

Environmental Impacts of Small Hydro Power Projects

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ABSTRACT

Small Hydropower (SHP), considered as the non-polluting renewable energy source having high conversion efficiency with spectacular flexibility and operational & economic superiority over other power generation modes upto 25 MW, has been accorded top priority by Ministry of New & Renewable Energy sources (MNRE), Government of India due to its environment friendly nature. Environment impact assessment (EIA) can be used as a tool to assess the environmental impacts of SHP projects in pre-construction, construction and post construction phase. Ministry of Environment & Forest (MOEF), Government of India has set the guidelines for EIA, preparation of Environment Management plan (EMP) and monitoring of mitigation measures for large number of industrial, construction & other projects including power projects.

The present paper outlines the advantages of SHP, barriers in the development of SHP, EIA process in India, regulatory framework, EIA of SHP projects, case studies of EIA of six SHP projects in the state of Uttarakhand, their impacts on ecological resources & human environment and EMP. It is concluded that there has been low to medium impacts of the projects on the surrounding environment.

1 INTRODUCTION

Hydropower is a renewable, clean and non-polluting energy resource with high conversion efficiency showing spectacular operational flexibility and operational & economic superiority over other power generation means. As per an assessment, India's economically exploitable potential is 84044 MW at 60% load factor and the installed capacity of about 1,50,000 MW. All India power shortages stands at 13%. To meet the challenge, SHP upto 25MW has been accorded top priority by Ministry of New and Renewable sources, Government of India with an estimated potential of 15,000 MW.

Depending on the site & layout of the scheme, temporary & permanent impacts have been reported to occur during construction and operational phases of SHP plants. The effect on downstream water supply and drainage has been identified as one of the main causes that can be well addressed. Alongwith other compensatory measures like provision of separate drinking water, irrigation lines, fish ladders etc. In India, SHP with an outlay of less than Rs. 1000 million are exempted from Environment clearance from MoEF but need to obtain all clearances from State government. There is no international consensus on the definition of small hydro power (SHP). In India and China, it refer to SHP upto 25 MW and in sweden, upto 1.5 MW. However, a capacity of 10 MW is generally becoming accepted worldwide. In India, the SHP are classified based on station capacity; Micro hydro: <100 KW; Mini hydro: 101-2000 and Small hydro; 2001-25000 KW. The classification on the basis of head is; ultra bw head: < 3m; low head: <40m and medium / high head: >40m. Run-of-river SHP scheme has little or no reservoir impoundment. Although, SHP has less ecological problems but advances made are not properly harmonized with environmental protection. Environment Impact Assessment (EIA) has been formally introduced in India in 1994 and relied on institutional framework with strong support of legislative, administrative and procedural set up.

The present paper outlines the advantages of SHP, barriers in the development of SHP, EIA process in India, regulatory framework, EIA of SHP projects, case studies of EIA of six SHP projects in the state of Uttarakhand, their impacts on ecological resources and human environment and EMP. It is concluded that there is negligible impacts of the projects on surrounding environment and therefore the project are environmentally safe.

2 GLOBAL STATUS OF SMALL HYDRO

Small hydropower is often used to supply electricity in remote or autonomous locations not connected to the electrical grid and can replace existing diesel generators or provide a community with electricity for the first time. Table 1 gives the global SHP potential of the world.

Table 1.0: Installed SHP capacity of the world ^{1,2}

Regions	Installed SHP capacity (MW)	% age
Asia	32,641	68 %
Africa	228	0.5 %
South America	1280	2.7 %
North & Central America	2929	6.1 %
Europe	10,723	22.3 %
Australasia-Oceania	198	0.4 %
Total	47,997	100 %

Globally, China is the major player in the rural electrification programme as it has developed more than half of world's installed SHP capacity. Other developing countries with significant SHP capacity are India (1694 MW), Brazil (859 MW), Peru (215 MW), Pakistan (107 MW), Sri Lanka (35 MW) and Papua New Guinea (20 MW),

3 BENEFITS OF SMALL HYDRO

- (i) Combine the advantages of sustainable hydropower with decentralized power generation.
- (ii) Capable of complementing power source to intermittent renewable energy sources e.g. (wind and solar), as the flow can either be regulated to reserve generating capacity during peak demand periods or when the capacity of other renewable energy sources becomes limited.
- (iii) Can be integrated into existing irrigation structures, flood control and dams reservoirs well suited to the construction of small engineering works.
- (iv) Electrify to remote communities and industries away from grid supply in decentralized manner.

4 BARRIERS TO POTENTIAL DEVELOPMENT

Recent growth of SHPs have been reported to be disappointing due to the following reasons:

- (i) Institutional barriers like approval for concession to use and divert water from the river and difficulties in getting affordable connections to the grid.
- (ii) Impression that hydro plants adversely affect fish migration, fishing, boating, and other river-leisure interests.
- (iii) Impression that the technology is already matured and fully developed.
- (iv) Long useful life and low running costs.
- (v) Liberalisation of electricity market.

In view of the above concerns, SHPs deserve to be more widely and effectively developed and promoted and a better environmental integration may have a positive effect on administrative procedures to get the construction and operation authorizations easily.

5 THE EIA PROCESS

The Environmental Impact Assessment (EIA) optimises a trade-off between developmental activities and socio-ecologic losses and is a management tool linked closely to the project life cycle to ensure that appropriate environmental information is provided at the correct time¹⁰.

The EIA was first introduced in India during 1980s on the controversial Silent River Valley hydroelectric project which envisaged the construction of 130 m high dam across the Kuntipuzha river (Kerala). It was considered a big threat to the biodiversity and forest ecosystem of the Silent valley and in 1985, the project was abandoned and Silent Valley was declared as a National park. This was marked as a new beginning in India and led to the extension of EIA to other activities. The Projects like mining, industries, hydroelectric plants, thermal power plants, atomic power plants, ports and harbours, rail, roads, highways, bridges, airports and commercial project required EIA, if:

- (i) The approval of public investment board/planning commission/central water commission/central electric ity authority etc is required.
- (ii) Project is referred to Ministry of Environment and Forest (MoEF) by other ministries,
- (iii) Project is located in environmentally fragile or sensitive areas and
- (iv) Project is under dispute.

EIA process involves three steps-(a) preparation of the EIA report involving scoping to documentation, (b) review and decision-making and (c) post project monitoring. Each is being briefly discussed as under:

5.1 Screening

It determines whether EIA is required or not. Out of 32 activities listed in schedule I of the notification of MoEF (1994), any project in ecologically fragile areas and any project falling under coastal zone, requires an EIA. The investment clause specifies that new projects with investment of more than 100 crores and modernisation projects involving investment of more than 50 crores require EIA.

5.2 Scoping

It identifies the concerns and issues to be addressed for a project. MoEF has set guidelines and review checklists for all the sectors. Study of alternatives and public hearings are undertaken at this stage only. Alternate scenario must account for no project condition along with project scenario employing best-suited technology or processes (MoEF, 2001b).

5.3 Baseline Analysis

A comparison of project-induced environmental changes with the expected environmental changes without proposed project is assessed through baseline analysis. The project engineering deals with process technology, raw material, water and energy requirements, while environmental aspects deals with data on air emissions, wastewater, noise, solid waste and hazardous/toxic waste etc. The guidelines are prescribed by MoEF on the monitoring and analysis of the baseline data.

5.4 Impact Prediction

The prediction analysis is conducted to forecast the nature and significance of the expected impacts. It is conducted to forecast the nature and significance of the expected impacts or no impacts (environmental and socio-ecological impacts prediction).

5.5 Impact Mitigation Measures

Impact mitigation measures are proposed to avoid or reduce environmental and social impacts. Environmental Management Plan (EMP), risk assessment report and disaster management plan (if hazardous substances are involved in the project), rehabilitation plan (if displacement of people is anticipated) are prepared to suggest

remedial measures. EMP covers the aspects like Pollution prevention, waste minimization, end-of-pipe treatment, mitigation measures and protection of the sensitive receptors. EMP includes the complete work plan, time schedule, place and cost of implementing the measures.

5.6 Documentation

Based on the above information, a concise but comprehensive report is prepared summarising the description of the project, regional settings, baseline conditions, impact prediction and important findings of the study. Project proponents may hire consultants to carry out the EIA and prepare the report for them.

5.7 Public Hearing

It provides an opportunity to involve affected people and vulnerable groups to develop terms of references for EIA, thereby, incorporating their concerns in the decision-making process. The State Pollution Control Board (SPCB) publishes notices for public hearing in two local newspapers, one of which in vernacular language of the concerned locality (MoEF, 1994) with mention of date, time and place of the hearing. EIA notification also provides access of executive summary of the project at the offices of district collector, district industry centre, commissioner of the municipal corporation/local body, SPCB and state Department of Power (DOE). The composition of the public hearing panel is specified by the law and consists of members of local authorities and representatives of the public nominated by the district collector.

5.8 Review and Decision-Making

Implementing Agency (IA) reviews the report with reference to the guidelines provided by MoEF in its manual and may visit the sites if necessary. On the basis, the IA either grants or rejects the environment clearance to the project. The assessment is to be completed within 90 days from the date of receipt of the requisite documents from the project authorities and completion of public hearing and the decision is conveyed to the proponent within 30 days.

5.9 Post Project Monitoring (PPM)

The PPM ensures that an action had been implemented in accordance with the measures specified while providing the Environmental Clearance (EC). Post-implementation monitoring is the responsibility of MoEF and SPCBs.

6 THE REGULATORY FRAMEWORK

The environmental regulations, legislation, policy guidelines, and controls of impacts are the responsibility of a variety of government agencies. The principal environment regulatory agency in India, MoEF formulates Environment policies and accords environmental clearances for projects. Important environmental legislations in India are:

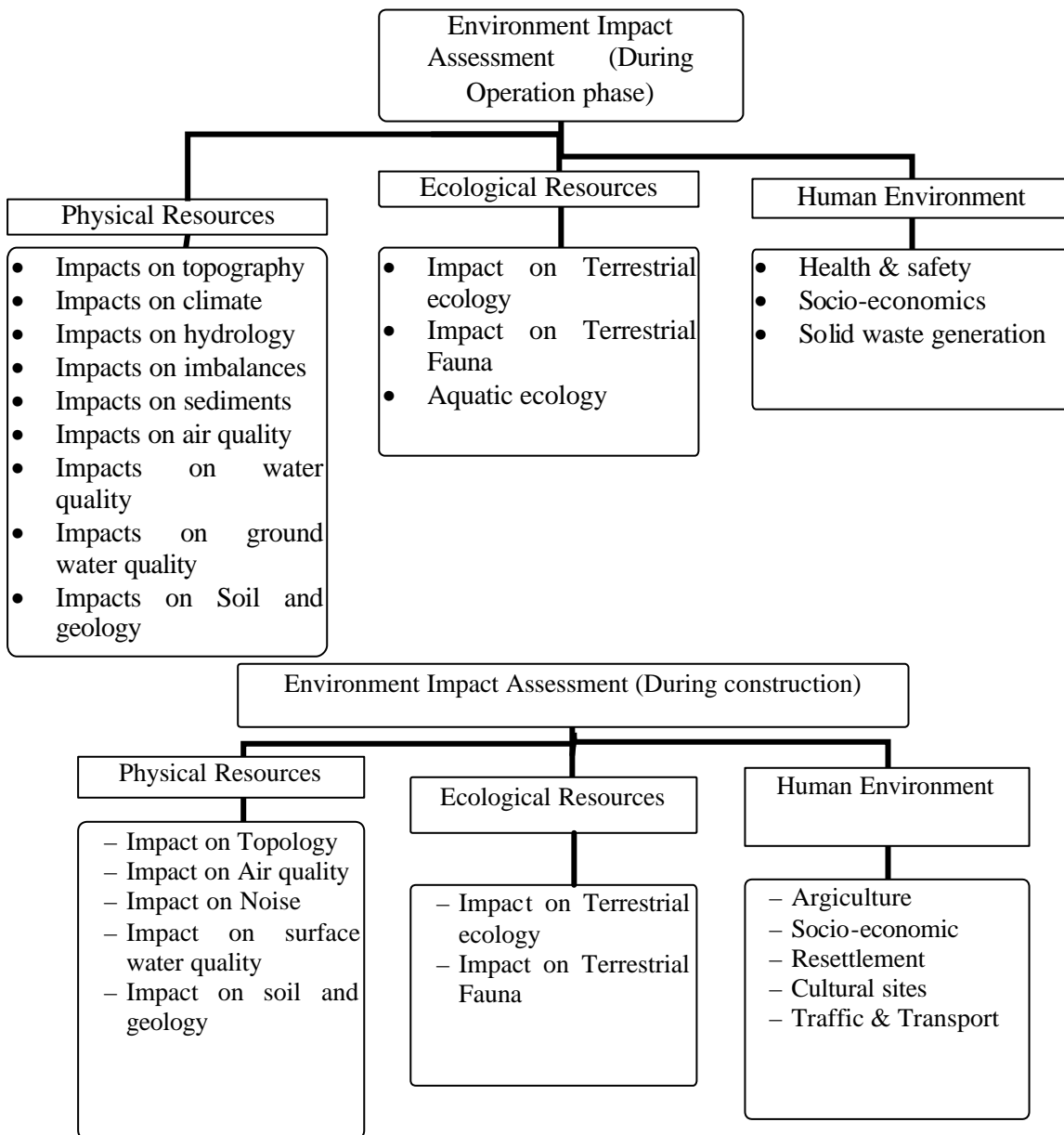
- (i) Environmental (Protection) Act 1986, amended in 1991.
- (ii) Water (Prevention and Control of Pollution) Act 1975, amended in 1988.
- (iii) Forest (Conservation) Act 1980, amended in 1988.
- (iv) Air (Prevention and Control of Pollution) Act 1981, amended in 1987.
- (v) Wildlife (Protection) Act 1972, amended in 1993.
- (vi) Environmental Clearance Notification, 1994.
- (vii) National Environmental Appellate Authority Act, 1997.
- (viii) National Forest Policy, 1988.
- (ix) Noise Pollution (Regulation and Control) Rules, 2000.
- (x) Ministry of Environment and Forest, Guidelines for EIA for River Valley Projects and
- (xi) National Policy on Resettlement and Rehabilitation for Project Affected Families 2003, Ministry of Rural Development (MORD) (2004).

7 EIA OF SHP PROJECTS

The EIA of the following SHP projects in the state of Uttarakhand has been conducted:

- (i) Kaliganga Small Hydel Scheme-I (2× 2,300 kw) and Scheme-II (2×3,000 kw) in Rudraprayag district
- (ii) Bhilangna small Hydel Scheme (2×2,250 kw) in Tehri district
- (iii) Madhyamaheshwar Small Hydel Scheme (2×2,800 kw) in Rudraprayag district
- (iv) Tankul Small Hydel Scheme (2×3,900 kw) in Pithorgarh) district, and
- (v) Kaldigad Small Hydel Scheme (2×3,000 kw) in Uttarkashi district.

The environment impacts assessed during pre-construction, construction and operation phase are categorised into 3 basic resources as per details given in the chart.



The salient feature of the above SHP having installed capacity ranging from 4300 to 7800 kw is given in table 3.0.

Table 1.0: Salient Features of Small Hydroelectric Projects

Item	Kaliganga - I	Kaliganga -II	Bhilangna	Madhyamaheshwar	Tankul	Kaldigad
Capacity	2×2300 KW	2×3000 KW	2×2250KW	2×2800 KW	2×3900 KW	2×3000 KW
District	District: Rudraprayag	District: Rudraprayag	District: Tehri	District: Rudraprayag	District Pithoragarh	District : Uttarkashi
Type of project	Run of the river with trench-type weir.	Run of the river with trench-type weir.	Run of the river with trench-type weir.	Run of the river with trench-type weir.	Run-off the river with trench-type weir.	Run of the river with trench-type weir.
Catchment Area	33 km ²	120 km ²	343 km ²	240 km ²	35 km ²	
Hydrology	Kaliganga is a tributary of Mandakini river.	-	Bhilangna is a perennial stream emanating from Gangotri group of glaciers.	Madhyamaheshwar Ganga is a tributary of Mandakini river that originates from glaciers	Shyamkholagad is a perennial stream and located at an average elevation of 1,800 m above MSL.	
Archaeological/ Historical site	Not present	Not present	Not present	Not present	Not present	

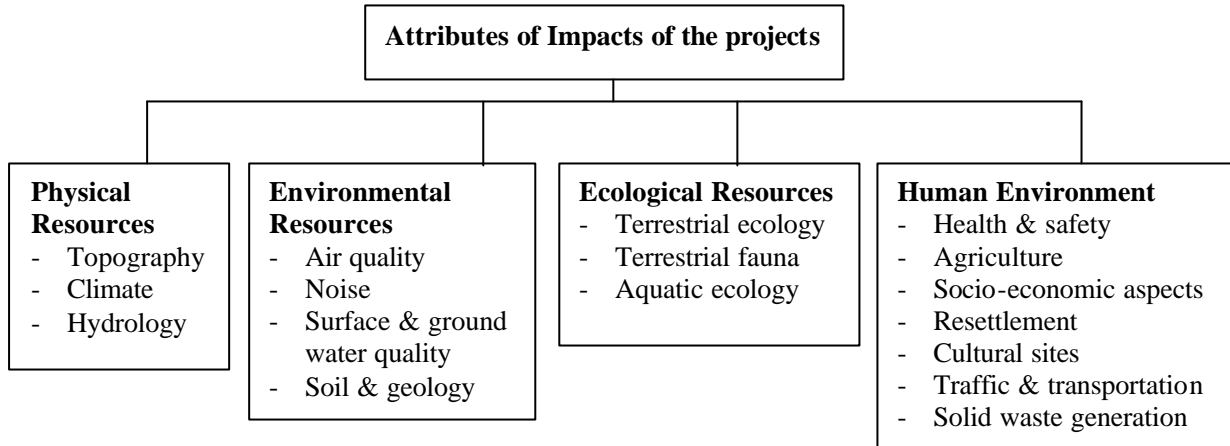
Table 2.0 gives the key environmental legislation with their scope, areas & key players

Table 2.0: Key Environmental Legislation

S. No.	Name	Scope and Objective	Key Areas	Operational Agencies/ Key Players
1.	Water (Prevention and Control of Pollution Act, 1974)	Provide for the prevention and control of water pollution and enhance the quality of water	Controls sewage and industrial effluent discharges	Central and state pollution control board
2.	Air (Prevention and Control of Pollution Act, 1981)	Provide for the prevention and control of air pollution	Controls emissions of air pollutants	Central and state pollution control boards
3.	Forest Act, 1927	Consolidate acquisition of common property such as forests	Regulates access to natural resources, state has a monopoly right over land, categorizes forests	State government, forest settlement officers
4.	Forest Conservation Act, 1980	Halt India's rapid deforestation and resulting environmental degradation	Restriction on de-reservation and using forest for non-forest purpose	Central government
5.	Wildlife Protection Act, 1980	Protect wildlife	Creates protected areas (national parks, sanctuaries) categories of wildlife protected	Wildlife advisory boards; central zoo authorities
6.	Environment Protection Act, 1986	Provide for the protection and improvement of the environment	An umbrella legislation; supplement laws	Central government nodal agency MOEF; can delegate powers to state department of Environment

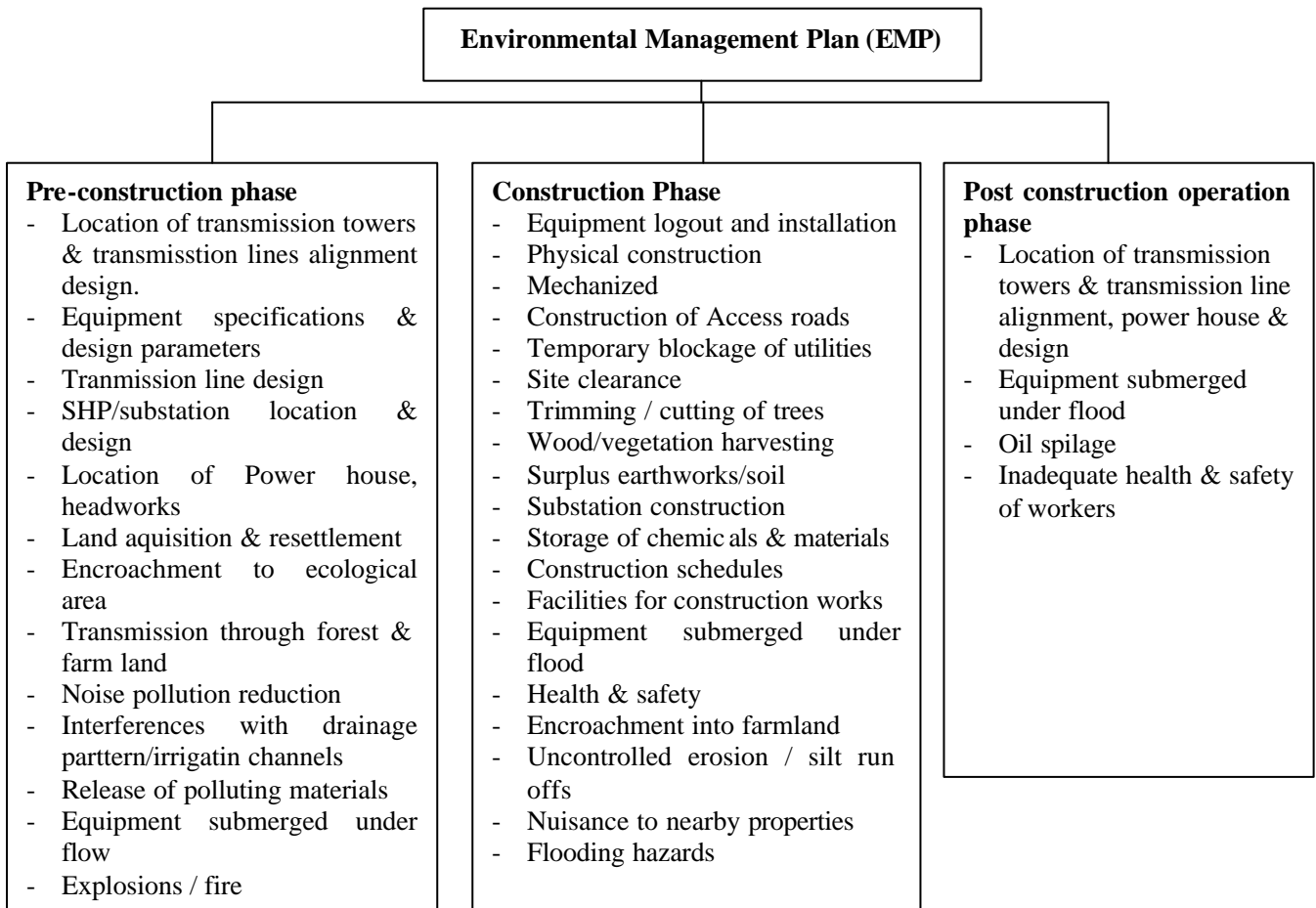
Environmental attributes of anticipated impacts of the projects are summarized in the following chart. It is mentioned that attributes of each resource assessed in terms of nature and magnitude of impacts and

management plan for mitigation in the applicable phase of the project.



It is found that the magnitude of the projects on the above attributes have been almost low with very few of medium range and therefore, over all impacts of these SHP projects has been rated as negligible.

Based upon the evaluation of magnitudes of impacts of the projects, Environmental management plan (EMP) has been worked out with financial estimates to monitor the mitigation measures. The project activities identified project phase wise is given below. The potential impacts, proposed mitigation measures & parameters monitored after the project implementation¹⁰ are reported⁶.



8 ENVIRONMENT IMPACTS OF PROJECTS

Based upon the predictions of impact, of six SHP projects as detailed above, impact assessment without and with project has been conducted and the results are reported in Table 3.0.

Table 3.0 Impact Assessment

S. No.	Parameter	Environmental Impact Units			
		Without Project	With Project	Net Change	Magnitude
1.	Crops	Nil	Negative	Small	Low
2.	Natural Vegetation	Nil	Negative	Small	Low
3.	Land Use	Nil	Negative	Small	Low
4.	Forests	Nil	Negative	Small	Medium
5.	Natural Reserves/Sanctuaries	Nil	Negative	Small	Low
6.	Fisheries	Nil	Negative	Small	Medium
7.	Eutrophication	Nil	Negative	Small	Low
8.	Wildlife	Nil	Negative	Small	Low
9.	Rare Species	Nil	Negative	Small	Low
10.	Endangered Species	Nil	Negative	Small	Low
11.	Species Diversity	Nil	Negative	Small	Low
12.	Minerals	Nil			
13.	Water Pollution	Nil	Negative	Small	Low
14.	Air Pollution	Nil	Negative	Small	Low
15.	Noise Pollution	Nil	Negative	Small	Low
16.	Solid Waste	Nil	Negative	Small	Low
17.	Land Pollution	Nil	Negative	Small	Low
18.	Soil Erosion	Nil	Negative	Small	Low
19.	Health	Nil	Positive	Big	High
20.	Benefits to Economy	Nil	Positive	Big	High
21.	Displacement of People	Nil	Negative	Small	Low

The above table indicate that all the six projects will have negative environment impacts of low to medium magnitude & positive impact w.r.t. health & economy. Therefore there is no significant negative environmental impact of any projects on surrounding environment and therefore are environment friendly.

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