Environmental Flow – A key issue in Sustainable Hydroelectric Projects

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Keywords

Hydroelectric projects, sustainability, environmental flow, Hydrological methods, basin-wide development

ABSTRACT

The envisaged economic growth of India requires a commensurable growth of the energy sector. In view of the fast depleting conventional sources of energy, increased focus is now required in the development of non-conventional sources of energy, particularly hydropower sector. Unfortunately the trend of hydropower development vis-à-vis overall power development during the last fifty years is not compatible to what it ought to be, for a well-balanced distribution. With the growing focus on environment, more and more of hydropower projects in the country face resistance from different groups on environmental and social issues, thus resulting in time overrun, public anger and sometimes even abandoning the project. While the importance of environment is undeniable, it is equally accepted fact than in the quest of energy needs, some tradeoffs are inevitable. A strategy need to be evolved to make the project acceptable to stakeholders for sustained growth of economy and ecology. These successful negotiations must be concluded with affected local communities at the planning stage for a project to move ahead. Amongst all the issues that hamper smooth commissioning of the project, environmental flow remains a contentious issue because of subjectivity involved. The paper discusses the methods available to determine the environmental flow and the bottlenecks. The paper also discusses the strategies to make the development of hydropower an acceptable proposition in the country.

INTRODUCTION

Availability and access to reliable sources of energy are catalysts for economic growth. The envisaged growth of the Indian economy cannot be achieved without a commensurate increase in the availability of energy. India's power sector needs to keep pace with the infrastructure growth and overall development. Even with the modest growth rate of 8%, the total demand for electricity in India is expected to cross 950,000 MW by 2030. If emergent measures to address the power situation are not taken, the power sector can become a major stumbling block to growth. India needs to eliminate shortage of energy supply and enhance the availability of commercial energy resources if it has to sustain the projected economic growth.

POWER POSITION IN INDIA

With 187 GW of installed power generation capacity, India ranks fifth largest power producer in the world after the U.S., China, Japan and Russia. Paradoxically, India is one of the lowest in terms of per capita consumption of power with about 779 kilowatt hours a year, which is only one third of world average and about one fourth of China. Over half of the country's population does not have access to electricity or any other form of commercial energy thus putting increased pressure on biomass.

The stressed energy sector is evident from the fact that between April to December 2012, India faced a peak deficit of 12,159 MW (- 9%) or 65,076MU in energy terms. Due to growth in population, urban needs

and economy, the energy demand of India has far outpaced the supply. In the quest of closing this vast demand and supply gap and fulfilling the projected energy requirement of the country India relies heavily on fossil fuels. But the country lacks sufficient domestic conventional energy resources. The imports of petroleum and gas would continue to increase substantially involving a large energy import bill. As India enters a period of sustained economic growth and higher consumption of energy, it is imperative that India needs an increased thrust on tapping alternate sources of energy, predominantly hydro power. As over 50% of the total carbon emissions come from the power sector, this increased thrust will help the country in reducing carbon emissions as well.

HYDROPOWER

Amongst all the options of renewable energy, hydropower remains the richest renewable and environment-friendly source of energy. When compared with conventional sources of energy, the hydropower projects have a big positive impact on environment. A 500 megawatt coal plant produces 3.5 billion kilowatt-hours per year. It burns 1,430,000 tons of coal, uses about 8 billion litre of water and 146,000 tons of limestone. It also puts out, each year 10,000 tons of sulfur dioxide which is the main cause of acid rain, 10,200 tons of nitrogen oxide, 3.7 million tons of carbon dioxide, 500 tons of small particles, 720 tons of carbon monoxide, 125,000 tons of ash and 193,000 tons of sludge from the smokestack scrubber, 100 kg of arsenic, 55 kg of lead, 2 kg of cadmium, and many other toxic heavy metals. The 8 billion litre of water it uses for cooling is raised by about 8 degrees centigrade on an average before being discharged into a lake or river. By warming the water year-round, it changes the habitat of that body of water.

In contrast, the World Bank notes “Accelerating the use of renewable energy is also indispensable for improving air quality and the local environment and for meeting India’s commitments to reducing its carbon intensity. On an average, every 1GW of additional renewable energy capacity reduces 3.3 million tons of carbon-di-oxide every year. Reducing particulate concentrations is also estimated to save 334 lives for every million tons of carbon abated. ”

HYDROPOWER DEVELOPMENT IN INDIA

In spite of the paramount importance to meet the acute energy needs of our country, the trend of hydropower development vis-à-vis overall power development during the last fifty years is not compatible to what it ought to be, for a well-balanced distribution. During last two five years plans, the country could achieve only about half of its hydro capacity addition target. The consistent below par performance need a though relook on the issues that hamper the development.

Apart from usual concerns like involuntary resettlement, local culture and religious beliefs associated with every hydropower project, the most challenging aspect of hydropower development is the environment concern. In few cases like Loharinag Pala Project, Pala Maneri and Bhairon Ghati projects this can snowball into a major issue with ultimately leading to abandoning of the project.

ENVIRONMENT – A KEY ISSUE

Till nineties, the environment and social concerns related to water resources projects were mostly focused on upstream of dam. The issue of minimum flow gained attention in 1999 when the Supreme Court of India directed the government to ensure a minimum flow of 10 cumec in the Yamuna River as it flows through New Delhi. Since then, the environmental impacts and social issues downstream of the dam started gaining equal and even more importance. The lack of awareness has led to a growing perception that hydropower projects are intrinsically negative and must not be built or contemplated. In the backdrop of growing environment concerns, the Water Quality Assessment Authority (WQAA) was constituted in 2001 to look take measures, inter alia , for collection and dissemination of information and preparation of manuals, codes or guides relating to the prevention, control and abatement of water pollution.

THE CONFLICT

In the early days, it was widely believed that the environment flow in absolute terms is enough to conserve the river ecosystem. Consequently the run of the river projects where water is returned to the river after generation were not perceived to have any appreciable effect on environment. This has resulted in increased preference given to run-of-the-river hydropower projects over the storage ones, particularly by the new entrants in the field. With the growing awareness towards environment, the environmental flow is presently not just seen as a number but considered as the flow that is necessary to ensure the existence of habitats in a river in different flow regimes. At one end, the hydropower projects are essential for meeting energy needs. At the other, the environmental flow, particularly in run of the river projects where it cannot be used in energy production, adversely affects the economics of the project and may even make it unviable. The infrastructure in water resource sector is capital intensive and because of high stakes involved, this conflict, particularly during low flow and peak demand period makes determination of environmental flow a highly contested process. Unfortunately, opposition to hydropower projects is also not backed with any systematic studies and as a result, this conflict continues to be a major stumbling block. The social issues add another dimension to this conflict.

METHODS AVAILABLE TO DETERMINE ENVIRONMENT FLOW

The methods to calculate the environment flow are broadly classified into four distinct categories, namely hydrological index methods, hydraulic rating methods, habitat simulation methods, and holistic methodologies. None of the method can be singled as a panacea for determining environmental flow. The Table 1 below indicates the relative advantage and disadvantages of these methods

Table 1

Method	Sub Type	Advantages	Disadvantages
Look-up Table	Hydrological Ecological	Inexpensive, rapid to use once calculated	Non site-specific, Hydrological indices are not valid ecologically Ecological indices need region specific data to be calculated
Desktop	Hydraulic Ecological	Site specific Limited new data collection	Long time series required No explicit use of ecological data Ecological data time consuming to collect
Functional Analysis		Flexible, robust, more focused on whole ecosystem	Expensive to collect all relevant data and to employ wide range of experts. Consensus of experts may not be achieved
Habitat modeling		Replicable, predictive	Expensive to collect hydraulic and ecological data, replicable, predictive

The look up tables and desktop methods are fast , use daily or monthly flow data to give information about environmental flow and more suitable for basin planning. A Working Group created in 2003 to advise the WQAA on ‘minimum flows in rivers to conserve the ecosystem’ reviewed the international practices and suggested that due to a variety of reasons, including the high hydrological variability and difficult tradeoffs between environment and agriculture, the practices adopted in other countries for assessment of EF are unlikely to be applicable in India. The Working Group also noted in the report dated July 2007 - “The main difficulty in quantifying the minimum flows are absence of an acceptable definition of ecological needs and, also, the absence of an agreement on the priority of environmental Flow Releases (EFR). Moreover, while the domestic and agriculture requirements are easily quantified, it is difficult to decide as to what comprises the legitimate ecological needs”. The Working Group advocated simple hydrological methods to estimate the ‘minimum flows’ to maintain prescribed water quality standards. These methods, however, have an element of subjectivity and often opposed as being biased. The application of these methods makes the project, with vulnerable to criticism and opposition during the construction stage. Recently abandoned Loharinag Pala Project on Bhagirathi River is one such example.

Extensive work has been carried out in this area in many countries viz; South Africa, Australia, United States and United Kingdom and more than 200 methodologies have been developed. However, no significant work has been done in other parts of the world including Eastern Europe, Latin America and Asia. Various methodologies are being followed in different countries. A hydrological index is for example used in France. The French Freshwater Fishing Law of 1984 requires that flows remaining in the river in bypassed sections of rivers must be a minimum of 1/40 of the mean flow for existing schemes and 1/10 of the mean flow for new schemes. In regulating abstractions in the UK, an index of natural low flow has been employed to define the environmental flow. Often used is the Q95 Index: the flow that is equaled or exceeded for 95% of the time. The Q95 Index was chosen purely on hydrological grounds.

In India too, the consideration of minimum flows has, started attracting attention recently and no guidelines have been formulated as yet. Amongst the bottlenecks to this endeavor, some remain peculiar to the Indian conditions such as high variability of the flows during the year, interstate flow of most of the major rivers and non-availability of enough data for implementation of sophisticated methodologies. Moreover, in a country like India, the allocation of water for environment is less of a technical and more of a social decision. Ensuring a fair and equitable allocation to ensure sustainability of both project and the environment requires a thorough analysis and studies and should maintain a balance between ecology and economy.

The amount of subjectivity involved in determination of environment flow can be gauged from the high degree of variation in computation of minimum flow requirement by various methods. Pradeep Kumar (2007) computed minimum flow requirement in Satluj river d/s of Nathpa and d/s of Sholding confluence based on practices prevailed in various countries and other popular methods. The arrived flow requirement varied from 5 cumec to 80 cumec. This variation underlines the need of evolving a mechanism to arrive as acceptable figures for environment flow.

THE STRATEGIES

Acceptance of Environment Flow as Optimal Flow

To begin with, those who oppose the hydropower development projects need to accept that no development can leave a river in pristine condition. The best development is the one that optimally caters the competing uses. As Says Earl Eiker, Chief of Hydraulics at the U.S. Army Corps of Engineers. "If you're going to have sustainable development, you can't leave the environment totally pristine. This is a trade-off that we must accept, though impacts on the environment can and should be minimized. But without water resources development, this country wouldn't be what it is today. We all like to know that we will have water when we turn on the taps or lights when we flip the switch". In the developing country like ours, the environment flow therefore, needs to be redefined as optimal flow which balances the ecology and economy. Such flow assessed as part of project planning and design studies be based on the relationship between economy and ecology during the planning of the projects itself as an input in the decision-making process.

Formation of Multi-disciplinary Team of Experts

The availability of sufficient data to undertake the desktop studies is often a bottleneck. Invariably, the decisions are taken based on expert opinion in a particular field and may be subjective. For example, in Tenent method , experts may differ on classification of the river which ultimately have a huge bearing on the flow. A better approach is to fix an optimal flow based on desktop methods and then constitute a multi-disciplinary team of experts from different domains like hydrology, ecology, water quality, sociology and morphology, who can form a consensus to arrive an optimal flow to balance development and ecology. The team approach is also more consistent with the recognition that environmental flow assessment is a multi-disciplinary subject, requiring input from a wide range of specialist areas. However, the process need to be transparent and the team of experts should clearly bear in mind that in maintaining such balance between conflicting economy , sociology and ecology the trade-offs will be inevitable .

Basin-wide Assessment

Over the years the focus of planning of the projects has been on individual projects rather than the holistic development. Enriched with recent experience of planning and development of hydropower projects in some states, the growing consensus is that this approach has serious limitations particularly when the cascade development on same river. The optimized basin wide impact of projects considering environmental, economic, social impacts of the taking entire river basin is taken as the unit of analysis, instead of individual planned ones needs to be seriously considered. Such an assessment may be made by a neutral agency and should consider cumulative impacts and benefits, various alternatives and identify mitigation and compensatory activities. A recent study on assessment of cumulative Impact of hydropower Projects in Alaknanda and Bhagirathi Basins up to Devprayag is an important step in this direction.

Building a Public Opinion

In this conflicting interest, no solution can make everyone satisfied and adequate preparedness needs to be ensured to deal with the issues and controversies. A transparent and open process to ensure a balanced and reasonable perspective on all interests is the first step in this direction. A great deal of information is required both for the general public and the media. The technical issues need to be brought out to the public in simple language with graphics and real life examples and emphasize why the benefits of the project outweigh the negative consequences. It must be borne in mind that the information need to be more focused on general public, their needs and impacts on their life. This may require a well-oiled media campaign. Unfortunately, our planners are always averse to media which result in misinformation emphasizing the negative consequences. Sharing of information with media can built a public opinion for the project. Good media information about the project, its benefits and socio-economic impacts as well as ecological impacts needs to be spelt out.

People's Participation

People's participation is vital. All stakeholders, particularly local populace and religious groups need to be involved to imbibe a sense of ownership in them. The people should be encouraged to voice their opinion and raise queries and we must be prepared to address them. The project must create employment opportunities for the region and extensive measures under Corporate Social Responsibility should be undertaken and publicized. These measures should also include addressing religious sentiments and should precede the work on development of the project. The populace should be able to visualize the benefits of the upcoming project

A discussion process with the stakeholders and public will not only avoid hampering of the project at the later stage but also will result in an optimum development with least impact as well as greater acceptance amongst to the affected people. The focus should be more on trust and understanding rather than legislation and an opaque process. The involvement of stakeholders can be looked beyond conceptualization to construction and post construction period like implementation of mitigation measures, compensatory afforestation and monitoring the implementation of environmental management plan. This approach at the planning stage would help identify opportunities for maximizing benefits and mitigating or compensating for risks, leading to better outcomes for all those involved.

CONCLUSIONS

The large-scale hydropower infrastructure and availability as a reliable source of power ensures enhanced economic activity by creating employment opportunities, promoting the latent demand and reducing pressure on conventional sources of energy. It needs to be ensured that the positive impacts substantially overshadow the negative consequences like resettlement, reduced natural resources for the local populace and environmental degradation. With proper planning, a sustainable development plan to maximize the benefits can be prepared while sharing benefits with directly affected people, communities or other stakeholders , thus fulfilling the social responsibility with active community participation. The

environment flow must be assessed in holistic manner with multidimensional approach and ensuring people's involvement. Issues of resettlement, sustainable livelihoods, cultural impacts and flood control must be addressed for the project to have greater acceptability.

To summarize, a quote from USBR reflects the sentiment well - "We know that any innovation introduced by people has an impact on the natural environment. That impact may be desirable to some, and at the same time, unacceptable to others. Using any source of energy has some environmental cost. It is the degree of impact on the environment that is crucial. As we learn to live in harmony as part of the environment, we must seek the best alternatives among all ecologic, economic, technological, and social perspectives. The longer we delay the balanced development of our potential for hydropower, the more we unnecessarily use up other vital resources"

ACKNOWLEDGMENT

The authors wish to place on records, their sincere thanks to the Central Water Commission for according permission to bring out this paper. The views expressed in the paper are of the authors and not necessarily of Central Water Commission or Government of India.

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