

EIA: A Vital Instrument for Prediction and Mitigation of Environmental Impacts of Hydropower Generation

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ABSTRACT:

The construction, commissioning and expansion of any type of development projects have a profound influence on the existing physical, biological and social components of an environment. Therefore, the first tier of impact assessment shall ideally start with determining the projects feasibility with respect to location. Assessment of area characteristics also involves evaluation of the proposed project with respect to site adequacy. This includes project feasibility with respect to existing meteorological conditions, assimilative and regenerative capacity of an area, land use, geological characteristics, local livelihood and damage potential to biodiversity. If any of the above said indicators are adversely altered by the project activities and services then the project is likely to have significant impact. Hydro power generation projects result in environmental impacts both during the construction and the operational phases. **Construction Phases Beneficial Impacts** viz. Employment, Infrastructure development, Communication improvement etc. **Adverse Impacts**; Besides the some beneficial impacts there are certain other impacts that may cause adverse impact to the surrounding area or environment. Biotic: Submergence of forest land, Effects on flora & fauna **Operation Phase Beneficial Impacts** Socio-Economic Increased/improved crop production, Power generation, Water supply, Ground water recharge, Flood moderation, Agro-industry and Tourism BIOTIC Increased aquatic life, Afforestation , green belt development, Attraction of Migratory birds etc. **Adverse Impacts** PHYSICAL AND BIOTIC Hydroelectric developments have major repercussions because they alter the physical environment. Viz hydrologic regime, hydraulic characteristics, sedimentation characteristics, climatic conditions, water quality Increased aquatic weeds, Spread of water bones disease, Deterioration of water quality and Change in Species composite. The Environment Impact Assessment is an anticipatory, participatory, integrative environment management tool which has the ultimate objective of providing decision makers with an indication of the likely consequences of their decision relating to new projects. It is necessary to know about the possible impacts of any developmental plan on our environment. Fortunately, adequate legislation could be brought into force to make proper assessment of all such environmental impacts. The objectives of environmental impact assessment are to ensure that development is sustained with minimal environmental degradation

INTRODUCTION

India is currently facing an energy deficit. In Northern region there is an energy deficit of 13.41 percent and a peaking deficit of 17.62 percent and the demand for energy is projected to rise further. According to estimates by the Central Electricity Authority, the demand for peaking power in the Northern Region alone is projected to rise from 35, 145 MW during 2007-08 to 48137 MW in 2011-12.

To meet the all India peak demand and energy requirement at the end of 12th Plan, a capacity addition of more than 90,000 MW has been assessed during 12th Plan (2012-2017), which includes 30,000 MW of hydro electric power. The construction, commissioning and expansion of any type of development projects have a profound influence on the existing physical, biological and social components of an environment. Therefore, the first tier of impact assessment shall ideally start with determining the projects feasibility with respect to location.

Assessment of area characteristics also involves evaluation of the proposed project with respect to site adequacy. This includes project feasibility with respect to existing meteorological conditions, assimilative and regenerative capacity of an area, feasibility with respect to land use, geological characteristics, local livelihood and damage potential to biodiversity. If any of the above said indicators are adversely altered by the project activities and services then the project is likely to result in significant impact.

Environmental Impact Assessment is a systematic process to identify, predict and evaluate the environmental effects of the proposed activities and projects. The purpose of EIA is to provide information for decision making on the environmental consequences of proposed actions and promote environmentally sound and sustainable development through the identification of appropriate enhancement and mitigation measures.

Hydro power generation projects result in environmental impacts both during the construction and the operational phases. By using the EIA tool the following likely impacts of proposed actions can be predicted during the planning phase of the activities.

CONSTRUCTION PHASES:

Beneficial Impacts

Socio-Economic

a) Employment

During the construction phase of the projects the opportunities of employment for local inhabitants have emerge. There is not only employment opportunity for qualified local youth but indirect employment such as contractor ship etc is also created.

b) Infrastructure development

There is a vast opportunity of construction of roads, hospitals, schools, community centers, and training institutions in the project area during the construction of project development.

c) Communication improvement

Generally the project area falls in remote place where the basic amenities like communication and other facilities of connectivity are devoid of. On setting the hydro power projects these fundamental facilities are the primary requirement of the project proponents.

Adverse Impacts

Besides the some beneficial impacts there are certain other impacts that may cause adverse impact to the surrounding area or environment. Form time to time the impacts or issues are being raised by the pressure groups etc. These impacts may summarized as follows

Socio-Economic

a) Displacement of people

This is a major and most challenging aspect of any development project. The community residing in the area is force to displace from their roots and have to resettle in new locality is not easy task. They are force to leave their dwelling place as well as the emotions the attached to them which can not be compensated.

b) Loss of homestead/ heritage sites /monuments, if any

Cultural distinctions and social relationships within a community are a fundamental part of social life and play an important role in balancing the forces of social conflict and of social cohesion. Cultural distinctions and social relationships at the community level are related to a series of factors: physical proximity, age and length of residence, kinship, ethnicity, religion, social class, work and gender. Due to construction of Hydro Power the homestead of the locality are lost. Besides this the heritage sites of historical importance are to be demolished. The monuments of the area are also replaced.

Biotic

a) Submergence of forest land, agriculture land, wetlands and fish breeding grounds

The loss of forest due to acquisition of forest land for construction of project is significant impact on the forest. There is a big impact of projects in agriculture lands, wetland and the breeding grounds of fishes and other aquatic animals.

b) Effects on flora & fauna

The major effect of construction activities on the surrounding flora of different status is serious challenges to our environment. The clearing of project site for construction requires felling of trees. The project site may have dominated by plants, shrubs and herbs species, some of which may have the significant value and vulnerable in nature may also suffer the disturbance and extinction. The construction activities are likely to affect the movement of the animal. The increase in noise level due to construction activities the feeding, breeding and movement of wild animals may affect considerably. The felling of trees in project area may affect the avifauna. The

movement of labour force and other staff engaged for construction of project may kill the wild animal in the project area.

c) Ecology of the area

The river ecology which is lotic in nature may change into lentic one by creation of reservoir. Thus the hydro power project changes the ecology of the area. The generation of dust by the movement of vehicles and construction work, crusher operation may cause increase in SPM and RPM level in the area. Dust is likely to settle on the surrounding flora. This kind of impact shall be temporary, localized and reversible. The extraction of rocks and sand shall be done for the construction work from quarry site may impair the ecology of the area. The other impacts due to construction of projects may cause soil erosion due to dumping of muck and other reasons.

OPERATION PHASE:

Beneficial Impacts

Socio-Economic

The socioeconomic impacts are addressed under four headings: Land Use, Economic Impacts, Health and Safety Impacts, and Social Impacts.

a) Increased/improved crop production

On construction of hydropower project the facilities of irrigation in and around the surrounding areas are enhanced consequently the production of agricultural yield also increases.

b) Power generation

The prime benefit of the hydropower project is the generation of electricity. The electricity generation of any nation is the key indicator of its growth as it has become the prime requirement for every sphere of life.

c) Water supply

The reservoir based hydropower project has the main source of water supply for water deficit area.

d) Ground water recharge

The water table and aquifers of the project area are recharged sustainably. Thus the benefit of hydro power projects is helpful for enhancement of the ground water recharge.

e) Flood moderation

The devastating flood on the downstream has been causing the huge loss of life and property. By creation of reservoir for development of hydropower production the flood control can be done by regulated discharges of water. Thus the hydropower generation by creating the reservoir is helpful in flood moderation of the downstream area.

f) Agro-industry

As hydropower projects produce electricity and conserve the water resource which may sustainably utilize for setting up the agro-industries near the project area.

g) Tourism

Due to change in land use pattern of project area and altering the ecology of the area by creating the reservoir creates the opportunities of tourism.

Biotic

a) Increased aquatic life

Reservoir based hydropower projects are most helpful for augmentation of aquatic life.

b) Afforestation, green belt

The afforestation works which is also a statutory requirement is done in catchment and around the project area. The plantation works and creation of green belt in the periphery of the project area enhance the biota.

c) Migratory birds

More migratory birds are attracted to the reservoir area as new wetland has come up.

Adverse Impacts

Greenhouse effect

The greenhouse gas emissions by hydropower plants are widely debated in the world today. Even though hydropower is considered to be a renewable source of electricity, some emissions of

greenhouse gases normally do occur, at least during construction. Emissions are very low for run-of-river power plants, while there are divergent opinions and observations about the magnitude of the emissions from reservoir power plants. Different studies have suggested very different amounts of emissions; according to recent reports the emissions range between 4 and 410 g CO₂ per kWh (Gagnon & Van de Vate, 1997).

Emissions from the manufacturing and construction phase are low. The gases are mainly emitted during manufacturing of the cement and during transportation of building material to the power plant. Therefore, emissions are lower for earth and rock-filled dams than for those made of concrete. Run-of-river plants generally have lower emissions than reservoir power plants since run-of-river plants do not use large quantities of building materials.

Physical

Hydroelectric developments have major repercussions because they alter the physical environment. The creation of reservoirs can modify many environmental components, among them are following:

- A. hydrologic regime
- B. hydraulic characteristics
- C. sedimentation characteristics
- D. climatic conditions
- E. water quality

Aesthetic

Each component of a hydro scheme - powerhouse, weir, spillway, penstock, intake, tailrace, and substation and transmission line - has the potential to create a change in the visual impact of the site which is important to the public, who is increasingly reluctant to accept any changes to their visual environment.

Biotic

As a global average, no significant impacts on biodiversity from hydropower are to be expected, since hydropower has no relevant global environmental impacts. The slight emission of greenhouse gases is negligible as compared to other power options. For individual hydropower projects, however, especially those located in tropical regions, global impact should nevertheless be considered especially with respect to carbon balance.

Flora and fauna of rivers are affected due to the alteration of several factors such as:

- extension and frequency of flooding
- drought conditions below diversion points
- stresses from rapid changes in water level
- water quality changes
- change in groundwater conditions

The composition of species can be altered due to hydropower. Organisms may disappear or be replaced by others, due to the changed conditions. The water level in reservoirs can vary several meters as opposed to perhaps only one meter at most during natural conditions. These fluctuations will lead to an almost barren shore where the plant cover between the upper and lower water levels has been almost totally lost.

Along the shores of the downstream river the short-term regulations will cause similar effects. Organisms living in the riparian zone are an important source of food for fish in the river but also make important contributions as food to terrestrial animals. Due to the water regulation this food source will decrease and the organisms living in the open water mass, i.e. plankton, will be more important for food. However, the more stable conditions resulting from hydropower utilization can in some cases also cause an increase in the growth of certain species. Hydropower facilities disrupt the natural waterways. This will have effects on migrating animals, such as anadromous or catadromous fish. Such obstructions can to some extent be circumvented by the construction of fish way passes, such as different kind of ladders. All too often, however, such measures appear to be inefficient, inappropriate, or prohibitively expensive.

When a river is harnessed for hydroelectric purposes, the natural flow conditions are changed. At the location of a dam, waterfalls and rapids often disappear and downstream from the dam the timetable of fluctuations in water flow is altered. The natural flooding of a river over its banks also ceases. In many regions this flooding is important because it provides nutrients to the aquatic biota and creates sheltered habitats on the floodplains. River regulation can also affect groundwater conditions, leading to impaired water quality. A reduced water flow, following diversion, can cause secondary damages in urban watersheds where pollutants entering the river from other sources (e.g. sewage outfall, etc) are no longer diluted as they once were.

The aeration levels in the water may also be affected when water flow is regulated. In deep reservoirs anoxic conditions might sometimes arise. Thermal stratification occurs where warm water accumulates on top of the colder bottom layer. In sub-tropical and tropical areas the stratification often becomes permanent leading to oxygen deficiency below the thermocline. Thermal stratification is especially problematic in regions with small seasonal changes in air temperature. The water intake to the turbines is often located in the deep part of the reservoir. There, combinations of settling organic particles and a low content of oxygen may lead to unhealthy conditions for aquatic life. The deterioration of the water quality below dams may affect living organisms over long distances.

An additional problem with anoxic reservoir bottom layers is that reducing conditions will prevail. This means that available sulphur compounds will be transformed to hydrogen sulphide (H_2S), which is toxic to living organisms and corrosive to steel.

Phosphates, which have been trapped in the bottom sediments, may be released under anaerobic conditions and available as a nutrient for plants and therefore stimulate the growth of organisms in the reservoir. The decomposition of these organisms will deplete the oxygen levels even further. Anaerobic conditions can also lead to the release of naturally occurring toxic trace metals, like mercury.

In small-scale projects, the impoundment areas are generally shallow and/or the through-flow is fairly rapid. Therefore, small hydropower systems often do not have problems with deoxygenated. The above list of environmental changes following dam construction could be much longer and most of the alterations observed cause a depletion of biodiversity.

However, since such aspects are treated elsewhere, the intention here has been to just illustrate the complex nature of habitat alterations induced by river regulation. One should also bear in mind that not every negative impact observed globally occur at the same time or in one single project.

CONCLUSION

Keeping in view the above discussed possible impacts, no matter whether these are the beneficial or adverse due to developmental activities must be address before setting of the project. For this purpose a powerful tool is required. The Environment Impact Assessment is an anticipatory, participatory, integrative environment management tool which has the ultimate objective of providing decision makers with an indication of the likely consequences of their decision relating to new projects. It is necessary to know about the possible impacts of any developmental plan on our environment. Fortunately, adequate legislation could be brought into force to make proper assessment of all such environmental impacts. The objectives of environmental impact assessment are to ensure that development is sustained with minimal environmental degradation.