



6 SUMMARY RECOMMENDATIONS

A river as a natural resource comprises social, economic and ecological aspects that should be utilized optimally for the welfare of the people. Hence, in this particular section, broad solutions have been provided considering need of overall socio-economic and environmental development of Satluj River Basin. Also, the business solutions for effective utilisation of natural resources existing within the river basin have also been discussed.

For the overall effective environmental management of the Satluj River Basin, there is a strong need for managing water uses and water quality, for development of river environment and water-resources infrastructure, development of flood control measures and introduction of research and development (R&D).

The broad solutions have been framed for overall Effective Environmental Management in the Satluj Basin including following:

- Business solutions for effective management
- Water Management for managing the use of water for irrigation, human consumption etc.
- Socio-economic development of the region
- Involvement of all relevant government agencies including sectoral agencies, hydro power regulators and local government etc and their roles and responsibilities
- Special interventions needed for RHEP and NJHEP influence areas
- Interventions needed for flood management

To achieve goals of effective environmental management in the Satluj River basin, the following are recommended:

- For the development of entire Satluj river basin, all proposed hydro electric projects should be reviewed considering conservation of natural environmental resources, public service and economic viability as prior issues.
- Those who obtain the utilization and amenity benefits from the water and water resources of the Satluj and linked perennial and seasonal streams, infrastructure should gradually bear the cost of river-basin management including local habitat.
- For overall conservation and sustainable development of the Satluj River Basin, commitment is also required from local habitants. Local people should be involved in decisions on all management aspects i.e. planning, implementing, supervising, controlling and funding. A coordination body could be framed to keep a check on all planning and development work related to Satluj river system. This committee could be referred to as a Satluj Resources Management Committee (SRMC).



- For the management of entire river basin, major perennial streams/khads should be undertaken for the conservation and development work on priority basis by considering the socio-economic and environmental aspects linked to that particular stream/khad in terms of social status of the people, water demand, level of utilization, water availability and terrestrial /aquatic ecology etc.
- Efforts should be made to corporatize the development activities of Satluj river basin by using the potential of both central and local government-owned corporations, public-private cooperation and private companies.
- It is recommended to have zones of development along Main River and along main streams based on usage of water and other natural resources and paying capacity of local habitat in the area. Based on zoning mechanism, a Corporation may be formulated at Zonal level to keep a check on local development of the area.

Strategies for Hydro development

Himachal Pradesh has an enormous hydro-potential. Through preliminary hydrological, topographical and geological investigations, it has been estimated that about 20463.5 MW of hydel power can be generated in the State by constructing various major, medium, small and mini/micro hydel projects on the five river basins. Out of the total hydel potential only 3275.25 MW has been harnessed so far.

From the Sixth Plan onwards, the hydro-power generation in the Pradesh has been accorded top priority as it will bridge the gap in the demand and supply in the northern region of the country. During the Tenth Five Year Plan, a phased programme had been chalked out to take up various major, medium, small and mini/micro projects in the State besides completing the ongoing projects as early as possible. The State Government had prepared an ambitious plan to accelerate hydro generation by adding 459 MW power under state sector during the 10th Plan i.e 2002-2007 in comparison to earlier achievements of 139.5 MW in 7th Plan, 27.30 MW in 8th Plan and 33.50 MW power in 9th Plan period. Accordingly, the State Government has undertaken several projects. The sites thus identified by the State Government are complying with the guidelines prescribed by the Central Government and the procedure thus followed insists upon the greater public consultation, better monitoring of environmental and social aspects of projects, improvements in resettlement policy and practice, as well as in institutional capacity related to project identification, engineering and design.

It has been envisaged to exploit the hydro-potential of the complete Basin, with projects like Khab in the upper reaches, 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 which was completed in 1963.

Given a large number of operating and proposed projects in the Satluj Basin, over the time, it is anticipated that in their immediate vicinity of influence and beyond, there would be direct and indirect environmental and social impacts. 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 induced and cumulative ill-effects associated with them too, like impact on ecology, alteration in water temperatures and chemistry, impact on erosion, impact on frequency of disasters etc.

A careful approach and a wider perspective have to be adopted to manage and sustain hydro development. Some of the approaches and interventions could be related to state government policies, involvement of state owned utilities, federal generating units or private participation as well as environmental and social commitments and compliance. These have been discussed in subsequent paragraphs.

The state government should adopt a multi-pronged strategy for speedy development of its hydro power potential. Its main elements could be:

- to involve 'proven developers' for the larger projects.
- to make for a 'time-bound and committed development' by the developer.
- to plan to facilitate development of 4-5 projects simultaneously at any given location by the various developers this helps to achieve benefits of time and cost-reduction by the state through 'competitive bench-marking' amongst the various developers operating at the same time.
- as per the nationwide studies undertaken by Central Electricity Authority, various potential sites in the state could be ranked to determine priority in their development. Preliminary and pre-project actions such as detailed surveys and investigation and preparation of DPR for the various sites should be undertaken in order of priority.
- Steps would be taken by the state government to enhance human resources in the area of hydro power through prestigious technical institutions

The thrust on hydro power should aim at a 'harmonious blend' of public-sector and private participation.

The state government is emphasizing more on doing business with the federal generating companies or through private participation as they had the manpower, the experience and the technical ability to undertake small, medium and large hydro projects. They could also raise financial resources easier, both from within and outside India. With their past precedents, they could also obtain the various domestic clearances and approvals more easily.

The engagement with these developers could have arrangements for to:

- Carry out a survey and investigation, prepare a detailed project report, including a catchment-area plan, and conduct an environmental assessment study.
- Prepare and implement a rehabilitation and resettlement plan as per the state guidelines and the federal policy on the subject.
- Obtain the various approvals and clearances, with help to be rendered by the state government where required.
- Arrange all finances required to implement the project.



- Acquire the project-land, with the help of the state government if so requested by the company.
- Endeavour to adhere to the deadlines for commissioning the project.
- Evacuate power to be generated by the project, through an integrated transmission system to be developed by the state/ federal agencies for that river-valley and which would connect the project to the national power grid.
- Render 12% of all power generated by the project, free, to the state government.
- Resolve all disputes through arbitration, where mutual discussions fail in that regard.

Most of the above parameters proposed above are in line with the federal guidelines.

6.1 Involvement of all relevant government agencies and their roles and responsibilities

The stakeholder involvement for the river basin development may be categorised in following three categories:

- The government, as the owner of the water resources and infrastructure, and to enhance the national welfare, should play the role of controlling, regulating and policing at the national and regional levels. It has also the right to have part of the revenue that the river-basin management institution gains while, on the other hand, it is obliged to contribute funding for activities towards public safety and welfare.
- The State level agency e.g. Satluj River Basin Management Agency (SRBMA) may be formulated and as the operator, it should have authority delegated by the government to manage water resources and infrastructure, perform river-basin management and develop the management system.
- The river-basin management institution should have the right to collect fees from the beneficiaries as well as to receive contributions from the government for public-safety and welfare activities.

To provide good services and promote public and private participation in the river-basin management, as well as give accountability for performing tasks for the government and society, the above mentioned three level stakeholder consultation has been suggested to have overt all river development and management .

Society, as users, has the right to receive good services and participate in decision-making processes, but it is expected to use water efficiently, take part in sustaining the environment, provide its financial responsibilities and, finally, provide constructive social control on river-basin management. Legal bodies and social bodies, such as water users associations, are also a part of this system.

Water-resources management should be conducted by a Satluj River Basin Management Agency (SRBMA), a neutral and professional institution, which applies a balanced approach in its undertakings as well as protecting public interests in water-resources management and relying on public and private participation.

The overall tasks of SRBMA could include the following:



- Development of Satluj river basin by conserving the river as an integrated part of the ecosystem, while preserving its economic potentials and functions for the people's welfare.
- Improve the performance of river-basin management in a useful manner.
- Improve public and private participation in water resources management, including payment for services, in order to reduce demands on the national and regional government budgets.
- Develop a harmonious and well-motivated working environment to sustain prime class service for public demands through competent management of water resources infrastructure for stakeholders' satisfaction.

Scope of work for SRBMA

The basin Agency should develop master plans (including coordination with related agencies) in conservation, water-resources development, water-pollution control, and flood control and land use of riverbanks. It should operate and maintain water-resources infrastructure, manage water and water resources and carry out watershed conservation in coordination with related agencies.

It may be highlighted that to address the ecological issues threatening the Satluj river's power potential, SJVN has already taken an initiative to launch a Satluj Basin Power Producers Forum and it has been launched formally in November 2005. The combined forum would develop a comprehensive approach towards problems of high silt content, flash floods and evolve a strategy for the plans related to environmental issues and data sharing systems for mutual benefits. The forum will offer technical expertise for environmental management and general area development. It is proposed to work out an integrated catchment area treatment plan and strategies so as to provide opportunities of joint learning and avoid duplication of efforts and expenditure.

6.1.1 Forum of Hydropower Developers of Satluj Basin

I. Preamble

The power potential of Satluj basin has been estimated at more than 10,000 MW installed capacity. 17 power plants of capacity 100 MW and above have been identified in Satluj basin, of which four are under operation, two under construction and others in the planning/ investigation stage. Presently, only Bhakra dam is a storage dam project on Satluj river. Kol dam project, immediately upstream of Bhakra dam, has a limited life of 18 years to function as a storage dam after which it has also to operate as a run-of-the-river plant. Nathpa Jhakri Project, the biggest power plant on Satluj with an installed capacity of 1500 MW is also a run-of-the river scheme. Although most of the other projects on main Satluj river and its tributaries are planned as run-of-the-river schemes, but keeping in view the acute silt problems in such schemes, a thinking has been generated that it is necessary to have some storage dam projects in the Satluj basin for improving functioning of downstream projects. Satluj river largely runs through a narrow gorge upstream of Kol Dam and enough storage at just one dam site with reasonable height of dam between 200-250m is not available. Reservoir flushing from the diversion structure at the existing/ proposed power plants is an essential part of operational strategy and flushing may also have to be resorted to through the envisaged storage dams to prolong their life.



As there are power plants in cascade in Satluj basin and there are numerous developers in the Private sector, State sector and Central sector operating in the basin, a consensus on co-operation strategy, for operating existing as well as planned power plants, is essential. It is also necessary to reduce the impact of silt which would yield beneficial results to all the power plants operating/ planned in the basin. Long term measures for silt control like catchment area treatment through vegetation, toe walls and bench development to stabilize slide prone areas, check dams etc. are essential. Since the benefits of silt control measures in the catchment shall flow to all the power plants in the basin, it is necessary to share the expenditure on these measures as it involves not only huge expenditure but one or two projects cannot be loaded with extra cost which would offset basic viability of the projects.

Further, the basic inputs for planning of the power projects in Satluj basin are the river discharge, silt load and other meteorological parameters. Presently, there is duplicacy in observing these data and agencies like BBMB, HPSEB, SJVNL, CWC, NTPC etc. are recording the data to meet the requirement of an individual organization. Since the planning and development of the power potential in the basin keeping in view peculiar considerations, has to be based on systematic basin analysis, it is necessary that a joint understanding on maintenance of these observation sites and exchange of data between various organizations be resorted to as per their requirement thereby not only curtailing recurring expenditure but also avoiding duplicacy. Similarly, testing laboratory could be upgraded with the state of the art facilities on shared basis.

Treatment of the catchment area through CAT plans and other measures may also be done in a comprehensive manner for the whole of the basin.

There are certain laws, regulations and guidelines issued by various authorities including Govt of India & State Govt. which have an impact on the working of power projects in Satluj basin. The latest is the requirement of minimum discharge in the river during lean season. There is a need for power producers to take up such matters jointly.

While operating power stations in cascade as is likely to be the case in Satluj basin, several issues are likely to come up and co-operation would be required amongst all the power producers.

It is to the above ends, that a permanent Forum of Hydropower Producers of Satluj Basin is desirable.

II. OBJECTIVES

*To cooperate and monitor schemes & strategies under the following “**Five Point Programme**” as hereunder to achieve common goals and objectives and suggest means & measures for their effective / efficient implementation and to explore the possibility of fruitful cooperation in the energy sector, beyond the initial scope of Forum amongst the member organizations and other Regional / Basin wise or individual organizations engaged in Energy Sector.*

1. Environment:

To join efforts to pursue the goal of eco-friendly energy and to evolve integrated Catchment Area Treatment Plan for the Satluj Basin comprising afforestation, check dams and slope stabilization.



2. Operation of Power Stations & Sharing of Technical Expertise and Experience

To join hands for comprehensive planning of operations of power stations in the Satluj Basin for unhindered operation and optimized utilization of run off and to pool the expertise to tackle eventualities of operation outages due to floods or mishaps to achieve reliable energy for the people of India for a sustainable economic growth.

3. Data Sharing

To create, upgrade and share facilities to generate input data such as discharge data, silt data, meteorological data and share / utilize common Laboratory testing facilities.

4. Disaster Management and Planning

To develop and implement effective flood forewarning and disaster management systems.

5. Common Issues with State Government & Government of India

To share views and derive common approach towards implementation of guidelines and statutes of State / Union Government and communicate constructive suggestions / modifications / alterations.

III. CONSTITUTION

- i) Chairperson: CMD/ CEO of one of the member Organizations by rotation.
- ii) Members: All CEOs of Member Organizations, one Director/Member and Nodal Officers appointed by the Member Organizations
- iii) Member Secretary: Nodal Officer of the Organization whose CEO is Chairperson.
- iv) Working Committee: All Nodal Officers appointed by the Member Organizations.

IV. TENURE

The tenure of the representative body is perpetual and the Chairperson shall be one of the CMDs/ CEOs of the member organizations for one year on rotational basis.

V. SCOPE

The Forum shall deliberate issues concerning member Organizations, related to the Objective, suggest strategies/ programmes and take up common issues with the Union/ State Governments.

VI. PERIODICITY OF MEETINGS

The Forum shall meet on quarterly basis minimum or at such frequent intervals as deemed necessary at the level of Nodal Officers representing member Organizations. The Forum shall convene a Conclave of Member Organizations on Annual Basis to be attended by the CMDs/ Chief Executive Officers of Member Organizations. The Meetings / Conclave shall be hosted by the organization to which the Chairperson for the tenure, belongs.

Functions of Forum Of Hydro Power Producers Of Satluj Basin

The Forum shall formulate / implement and monitor schemes & strategies under a “Five Point Programme” through cooperation amongst the member organizations.



1. Environment

The Forum realizes the importance of preserving the environment and maintaining the nature's balance. Hydropower, utilizing an environment friendly & renewable resource flowing in our rivers can further contribute towards this end by devising the Catchment Area Treatment Plans in a manner suitable to the region and benefiting the local populace together with the control of soil erosions, landslides and taking up afforestation.

The Forum shall discuss amongst the member organizations to evolve an integrated Catchment Area Treatment Plan for the whole of Satluj Basin to avoid any duplication and use collective wisdom & experience in tackling the problem areas specific to the basin. The Forum shall hold discussions with the Forest Department, GOHP and seek their advice in the formulation of the Integrated CAT Plan. The Forum shall develop a mechanism to monitor amongst the power producers themselves, to monitor that the Projects in the basin do no harm to the river water by pollution and dispose the muck at designated sites in the prescribed manner.

2. Operation of Power Stations and Sharing of Technical Expertise & Experience

The Forum shall discuss and finalize the operation of already commissioned Power Stations in the Satluj Basin for avoiding any hindrance and optimized utilization of run-off. A plan shall be prepared for the upcoming Power Stations in the basin.

The Forum shall pool the expertise available with the member organizations to tackle eventualities of operation outages due to floods or mishaps to achieve reliable energy for the people of India for a sustainable economic growth.

3. Data Sharing

The Forum shall discuss and formulate a Plan to generate input data in respect of discharge, silt & meteorological observations and share / utilize common Laboratory testing facilities. For the purpose, the member organizations shall be asked to submit the information regarding the existing facilities concerning hydro-meteorological data and their extent on time scale along with the Laboratory testing so as to plan the requirement catering to the Basin as a whole, their up gradation and the fund needed/ sharing pattern for the same.

4. Disaster Management and Planning

The Forum shall share the experience of the member organizations in tackling the flash floods and eventualities arising out accidental flooding or massive landslides. The experience in crisis management and long term measures adopted for the remedies such as forewarning shall be discussed.

The data on the latest systems/ techniques available around the Globe shall be collected to plan and place in position the state of the art Flood Forewarning and Disaster Management System. Dedicated cells shall be planned to cater to the requirement towards this objective and the necessary training shall be organized for the concerned personnel in individual member organizations.



5. Common Issues with State Government & Government of India

The Forum shall discuss the issues common to the Member Organization with respect to the guidelines and statutes of GOHP/ GOI and formulate a common approach for taking up the issues and shall present before the concerned Governments, constructive suggestions for any modifications or alterations.

The Forum shall also look into the possibility of enhancement of its scope of cooperation with the Power Developers engaged in the Energy Sector in general and those in the other river basins of Himachal Pradesh.

6.1.2 Issues related to Catchment Area treatment

It is well established fact that the reservoirs formed by weirs/dams on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential process of erosion, entrainment, transportation, deposition and compaction of sediments. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity and thus affecting the water availability for the designated use. The eroded sediments from catchment when deposited on stream beds and banks causes breaches of river reach. The removal of top fertile soil from catchments adversely affects the agricultural production. Thus a well designed catchment area treatment plan is essential to ameliorate the above mentioned adverse process of soil erosion and maintenance of ecological balance including atmospheric equilibrium which is vital for sustenance of all life forms, human, animal and plants of valleys. Therefore proper soil and moisture conservation treatment, bio-engineering works, habitat improvement by way of incentive management of wildlife sanctuary and eco development activities are required to be carried out in the catchment area. The human and cattle population living and around the area are dependent on natural resources of forests because of which a greater emphasis has to be laid to undertake afforestation, pasture development, bio-diversity conservation with soil and moisture conservation works in the catchment area including eco development activities panchayats with the provision of alternative sources of domestic energy on a subsidized basis (50% cost to be given by beneficiary) to reduce pressure existing forest areas.

The Satluj river basin has been studied from the soil erosion vulnerability point of view. To ascertain soil erosion intensity parameters, a universal soil loss equation (USLE) modelling has been carried out. The following thematic layers were used for the modelling purposes:

- A latest land use map derived using latest satellite imageries of the basin
- Slope map derived using digital elevation model (DEM)
- Soil map of the area

Based on the modelling results, a thematic map for soil erosion intensities have been shown in Chapter 5, Fig 5.2. It is inferred from the modelling results that area in and around Karcham area up to little upstream of Nathpa dam is most vulnerable to soil erosion. Catchment area treatment measures should be undertaken in an integrated for vulnerable areas of the entire Satluj basin. The Forum for hydro power producers have already decided to discuss amongst the member organizations to evolve an integrated



Catchment Area Treatment Plan for the whole of Satluj Basin to avoid any duplication and use collective wisdom & experience in tackling the problem areas specific to the basin. As there are many protected areas in the basin, the CAT measures should keep focus on PAs also.

The Catchment area treatment should mainly focus on:

- To achieve in situ and ex situ conservation and also ecological rehabilitation in the projects areas leading to an all round eco-development activities on sustainable basis.
- To initiate measure to rehabilitate the degraded habitat through afforestation of native species and assisting of natural re generation
- To improve alpine pasture land for augmenting grass and fodder availability and to solve the problem of grazier
- To carry out soil conservation measure in the catchments to ensure longevity of projects
- To increase the potential/production of the bio mass in the area and to ensure sustainable use of natural resources
- To provide employment to the local people by engaging them in project activities such as afforestation, fire , anti poaching, rural infra structure activities and other works except soil conservation works
- To build capacity of PA's staff in wildlife management skills by providing training in India and abroad to meet the challenges of 21st century
- To strengthen the extension and follow –up activities i.e. monitoring and evaluation of wildlife management and forestry development activities, publicity, motivation and extension programme to be given the desired focus

Components of CAT

CAT plan project should be designed to develop the project area in an integrated manner by improving the vegetative cover over the degraded and blank areas and also to treat flood prone areas to stabilized nallah, river banks and landslips by providing suitable bio-engineering structure and various soil conservation measures. Apart from that one of the most important parts of successful wildlife management, habitat improvement and its manipulation as per the needs of wildlife conservation along with anti poaching, fire control measures with mitigation of human-wildlife conflict in PAs. The important steps to be undertaken in this regard during the project period are as under:

- ❖ Management of protected areas- in situ conservation
 - Habitat improvement
 - Biological works
 - Afforestation of degraded forest land
 - Enrichment plantation
 - Assisted natural regeneration
 - NTFP (non timber forest produces) plantations
 - Nursery development
 - New nurseries development
 - Maintenance of nurseries



- Treatment of culturable waste land
- Treatment of alpine pasture
- Construction of water holes
- ❖ Soil and moisture conservation
 - Landslides/slips stabilization
 - Nallah stabilization
 - River bank stabilization
- ❖ Protection of forest and wildlife
 - Fire protection
 - Anti poaching measure
 - Demarcation of boundaries and construction of boundary pillars/check pillars
 - Construction of forest barriers/check posts
 - Communication network in Pas
 - Sign and slogan boards
 - Reward/incentive to informers
 - Wildlife census operation
 - Compensation against wild life depredation
- ❖ Mitigation of human-wildlife conflict
 - Eco-development activities
 - Village support activities
 - Distribution of CGI sheets
 - Distribution of GI pipes for installation of religious flag
 - Construction of Sulabh shauchalayas
 - Construction of cattle pond
 - Construction /repair spring water bowaries
 - Vaccination of domestic cattle
 - Fuel saving devices
 - Distribution of LPG cylinders
 - Construction of crematoria
 - Distribution of solar lights
 - Income generation activities (IGA)
 - Vermi composting and organic farming
 - Raising of nursery and cultivation and sale of NTFFP
 - Bee keeping
 - Flori culture
 - Extraction and sale of oil from stone fruits
 - Agricultural improvement/horticulture and vegetable farming
 - Animal husbandry support and dairy development
 - Sustainable eco-tourism development
 - Construction of trekking routes
 - Development of camping sites
 - Training of local youths for tourism activities
 - Maintenance of local temple as local cultural, heritage and hill architecture
 - Field equipment and medicines for management of wild life sanctuary
 - Development of forest infrastructure in PAs
 - Construction / maintenance of B/paths and I/paths



- Construction of I/hut
- Construction of building/transit camp
- Construction of information hall/training hall
- Construction/repair of bridges
- Research and studies
- Training of forest officers/officials in India and abroad
- Publicity nature awareness camp, exposure visit and extension programmes/workshops/meeting and evaluation etc
- Operation support/establishment

CAT measures formulation objective should also be to improve the productive potential of natural resources and increase incomes of the rural households using socially inclusive, institutionally and environmentally sustainable approaches. Improvement in soil fertility of the existing arable lands through environment friendly technologies by emphasizing the use of biological inputs should be considered. The synergies between different watershed development programmes in the basin would lead to favourable impacts in the form of reduced soil erosion, increase in green cover, fodder sources, people's participation, equitable sharing of benefits, transparency leading to enhanced incomes etc. The implementation of catchment area treatment measures should be over by the dam construction is complete. Only maintenance could exceed beyond the construction periods.

6.2 Institutional Issues

Recommendations for state

Out of total geographical area of 55673 sq km, the reported area of Himachal Pradesh is 34024 sq km up to the year 1994-95 which means that an area of 21648 sq km is yet to be surveyed. Though there are two settlement circles working in the state yet the priority assigned for taking up settlement operations does not seem to have adequate considerations. It is also observed from State of Environment report that state owned forests have increased merely by 35 sq km during past 29 years which can not be termed as satisfactory progress for a hilly state HP. Suitable policy guidelines are required for government to document on forest for right holders for extracting timber and from grazers for grazing their cattle needs.

- The vestment of village common lands in the government since early seventies the village community believes that maintenance, preservation and regeneration of forests in general is the duty of state government.
- There is also a need of proper management of vast wasteland for which demarcation programme is already going on. This requires monitoring and proper coordination
- The problem of soil erosion in vast wasteland for the depleted and degraded forest produce must insure that the off take is less than regeneration. The average annual removal of trees is about 4 lakh cubic m which is quite high. Afforestation programmes must reckon on with this rate.
- It is also important to initiate necessary measures to preserve the run-off water and also to strengthen the irrigation base by making maximum use of available



water resources as this will help in improving land use pattern. It has been observed that net irrigated area has increased from 16.6 % to 17.7 % for last 29 years which is not at all an encouraging trend.

- Landuse pattern improvement has to be planned properly by state landuse board (SLUB) whose functioning is yet to be improved.
- Flori-culture needs to be strengthened along the stretch of Satluj basin
- Realizing the role of irrigation in agricultural production, the ministry of water resources has laid new thrust on farmer's participation in management of irrigation. This needs an improvement in HP
- Tourism is being developed as stand alone development in the region. However carrying capacity analysis and EIA be used as pro-active development control tool in developing tourism projects.

The above issues make us to understand that so far, government of HP has not come up with a detailed development plan in the Satluj basin in view of various hydro and other developments. The state must introduce an integrated development plan of various sectors in Satluj basin for which a sincere effort based on detailed carrying capacity study of the basin keeping in view environment and development side by side is an urgent an important solution.

6.3 Business solutions for Effective Management

To achieve sustainable development in river basin, the budget for river basin management needs to be secured. This requires beneficiaries to gradually bear the cost for the river-basin management through the application of the following principles.

- The beneficiaries-pay principle consists of the users-pay principle, where the water users pay water use fees and taxes; and the polluters-pay principle, where the water polluters pay pollution fees and taxes.
- The government-obligation principle applies for funding semi commercial water use (hydro-power, irrigation etc) and social services (flood control, water-quality control, water-resources conservation).
- The participation of Private-Sector should be explored and promoted in all hydro development projects taking place in Satluj /river Basin to keep a regular flow of capital in order to take up the various development activities in the river basin

The basic concept of private sector participation is as follows:

- Private sector participation means a concession given by the government.
- The private sector has a right to have revenue.
- The government gives protection, assurance and regulation.
- Private-sector participation does not overburden the users.

Water and water resources may be developed by the private sector under the conditions that:

- The water user should have a license from the government.



- The water use is based on a principle of cooperation.
- The water user should keep conserving the ecosystem.

Water is an economic good that has a social function as well so that it should not be managed merely commercially or merely socially. Based on this concept, private sector participation in the development and management of water resources could be carried out through a partnership with the SRBMA. The SRBMA functions as the government's agent in managing water resources to keep the balance of the two, in order to achieve the business purpose as well as to keep the public service.

To improve governance in water-resources policy, a cost-allocation concept of beneficiaries' contribution to the water-resources management cost should be prepared by applying economic instruments, e.g., the full cost-recovery principle.

6.4 Water Management in Satluj river Basin for managing the use of water for irrigation, human consumption etc.

Water-resources development is an attempt to optimally use water potentials and prevent loss of capacity. Considering the uneven distribution of water availability during the year, it may be necessary to carry out water-resources development so that economic development could be achieved without compromising the water needs linked to people and ecology of the area.

In the upper reaches, reservoirs are built/ proposed to control floods and silt, store water during the rainy season and to supply water in the dry season. In the middle and lower reaches, barrages and intakes are built for various purposes (irrigation, industry, drinking water, etc.). Water resources development should use a holistic approach, well planned, with sustainable and environmentally sound management, performed in stages, reviewed and adjusted to the government's national policies.

Adoption of Water-resources management practices in the Satluj river Basin will enhance the development benefits and prolong the life of the water-resources infrastructure. In water resources management, O&M are the main activities during the post- development phase of managing the water-resources infrastructure. Operation is an attempt to control and allocate water and its resources to achieve optimum utilization according to the purpose and minimize negative impacts, such as flood and drought. Maintenance is an attempt to securely sustain water resources, infrastructure and the environment.

Watershed conservation should include re-greening of the area, reforestation, terracing, and other related activities in the frame of increasing sustainability of the watershed. To implement watershed conservation, it is necessary to establish coordination among related institutions. The Satluj River Basin Management Agency (SRBMA) shall play an important role, especially preparing recommendations on the water-resources conservation program based on a Watershed Conservation Master Plan.

The SRBMA should issue technical recommendations on applications for water use licenses. Water allocation is an attempt to manage a reservoir operation pattern (planning) based on demand proposals and water availability prediction. This



allocation plan could be discussed with all concerned governmental agencies for their common consensus and approval for implementation. Water distribution is an attempt to operate water resources infrastructure in order to distribute water to beneficiaries according to the agreement.

6.4.1 *Satluj River-environment management.*

River-corridor maintenance controls river corridor land use to protect the function of the river-safety area and to increase the benefit of the river for tourism and water sports. In any management practices, the river basin management agency cooperates with related institutions and authorities. The SRBMA should implement the river-environment land-use management practices by preparing land use patterns (planning) based on local and regional spatial planning through close coordination with related institutions in the basin.

6.4.2 *Water-resources infrastructural management.*

The SRBMA should implement the water resources infrastructural management practices mainly related to maintenance. Preventive maintenance takes the form of routine and periodic maintenance, and small repairs to prevent serious damage. Corrective maintenance covers large-scale repair, rehabilitation, and rectification to restore and increase the functions of the water resources infrastructure. Emergency maintenance involves temporary repairs that have to be done urgently due to an emergency condition, such as a flood. A water-sector apex body should manage coordination framework for water resources. The apex body, comprising various regulators concerned with development and management of water resources, together with stakeholder representatives, should be responsible for guiding the development and management of water resources. The apex body will give guidance in policy formulation, resource allocation, program implementation and regulatory control in general and inter-sectoral coordination and issue resolution in particular.

6.4.3 *Research & Development Work (R&D)*

To carry out water management activities, it is necessary to follow knowledge development and proactively try to introduce innovations both in technology and management systems. To properly carry out water resources management in the Satluj River Basin, the SRBMA should carry out R&D programmes, through cooperation with both national and international institutions.

6.4.4 *Data networks and management information systems.*

Data sharing and information systems among government agencies should be developed and operationalized. The SRBMA should develop a water resources data center for society and concerned agencies.

To promote sustainability of hydrological operations and data, hydrology institutions and organizations should have appropriate administrative and budgeting arrangements along with a personnel program.

6.4.5 *Stakeholder Representation*

To promote stakeholder participation, a permanent group of stakeholders, NGOs, and public representatives should be part of the apex body. These committees, are supposed to be coordination bodies where decisions on management policies (planning, implementing, supervising, controlling, and funding) in their respective areas are made.



This basin committee should also have a technical team for each activity area including activities related to water allocation and flood control but it should be expanded to cover other areas as well, such as watershed management and water- quality control.

6.4.6 Technical aspects.

To improve water-resources management by means of enhancing R&D activities, individual capacity-building and demand- and supply-management techniques, the decision support systems in all engineering aspects of water-resources management, covering database management systems should be considered.

6.4.7 Management aspects.

To promote protection and conservation of resources in the river basin, the following activities should be considered by SRBMA:

- Public and private participation in water-resources development and management will be more widely opened.
- Due to the decentralization policy, the local governments are supposed to receive part of the revenue from the natural resources in their respective areas.
- Water-resources management should be undertaken in an integrated (multi-sector), comprehensive (upstream-downstream), sustainable (intergeneration) and environmentally sound concept, for fair and just results. In line with this ideal, the river basin as a hydrological unit is considered as one management unit, under implementation of the decentralization concept in an autonomous spirit that embraces river-basin management trans-boundary aspects.
- Entire river basin should be managed by a neutral and professional institution that applies healthy corporate principles and general utilization norms in water resources, based on public and private participation. Participation of the public and private sectors and of the community is an important aspect in performing better water-resources management in the context of the paradigm shifts.

6.4.8 Decision Support System (DSS)

A spatial distributed system has to be considered which is subdivided into a number of spatial elements. A DSS should also be able to handle different temporal scales (e.g. based on different scenarios of future developments). As the object of planning is a natural system which depends on a complex of influencing factors, a large variety of data and information has to be considered. These data are provided by different disciplines. Sustainable river basin management requires a cooperation of ecologists, hydrologists, water managers, computer scientists and socio-economists (refer Figure 6.1).

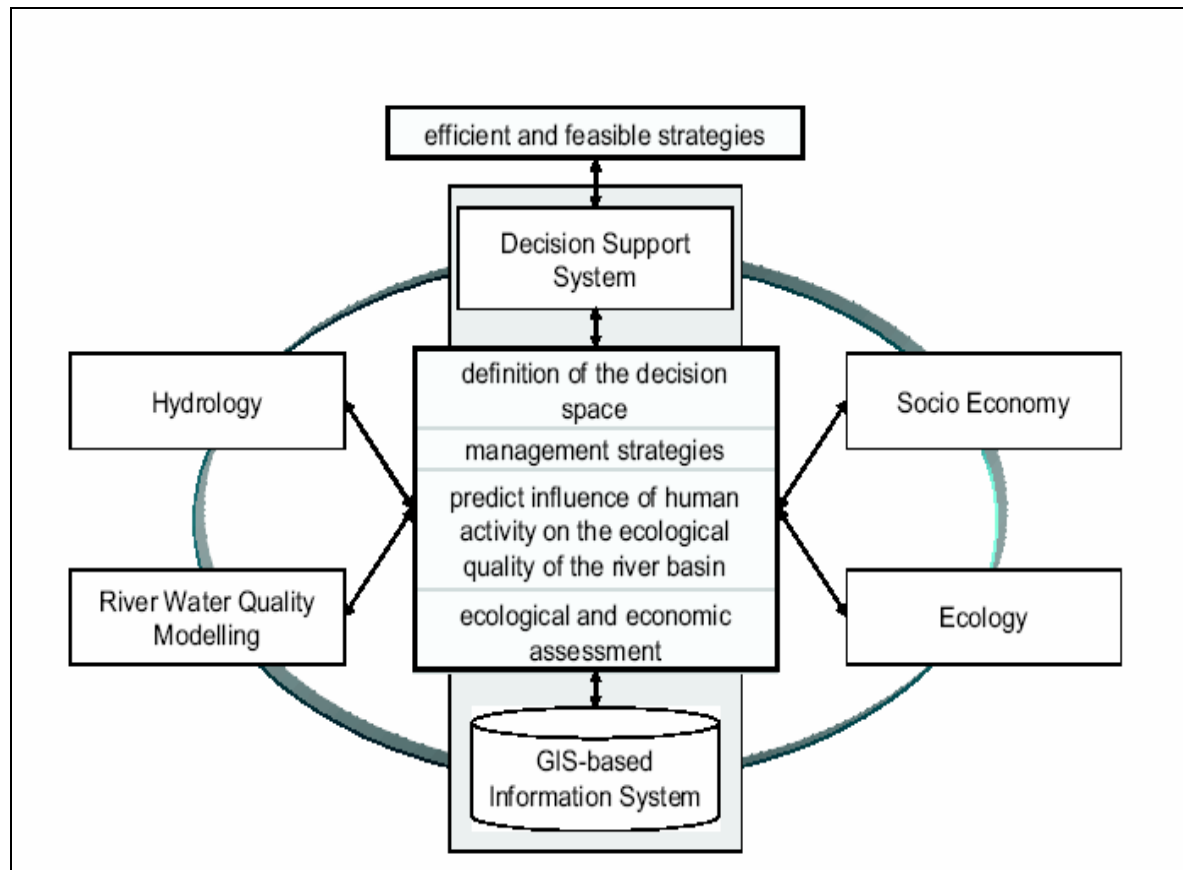


Fig 6.1 Decision Support system

Local measures and regional management strategies should be planned and synchronized in cooperation with local and regional authorities and stakeholders. Under consideration of their different spatial scales the possible ecological consequences of measures have to be assessed based on simulation models or expert knowledge.

In some cases monitoring programmes have to be initiated to provide better data and information about the different quality elements. Costs, benefits and possible conflicts have to be estimated with socioeconomic methods under different management schemes and under consideration of different baseline scenarios. Resulting from these activities a multi-criteria analysis has to be applied in order to find the most cost-efficient, feasible combinations of measures according to the preferences of decision makers. The most cost-efficient, ecologically effective management strategy has to be selected combining different measures. But not only efficiency and costs of technical measures have to be considered but also the social impacts of these measures which depend on the transfer of benefits and burdens related with them.

Decisions about the River Basin Management Plan should be based on an assessment of the cost efficiency of various possible management strategies at river basin scale mainly. The possible exceptions from the environmental objectives at water body scale demand a comprehensive consideration of the socio-economic circumstances as well as the interdependencies within the river network. Setting exceptions at one water body can influence the achievement of the good ecological status of other water bodies (e.g. regarding ecological continuity for long-distance travelling fishes). Here decision



Tools for decision support in the implementation

The design of the spatial decision support system for integrated management of the basin is based on a central logical model of work-flow, objects and methods on the one hand. On the other hand software services are provided to planners, decision makers, administration, NGO's and stakeholders for support of decentralized collaborative negotiation and decision procedures:

- display and analysis of the state of the water bodies, deficits, spatial representations of measures and their consequences using an internet enabled Geographic Information System;
- support for access, organization and documentation of the different steps of decision making via an assistant like, internet based user interface;
- multi-criteria exploration of the decision set, setting of a reasonable goal and search for efficient measures close to the goal.

6.5 Interventions for reducing the impacts of flood

Flood losses are most devastating natural disasters in the area. The frequency of floods has increased in past few years (ref. Figure 6.3). Last flood was occurred during year 2002 that caused huge loss in terms of human lives, infrastructure loss, investment loss in form of failure of hydro power projects etc., loss of agriculture etc. Climate change phenomenon compounds the existing challenge of managing the flood loss.

It becomes a necessity to come out with proper remedial action plan as a safeguard to natural flood hazard to avoid human and infrastructure losses. Our prime concern here is to come out with the interventions for concerned institutions to control the floods and flood related disaster risks. The following planning instruments are needed:

- **There is a need to avoid the institutional traps to make flood management practices to be successful. The following are suggested to incorporate under institutional mechanism:**
 - review the existing water sector policies, strategies, priorities, and investment plans for management with particular emphasis on reducing the adverse impacts of floods in the down stream and review of institutional arrangement that influence who is at risk to flood and other interacting stressor;
 - assess the completeness and adequacy of the existing flood management plan based on technical, institutional, environmental, social, economic, financial, and other relevant factors;
 - assessing the institutional influence on capacities to cope and adapt the risk;
 - adjustment of policies and strategies, and institutional strengthening, improvement of coordination, legislative reforms, financing, cost recovery, and standardizing the justification of proposed works;

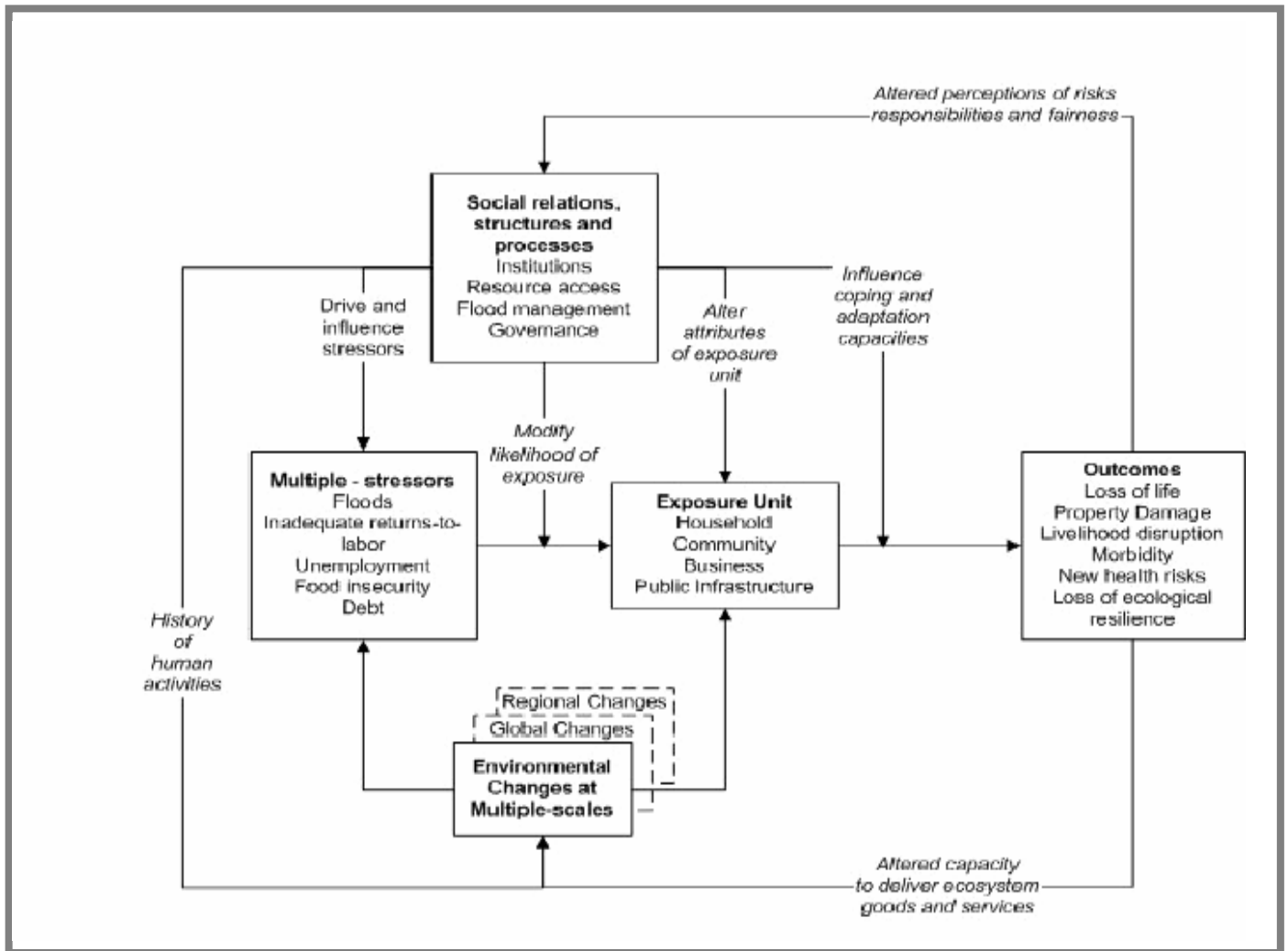


Fig 6.3 Various Environmental & Social aspects linked to natural Flood Hazard

- help integrate sound environmental management and increased social awareness into the planning, design, and implementation of flood management;
- assess the need for improved flood forecasting, flood warning, and disaster preparation; and
- prioritize flood management interventions in River basin.

☛ **There is a strong need of Policy Dialogues with respect to following:**

- coordination between central, state and local level agencies whose activities relate to flood management;
- flood plain zoning and flood risk mapping
- financing of capital investment and operation and maintenance costs;
- cost recovery;
- control of encroachment in areas in downstream



- enhancement of positive environmental impacts wherever possible through adjustment of the arrangement and function of project interventions;
- rationalization of design standards and approaches to planning flood protection;
- environmental concerns adhere strictly to the Government's environmental laws/rules, the policies and guidelines.

☛ **Environment Impact and Mitigation**

- by approaching flood protection as a particular application of natural resources management throughout the entire river basin, overall environmental improvement planning for the basin is required.
- environmental impact assessments (EIAs) and Summary EIAs should be made available to all stakeholders involved in the flood management work inside
- review and improvement of existing flood protection measures in a consistent manner to avoid the negative environmental impacts to be severe.
- integration of environmental considerations at provincial level into the planning, design, and implementation processes to ensure that potentially negative impacts will be avoided or reduced to an acceptable limit, and to enhance the long term sustainability of all such measures.
- there is also a need to increase the awareness throughout the community of the value of environmental safeguards as opposed to short-term solutions to isolated problems.
- planning for dam safety and related remedial measures in the area
- protection and restoration of flood retention basins;

☛ **Link efforts across government agencies and local communities: Effective flood management can protect million of people, their property and livelihoods if social aspects linked to the flood management programme are carefully handled**

- flood management plan should include building controls and planning measures aimed at increasing the safety of humans against flood hazards, and the possibility of extending such initiatives should be reviewed from time to time.
- appropriate planning should be done to avoid adverse effects on poor households,
- plan should include all measures to ensure that benefits reach the poor and help alleviate poverty and this should consider the perceptions of the people in terms of discourses and social practices
- social analyses should be conducted, and detailed socio-economic profiles should be prepared for all vulnerable groups and for all groups who would be adversely affected by the proposed flood protection works.



- all local NGO's or village level groups working for flood management should involve right from the planning stages to make the local village people understand about the benefits of flood management work

6.6 Specific Recommendations for managing environmental and social issues

The flow of river at Jhakri outfall location is proposed to fully divert through 15.1 km headrace tunnel under Rampur Hydroelectric project and the same would be again released to the river at Bael, which is at d/s but since there are no existing or proposed irrigation/ water supply schemes linked to river Satluj, thus no significant impacts are anticipated. The natural springs, khads, chashme and bowli (kachchi and pukki) or tributaries flowing in vicinity are the key sources of water for villages falling along the river stretch. Majority of these sources are perennial with seasonal variations in the water flow. The discharge rate varies from 0.7 l/sec to 0.005 l/sec. The same source is used for all purposes, including drinking, cooking, bathing, livestock rearing, etc. Irrigation in the area is rain fed or water demand for agriculture practice is being fulfilled by khuls (canal). As reported by the IPH, Rampur, their water supply schemes are also dependent on natural springs/bowlis located on upper reaches of mountains, hence, the reduced flow in the river due to proposed project will not hamper the water supply schemes in the area.

It is advised to take following pre- project precautionary measures:

1. Adequate measures should be taken during blasting process for construction of tunnel so as to avoid /minimize the impacts on already laid IPH water supply lines or storage tanks.
2. Regular monitoring is proposed to be taken up by concerned agency to check the flow variations of springs/chasme to keep a check on any negative impact of blasting or construction activity on drying of springs. However, SJVNL has already taken up monitoring work for project affect areas, the same should be extended to adjacent areas depending on complains received from particular village.
3. The lesser flow in river especially during lean seasons would impact the dilution of sewage and hence, as pre-project measurements, SJVNL should take up the issue with IPH and other concerned agencies for strengthening and expansion of existing sewage treatment facility.
4. Awareness and education programmes should be planned and be executed with regard to the following:
 - i. use of soak pits in all villages falling to avoid open defecation practice, which is prevalent in the area
 - ii. installation of bio gas plant should be encouraged in the area
5. use of soak pits and to avoid the open defecation in the area and to encourage the installation of bio gas plants in the region should be taken up in villages falling in the area



6. Periodic monitoring of stream flow should also be carried considering the long-term planning needed for the region.

The river water quality along different stretches should be regularly monitored to establish the time series variations in river water quality and to observe any changes on quality of river due to running of turbines at proposed powerhouse. The following parameters may be monitored considering the existing values in mind:

River flow measurement at two or three intermediate locations	Dissolved Oxygen
Temperature of river water	BOD
Conductivity	Alkalinity
Turbidity	Total Hardness
Total Solids	Calcium
Total Dissolved Solids	Sodium
Total suspended solids	Chromium
pH	Nickel
Sulphates	Mercury
Fluorides	Chlorides

Land Environment

To conserve the existing land use of the area, land areas taken for the purpose of muck disposal sites, borrow pits, temporary camp sites, landfill sites, waste dumps etc should be monitored and treated as per requirements. In addition, change in the existing land use pattern should be monitored once in five-year using satellite imageries.

Health of Habitats

The construction activities that are taking place because of the hydropower project in the area will involve the engagement of a work force in the area, thus changing the population density and increasing the floating population during construction activities. This may result in a change in the existing health scenario due to increased pressure on existing infrastructure i.e. water supply sources, sanitation, etc. It is required to take following precautionary measures:

1. make local people aware about the diseases through organizing village level educational programmes
2. Close monitoring should be done to keep check on no. of patients suffering from water borne diseases and data should be well procured
3. Health care infrastructure building including more number of ambulances, more number of beds in existing hospitals, adequate medical care equipments in hospitals and clinics and transfer of competent and senior doctors to Government hospitals .



Erosion and Siltation

Soil erosion rates, efficiency of Soil conservation measures, needs to be closely monitored periodically. To do this all concerned departments should be involved for data and information sharing.

Ecology

With the help of Forest department and Fisheries Department, status of afforestation programme, changes in species composition of the terrestrial and aquatic fauna and flora should be monitored and adequate steps should be taken to conserve the aquatic and terrestrial habitats in terms of endangered species i.e. identification of spawning grounds, conservation of stream flow, development of new paths for migratory fishes for spawning etc.. The parameters to be monitored regularly for aquatic ecology are discharge of water at Jhakri tail race point and at powerhouse in down stream.

Infrastructure Building

Due to heavy influx of floating population near the project sites, great pressure is observed on existing infrastructure i.e. water sources, sanitation, solid waste, road conditions, medical facilities etc. It is advised to take up the issue with concerned agencies for better infrastructural facilities especially at Rampur and Bael.

Any induced development directly attributable to RHEP project

The increasing population of Rampur and near by areas due to massive project development will definitely put pressure on existing infrastructure facilities which, will further affect the health of the local environment including human population, aquatic & terrestrial ecology and of course the river/streams. Diversion of water from Jhakri to Bael through tunnel will leave dry conditions in river, which will restrict use of river water in future that could be otherwise foreseen in future with growing population and increasing needs of the area.

6.7 Various Trade offs involved in Hydropower projects vis-a-vis. Decision making

Hydropower has several advantages over most other sources of electrical power, including a high level of reliability, very low operating costs, and the ability to easily adjust to load changes. Also, hydropower does not contribute to air pollution, and reservoirs can also be used for recreation, water supply, and flood control. However, like all electricity options, hydropower involves trade-offs. Hydropower dams can cause environmental problems, such as modification of fish habitat through altering of stream and lake levels.

Advantages Of Hydropower	Disadvantages Of Hydropower
Renewable Resource	High Initial Cost Of Facilities
Fuel Saver	Precipitation Dependent
Flexible To Meet Load	Changes In Stream Flows
Efficient	Inundation Of Land And Wildlife



	Habitat
Reliable And Durable	Loss Or Modification Of Fish Habitat
Low Operation And Maintenance Costs	Fish Entrainment And Passage Restriction
Proven Technology	Changes In Reservoir And Stream Water Quality
No Atmospheric Pollutants	

Hence, before initiating the project development, the developers of dams and hydropower projects need to fully understand the ecological requirements of water bodies and downstream flow-related social consequences, and to account for the trade-offs between project benefits and the environmental and social costs involved and make well-informed and intelligent decisions. While careful planning and operation of hydropower facilities can minimize environmental damage, environmental costs may prohibit the development of hydropower in some areas.

With regard to this issue, The World Bank has developed special environmental and social “safeguard” policies. These policies define minimum requirements to be observed in projects and cover:

- Environmental assessment;
- Forestry;
- Indigenous peoples;
- Involuntary resettlement;
- Management of cultural property;
- Natural habitats;
- Pest management;
- Projects in disputed areas;
- Projects in international waterways;
- Safety of dams.

Projects affecting one or more of these categories require special attention throughout their selection, planning, implementation, and operation.

Structured Decision-Making is a concept especially relevant for large and/or regional dams and multi-purpose hydro projects, where multiple decision makers (not only at the national level, but also at the regional and local level) and many stakeholders with multiple objectives, working under highly complex political and socio-economic environments need to make the most effective decisions they can. SDM can improve the decision-making process by incorporating a structured process in the evaluation multiple issues involved in the preparation of a complex infrastructure project (i.e jurisdictional overlaps and dependence on cooperation outside of laws and legislation, scientific uncertainties, social and environmental issues, and trade offs across high-stake values, among others). As demanding as it is, the ability to make clear, effective decisions about dams and river management in an efficient manner is critical.

Dams and multipurpose hydro projects, if designed and developed in a sustainable manner are key components in both energy and water security. As mentioned before in Chapter 1, the electricity deficit figures for all India are 12.9% and 12.3% respectively for 2006-07. It is not longer adequate to debate the theoretical nature of the pros and cons of dams and hydraulic infrastructure. Generalized discussions that hold back efforts to make sustainable decisions run the risk of exacerbating environmental, social and economic degradation in some of the poorest countries so of the world.



International standards set up by different international organizations offer many lessons on how to assess natural resource investments. They identify the need for consultation, good science, environmental and social assessments and especially attention to affected people. But, much is left to practitioner, including some of the more challenging and sensitive issues in decision-making. For example, a decision process needs to consider how to:

- (i) ensure each investment/management decision supports declared development objectives,
- (ii) identify stakeholders, address their expectations and nurture meaningful consultation,
- (iii) create the right balance of analysis (data and information collection) and deliberation (consultation and dialogue),
- (iv) develop a common, decision-focused information base and manage inevitable gaps in knowledge and information, and
- (v) articulate and incorporate values of governments, experts and stakeholders, among others.

The intent of structured decision processes should be to build better insights for decision makers (particularly with respect to alternatives and trade offs), enable more meaningful stakeholder participating and instill greater transparency in planning and resource management decisions.