COST BENEFIT ANALYSIS URI I STAGE II HE PROJECT

BACKGROUND

Cost benefit analysis is a tool which modern financial analysts adopt before undertaking any financial operation or commercial activity. A cost-benefit analysis is done to determine how well a planned action will turn out. The analysis relies on the addition of positive factors and the subtraction of negative ones to determine a net result.

Environmental cost-benefit analysis, or ECBA, refers to the economic appraisal of policies and projects that have the deliberate aim of improving the provision of environmental services or actions that might affect (sometimes adversely) the environment as an indirect consequence (Atkinson and Maurato, 2008). It is one of the most widely used approaches to gain economic information about the social costs and benefits of hydropower (Johansson and Kristrom, 2018).

Environment cost benefit analysis is part of impact assessment process, where environment costs and benefits of the project are represented in monetary units, as far as possible with a view to have clear understanding of environment feasibility of the project. Ecological and environmental losses and socio-economic distress caused to the people whoare displaced are weighted against economic and social gains.

GUIDELINES FOR DETERMINATION OF ENVIRONMENT COST AND BENEFITS

The MoEF&CC vide letter No. 7-69/2011-FC(Pt.), dated 1st August 2017, issued Guidelinesfor conducting Cost Benefit Analysis for projects involving diversion of forest land underthe provisions of the Forest (Conservation) Act, 1980. Though it is applicable for conductingcost-benefit analysis for projects involving forest diversion, it provides a broad and self-explanatory methodology for assessing ecological and environmental losses and economicdistress caused to the people who are displaced and weighted against economic and social gains.

For Uri-I Stage-II HEP, no surface forest land is proposed to be diverted, only 17.0 ha underground forest land is required for construction of underground structure. Environment cost benefit analysis has been carried out by following MoEF&CC guidelines inthis regard, as applicable to this project. In addition, environment cost, other than the cost of diversion of forest land has also been considered.

ENVIRONMENT COST

The MoEF&CC guidelines cover the cost benefit analysis due diversion of forest land only. It does not cover the environment costs and benefits due to other project related impacts due to acquisition of private land, landscape fragmentation, conversion of lotic to lentic aquatic ecosystem, barrier to upstream and downstream movement of fish, change of flow regime, sedimentation profile, reduced flow in intermediate stretch, Impairment of terrestrial species movement/ migration routes, limited free flowing stretch in cascade of projects, socio-economic and cultural impacts due to displacement of population, loss of

houses, agricultural land, etc., changed social mix due to arrival of migrant population, air and noise impacts, etc. Therefore, cost of mitigation of these impacts needs to be factored into assessing environmental costs.

Ecosystem Services Losses

As discussed in Chopra (2006) report the ecosystem services provided by forests include: i) Provisioning goods such as wood, non-timber forest products (NTFP), fuel, fodder, water and provision of services such as grazing, tourism, wildlife protection and life support, ii) Regulating Services like climate regulation, disease control, flood moderation, carbon sequestration and health of soils and water regimes, iii) Non-material benefits obtained from ecosystems like spiritual, recreational, aesthetic, inspirational, educational, communal, symbolic, and iv) Supporting Services like necessary for the production of all other ecosystem services: Biodiversity, Nutrient cycling, and Primary production.

Therefore, based upon Chopra (2006) report the Hon'ble Supreme Court of India has made it mandatory vide its order dated 28.03.2008 for the user agency to compensate for the diversion of forest land for non-forest use for developmental activities on the recommendations of Central Empowered Committee (CEC) to make payment of Net Present Value (NPV) of such diverted land so as to utilize this for getting back in the longrun which are lost by such diversion. The economic value of loss of ecosystem services due to diversion of forests shall be the net present value (NPV) of forest land beingdiverted as per MoEF&CC Guidelines.

As per MoEF&CC guidelines dated 1.8.2017, the economic value of loss of eco-system services due to diversion of forests shall be the net present value (NPV) of forest land being diverted as prescribed by the Central Government (MoEF&CC). In case of National Parks, the NPV shall be ten (10) times the normal NPV and in case of Wildlife Sanctuary the NPV shall be five (5) times the normal NPV or otherwise prescribed by the ministry or any other competent authority.

In case of Uri-I Stage-II HE Project, no surface forest land shall be diverted for the project, however, 17.0 ha underground forest land is required for construction of underground components like HRT, TRT and Powerhouse. Ecosystem service cost is calculated accordingly.

Loss of Animal Husbandry Productivity, including Loss of Fodder

The diversion of forest land not only affects the forest dependent people but the livestock also. Livestock depend to a certain extent on fodder and grass of common property resources (CPR) and forest for their feed beside crop residue; in turn the animals return these feed resources to cropland via soil nutrients through manure and application of manure helps to improve soil texture and decompose litter more easily (Bajracharya, 1999).

The main source of fodder is the forest for majority of households. The green fodder includes the grazed green grass, hand cut green grass and leaves of many shrubs and tree leaves from trees. Moreover, rearing mechanism in rural area is integrated with forest

Sr. Manager (E)
Uri Power Station
NHPC Ltd Gingle
Baramulla (J&K)193122

ecosystem due to their symbiotic dynamic relationship among the forest, livestock, and crops. According to MoEF&CC guidelines this loss is to be quantified and expressed in monetary terms or 10% of NPV applicable, whichever is maximum.

As diversion of overground forest land is not involved, this cost has not been considered and kept as zero.

Cost of Human Resettlement

The dam/barrages projects invariably require the acquisition of land – forest as well as private including community land and revenue land for various project components like submergence area, dam/barrage complex, residential colonies, powerhouse, storage yards, approach roads, etc. Despite best efforts to minimize displacement of people, compulsory acquisition of some extent of private and government land for the public purpose becomes necessary in many projects due to locational constraints. For this the acquisition of the land shall be in consonance with "The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 in force since January 1, 2014, conjointly with the provision of the State R&R Policy if any, for the Rehabilitation & Resettlement of displaced/project persons.

As per MoEF&CC guidelines dated 1.8.2017, the cost is to be quantified and expressed in monetary terms as per R&R Plan. However, in the present project, there is no acquisition of private land, therefore this cost is not counted.

Loss of Public Facilities and Administrative Infrastructure

Many a times, public infrastructure (Roads, buildings, schools, dispensaries, electric lines, railways, etc.) existing on private land or in forest land are to be lost under proposed acquisition/diversion for project works. These structures shall be relocated, the provision for which is generally made under sub-head "B-land" in the DPR. For relocation of such facilities likely to be diverted, forest land would be further required. Similarly, if located in non-forest land, these shall have to be relocated at appropriate location with the consent of stakeholders. As per MoEF&CC guidelines dated 1.8.2017, the replacement cost of such facilities has to be quantified and expressed in monetary terms as per actual cost basis at the time of diversion. As there is no loss of public facilities and administrative infrastructure, these costs are not counted.

Possession Value of Forest Land Diverted

The Forest land that is diverted for the project is unlikely to be returned and remains in the possession of the user agency. Therefore, as per MoEF&CC guidelines 30% of environmental costs (NPV) due to loss of forests or circle rate of adjoining area in the district should be added as a cost component of possession value of forestland, whichever is maximum.

Cost of Suffering of Oustees

The social cost of rehabilitation of oustees (in addition to the cost likely to be incurred in providing residence, occupation, and social services as per R&R plan) be worked out as 1.5 times of what oustees should have earned in two years had he not been shifted.

Sr. Manager (E)
Uri Power Station
NHPC Ltd Gingle
Baramulla (J&K)193122

In the case of proposed project, the required 85.0 ha non-forest land is already under possession of NHPC. No private land shall be acquired for the project, therefore there is no displacement due to the construction of proposed project.

Cost of Habitat Fragmentation

Habitat fragmentation often refers to the reduction of continuous tracts of habitat to smaller, spatially distinct remnant patches, and habitat loss typically occurs concurrently with habitat fragmentation (Collinge 2009, Wilson et. al., 2016). The fragmentation is the process of breakdown of an environmental unit in fragments, more or less isolated. Around the reservoirs, for example, these fragments end up with very distinct environmental conditions than those existing before project construction. The creation of reservoirs modifies the natural landscape, transforming it into fragmented patches. This discontinuity in the landscape implies profound changes in population structure of flora and fauna (Lopes et. al., 2014). Fragmentation increases the vulnerability of patches to external disturbance with consequences for the survival of these patches and of the supporting biodiversity (Nilsson and Grelsson, 1995).

Creation of dams/barrages as barriers across the river come in the way of movement of fish fauna who move freely in flowing water. Migratory fish species, such as Snow trout (*Schizothorax* species) is present in Jhelum River in this stretch, which requires free movement upstream and downstream depending upon water temperature and discharge and use tributary habitat for breeding and spawning. Creation of barrages will change the habitat of fish species.

The quantitative estimation of habitat loss and fragmentation being a complex, multidimensional process is fraught with numerous difficult issues even though it has been attempted by IIRS, Dehradun in a study (Roy et. al., 2012). However, monetization of losses have not been attempted in these studies. In order to overcome the same, MoEF&CC has adopted straightforward rule that while the relationship between fragmentation and forest goods and services is complex, for the sake of simplicity the cost due to fragmentation has been pegged at 50% of NPV applicable as a thumb rule.

In the present case, the project is not creating any additional barrage/dam and will be using existing barrage of Uri I Stage I, therefore, these impacts are not accounted for in cost benefit analysis.

Compensatory Afforestation & Soil Moisture Conservation Cost

Compensatory afforestation refers to the practice of ensuring that when a forested area is diverted for non-forest purposes, another area is afforested to maintain biodiversity equilibrium. It is the provision which direct to do plantation of new trees to compensate loss of trees that happened during any infrastructure or development project activity. It is treated as a replacement cost of diverted forest land by way of either afforestation in equivalent new non-forest area or double of area diverted in a degraded forest area. The norms for raising plantation have been fixed by the MoEF&CC. The actual cost of Compensatory afforestation & soil moisture conservation and its maintenance in future at

the present discounted value shall be considered as substitution cost per MoEF&CC guidelines dated 1.8.2017.

Reduction of Flow in the Intermediate Stretch

The area downstream of a barrage is obviously impacted by reduced water flow. "Downstream of a dam, the river is starved of its structural materials and cannot provide habitat," according to the Hydropower Reform Coalition, a collection of 150 environmental groups. "Most dams don't simply draw a line in the water; they eliminate habitat in their reservoirs and in the river below."

Impact on river fishery due to changes in flow regime, effect of dam/barrage blocking fish migration, changes in water quality (e.g., loss of nutrients and sediments trapped by dam, silt free water, loss of pools and riffles, change and decrease in populations of macroinvertebrates the key indicators in river health).

These impacts can be valued through Willingness to Pay methodology. Though not fool proof, a rule based upon the same is recommended. To offset the adverse impact of reduced flow in the intermediate stretch in case of the run of river hydropower projects, a compensation @ Rs.0.50 lakh per MW power capacity and Rs. 0.50 lakh per km from diversion structure to the tail race outlet of the project is adopted by the Government of Himachal Pradesh.

In the present proposal, the existing structures like barrage, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Stage-I Project (Uri-I Power Station) shall be utilized for Uri-I Stage-II HEP.

The construction of underground structures like 10.4 km long HRT, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage-II Project.

For stretch downstream of the Uri-I Power Station barrage up to the TRT outlet, which is about 17.0 km considered as the stretch with reduced flow.

BENEFITS

Hydropower is a clean renewable source of energy and relatively non-polluting and environment friendly. It provides valuable peaking power with the ability to start and stop quickly with instantaneous load acceptance/rejection making it suitable for meeting peaking power demand for enhancing grid reliability and stability.

Minimal impact on Environment and Forest Aspect

Uri- I Stage II HE project will utilize the already completed structures of existing Uri I Power Station which include Barrage, Cut and Cover Culvert, Desilting Basin, Open Power Channel, Adits. And it involves construction of HRT, Powerhouse and TRT only. There is minimal Forest Land involved in the construction of the Project. Besides, the revenue land is alreadyavailable with the existing Uri Power Station for muck sites and also for installation of Machinery and mobilization of Manpower required for the construction of the project.

महा. प्रबंधक (वि.) Manager (E)
उड़ी पनबिजली स्टेशन Uri Power Station
एन. एच.पी.सी. लि. NHPC Ltd
बारामूला (ज. व क.) Baramulla (J&K)

There is no requirement of additional private and revenue land for the construction of the said project. The Forest land involved for the construction of HRT, Powerhouse and TRT is underground and hence there is no involvement of trees in their alignment of the structures.

R&R Aspect/ No displacement of the Population

For the development of proposed project, the land required for the construction of the project is already available with the existing Power station and hence, there is no involvement of the additional revenue land due to which the local population shall not be affected. Also the project will utilize the already completed structures of existing Uri-I Power Station which include Barrage, Cut and Cover Culvert, Desilting Basin, Open Power Channel, Adits and there will be no submergence of any forest/revenue land.

Optimum Utilization of the additional Kishanganga Water

Kishanganga Hydroelectric Project (KGHEP) was commissioned in May-2018. It is an inter basin transfer project where water comes to Uri-I Barrage site through Boniyar Nallah-Madhumati Nallah- Wular Lake- Jhelum. With the construction of proposed Uri-I Stage-II HE Project, NHPC would be able to make optimum utilization of this surplus water that is being otherwise discharged through the Dam gates. By tapping this water, NHPC will be able to generate additional electricity that would be beneficial to the nation.

Generation of Local Employment and other indirect benefits

With the construction of proposed project local manpower under various categories viz Unskilled, semi-skilled and Skilled categories shall be required during construction activities. Besides, inspection vehicles are also being deputed for various inspection works. In addition to that hiring of various services are also required during the construction activities. In order to benefit the local population NHPC framed a policy to cater local population which will benefit the surrounding community. Locals will be given preference for all the categories of manpower based on the skillset available with the local population, hiring of vehicles are being reserved exclusively for the local population. Also, other small contracts are given to local qualified contractors. As per the PAF policy of NHPC a contract upto the value of Rs 60.00 lac has been kept reserved for local contractor so that the immediate surrounding shall be benefitted.

Economic Benefit to Local Population

Local area development, creation of new infrastructure and updating of existing infrastructure, etc. Scope for ancillary industries due to increased agriculture production in the area along with opportunities for trade and commerce, etc. Increased opportunities for services sector like, transport, execution of small contracts, etc. Monetary value has been taken from the budget for Local Area Development i.e. Rs. 15.00 crore.

Environment Benefit due to Green Belt Development

The benefits from tree plantation in the area will accrue over next 50 years monetized and discounted to the present value to be included as benefits of plantation. For monetization of benefits of plantation, budget of plantation around degraded areas and green belt

development around the project components have been taken i.e. Rs. 30.00 lakh. In addition to this plantation over restored muck dumping sites is also proposed with financialprovision of Rs. 47.42 lakh.

Other Benefits

In addition, there are several benefits that may accrue due to the implementation of the project such as flood control, water supply, fish production, recreational opportunities. These benefits are monetized based on budgets proposed for fisheries development plan, CAT plan and Biodiversity Conservation and Management Plan.

Table provides the environment cost and benefit analysis for Uri-I Stage-II HE Project.

Table 9.1: Environment Cost and Benefits Analysis

S. No.	Environment Cost/Benefit	MoEF&CC Guidelines for CBA of forest land diversion,2017	Parameters	Total Cost/Benefit (Rs lakh)
A	**Environment Cost**			
1	Eco-system services losses due to proposed forest diversion	Economic value of loss of eco-system services due to diversion of forests shall be the net present value (NPV) of forest land being diverted	Diversion of surface forest land is not involved for the project; only 17 ha of underground forest land will be diverted for underground structure such as HRT, TRT, Powerhouse, etc. Cost is considered as per NPV @ Rs10,69,470/- per ha, keeping in view Class VI, Open Forest.	181.81
2	Loss of animal husbandry productivity including loss of fodder	To be quantified and expressed in monetary terms or 10% of NPV applicable, whichever is maximum	As there is no diversion of surface forest land for the project, this cost is not applicable.	00.00
3	Cost of human resettlement	To be quantified and expressed in monetary terms as per R&R Plan	No private land is proposed to be acquired for the project.	00.00
4	Loss of Public facilities and administrative infrastructure (Roads, buildings, schools, dispensaries, electric lines, railways, etc.) on forest land, which would require forest land if these facilities were diverted due to the project.	To be quantified and expressed in monetary terms as per actual cost basis at the time of diversion.	The required non-forest land is already in possession of NHPC. There is no impact on public facilities, administrative infrastructure and common properties resources	00.00
5	Possession value of the forest land diverted	The Forest land that is diverted for the project is unlikely to be returned	For underground structure like HRT, TRT, Powerhouse 17.00 ha of underground	54.54

S. No.	Environment Cost/Benefit	MoEF&CC Guidelines for CBA of forest land diversion,2017	Parameters	Total Cost/Benefit (Rs lakh)
		and remains in possession of the user agency. Therefore, as per MoEF&CC guidelines 30% of environmental costs (NPV) due to loss of forests or circle rate of adjoining area in the district should be added as a cost component of possession value of forestland, whichever is maximum.	forest land is required to be divert for non-forestry use. Cost is considered as per NPV @ Rs10,69,470/- per ha, keeping in view Class VI, Open forest.	
6	Cost of sufferings to oustees	The social cost of rehabilitation of oustees (in addition to the cost likely to be incurred in providing residence, occupation and social services as per R&R plan) be worked out as 1.5 times of what oustees should have earned in two years had he not been shifted.	No private land is required for proposed project, due to which the local population shall not be affected.	00.00
7	Habitat fragmentation cost	While the relationship between fragmentation and forest goods and services is complex, for the sake of simplicity the cost due to fragmentation has been pegged at 50% of NPV applicable as a thumb rule.	In the present project, no surface forest land is diverted causing habitat fragmentation, therefore, this cost is not considered.	0.00
8	Compensatory afforestation & soil moisture conservation cost	The actual cost of compensatory afforestation and soil & moisture conservation and its maintenance in future at present discounted value	As 17.00 ha of underground forest land is diverted for underground components, therefore Compensatory afforestation is not applicable in this case.	0.00
9	Reduction of Flow in the intermediate stretch	To offset the adverse impact of reduced flow in the intermediate stretch. Based on Himachal govt guidelines for run of river hydropower projects, a compensation @ Rs.0.50 lakh per MW of power capacity and Rs.0.50 lakh per km of river stretch	River length from Uri-I Power Station barrage up to TRT outlet is about 17.0 km. The generation capacity of proposed project is 240 MW. Therefore, the cost will be Rs. 120.0 lakh (240 MW x Rs. 50000) + Rs. 8.50 (17 km x Rs. 50000).	128.50

S. No.	Environment Cost/Benefit	MoEF&CC Guidelines for CBA of forest land diversion,2017	Parameters	Total Cost/Benefit (Rs lakh)
		downstream of diversion up to tailrace outfall.		
Total Environment Cost(A)				**364.85**
B	**Environment Benefits**			
1	Increase in productivity attribute to the specific project	To be quantified and expressed in monetary terms avoiding double counting	(i) Benefit from the power generation @ Rs. 3.38.00per unit for 929.13 million units per annum which will be generated in 90% DY fora period of 40 years (life of hydropower project).	1256183.76
2	Economic benefits due to direct and indirect employment due to the project.	Manpower requirement is sourced from the client information/DPR during construction and operation phase	(i) During peak stage of construction, employment will be generated for 500 skilled/semi-skilled/unskilled labour. Assuming that on an average 500 persons are employed with an average minimum wage of Rs 15000/-pm for 4 years	3600.00
			(ii) After completion during operation about 150 people will get employment for O&M, routine upkeep/ maintenance of roads and buildings, etc earning an average salary of Rs. 50000 per month for a period of 40 years	36000.00
3	Economic Benefit to Local Population apart from direct and indirect job opportunities	Project will benefit to the local population through a Local Area Development Plan where project affected and benefitted villages will reap benefit of welfare schemes budgeted as part of the project.	Local Area developmentplan has been prepared as part of the EIA report. This will be further refined after receiving inputs from local population during public consultation process. A budgetary provision of Rs. 15 crores have made towards this head.	1500.00
4	Environment benefit due to Green Belt Development	Project has made provisions of green belt development around the project components and also plantations are proposed in command area as detailed in EIA report	Total green belt area, plantation over restored muck dumping site andother construction sites has been estimated to cover an area of about 25 ha. Budget has been covered in Greenbelt developmentPlan and Muck Management Plan.	77.42
5	Other benefits - CAT plan implementation,	Provisions have been made as part of EIA report	Budget of CAT plan implementation and	874.44

S. No.	Environment Cost/Benefit	MoEF&CC Guidelines for CBA of forest land diversion,2017	Parameters	Total Cost/Benefit (Rs lakh)
	biodiversity conservation, fish production, etc.	for Catchment area treatment plan and biodiversity conservation and management plan to improve the environment. Fisheries conservation and management plan has also been proposed for promoting reservoir fisheries.	biodiversity conservation plan has been considered under this head. Fisheries benefit has been taken @ Rs. 750/ha of the submergence area. Cost of CAT Plan Implementation is Rs.874.39 Area under submergence of operational Uri-I Power Station is 6.19 ha, i.e. 6.19 ha x 750 = Rs. 0.047	
Total Environment Benefit (B)				**1298235.62**
Environment Benefit Cost Ratio (B/A)				**3558.27**

SUMMARY/CONCLUSION

As can be seen from the above analysis, cost-benefit analysis is a complex process and methodology for such, and analysis is still evolving. Quite a few scientific studies have attempted to shed light on the economic importance of forest ecosystem services, where aggregate value is derived mainly from non-marketed services provided by non-consumptive uses, from future potential uses of genetic resources and the largest proportion from hydrological regulation and carbon cycling.

The complexity over the costs and benefits calculations on both sides of the divide limit the useful output of such studies especially on a smaller scale as part of EIA study. The cost-benefit analysis, with all its uncertainties and contingencies, can provide biased output in the absence of standard guidelines on inclusion of parameters on cost and benefits sides ofthe table and methodology of monetization.

Vikram Singh
वरि. प्रबंधक (वि.) Sr. Manager (E)
उरी पावर स्टेशन Uri Power Station
एन. एच.पी. सी. लि. NHPC Ltd Gingle
बारामुला (ज. व क.) Baramulla (J&K)193122