International Journal of Pollution and Noise Control
Vol. 1: Issue 1
www.journalspub.com

Environmental Impact Assessment of Hydroelectric Project During Construction Phase: A Case Study

Yapek Y. Taba[1], A. U. Roy[2], A. Bharti[3]*
[1] Environmental Science & Engineering, Department of Civil Engineering, North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh, India
[2]North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh, India
[3]Department of Civil Engineering, North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh, India

Abstract

When a proposed construction action is considered to threaten the physical, chemical, ecological, social and economic environment, then a thorough assessment is required to be carried out and measures are identified to prevent and offset the adverse environmental impacts by conducting comprehensive Environmental Impact Assessment (EIA). It is an important regulatory, legal and monitoring tool for all involved in decision making including planners, engineers, scientists, administrators, academicians and all stake holders in the sustainable development of hydroelectric projects pre, post and at the end of life of the installed project. It also gives avenues to the project affected citizens to voice their concern freely in the open forum, through the government mechanism, thus establishing the democratic sanctity of the constitution. Pare hydroelectric project is being constructed across the river Dikrong in the Papumpare district of Arunachal Pradesh, India to generate hydroelectricity. The project is currently under construction and has been evaluated for physical, chemical, ecological and socio economical elements in this case study. Sample pertaining to water, air and soil within a radius of 5 km is tested and results are analyzed. An Environmental Management Plan (EMP) is formulated, outlining preventive and curative strategies for minimizing adverse impacts during construction and operational phases of the project.

Keywords*: ecology, hydroelectric, hydel, EIA, water, air, soil*

****Corresponding Authors***
Email-id: yapekyudiktaba@gmail.com, agnivesh.roy@gmail.com, ajaybharti123@rediffmail.com

INTRODUCTION

Hydropower is a renewable, clean and green energy resource having high conversion efficiency, operational flexibility, long term dependability and economic superiority over the other power generation methods. There are several hydel power plants across the world which is operational even after completing hundred years of project commissioning. In addition to electricity generation, other environmental benefits include reliable water supply, improved water quality, flood control, fishery, reclamation of degraded land and irrigation. A reliable and bounty water supply will itself pave way for palatable water supply and a sanitation system for the nearby human settlement, which is one of the most hygienic approaches to keep water borne disease at bay.

However, when a proposed action is considered to threaten the physical, chemical, biological, ecological, social or economic environment, then a thorough assessment is done and measures identified to prevent and offset the adverse environmental impacts by conducting Environmental Impact Assessment (Lawrence, 2003). EIA systems are important legislative and scientific tools that potentially improve the quality of the decision making process for sustainable development.

In other words – Environmental Impact Assessment (EIA) is a systematic process used to identify, evaluate and mitigate the environmental effects of a proposed project prior to major decisions and commitments being made (UNEP). The primary purpose of EIA is to encourage the consideration of the environment in the process of planning and decision making and to ultimately arrive at actions which are more environmental compatible. National Environmental Policy Act which became effective on January 1st, 1970 in the United States of America (NEPA, 1978). It is thus a means to ensure that projects are implemented with full awareness of environmental factors.

Ministry of Environment & Forest, Government of India has on 14th September 2006 vide "The Gazette of India: Extraordinary" under the provisions of the Environment (Protection) Rules 1986 has legislated a law making Environmental Impact Assessment mandatory for all projects with an Environmental Management Plan (EMP) formulated for mitigation measures. (MOEF, GOI, 2006).

OBJECTIVE

The objective of the study is to prepare Environmental Impact Assessment Report during the construction phase. The study has been conducted to carry out comprehensive EIA based on season data covering the following; assessment of the existing status of water, soil and air, identification of potential impact on various environmental components due to activities during construction phase, preparation of EIA report based on the identification, prediction and evaluation of impacts. Further, an Environmental Management Plan (EMP) is formulated outlining preventive and curative strategies for minimizing adverse impacts during construction and operational phases of the project.

PROJECT LOCATION

Pare hydroelectric project is being developed by NEEPCO a public sector undertaking. It is a run of the river scheme on the river Dikrong in the Papumpare District of Arunachal Pradesh. The dam site is located at 27°14'13" (N) and 93°48'56" (E). River Dikrong is a tributary of river Brahmaputra. The project envisages constriction of a 78 metres high concrete gravity dam and 2.82 km long headrace tunnel of 7.5 metre diameter. The installed capacity of project is 110 MW.

The project comprises of intake tunnel, coffer dam, HRT, surge shaft, penstock, power house, tail race tunnel, switch yard and transmission system. The catchment area of project area is 824 sq. km and the maximum head available is 67.3 metres.

The average rainfall in the area is 3800 mm and atmospheric temperature varies between 32°C and 16°C. At the full reservoir level, the water spread will be approximately 111.6 hectare. The layout of the Pare HEP is given in Fig. 1 and a satellite view of the area in Figure 2.

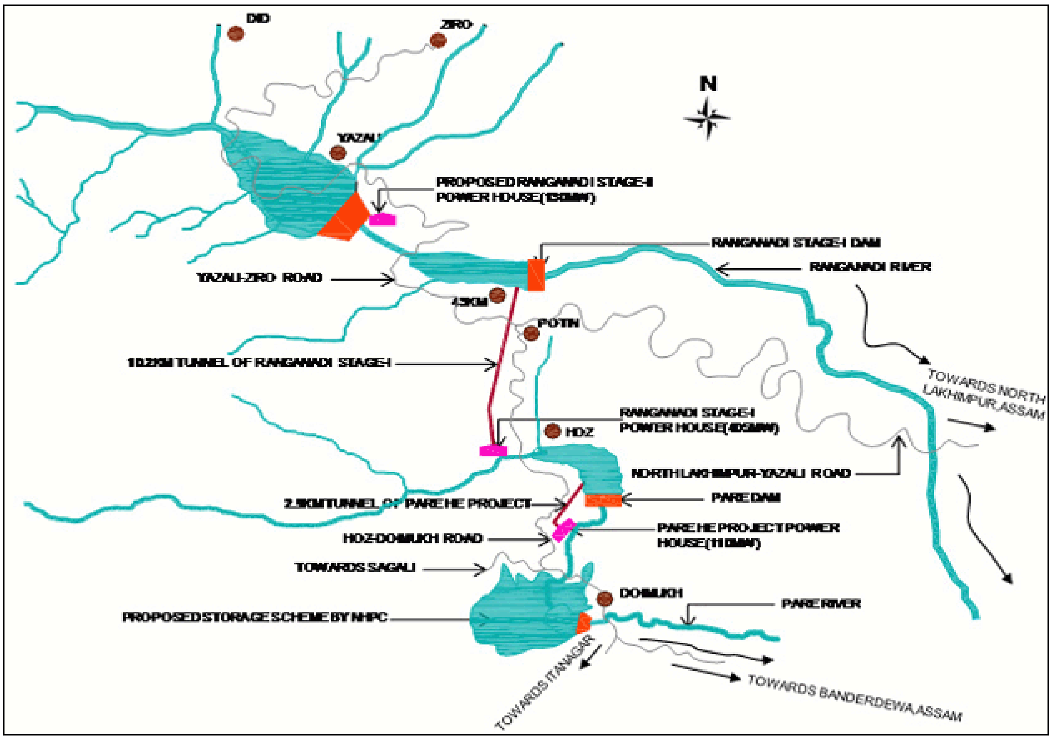

***Fig. 1** Layout of Pare Hydroelectric Project*
Source: NEEPCO

***Fig. 2** Satellite view of Pare Hydroelectric Project*
Source: Google

METHODOLOGY ADOPTED

The methodology involved was divided into three phases wherein phase I included the collection and analysis of baseline data, phase II focussed on the interpretation of the data collected to determine the environmental impact during construction phase and phase III focused on the assessment of potential negative and positive impacts and recommendation of mitigate measures to minimize negative impacts.

Study Area

The study area considered is 5 km u/s of dam site till 5 km d/s of dam site towards power house with 0.5 km on either side of the river Dikrong. Aslam, (2014) in his study for Bhaurat Dam project had taken a study area of 10 km of radius from the dam site. However, in the present study it was observed that there are other projects within the proximity of 10 km radius and hence study area should be limited to 5 km radius from dam site.

Scoping Matrix

Scoping is a tool which gives direction for selection of impacts due to the project activities on the environment (Canter, 1996). As part of the study, exercise was conducted in selecting most probable types of impact occurring during construction phase and some of which is given in Table 1.

RESULTS, ANALYSIS AND DISCUSSION

Test and analysis of each parameter are key quality control instruments for accuracy and veracity of report (Chesoh and Sarawuth, 2011).

Soil Parameter

The soil of the area is typically sandy loam type with bulk density varying from 1.45 to 1.62 gm/cc. The water content of soil was observed to be highest near the power house. The soil of study area is alkaline in nature with pH value ranging from 7.39 to 7.62. The Electrical conductivity ranged between 1126 µS/cm and 1500 µS/cm. The concentration of nutrient like nitrogen and phosphorous is indicative of medium soil fertility and low potassium concentration indicates further lowering of fertility. Soil salinity is also low at all the observed locations.

Table 1 *Some Of The Scoping Matrix For EIA Study Of Pare Hydroelectric Project During Construction Phase*

Land

- Soil erosion
- Pollution by construction spoils
- Solid waste from workers colonies
- Land use change

Water

- Increasing turbidity
- Degraded water quality due to disposal of waste from workers colony
- Muck disposal

Air

- Suspended dust in air from crushing units, unpaved roads and site work.
- Fugitive Emissions
- Emissions due to fuel combustion of construction equipment

Table 2 *Physico-chemical composition of soil in the study area*

Parameter	Sampling Sites		
	Site I	Site II	Site III
Month: December 2015			
Bulk Density (gm/cc)	1.42	1.56	1.57
Water Content (% w/w)	39.30	40.65	40.94
pH	7.37	7.5	7.48
Electrical Conductivity (µS/cm)	1495	1247	1126
Organic Matter (%)	1.7	1.3	1.2
Month: February 2016			
Bulk Density (gm/cc)	1.52	1.64	1.60
Water Content (% w/w)	38.90	41.05	39.85
pH	7.45	7.60	7.62
Electrical Conductivity (µS/cm)	1500	1240	1140
Organic Matter (%)	1.65	1.50	1.30
Month: April 2016			
Bulk Density (gm/cc)	1.37	1.61	1.53
Water Content (% w/w)	40.12	42.05	41.10
pH	7.29	7.37	7.42
Electrical Conductivity (µS/cm)	1490	1260	1150
Organic Matter (%)	1.6	1.5	1.4

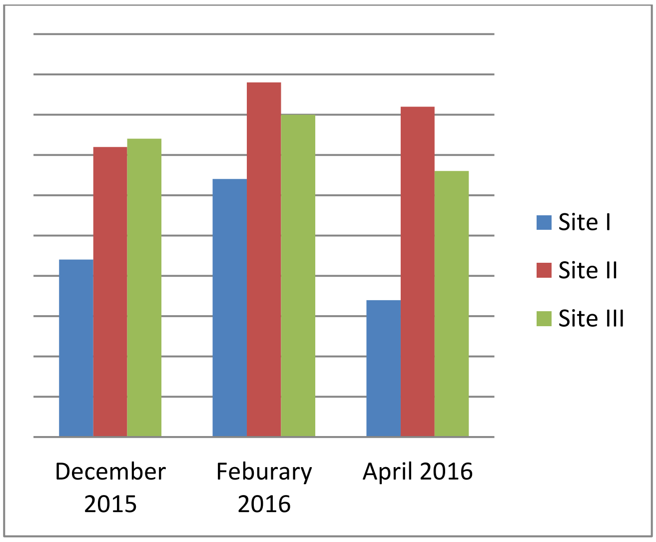

Fig. 3A *Bulk Density Profile Of Sites In Seasons*

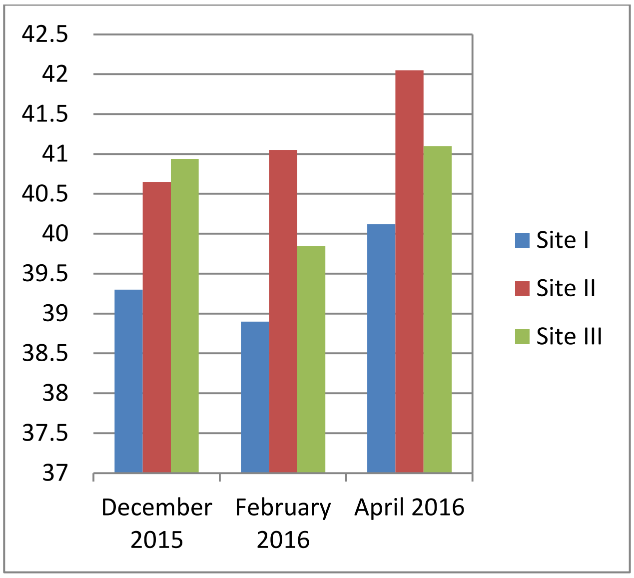

Fig. 3B *Water Content Profile Of Sites In Seasons*

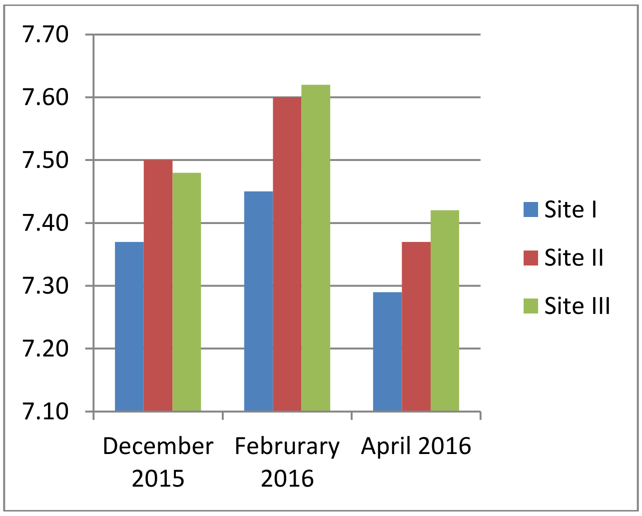

Fig. 3C: *pH profile of sites in various seasons*

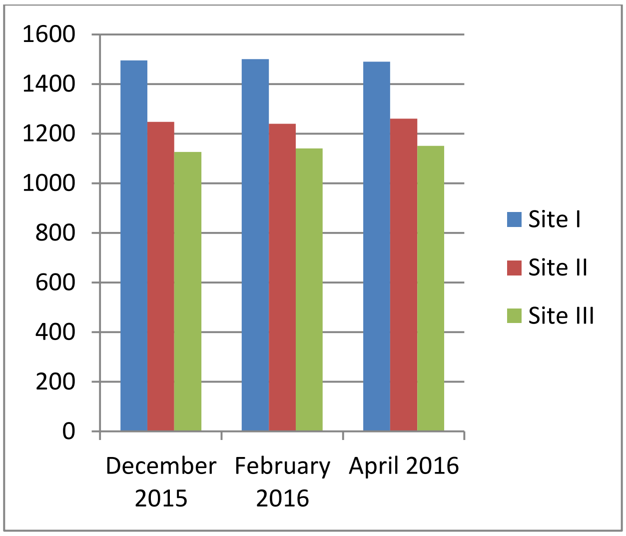

Fig. 3D: *Electrical conductivity profile of sites in seasons*

Air Parameter

The ambient SO_2 concentration ranged from BDL to 10.2 µg / m^3 at the three locations. It was observed that SO_2 level was highest at Jampa village which is the dam site. The NO_2 level varied from 7.2 to 18.4 µg / m^3 and was also maximum at the dam site. The SPM values ranged between 18 to 50 µg / m^3 and the same was also found to be the maximum at the dam site. This could be due to the reason of the ongoing construction activity and will probably decrease no sooner the construction activity ceases. The concentrations of all the three parameter were found to be within the permissible limit in the company residential area and village settlements.

Water Parameter

There is no major source of organic pollution observed in the river stretch and the upstream catchment has low population density with low crop intensity and no industry. The area is dense forested and vegetated but at the same time erosive siltation is also observed. Three seasons water samples were analysed for parameters. The pH of water is almost neutral and meets the drinking water standards. The low EC and TDS values indicate the lower concentration of cations and anions. The concentration of TDS in all the seasons is observed to be less than 500 mg/l. The total hardness in water sample could be due to the presence of salts of Ca, Mg, Fe. This could be coming from construction spoils and muck dumped on the banks of the river. Alkalinity of the tested water was found to be higher than the total hardness in all the locations indicating the cause to be carbonate hardness and not bicarbonate hardness. The level of chlorides and sulphates were well within the permissible limits. No presence of heavy metal was found. The BOD values are well within the permissible limits and total coli form count is nil. High dissolved oxygen values indicate good quality of water.

CONCLUSIONS AND FUTURE SCOPE

The EIA of the project during the construction phase has been done meticulously monitoring and surveying for a period of 6 months with test and analysis carried out as per the standard methods. Based on the results we can conclude that the ongoing construction activity has not affected or altered the quality of soil, water and air to any level of concern. It is obvious that any construction activity will involve emission of dust, however, care has been taken to control dust by regular water sprinkling on roads and at crusher and quarry sites. The muck generated is largely utilised for land area development which is important in the hilly region. Comparing with the pristine natural stage, we can conclude that minimum negative impact on the environment is seen in air, water and soil. The project developer has undertaken afforestation works, methodical dumping and maintained continuous environmental flow, thus up keeping the provisions of maintaining as close to nature as possible.

EIA is an important instrument for assessment of developmental activities through methods which generate information to identify, analyze, evaluate and give mitigation measures at the project level indicating the quality of the environment before, during and after the proposed developmental activity. However, it suffers from the limitation, of being undertaken at the project level only with a limited scope of study. A better approach could be carrying out CEIA incorporating river basin planning integrated with hydro power development plan for the entire region. It should be undertaken at the policy and planning level and integrated with land use and resource availability. CEIA of basin reflect a broader framework of analytical and planning approaches to assess multiple projects with multiple activities at various levels accumulated over time and space over differentiated temporal and spatial attributes. Hence, in addition to project level EIA, it is essential to look from the perspective of CEIA at basin level for hydropower development within the entire north east region to ensure that quality development is done with quantified economic growth and optimum resource utilisation (Roy et al., 2015).

ACKNOWLEDGEMENT
The authors are thankful to the Head of Project, Pare Hydroelectric Project, NEEPCO for his kind permission to carry out survey, conduct test and providing information to the best of his knowledge in carrying out the comprehensive study in the interest of project betterment through research.

REFERENCES

1. Aslam Z. (2014) "*Study of Water & Air Environment for Impact Analysis of proposed Bhaurant Dam using Interaction Matrices Approach*", IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), Vol. 8, Issue 8, Ver.III, pp 08-16.
2. Canter, L.W. (1996) "*Environmental Impact Assessment*", 2nd International Edition, McGraw Hill series in Water Resources and Environmental Engineering.
3. Chesoh and Sarawuth (2011) "*Environmental Impact Assessment of Power Development Projects: Lessons from Thailand Experience*", Asian School Sciences, Vol. 7, No. 9, pp 185-199.
4. Council on Environment Quality, *National Environmental Policy Act - Regulations*. Federal Register, 43, 55978 – 56007; 1978
5. Lawrence, D.P. (2003) "*Environmental Impact Assessment: Practical solutions to Recurring Problems*", John Wiley and Sons Inc., publications, 2003.
6. Ministry of Environment & Forest, Government of India, "*EIA Practice In India*", http://envfor.nic.in/ Impact Assessment Division, New Delhi 2006.
7. Roy, A.U., Prasad, R.K. and Bharti, A. (2015) "*Environmental Impact Assessment of Hydro Power Development – A Critical Review*", International Journal of Engineering Research & Management (IJERM), ISSN:2349-2058, Vol. 2, Issue 7, pp .
8. United Nations Environment Programme (UNEP) *Guidelines for assessing industrial environmental impact and environmental criteria for the siting of industry and environment office*. United Nations Environment Programme, Paris; 1980

