

# Sustainability Assessment of Human Intervention in terms of Hydroelectric Project on Alaknanda River Valley

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## Abstract

*The Indian Himalayan Region (IHR) with its major river systems has vast potential for hydropower development. Recognizing this potential, the Government of India in its recent initiative for 50,000 MW power generation proposes to develop several hydropower projects in the IHR. The Himalayan region is ecologically sensitive, and the catchment is endowed with potential for vast hydropower projects. Due to human intervention and dense allocation of projects, subsequent social and environmental issues are raised. It is recognized that in the Himalayan region which is important from the conservation point of view, project specific Environmental Impact Assessment studies are probably insufficient to tackle the environmental issues that are likely to result on account of the proposed hydropower projects and needs few additions or modification. This paper examines the processes/steps involved in EIA for the development of projects which involve human intervention like dams in the Himalayan region, with the subsequent impact on the environment. This paper aims at studying the main considerations taken for EIA and the extent to which it suppresses or reduces the impact of Hydroelectric Power Projects. In current practice, the approach is to exploit natural resource for development of the nation, but these young fragile mountain ranges needs more of conservatory approach rather than exploiting the same in order to maintain the geo-biodiversity of the region and to sustain ourselves.*

## Keywords:

***Environmental Impact Assessment, Hydroelectric Project, Indian Himalayan region, Human intervention***

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## Introduction

The Indian Himalayan region is earmarked for widespread dam building, but aggregate effects of these dams on terrestrial ecosystems are unknown. Disturbance due to dam construction would likely reduce free species richness by 35% Tree density by 42% and tree basal cover by 30% in dense forests. It is projected for 2025, the SAR model (ref. 7). *These results combined with relatively weak national environmental impact assessment and implementation, points towards significant loss of species of all proposed dams in the Indian Himalayas are constructed. There is need of cumulative environmental impact assessment EIA fails to consider whether investment in improving the efficiency of a new power plant.*

Research is also intended to know whether the real extent of impact on environment of land development projects can be measured, as these projects affect the flow and course of a river, flora and fauna of an area, and also brings physical and structural changes in the surroundings. These changes are important as they have an Economic significance and impacts. The question is “Does EIA has any significance in assessing the mentioned perils?”

A hypothesis for the research is that the present framework for EIA, specifically for Himalayan river valley projects is insufficient to handle the concerns in a region of unique importance. Unique importance indicates towards vital resources in Indian Himalayan region for the whole Indian subcontinent and it needs to be protected in order to achieve sustainable development. The literature reviewed is

mostly based on internet sources, EIA Policy booklets and other various sources of secondary data.

The following methodology shall be adopted for this research:

- Literature Review
- Identification of Objectives of study
- Critical Analysis
- Findings and Conclusions

## Background

The Indian Himalayan Region (IHR) spreads from Arunachal Pradesh in the east to Jammu and Kashmir in the west covering 530,795 sq. km of geographical area holds a special place in the mountain ecosystems of the world. These young and fragile mountains of the Himalayas are of high conservation significance due to their floral, faunal, geo-hydrological, ecological, socio-cultural and aesthetic values. The region is also known as the water tower of the Earth and gives water to a larger part of the Indian subcontinent. The availability of a large volume of water combined with suitable slopes offers tremendous potential for the hydropower development in the region. Looking at the rich water potential of the IHR and increasing energy demands of the country, the Government of India recognized the fact that the hydropower potential of the country needs to be harnessed to the maximum for the economic development of the country. According to the assessment made by the Central Electricity Authority (CEA), the country’s hydropower potential is 148,701 MW, however, only 22.37% hydropower potential

has been developed and 9.09% is under construction. IHR accounts for approximately 18% of India's total geographical area and contrarily own more than 75% (117,139 MW) of total exploitable potential (Table 1). National Electricity Policy of India has been accordingly framed for fully meeting the power demands of the country by 2012 along with increasing per capita availability of electricity to over 1000 units by 2012. In a landmark move towards implementation, the Prime Minister of India launched a 50,000 MW hydroelectric initiative programme, formulated by CEA for preparation of Preliminary Feasibility Reports of 162 new hydroelectric schemes (47,930 MW) and surprisingly out of these 162 schemes, 133 are in IHR.

### EIA and IHR

An environmental impact assessment (EIA) is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made."

### History & Background

As per MoEF, Govt. of India, EIA is a "management tool for ensuring optimal use of natural resources for sustainable development. The sectors for which environment committee has been set up include projects related to mining; industries; thermal power; river valley, multipurpose, irrigation and hydro power; infrastructure and miscellaneous; and nuclear power projects. As a part of EIA, the projects are appraised by the Environmental Appraisal Committees and approved or rejected. For site specific projects like mining and river valley projects, site clearance is sought from the concerned authorities along with environmental clearance. Site Clearance is sought to check that the site selected is not ecologically fragile and environmentally sensitive. Following this, it is ensured that the project implementation takes into consideration the stipulated environmental safeguards. MoEF has also been sponsoring for Carrying Capacity Studies for different regions. The absence of independent body for EIA leads to inter departmental coordination error and corruption in the process, *currently, the MoEF is the agency for the preparation of the EIA statement, with the help of external consultant. The amount allocated and spent for preparation of EIA is only 1% of total project cost.* Sector wise EIA is needed. This is critical to judge the impact of micro-level economics, developmental and other policies, schemes and programs.

The Indian Himalayan Region (IHR) with its major river systems has vast potential for hydropower Development. Recognizing this potential, the Government of India in its recent initiative for 50,000 MW power generation proposes to develop several hydropower projects in the IHR. Some of the important social and environmental

issues are raised that arise due to dense allocation of hydropower projects in the ecologically sensitive Himalayan region. It is recognized that in the Himalayan region which is important from the conservation point of view, project-specific Environmental Impact Assessment studies are probably insufficient to tackle the environmental issues that are likely to result on account of the proposed hydropower projects.

### Environmental implications

Over the years, there has been a realization that development of hydropower projects

has an eventual impact at an environmental and social basis. Ecological disturbances, loss of biodiversity, loss of productive lands, damage to Forests, dilapidation of other natural resources, social and cultural change, change in socioeconomic status, etc. are the major implications of hydropower projects which a region and its people may have to face. Issues directly related to design and development of hydropower projects are location specific, thus the environmental and social consequences will certainly vary spatially.

**Table 1: Status of hydroelectric potential development**

Region/state	Identified capacity (as per reassessment)	Capacity developed		Capacity under		Capacity yet to be developed	
	MW	MW	(%)	MW	%	MW	%
Uttarakhand	18,175	2980.1	16.40	1926.0	10.60	13,269.0	73.01
Jammu and Himachal Pradesh	14,146	1864.2	13.18	899.0	6.36	11,382.9	80.47
Meghalaya	18,820	6085.5	32.34	4435.0	23.57	8,299.6	44.10
Sikkim	2,394	185.2	7.74	84.0	3.51	2,124.8	88.76
Arunachal	4,286	594	13.86	2015	47.01	1,677	39.13
Nagaland	50,328	423.5	0.84	2600.0	5.17	47,304.5	93.99
Assam	1,574	99.0	6.29	0.0	0.00	1,475.0	93.71
Manipur	680	375.0	55.15	0.0	0.00	305.0	44.85
West Bengal	1,784	105.0	5.89	0.0	0.00	1,679.0	94.11
Tripura	2,841	156.5	5.51	292.0	10.28	2,392.5	84.21
Mizoram	15	15.0	100.00	0.00	0.00	0.0	0.0
Total	2,196	0.0	0.00	0.0	0.00	2,196.0	100.00
Total	117,239	13,425.0	11.45	12,336.0	10.52	93,000.3	79.32

Establishment of a hydropower project involves substantially large infrastructure development in terms of storage structures, diversion tunnels, powerhouse, residential/office area, roads, transmission lines, etc. Undeniably such a massive action has the potential to greatly affect the

expanse, predominantly if it is taking place in the fragile Indian Himalayan Region. Again it is worth noting that the entire Himalayan system is well knit and alterations to any one aspect may have cascading effects. Therefore, developmental interventions in the mountains should have a

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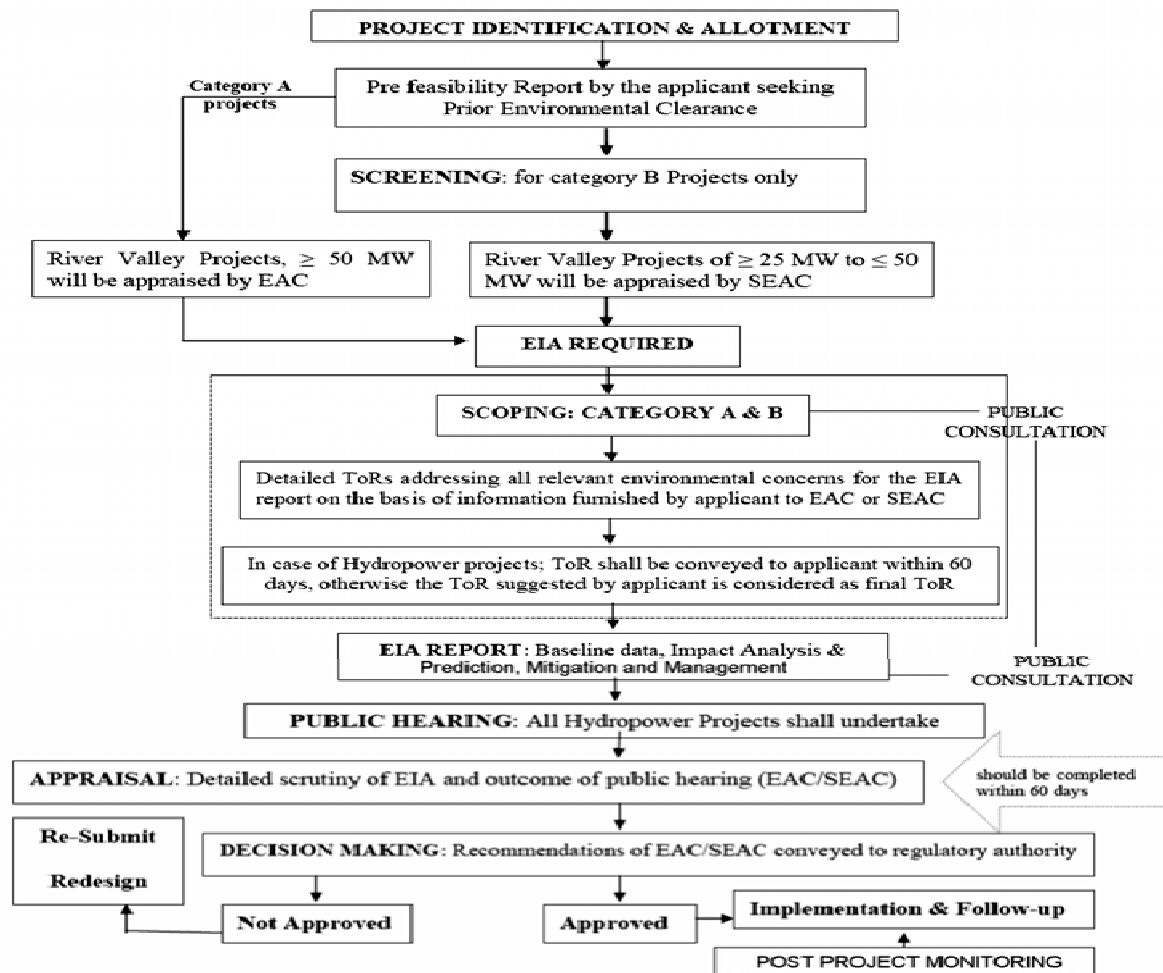
different approach, given the fragility and vulnerability of the ecosystem on account of unique mountain specificities.

### **Existing EIA framework**

Environmental Impact Assessment (EIA) legislation has emerged as a management tool for mitigating the environmental implications of developmental interventions and is now being practiced in more than 100 countries worldwide. EIA aims to achieve or support the ultimate goals of environmental protection and sustainable development and proposes mitigation of adverse impacts. In India, EIA was introduced in 1994 when the Ministry of Environment and Forests introduced EIA notification under the Environmental Protection Act (EPA) 1986

and made EIA mandatory for 29 highly polluting activities. Further amendments in EIA notification (2006) included a total of 32 activities under obligatory consideration. A summarized view of the entire process of environmental appraisal as per present EIA framework is presented in Figure 1. The other allied legislations dealing with the environmental clearance process are: Wildlife (Protection) Act 1972, Forest (Conservation) Act 1980, the Water (Prevention and Control of Pollution) Act 1974, Water (Cess) Act 1977, National Environment Appellate Authority Act 1977, Air (Prevention and Control of Pollution) Act 1981, Environment (Protection) Act 1986, the Public Liability Insurance Act 1991 and the National Environment Tribunal Act 1995.

**Figure 1: Summarized framework for EIA of hydropower projects.**



Source: EIA Policy doc.

Despite the existence of good EIA guidelines and legislation, environmental degradation continues to be a major concern in developing countries. From the references it has been observed that EIA alone has not been effective in controlling the impacts owing to limitations, weaknesses and loopholes used effectively by the processors.

EIA, therefore, has not been able to provide 'environmental sustainability assurance. In the context of upcoming hydropower projects in the IHR, immediately after the launch of 50,000 MW hydroelectric initiatives, serious environmental concerns and disparities in EIA studies of few of the

hydropower projects have highlighted the inadequacies of EIA studies.

In an effort to understand the root causes of the environmental concerns rather than only discussing them, a case study of Alaknanda river catchment up to Karnprayag in

Uttarakhand, done by Devendra Kumar Agrawal, Mahendra S.Lodhi, Shradha Panwar in year 2010 in the article No. 2, Vol. 98, *Current Science* has been studied to look in with a view to find appropriate answers for ensuring environment friendly hydropower development in the IHR.

**Table 2: Salient features of the proposed hydropower projects in Alaknanda catchment**

Project name (project code)	Developer	Influence capacity (MW)	Installed		Location of dam			Length of tunnel (km)	Dam/zone area (sq. km)
			Latitude	Longitude	barrage height (m)	Submergence area (ha)	PMF (cumec)		
1	2	3	4	5	6	7	8	9	
10									
Malari–Jhelum	THDC	55	30°40'	79°53'4.5"	24.5	10.45	5325	4.5	217.37
Jhelum–Tamak	THDC	60	30°38'45"	79°49'57.5"	24.5	13.9	5845	5.7	241.23
Tamak–Lata (8)	UJVNL	280	30°36'00"	79°47'00"	12	NA	3560	12	332.76
Lata–Tapovan	NTPC	171	25 km u/s Joshimath	NA	NA	NA	NA	7.51	255.53
Tapovan–	NTPC	520	30°33'51"	79°33'46"	22	10	NA	11.77	363.86
Vishnugad–	THDC	444	30°30'50"	79°29'30"	65	24.5	10,800	13.4	323.604
Vishnuprayag	JPVL	400	30°40'10"	79°30'35"	NA	NA	NA	11.334	268.63
Alaknanda	GMR Ltd	140	30°43'09"	79°29'49"	36	3.74	3530	2.84	231.726
Bowala–	UJVNL	300	Near Birahi village	NA	5	NA	20,000	10.37	254.30
Nandprayag–	UJVNL	141	30°19'30"	79°18'20"	15	NA	11,000	5	204.68

Source: Pg- 154, Vol. 98, No. 2, *Current Science*, 25 January 2010.

Information in columns 2–9 is based on extracted information from feasibility reports of the hydropower projects. NA stands for 'not available'. Influence zone area statistics is based on 1: 50,000 scale base map of the study area.

### Results and discussion

- Hydropower projects in the study area are located so densely that the influence boundary of one project overlaps the influence zone boundary of another one or

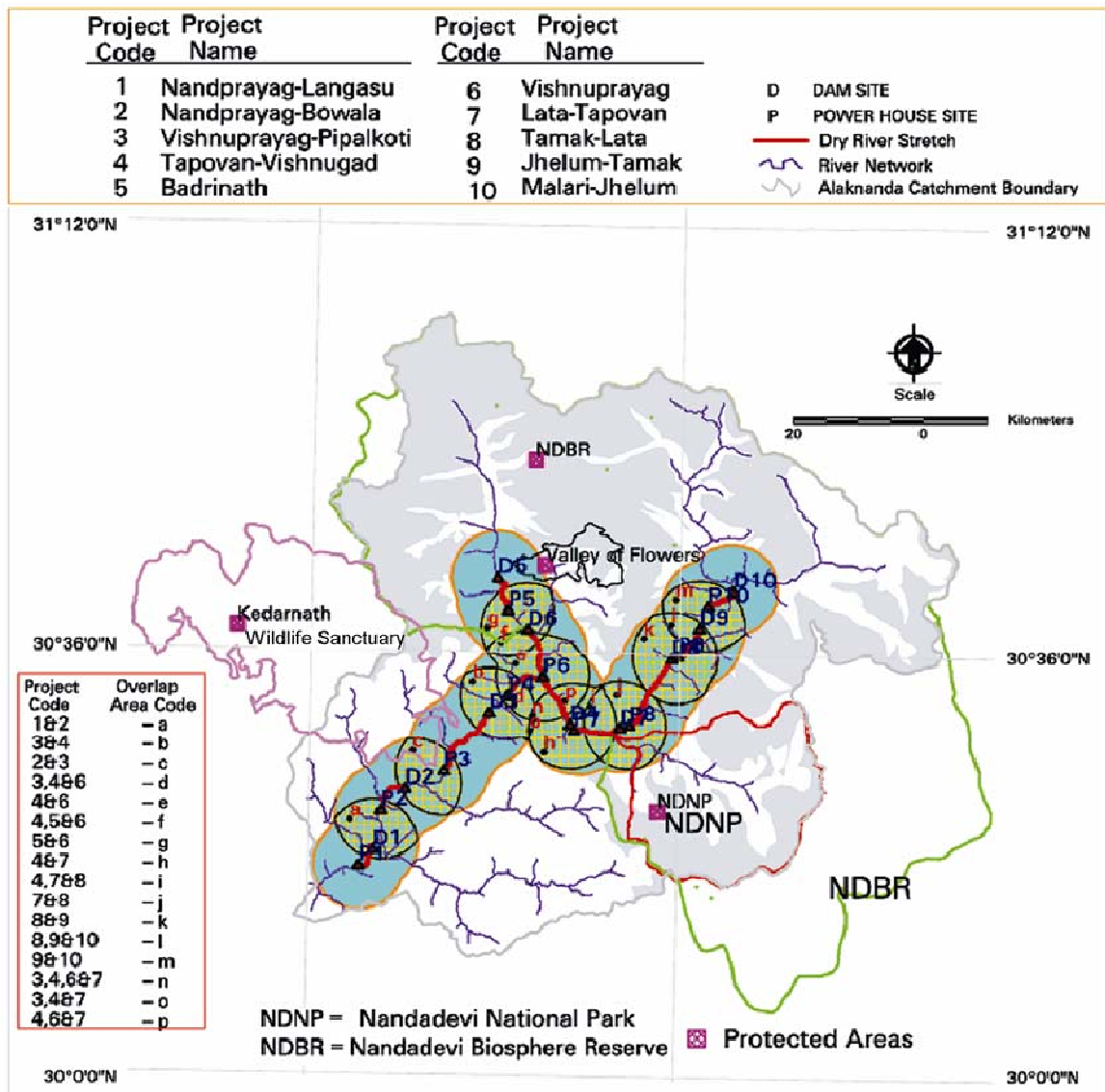
more hydropower projects located nearby (Figure 2). The cumulative overlapped impact zone is calculated and it is found that 924.85 sq. km (34.33%) of the total influence zone area is being overlapped. From the various past surveys, it is documented that the cumulative environmental effects result from spatial and temporal crowding of environmental perturbations. In view of the rich biodiversity, the synergistic and cumulative impacts resulting from these crowded

projects would certainly be over-looked by the project-specific EIAs in the absence of tactical assessment of these cumulative impacts (*ref. 7*).

- Damming of a river has been called a cataclysmic event in the life of a riverine ecosystem. The hydroelectric projects interrupt and alter the river's important ecological processes by changing the flow of water, sediment, nutrient, energy and biota. According to the United Nations, 60% of the world's 227 largest rivers are already severely fragmented by dams, diversions and canals, leading to the degradation of ecosystems. Due to dense allocation of hydropower projects in the study area, water released from the tail of

the tunnel would enter the reservoir of another hydropower project. As indicated in Table 2 along with the salient features and 'dry river stretch' marked on Figure 2, the proposed hydropower projects in the study area would cause practical drying up of the river stretch of almost 75 km especially during the lean season flow period. As a result, the velocity and volume of flow would change suddenly in stretches and this would have serious implications for the aquatic ecology of the cold water fisheries of the region. Although a minimum flow throughout the river course would always be maintained, the survival of aquatic ecosystem would certainly be severely threatened as a consequence of damming and diversion.





**Figure 2: Influence zone of the proposed hydropower projects and river stretches likely to run dry in the study area (Alaknanda catchment up to Karnprayag).**

Source: Pg- 160, Vol. 98, No. 2, Current Science, 25 January 2010.

- An extremely important issue pertains to dam failure. It is well known that the Alaknanda catchment lies in the geodynamically sensitive Himalayan region

(Seismic zone IV), thus naturally prone to disasters. Earthquakes of magnitude of 8.5 on Richter scale have been recorded in the Himalayas. It needs to be noted that the

kind of developmental interventions associated with hydropower projects, serious manmade disaster due to failure of dam/s may occur. The reasons of the dam failure could be technical flaw in the design or extreme rainfall event, etc. However, it is beyond argument that huge destruction of life, property and environment is expected. According to the EIA guidelines of MoEF, dam break analysis for disaster management planning is required for individual projects, wherein, there can be no consideration for other dam/s in upstream and down- stream, ignoring the cascading effects of dams proposed in a series. However, in real world situation, if a single structure is failing, that will trigger chances for failure of another structure in the downstream and so on, after the catastrophic event in Mandakini and Alaknanda basin in the monsoons of 2013 it is widely accepted by experts in the field (*Ref. 8*).

- With the development of hydropower projects, the natural flow of the river will be fragmented and would also disappear into the tunnels causing tremendous loss to the panoramic landscape of the region. Besides this, construction of hydropower projects will also lead to modernization of the area and in turn will cause degradation of the natural beauty of the valley that is characterized by scattered small hamlets spread over the mountain slopes with intermittent agricultural fields and herds of domestic animals being bred by ethnic communities attired in traditional dresses. In brief, the development of

hydropower projects in the region would certainly affect the tourism potential of the area.

- Another important implication would be felt by the pastoral communities of the region. It is analysed that the construction of the projects will lead to an influx of outsiders – labourers and contractors in the region, and this would lead to the dilution of the culture of the pastoral communities. Further, development of hydropower projects will cause change in land use pattern and this may significantly affect the availability of already limited pasture land (on account of increasing number of livestock) to the pastoral communities. The land use change pattern (such as growing influence of production forestry, expansion of agriculture on traditional grazing lands and intensification of agriculture through introduction of winter wheat) is said to be the prime reason for restrictions on accessibility of grazing resources to the transhumant pastoralists of the region.

In a nutshell, it is summarized that the proposed intense allocation of hydropower projects in various parts of the Himalayan region is likely to have major implications in terms of biodiversity elements, natural and man- made hazards, tourism potential and socio cultural setting of the region.

### Conclusions & Significance

The present study elaborates the scenario of opaque development of hydropower projects in inimitably priceless and fragile Indian

Himalayan region, and consequential environmental implications as a result of shortcomings of project-specific EIAs in mitigation and management of environmental impacts holistically. Looking on to the discoursed specificity of the Himalayan region and feature stresses, it is felt that the present framework for EIA, specifically for Himalayan river valley projects is insufficient to handle the concerns in a region of unique importance. Although the basic structure of EIA notification have been amended at times to rectify the identified shortcomings and making it more effective, this currently practised decision tool is operating as a 'stand-alone' approach and is thus confined to a single project activity only. There is no escape from the fact that hydropower development is vindicated for national needs and the Himalayan region is a potential source; however, making such a huge development sustainable in IHR indeed solicits regional/basin-wise cumulative and strategic assessment of impacts for effectual decision making.

Environmental assessment at region-wise planning/ policy level instead of project level approach can serve the purpose of environmental sustainability in the IHR. In the middle to late 1980s, a new decision tool came into debate internationally to cope with such issues, known as Strategic Environmental Assessment (SEA). SEA offers scope for making better decisions regarding policy level planning for a large scale development. Although the concept of SEA is limited in India, it has been

successfully implemented in the last two decades in various sectors in many countries. Looking at international experiences and our earnest needs, it is important to explore the opportunities of SEA for sustainable development in IHR. Along with scientific research and experimentation, discussions among planners/policy makers and stakeholders, appropriate and strong SEA framework should also be developed that can be effectually applied to sectoral development in India.

There is need to modify/formulate the EIA policies to achieve the above statement of purpose. Reviewing the EIA policy of India, and some case studies, it seems these are focusing more on getting the required clearances for the projects rather than judging the environmental impacts, a kind of Project induced EIA policy. It has to modify/shift to environment conservation approach. In many cases, responsible authorities don't have the expertise required to evaluate the impact in a prescribed format because of huge scale of the projects. In such cases, projects have been cleared to reduce the time delays in the process without the prior consideration of EIA. Such things have happened in the past in some mining and dam projects.

### Alternatives

Smaller Hydro projects have far less impacts; can be completed much faster, at much less costs and with much less resistance from local communities. It's far less expensive to ensure that existing hydro capacities perform optimally, are used to provide peaking power to the maximum

extent possible. (There is a large gap between potential and achievement here.) It's far more useful to do proper appraisal, public consultation, EIAs, EMPs, proper operation and implementation with due respect for law and sense of responsibility.

Why is there so less enthusiasm for these? In the EIA, implicit approach has been adopted to evaluate the projects which do not actually define or quantify the magnitude of the impact. It should be done explicatively in order to achieve better results.

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