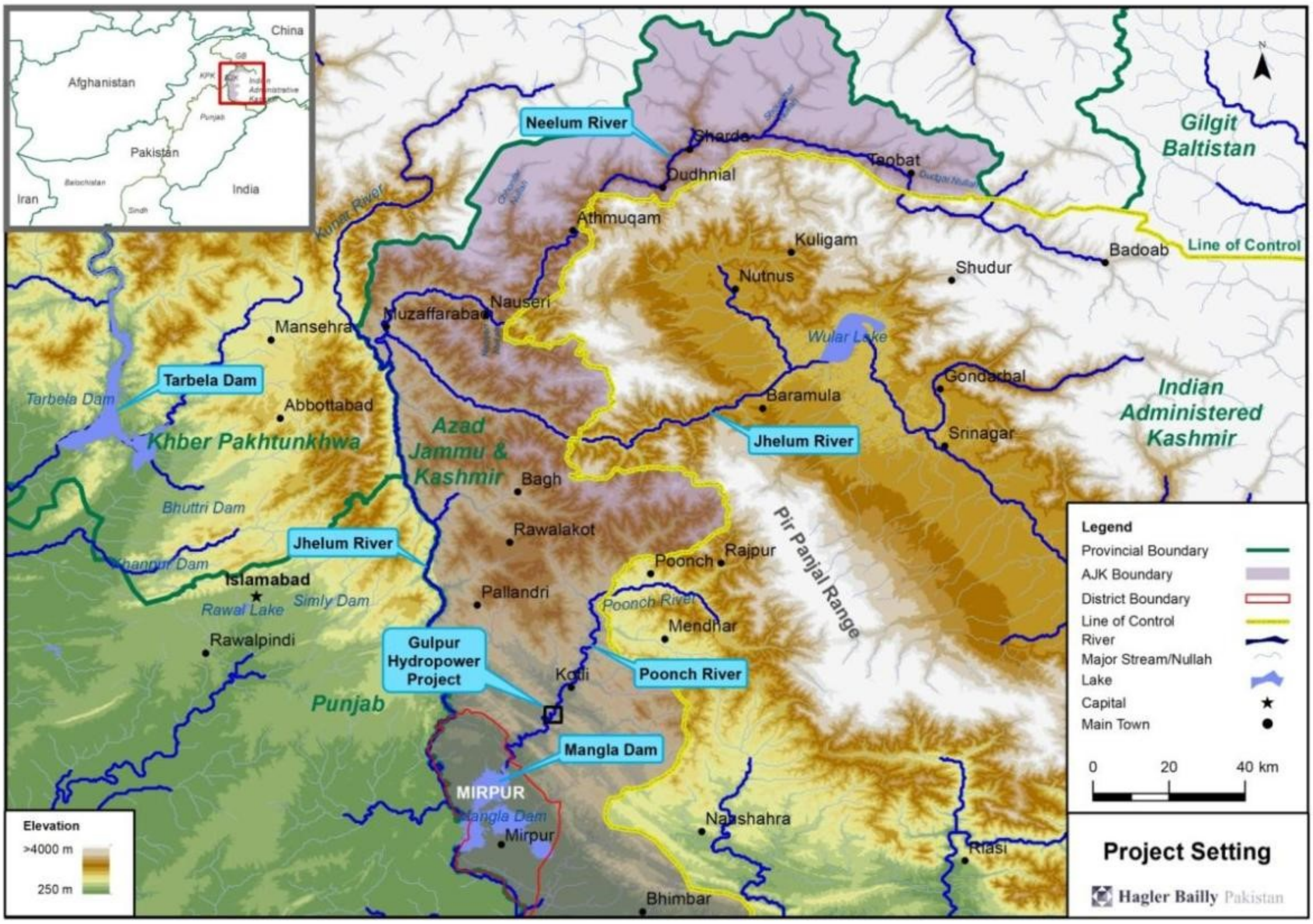
Netherlands Commission for
Environmental Assessment
Dutch Sustainability Unit

Advice on Environmental and Social Impacts Associated with the Proposed Gulpur Hydropower Project, State of Azad Jammu & Kashmir

PAKISTAN



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Advisory Report by the Dutch Sustainability Unit

Subject: Advice on Environmental and Social Impacts Associated with the Proposed Gulpur Hydropower Project, State of Azad Jammu & Kashmir, Pakistan

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1. Introduction

1.1 The project development proposal

Mira Power Limited (MPL) is an Independent Power Producer (IPP), and has proposed the development of the 100 MW Gulpur Hydropower Project (GHP) on the Poonch River in the State of Azad Jammu and Kashmir (AJK). The GHP would be within the Poonch River Mahaseer National Park.

Only 11% of the estimated 60,000 MW hydropower potential in Pakistan is currently developed[1]. In view of the current power shortages in the country, the government of Pakistan has introduced a policy of supporting small hydropower projects from Independent Power Producers (IPPs). Hydropower projects have a smaller impact on air quality and greenhouse gas emissions than do fossil fuel-based power generation.

The most significant aspects of the project design include:

- Run-of-the-river (RoR) type hydropower, with relatively little required storage. After passing through the powerhouse, water would be discharged back into the Poonch River.
- Construction of a 58m dam on a bend of the Poonch River.
- A surface powerhouse located about 1 km downstream of the dam.
- Up to three tunnels about 180m long, which would connect the water inlets from the dam to the powerhouse.

Figure 1 shows the general setting of the proposed project.

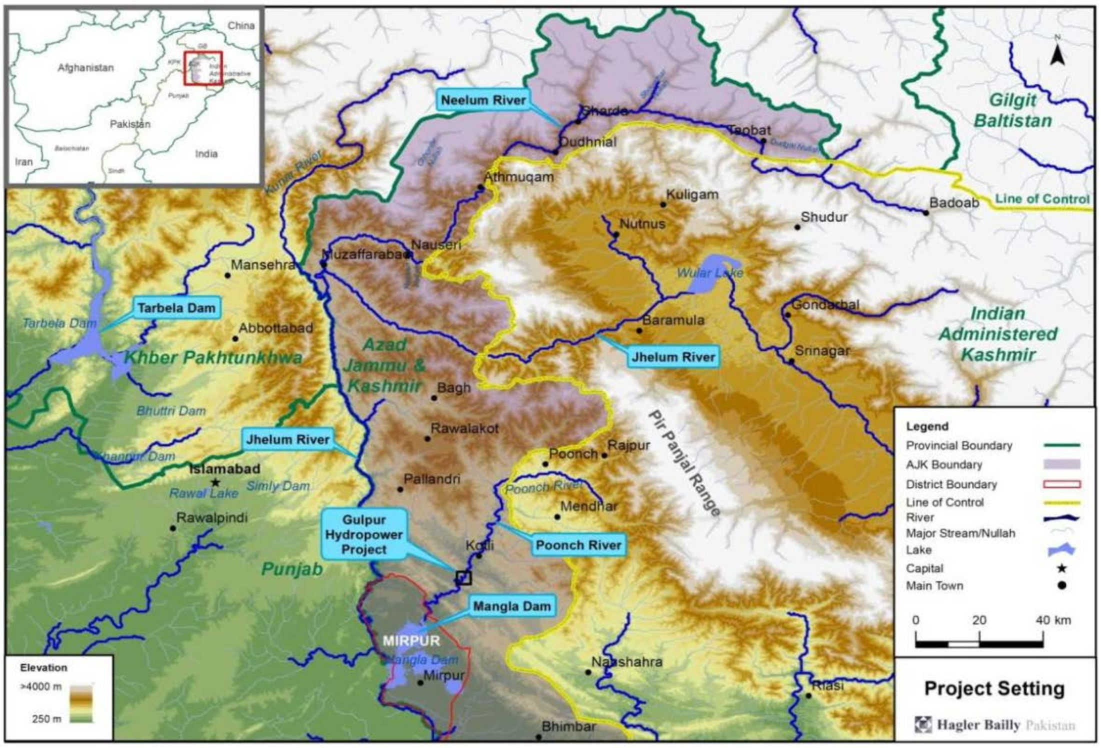

Figure 1: Setting of the Proposed Gulpur Hydropower Project

[1] Private Power and Infrastructure Board, Hydropower Resources of Pakistan, February 2011.

1.2 The request

The Directorate-General for International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs has asked the Dutch Sustainability Unit (DSU) to provide advice on environmental and social impacts associated with the proposed Gulpur Hydropower Project (GHP), to be situated in the State of Azad Jammu and Kashmir (AJK), Pakistan.

1.3 The approach

DGIS's request is addressed here in three parts. Part 1 briefly assesses the efficacy of the environmental and social impact assessment work undertaken to meet AJK and ADB safeguard requirements. Part 2 directly addresses specific concerns raised by DGIS. Part 3 assesses the GHP against 14 "sustainability factors" first introduced in the DSU's review of the Sounda Gorge Hydropower project in the Republic of Congo.

2. DSU Analysis

2.1 Part 1: Efficacy of the Environmental and Social Impact Assessment Work

Environmental and social assessment was presented in an Environmental and Social Impact Assessment (ESIA) document published in October 2014, and a Land Acquisition and Resettlement Plan (LARP) published in November 2014. Both were prepared by consultants to Mira Power Ltd., and for the Asian Development Bank.

Both studies are of a high standard. In particular, the ESIA is very sophisticated. It was produced by a consortium of Pakistani and South African consultants.

Worthy of specific mention are the work done on assessment of alternatives; the Environmental Flow Assessment (EFA); and, the Critical Habitat Assessment leading to the production of a Biodiversity Action Plan (BAP).

<u>Alternatives Assessment</u>

The analysis of alternatives focused on the following:

1. No project option
2. Alternative options for power generation
3. Options for project location and layout
4. Peaking vs non-peaking operation
5. Non-Flow or management alternatives
6. Balance between environmental degradation and economic benefit
7. Options for transportation of equipment to project site

Figure 2 indicates the main design differences between Option 1 and Option 3. (Option 2 was an intermediate configuration in terms of the location of the dam and the tunnel. Compared to the other two options it was found not to be technically feasible, and did not offer any significant socioeconomic advantage over Option 1 and was therefore dropped early in the analysis). As can be seen from Figure 2, Option 3 results in a much smaller length of impacted river.

It is also worthy of note that environmental analysis led to the discarding of the idea of Gulpur being a peaking operation[2]. Peaking operation can be detrimental to the ecology downstream of the dam. Low flows normally occur in the section of the river starting just below the dam, to the point where water is added back into the river at the outlet of the of the power house. With a peaking operation low flows are extended downstream of the power house, and during the period the power house is shut down to accumulate water in the reservoir upstream.

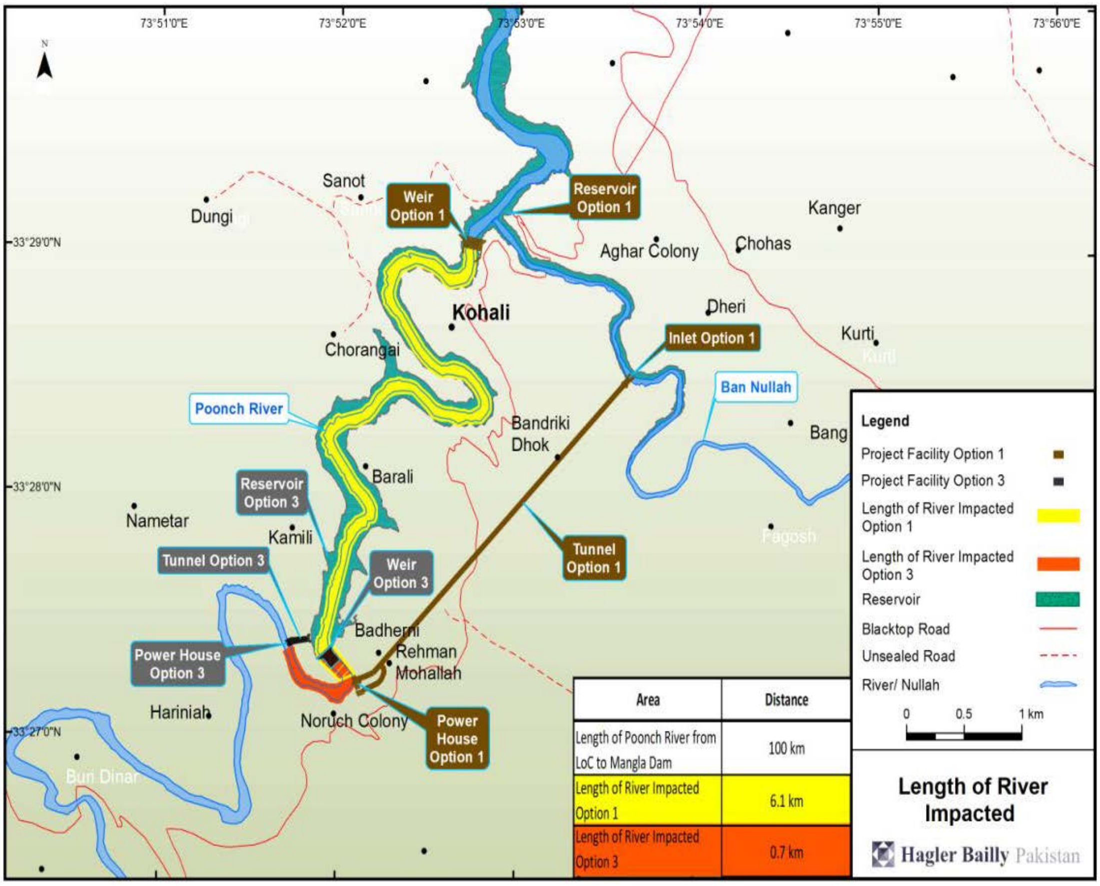

Figure 2: Length of River Affected: Option1 and Option 3

<u>Environmental Flow Assessment</u>

An important component of the ESIA was the Environmental Flow Assessment (EFA), which formed part of the strategy to assess the impact of the project on ecosystem services. It was used to predict the impact of changes in flows due to the dam and powerhouse on important ecological and social indicators. It was also used to determine whether "net-gain" of key indicator fish species was possible.

The objectives of the Environmental Flow Assessment were:

- To evaluate the present day condition (i.e. the present structure and functioning) of the Poonch River from upstream of Gulpur weir to Mangla Dam.
- To evaluate how the condition of the river could change under different operational

[2] Peaking in hydropower generation is defined as an operating mode in which water from the dam is released for only part of the day, corresponding to peak demand for power in the system.

scenarios for the proposed Gulpur project.

The DRIFT (Downstream Response to Imposed Flow Transformations) model was adopted for the environmental flow (EFlow) assessment. A diagrammatic representation of the integrated basin flow assessment process utilized by DRIFT is provided in Figure 3.

The DRIFT approach was used to assess "economic", "social" and "ecological" changes that are a response to the Project, and can account for the linkages between these. For example DRIFT was used to:

- Assess the impact of changes in flow regime on drift wood that is used by the community.
- Assess the impact of changes on flow regime on tourism and recreation.
- Predict changes to fish population, as well as the consequent impact on the communities which may rely on fishing for subsistence.

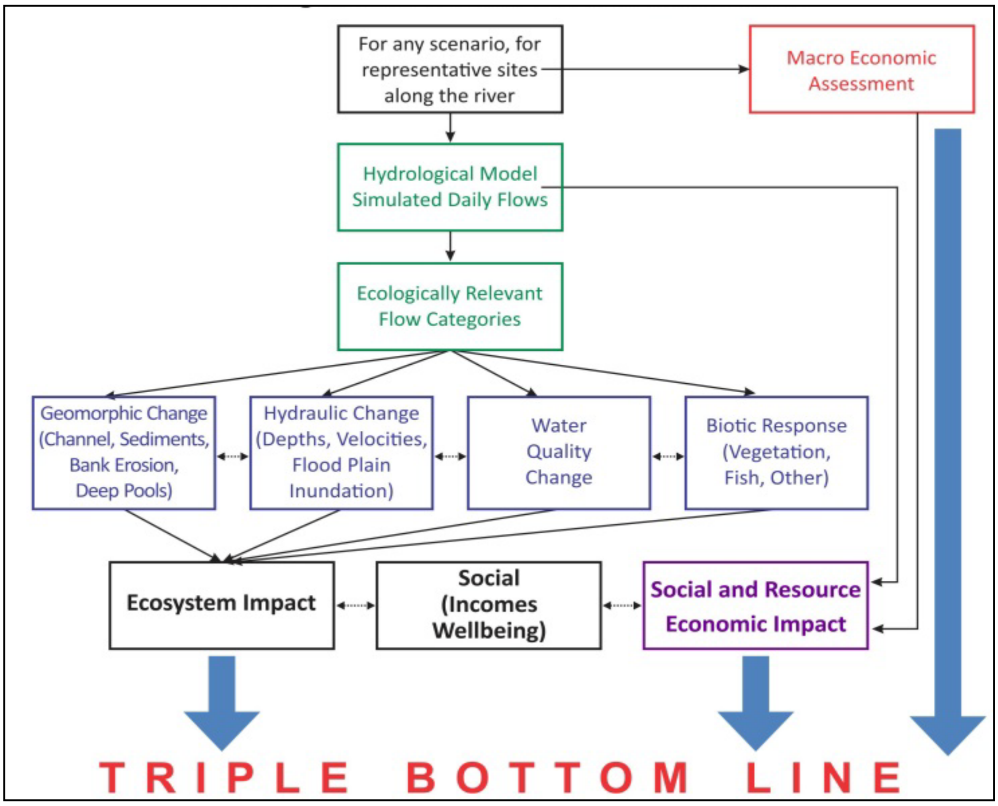

Figure 3: Triple Bottom Line (Ecological, Social and Economic) Integrated Basin Flow Assessment Process

DRIFT was used to evaluate different water management scenarios for the Poonch River at locations upstream and downstream of the proposed Gulpur HPP. These included:

- Flow Scenarios
- Management Scenarios including:
    - Business as usual (BAU) or Poor Protection
    - Protection Level 1 (Pro 1) or Moderate Protection
    - Protection Level 2 (Pro 2) or Enhanced Protection
    - Peaking Scenario
    - Various Turbine Configurations and Operating Rule Scenarios

Based on the EFlow assessment it was decided that a protection Level 2 Scenario is needed to ensure Net Gain of those biodiversity values for which the Critical Habitat was designated. In this case, this was Net Gain for the Mahaseer and Kashmir Catfish.

An important result of the EFlow assessment is shown in Figure 4 where "loss of ecosystem services" can be compared against "loss in revenue". Decision makers can then take a decision on acceptable environmental loss/degradation against project cost. An EFlow of 4 m3s-1 was set after discussion with stakeholders, including those in affected communities. This turned out to be on the lower side of the range considered. The main reason for this was that the principal improvement in river environmental quality is achieved through protection by putting in place a good management programme (i.e. the Protection Scenario under the BAP). Releasing additional flow from the dam at the expense of power generation is of marginal value in comparison to this.

The Eflow assessment was carried out at the early stages of design, such that design and operational activities could be amended in light of the findings of the assessment. Key changes to design included:

- Change to base-load power configuration: The turbines will be operated in base-load configuration instead of peaking to reduce downstream impacts on ecological integrity.
- Changes to turbine configurations: To allow constant Eflow releases.

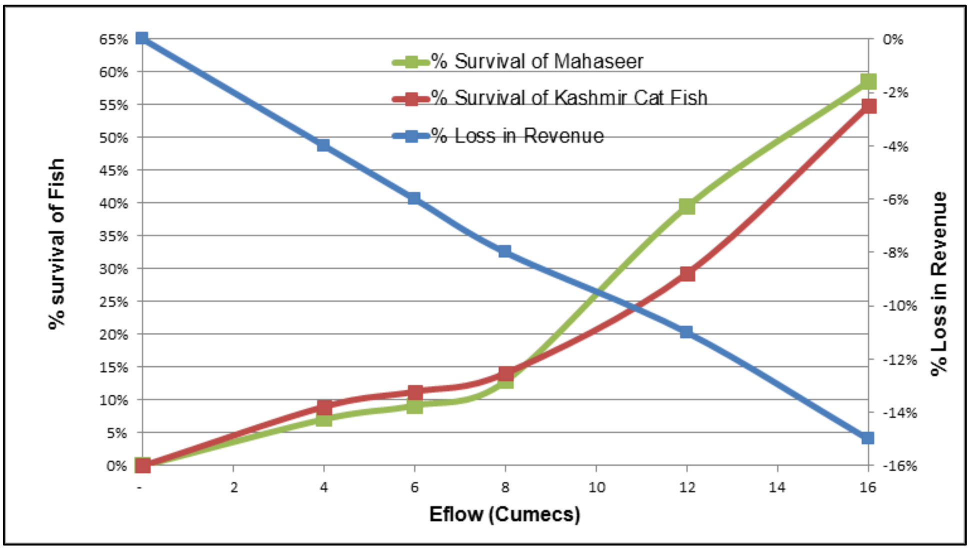

Figure 4: Loss in Revenue and Survival of Fish

2.2 Part 2: Specific concerns Raised by DGIS

(i) A 2014 Strategic Environmental Assessment indicates that there are other rivers in AJK (the Pakistan territory in question) that have greater hydro potential and comparatively lower environmental costs.

(ii) There are other planned investments on the Poonch River. While these investments have been considered in the ESIA, there does not appear to have been any overall river basin planning or modelling. This casts some doubt as to the validity of the ESIA cumulative modelling results and the viability of the proposed mitigation measures.

(iii) The developer, Mira Power, does not appear to have an established track record of operating in critical habitat settings.

(iv) As well, such a large financial investment in such a poor area is virtually certain to attract large in-migrations of people and associated development pressures, further casting doubt as to the validity of the modelling results and proposed mitigation measures.

(v) The financial resources allocated for Mitigation and Monitoring appear very modest ($145K/ year), particularly when considering i) the large $367M investment; ii) the critical habitat; iii) the likely cumulative environmental effects; iv) the low technical capacity levels within the region; v) the dependence on electricity tariffs after the initial 5-year construction phase.

These concerns are addressed in sequence, below.

(i) <u>Other Rivers have Greater Hydropower Potential with Comparatively Lower Environmental Costs</u>

An strategic environmental assessment (SEA) of hydropower planning in AJK was undertaken by IUCN in 2013[3]. This study mapped all known hydro projects proposed by the Water and Power Development Authority (WAPDA), the Private Power and Infrastructure Board (PPIB), the Hydroelectric Board (HEB), and the Private Power Cell (PPC). It then undertook a detailed analysis of the environmental and social sensitivity of rivers and nullahs (streams) where the dams were proposed. The outcome of this analysis is presented in Figure 5. It shows that the Poonch River and its tributaries is the most ecologically sensitive river in AJK, and that the proposed Gulpur Hydropower Project is ranked fifth in terms of its ecological impact. An equivalent ranking study of possible socio-economic impacts resulted in a similar outcome for the Poonch River, and for the GHP.

[3] IUCN (2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir.

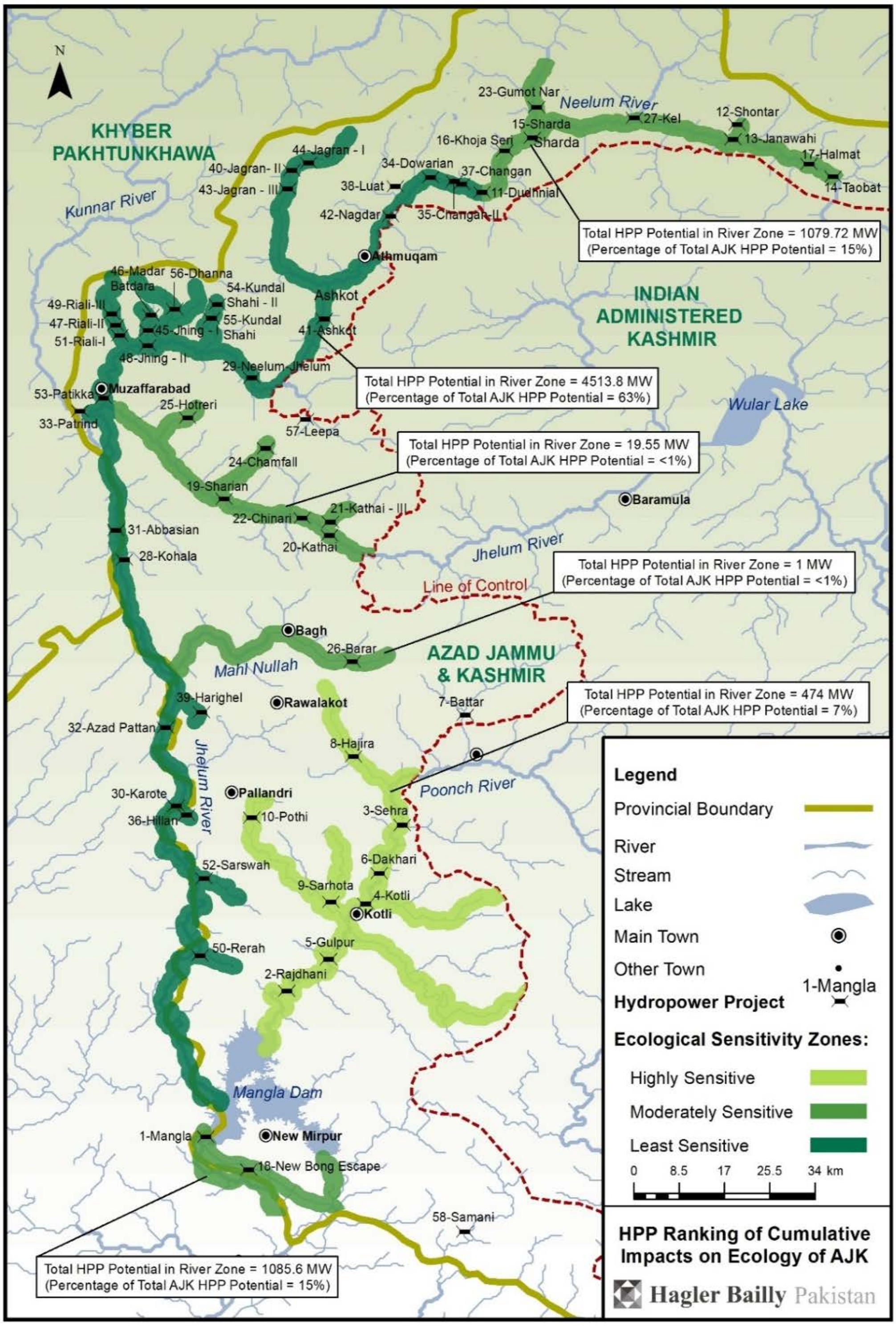

Figure 5: Ranking of Cumulative Impacts on the Ecology of AJK Rivers and Streams

> **Conclusion:**
>
> There are, according to a strategic environmental assessment, other rivers in AJK that have greater overall hydropower potential and with comparatively lower environmental costs.

(ii) (Lack of Overall River Basin Planning or Modelling

Section 7.6 of the ESIA focuses on the possible cumulative impacts associated with four other hydro projects proposed in the short-to-medium term for the Poonch River (Sehra HPP: a 130-MW RoR plant just downstream of the LoC; Kotli HPP: a 100-MW RoR plant just upstream of Kotli; Rajdhani HPP: a 132-MW RoR plant just upstream of Mangla reservoir; and, Parnai HPP: a 37.5-MW diversion plant in Indian Administered Kashmir).

Compared with most ESIA's, this is a thorough cumulative assessment. It is true, however, that it does fall short of comprehensive river basin modelling. However, Section 7.6.2 refers in detail to the aforementioned SEA of AJK hydropower planning. Given that the SEA was completed before the ESIA was submitted to ADB, it could be concluded that the ESIA has taken account of overall river basin modelling.

Since the publication of the SEA in early 2014, the Government of AJK has signaled its intention to establish a hydropower planning commission or authority. This would bring the four current proponent agencies mentioned above underneath one overall planning "umbrella".

Conclusion:
While the ESIA does not, itself, contain comprehensive overall river basin modelling, it does a good job of cumulative assessment, and it clearly refers to river basin planning undertaken as part of IUCN's SEA of AJK hydropower planning.

(iii) Mira Power does not appear to have an established track record of operating in critical habitat settings

Mira Power Limited is a special purpose company, setup specifically to design, construct, own, operate and maintain the GHP. As it stands, it has no actual track record whatsoever. It therefore seems inappropriate to claim that it has no track record of operation in critical habitat settings. Mira Power Limited is a subsidiary of Korea South East Power Co. Ltd. which, in turn, is a subsidiary of the Korea Electric Power Corporation. KEPCO is responsible for 93% of Korea's electricity generation, and the South Korean government owns a 51% share of KEPCO. It seems reasonable to assume that the Korean partners would have prior experience with operating in critical habitat settings, but further research would be required to answer this question.

Conclusion:
Mira Power Ltd has been established specifically to build, own, operate the GHP. It does not yet have a track record. The Korean partners have considerable experience in developing electricity generation projects around the world. It is assumed that they would have experience of operating in critical habitats, but further research would be required to answer this. Korean involvement in ongoing environmental management of the GHP would be advantageous.

(iv) A large financial investment in a poor area is certain to attract large in-migrations, with associated development pressures

The ESIA indicates that the project will employ about 700 skilled, semi-skilled and unskilled workers for its construction. Around 100 people will be employed during the operation of the Project. The Environmental Management and Monitoring Plan (EMMP) contained within the ESIA commits to sourcing a "majority" of unskilled, and to the extent possible, semi-skilled and skilled workforce from the local area.

The ESIA makes it clear that there may be negative social impacts as a consequence on in-migration. This is always the case when significant infrastructure projects are introduced in remote areas. Possible social impacts are discussed in Section 7.5 of the ESIA. Mitigation measures are outlined in the "social augmentation plan" outlined in Section 11.7 of the EMMP. The proponent has clearly identified and assessed the possible impacts of in-migration, and concludes that, on balance, the macro-economic and local economy benefits outweigh any local negative impacts.

Conclusion:
The project will, indeed, result in significant in-migration during construction and operation. This is not unusual for a large infrastructure project in a remote location. It will require careful management and monitoring.

(v) Financial resources allocated to mitigation and monitoring appear to be very modest

The proposal estimates a yearly monitoring/mitigation budget of $145,000 and a capital/one-off cost of establishing the monitoring/mitigation system of $273,000. While the yearly costs do not seem high, they are worked out in elaborate, line-by-line detail in Tables 11.5, 11.6, 11.7, and 11.8 of the EMMP. Within the available time the DSU has not been able to compare this estimate with the mitigation and monitoring budget of similar dams.

Conclusion:
While recurrent monitoring and mitigation costs do not seem high, they have been calculated in elaborate detail, to the level … for example … of individual vehicle oil change.

2.3 Part 3: Assessment of the GHP against Fourteen Hydropower "Sustainability Factors"[4]

In its advice on the sustainability of the proposed Sounda Gorge Hydropower Project in the Republic of Congo, the DSU proposed 14 "sustainability factors" that could be applied to dam proposals. These factors were originally proposed as a way in which alternative dam proposals could be compared. In the production of this advice, time was not available for applying the 14 factors to the three options presented in the Gulpur ESIA. In any event, the comparison of alternatives presented in Section 8 of the ESIA makes it clear that Option 3 is the superior choice from both an environmental and social perspective. Instead, in this section of the Gulpur advice, the 14 sustainability factors are applied to Option 3.

Environmental sustainability factors

1. Number of hectares of flooded area per megawatt installed capacity.

   According to the ESIA (Section 4), Gulpur will require 2.92 hectares per megawatt of installed capacity. This compares to 180 hectares for the Sounda project and for Aswan in Egypt and Cahora Bassa in Mozambique.

2. Number of persons to be relocated and reinstalled per megawatt installed capacity.

   Four households would need to be relocated to make way for the powerhouse and camp site. This would equate to 0.04 households relocated per MW of installed capacity.

3. Greenhouse Gas emission balance.

   The project will avoid greenhouse gas emissions of about 253,797 tons of carbon dioxide equivalent per year. In the time available, it was not possible to calculate the emission of greenhouse gases prevented by using hydropower instead of fossil fuels minus emissions caused by decomposition of organic matter over the lifetime of the project.

4. Loss or gain of natural habitat.

   This was a critical issue for the project, and was extensively dealt with in the ESIA. This was because AJK Wildlife legislation requires 'betterment of the park' to approve actions and activities normally prohibited in a national park. In addition, proposed ADB and IFC as lenders require 'net gain' in biodiversity in Critical Habitat, in this case triggered by national park, Endangered Mahaseer, and Critically Endangered Kashmir Catfish. The ESIA employed a sophisticated environmental flow model known as DRIFT (Downstream Response to Imposed Flow Transformations) to predict the impact of changes in environmental flow on river fauna.

[4] As originally outlined in DSU (2015), Advice on the Potential for Sustainable Development of the Sounda Gorge Hydropower Project, Republic of Congo.

According to the ESIA, "net gain" will be obtained through implementation of a Biodiversity Action Plan (BAP). This detailed plan is based around implementation of Protection Level 2, as accepted by stakeholders consulted during the DRIFT modelling process (see Appendix 1 for more details on the protection scenarios analysed by DRIFT).

5. Loss of cultural property.

   No cultural property would be lost as a consequence of the GHP.

6. Sedimentation of the reservoir and interruption of sediment transport impacting on marine life.

   This issue is dealt with extensively in Section 6.6 of the ESIA. However, there was not sufficient time to review this scientific analysis in enough detail.

7. Change in downstream river hydrology with effects on fishery, ecosystems, flooding, etc.

   Upstream migration will be halted by the weir, but there will be some downstream movement through the spills. The bulk of the tributaries of the Poonch River that are used for breeding by Pakistani Labeo, Mahaseer are located upstream of Gulpur HPP.

   Fish restricted to the lower part of the Poonch River will breed in the main river to some extent. Pakistani Labeo, Snow Trout and Mahaseer will most likely colonize the reservoir, which may lead to a slight increase in their populations upstream of the weir. Bulk of the favoured breeding sites for Garua are located downstream of the Gulpur weir. Garua bachwaa is also unlikely to colonize the reservoir. Thus, it is expected that the population upstream of the dam will be compromised by the weir. A hatchery for Mahaseer will be developed downstream of the weir.

Social sustainability factors

8. The credibility of the mechanisms and guarantees to be put in place to secure that the population will, indeed, reap the benefits of the project.

   Extensive commitments are made in Sections 7 and 8 of the LARP on income restoration, relocation, and rehabilitation. Implementation arrangements include a resettlement budget and financing plan (Section 9), an implementation schedule (Section 11), and monitoring and reporting commitments (Section 12). In addition, both the ESIA and LARP have extensive sections outlining how grievance redress mechanisms will be established.

9. The quality of the public participation process: the extent to which interested and affected parties are informed and can express their opinions in the project preparation and decision making stages.

   Both the ESIA, and the LARP included extensive consultation processes. These are explained in detail in Section 9 of the ESIA, and in Section 4 of the LARP. Both involved identification of project stakeholders; an outline of the approach adopted for the consultation; a description and analysis of the concerns raised by participants; gender involvement in the consultation process; and, awareness, fears, and concerns about the project.

10. The risk of induced impacts: Hydro-electric projects can set in motion the development of many other activities and the linked influx of people causing environmental and social impact.

    The risk of induced impacts associated with the influx of 700 workers during construction, and 100 workers during operation was analyzed extensively in both the ESIA, and the LARP.

11. The quality of mitigation, compensation, relocation and reinstallation programmes

    See response to factor 8.

Economic sustainability factors

12. Price of the environmentally and socially sustainably produced KWh produced by the Gulpur project as compared to the kWh prices of available equally sustainably produced alternative kWh that can be made locally available in a reasonable time-frame in equal quantities (opportunity costs of sustainably produced power).

    Section 8.2 of the ESIA outlines the comparative prices of power generation from alternative fuels (although not specifically from "environmentally and socially sustainable" fuels). The Gulpur project predicts a price of 10.2c/kwh. This compares with the following for other fuel sources in Pakistan:
    - coal-fired thermal (9.88c/kwh);
    - LNG imported (15.84 c/kwh);
    - diesel engine fuel oil (19.17 c/kwh);
    - hydel RoR (50-150MW)(9.39c/kwh);
    - hydel RoR (> 150MW)(11.15c/kwh);
    - wind (14.07c/kwh).

13. The balance of overall societal costs and benefits. A societal cost-benefit analysis of the alternatives (which takes into account all cost and benefits, including social and environmental costs and benefits) will rank them and make them mutually comparable and comparable to other energy options for which a societal cost-benefit analysis has been done).

    Section 8.6 of the ESIA discusses the tradeoff between economic benefit and ecosystem integrity. It is based on the environmental flow assessment outlined in Section 2.1 of this advice.

    Figure 8-5 and Figure 8-6 of the ESIA show that the improvement in ecosystem integrity of the river is more or less linear when EFlow is varied from 4 to 16 cumec. Figure 8-6 shows that when minimum flow is increased from 4 cumecs to 8 cumecs, the benefit to Mahaseer and Kashmir Catfish is not significant. However, when the minimum flow is increased from 8 cumecs to 16 cumecs, a noticeable benefit to their survival in the low flow segment of the river downstream of the dam area is predicted. The financial impacts however increase on a linear scale as the EFlow is increased. Loss in power generation is estimated at 4.0%, 7.8%, and 14.8%, for EFlows of 4, 8 and 16 cumecs respectively.

Institutional sustainability factor

14. The capacity of the government to regulate the Gulpur Hydropower project in its construction and operational stages and to effectively enforce the regulations imposed.

    Government agency capacity for environmental management in AJK should increase as a result of this project. The AJK Fisheries and Wildlife Department will formalize its commitment to establish a national park management plan (NPMP) by signing a cooperation agreement with Mira Power, where the company will provide technical and financial support for the development of the NPMP.

    The budget for operating expenses for implementation of the Biodiversity Action Plan (outlined in Table 11.8 of the ESIA) indicates that the recurrent costs of 26 "watch and ward" staff will be paid for by Mira Power.

3. Conclusions

From the analysis contained in Section 1 and Section 2, the DSU has come to the following set of conclusions:

1. The ESIA and LARP are of a very high standard. The Environmental Flow Assessment contained within the ESIA is of international "state of the art" quality. There have been no ESIAs of this standard prepared in the hydropower sector in Pakistan in the past, and the approach is worthy of emulation in other developing countries.

2. We believe that specific concern (i) raised by DGIS is valid. Further, we believe that concerns (ii), (iv), and (v) are less valid, and that concern (iii) is not relevant.

3. There are significant risks associated with hydropower projects in sensitive locations. In this case the risks have been extensively analyzed, and it is clear that the ESIA has substantially influenced the design of the project. Option 1 was the original preference of the proponent, but Option 3 has fewer environmental and social impacts. Option 3 is the alternative that was the main focus of the ESIA.

4. If the project is designed with the environmental management controls outlined in the ESIA, then it will result in a net environmental gain. This is required by ADB and IFC, because the project is proposed in a critical habitat area.

5. It is fair to assume that development of hydropower projects at other potentially 'better' sites in AJK from a point of view of nature protection, will follow in the future. A principal rejection of the Gulpur site on the argument that its choice has not been well justified therefore is less meaningful.

6. The management commitments made in the ESIA, and in the LARP set a very high “bar”. The AJK fisheries and wildlife department has given its approval for Gulpur with the condition that all future projects on the Poonch will have to prove net gain in biodiversity. If Gulpur does not go ahead, then this standard will likely not be met. In addition, current levels of environmental protection along the Poonch are poor. Poaching and illegal use of riverbed resources are rife. In the EMMP, Mira Power makes specific financial commitments to support proper environmental management by the relevant authorities along the Poonch. Given the current state of protection, there will not be much environmental resource left to protect if Gulpur does not go ahead.

7. If stakeholders are concerned about whether Mira Power will live up to the commitments made in the EMMP, they should assign resources to monitor its implementation.