacated by the occupant and would shift to newly constructed house in resettlement colony within a week. Transportation cost would be borne by RHEP/ SJVNL.

Other Schemes to Families / Individual:

1.Income Generation Scheme:

The other options/ alternatives available for rehabilitation (for other than landless PAFs) would be the income generation schemes.

It is to be ensured that entitled rehabilitation assistance by individual PAFs is properly utilized. It largely depends upon the attitude of the PAFs and their occupation & economic background. Some of the Income Generation Schemes are dairy farming, weaving, Bee keeping, Handicrafts (cottage units) /business.

2.Merit scholarship scheme for the wards of PAFs:

SJVNL will encourage the wards of the PAFs who qualify for vocational training courses. SJVNL will pay scholarships for studying the vocational courses. If the wards from PAFs are not available, only then this scheme would be extended to the wards of permanent residents of the affected panchayats declared by the project. Where as no job commitment will be given to the trained wards of PAFs/ permanent residents of the affected panchayats. They may be given preference in SJVNL as per job requirements. These measures are expected to yield good results in a meaningful rehabilitation of displaced persons who have minimum educational qualification for such training.

3. **Technical Education Scheme for Local Youths of Project area:**

This scheme envisages training to rural youths in the vocational streams to be arranged by SJVN in the local Industrial Training Institutes so as to enable the youth to become self sufficient to find a suitable employment in the industrial sector or to venture out their own plan in the acquired skill.

4. **Scheme for Infrastructural facilities and other aids to school:**

RHEP /SJVNL is committed to social upliftment of project affected families. In order to supplement these efforts, a scheme for providing infrastructural facilities and other aids to schools from primary level to Sr. Secondary level situated in and around RHEP has been formulated. Various provisions like providing desks/chairs, and other furniture, library books, laboratory equipments, education aids etc. has been kept.

Community Development Infrastructural Works

Various infrastructural works and community development would be done for development of the area / project vicinity.

Infrastructure for the Community:

RHEP affected areas/villages are under developed although some basic infrastructural facilities are available. Demands for additional infrastructural facilities & community development works may be raised for the development of this area such as approach roads, internal roads, paths/ construction of kuhl/canal, water supply schemes , con-

struction of playground and augmentation of school, sanitation & drainage facilities/street lighting, construction of community welfare centers bus-stand, hospitals, rain shelters etc. These infrastructural works would be initiated on the resolution received from Gram Sabha of the concerned panchayats affected by RHEP.

- Infrastructural works & Community Development:

  The infrastructural works include approach roads, village paths, internal roads, construction of kuhls, construction of playgrounds, augmentation of schools sanitation & drainage facilities, street lighting, dispensaries, community welfare centres, cremation grounds etc.

- Total budget of Rs 1250 lacs is kept for the Infrastructural works and community development of the project vicinity and the area falling under RHEP. This fund would be spent in five years in eight affected panchayats of RHEP @ 2.5 crore per annum based on the fund allocated as per percentages of the total marks distributed to the panchayats i.e. panchayat population, population of the affected villages, numbers of affected families in the affected villages , area of Govt. land acquired etc.

- Infrastructural works after the construction of the project:

  Provision for the infrastructural developmental works in the villages falling under RHEP would be continued @ Rs 75 lacs per annum after construction of the project based on the resolution received from the Gram Sabha of the concerned eight panchayats falling under the affected area of RHEP.

Livelihood Support :

Petty Contracts & Jobs:

The project authorities will consider to award petty contracts to the cooperatives of the eligible families or PAPs on preferential basis so that some of them may be engaged in such jobs. Class-D contracts (financial limit of D-Class Contractor shall be as recognized by GOHP) will be earmarked exclusively for PAPs based on following preference criteria.

i) Project Affected Families.
ii) Project Affected Areas/Panchayats.

Jobs with Contractors:

Contractors will be advised to give unskilled jobs wherever possible to PAFs on preferential basis. Such a measure can provide employment to PAPs to a considerable extent until the implementation of Income Generation Scheme.

Hiring of light Vehicles:

Hiring of light vehicles is one of the employment opportunities for the PAFs. Light vehicles may be hired from the PAPs on preferential basis for RHEP.

General awareness , Community Development & Welfare :

Awareness Programmes /Camps/field visits to the affected families :

Awareness programmes will be organized for the affected families to make them aware of good measures in the field of Health and hygiene, nutrition, adult education etc.

Mobile Health Van for the benefits of project areas :

SJVNL is concerned about the health of Project Affected Families. Initially, a mobile health van has been put into operation for providing medical services to the PAFs and this will continue.

Support Services for Horticultural/Agricultural/Veterinary:

Support services for horticultural/agricultural/veterinary activities will be provided to PAFs through training programmes which will be organized to make them aware of the technical know-how to improve the quality of fruit/crops and breeds/health of their cattle. In these programmes, the participants will also be exposed to new practices by the experts in these fields. Some incentives will also be provided to the participants dealing with the horticultural/agricultural activities during training programme.

Protection/Promotion of Cultural heritage & old monumental property in project vicinity:

Displacement of people may disturb the pre-existing community structure and cultural heritage. Melas and local festivals etc. are cultural heritage in rural area. SJVNL will facilitate protection of the existing community structure by providing funds for promoting the cultural heritage and old monumental property in project vicinity.

Promotion of Sports activity in various Panchayats:

SJVNL is particular about overall development of the youth/children in project vicinity. SJVNL will facilitate promotion of sports activities in various panchayats falling under RHEP by way of organizing inter panchayats sports tournament including providing of sports kits etc.

Support for Local Fairs & Festivals :

SJVN support is also envisaged for the local fairs and festivals which are organized from time to time in and around the project area. Since local public has strong belief in holding these these fairs and festivals, support to such activities from time to time will imbibe a sense of belongingness to the project amongst the local persons.

Restoration of Infrastructure damaged due to Construction of the Project :

a.) Individual Infrastructure

Compensation in view of likely damages to private property due to blast damages:
As experienced in NJHEP, during execution of underground works in the project may affect the surrounding area and damages might occur in dwelling units/private property. Hence compensation may be paid to compensate these damages to the affected villagers, if damages occur in their dwelling units due to blasting works.

b.) Community Infrastructure

Drinking water supply schemes / Restoration of dried up water resources.

As experienced in NJHEP during execution of underground works may affect natural water resources and that some natural water resources may dry up due to project activities. This demand has already been raised in various meetings with local bodies and panchayats. If water resources are dried up due to project works, the same will be restored and drinking water supply schemes will be provided.

Other Infrastructure.

Any other infrastructure damage due to project activities shall be repaired by SJVN.

Major Infrastructural Works for the Area :

Bus stand and senior secondary School at Rampur: Keeping in view the area development, a provision of Rs. 1200 lacs has been kept for the construction of the bus Stand at Rampur and additional accommodation for the Sr. Secondary School at Rampur.

Following major works other than two referred above are also being constructed by the project authorities. These additional works are useful for the local public.

a. Bridges in the project area:

For the development of RHEP affected areas, it has been decided to construct three bridges in the project area.

a) Bridge at Jhakri of span +/- 78 Mtrs;
b) Double lane bridge at Duttnagar(+/-125 Mtrs);
c) Double lane permanent bridge at Kunni Khadd.

b. Widening of the existing roads from Wazir Bowrie to Bayal and approach road to bridge at Wazir Bowrie :

The existing road is narrow which will be widened for construction activities. This will also facilitate development of the area.

c. Electric Substation (31mva) at Bayal to be utilized for power requirements of nearby villages:

Electric substation will be set up to meet the requirements of RHEP. A fund of Rs. 20 crore has been kept for this purpose. The electric Power availability and voltage level of this area will considerably increase and the local inhabitants of this area may set up small industries for their livelihood.

d. Rampur By-pass Road:

Fund of Rs. 2317 lacs has already been spent by SJVNL for Rampur Bye pass road.

It can be said here that in all the projects being developed or proposed to be developed in the Satluj basin will also adopt rehabilitation and resettlement measures on the similar lines as MOU with the state government with the developer keeps such provisions to keep R & R impacts to the minimum and living conditions of the people to be better than the earlier. These could also serve as benchmarks for the future R & R plans in the basin.

5.2.5 Human Health Risks

The information on health profile of the area as provided earlier (ref. Chapter 4) does not indicate any prevalent disease in the area, however, the number of patients suffering from G. Entritis, Diarrhoea and Dysentery generally increases in month of April, May and June, which is lean season in terms of flow availability in the river/streams. The total no. of patients as reported in Khaneri Hospital, Rampur in year 2005 during these months was 22, 49 and 43 respectively.

An area has unique characteristics in terms of climate that mosquitoes do not breed, but due to large influx of floating population (labours etc.) especially during construction stage of the projects and due to formation of reservoirs at dam sites, there could be a possibility of spreading vector borne diseases like malaria etc. among labours. In case these vectors are established post-medical care may have to be intensified.

The dam construction involves many diversified activities and requires large number of human work force. The change in population density through immigrants/in-flux may cause new health problems in this region i.e. HIV/AIDS etc. People may carry different types of contagious diseases that may spread in locality. In flux of human work force may also bring stress on available drinking water sources and sanitary facilities. The additional domestic sewage generated may cause drinking water contamination resulting in spread of enteric diseases in the absence of proper precautionary measures.

Due to impounding, it is likely that in due course because of increase in water detention period, decrease in dispersion of waste and aeration, and thermal stratification, algal growth may occur which on decay create taste and odour.

Management Interventions

1. Community Health Outreach Programs to emphasize long-term improvements in region's health status:
    - Augment existing government and NGO health programs.
    - Place high priority on health education for local project workers and community residents.
    - Vaccination programs - meningitis, tuberculosis & tetanus

2. The lack of existing data on prevalence of STDs requires that an HIV/AIDS specialist study be conducted to determine mitigating measures that are required at appropriate stages of the project. A range of management interventions are given below to prevent HIV transmission and to manage the impact of AIDS:

    - **Specific HIV prevention activities**
        - HIV/STDs/AIDS awareness centres for IEC (information, education and communication) activities
        - Peer education programmes within the workforce
        - Condoms provision
        - Training of health personnel, social marketing of condoms, technical and material support to STD clinics, etc
        - Integration of HIV/AIDS into thematic projects (e.g. emergency training)
        - Workers periodically brought out of the field with pay to receive health and safety training

    - **Specific HIV/AIDS management & mitigation activities**
        - Voluntary counselling and testing for education, free condoms and screening for sexually transmitted diseases.
        - Treatment
        - Provision for ART (Anti-Retroviral Treatment)
        - Medical Aid policies for workforce

- **Addressing "vulnerability" of the workforce**
  - Adjust labour recruitment policies to:
    - support better distribution across gender groups
    - promote use of local labour
  - Improve labour housing to accommodate families and enhance integration into the local community
  - Recreation provision
  - Remittance provision
  - Labour transport

Various organisations and NGO's already are involved in organising such awareness programmes. CII Himachal Pradesh State Council organised a HIV/AIDS sensitisation programme for Industrial Workforce of GPI Textiles Ltd and Drish Shoes Ltd at Nalagarh, Himachal Pradesh, in June 2006. With a view to galvanise awareness and support of youth towards the issue of HIV/AIDS, staff from HP State AIDS Control Society also attended the seminar.

There is a need for meaningful consultation with local communities so that management measures are culturally appropriate locally, and will have community support. Wherever possible, HIV/AIDS/STD management plans should be compatible with and integrated with local, regional and national initiatives, and be implemented in consultation with government, CBOs, NGOs and potentially clients and suppliers.

It is recommended that preventive measures like conducting awareness camps and free health check ups be introduced at early stages in the regions where hydropower projects have been envisaged in the Basin, so that the local population is aware beforehand.

5.2.6 Cultural Heritage loss

As motioned n Chapter 4, no archeologically or historically important sites exist in the study area and hence no impacts are foreseen. However, few of the old structures like temples exist near Rampur, Sarahan and Khab. Due attention should be given for protection of these old structures before taking up any development/construction work under proposed hydroelectric projects because of their religious and tourism importance.