SYSTEM-SCALE HYDROPOWER PLANNING FOR THE INDUS RIVER BASIN, PAKISTAN

INTRODUCTION

In Pakistan, the demand for power exceeds supply on a regular basis keeping the country in a perpetual state of crisis whereby power cuts and rotational load shedding have become part of everyday life. In addition, there are chronic water shortages due to the inability to capture and store the seasonal monsoonal rains, leaving the country in drought for the greater part of the year. The total annual renewable water resources per capita in Pakistan have plunged from 3,385 m^3 in 1977 to 1,329 m^3 in 2011 (FAO, 2012).

Figure 1. Regional Map of Pakistan Showing the Indus River Basin

Hydropower was first identified as a potential source of large quantities of clean, low cost, renewable energy at the time of Pakistan's independence in 1947. However, 67 years later Pakistan has exploited less than 12% of the identified hydropower potential in the country.

In 2008, the Water and Power Development Authority (WADPA) announced plans for the development of an extensive portfolio of multipurpose storage dams and run-of-river hydropower projects throughout the Indus River Basin (Figure 1) to address what has now become a critical situation for the nation. WADPA's "Vision 2025" program promises to develop 80 billion cubic metres (BCM) of additional water storage and add 37,770 megawatts (MW) of hydropower generation capacity to the national grid by 2025 (WADPA, 2014).

At current prices, the cost of implementing "*Vision 2025*" is estimated at US$ 32.15 billion (WADPA, 2014), making it one of the biggest development schemes in Pakistan's history. A major challenge is how to develop a program of this magnitude while meeting the growing expectations of donors and society to incorporate sustainability and social equity.

STRATEGIC SECTORAL ENVIRONMENTAL AND SOCIAL ASSESSMENT

Methods

A Strategic Sectoral Environmental and Social Assessment (SSESA) was commissioned by the Government of Pakistan to review the existing planning processes in relation to hydropower development. The objectives were to assess the current capacity to implement "Vision 2025" in a manner which balances the requirements of technical objectives, sustainability and social equity.

A team of local and international technical specialists with expertise in the legal, planning, engineering, design, environmental and social disciplines, reviewed various components of the existing hydropower project (HPP) planning and development process, including:

i. Legal, regulatory, institutional frameworks and policies relating to hydropower development.
ii. Available data on environmental and social resources of the Indus Basin and the adequacy of this data to determine a useful baseline condition.

iii. Planning frameworks for hydropower and identification of opportunities for reforms that would facilitate a system-scale approach.
iv. Cumulative environmental and social cumulative impacts that can be most effectively mitigated at the system-scale.

Findings were presented to over one hundred government and NGO stakeholders during workshops held in the provincial capitals of Peshawar, Quetta, Karachi and Lahore, and the national capital of Islamabad. Participants were asked to make comments and recommendations in response to the major findings of the SSESA.

Findings

From the analysis and outputs of the consultation workshops a number of findings were made that identified issues that acted as actual, potential, or perceived barriers to the sustainability and the adoption of a system scale approach to hydropower planning, including:

Policy

- Currently, only draft hydropower policy exists, this lack of direction erodes confidence of potential donors and investors.
- Current laws and policies relating to hydropower do not contain significant provisions for environmental and social considerations.
- The existing standard of project management and assessment is lacking resulting in slow and inefficient approval processes.
- A culture of integration of environmental/social considerations with the power sector is not well developed.
- Typically, donor safeguard policies relating to environmental and social issues are not adequately addressed adequately.

Capacity Building

- Capacity building for institutions responsible for strategic policy formulation, regulatory and legal framework, national development plans etc. is required.
- Capacity building for agencies responsible for project assessment, implementation and management is required.

Compensation and Resettlement

- Compensation and resettlement of project affected persons is not considered to be a high priority.
- Past projects have been stalled in the planning stages due to unresolved disputes around benefit sharing among provinces.
- The risk of delays can be reduced by adopting progressive benefit sharing policies that distribute monetary benefits equitably.

Baseline Data

- Significant gaps exist in the dataset relating to the physical, environmental, social, and cultural resources of the Indus Basin.
- The lack of a central hydro-meteorological database is not conducive with informed decision making and optimal outcomes.

Power Generation and Water Storage Planning

- The total hydropower potential in the Indus Basin is approximately 60,365 MW of which only about 12% (7,256 MW) is currently being exploited (PPIB, 2012).
- Pakistan's current water storage capacity is 14.7 BCM, or 30 days of consumption, significantly lower than the minimum desirable requirement of 120 days.

- Potential water storage capacity of all identified HPP projects with impoundments is 51.16 BCM which represents approximately 104 days of consumption.
- Pakistan's total installed electrical generation capacity is currently 23,871 MW, this will need to increase to 83,600 MW by 2033 to meet projected increases in demand.
- The water storage capacity shortfall for the Indus Basin is currently 10 BCM, which is likely to increase four fold in the next 20 years.
- Pakistan will need to increase its water storage capacity from the existing 14.7 BCM to 41.9 BCM to meet future water storage requirements.

Financial

- The cost/benefit analyses of HPP projects to date have not considered losses of ecosystem services, climate change impacts and climate change adaptation.
- Tendencies within the framework for delays in project approval, implementation, funding and dispute resolution pose a threat to the financial viability of projects.

Environmental and Social Impacts

- Primary cumulative impacts associated with HPP development are centred on land loss and disruption of environmental flows.
- Measures that minimise primary cumulative impacts will result in significantly more gains in sustainability at the system-scale.
- Primary cumulative impacts cannot be avoided, as HPP projects typically require large tracts of land and water flows for implementation.
- The cumulative impacts are far reaching and result from actions of multiple stakeholders, mitigation requires action at the project, planning and system levels.

Climate Change

- Hydropower projects are vulnerable to the effects of climate change due to existing water stress and projected changes in monsoonal weather patterns.
- Uncertainty in climate projections and a lack of reliable hydrological records for the Indus Basin are a constraint to effective HPP planning and operation.
- Water storage and controlled releases from large impoundments is a potential adaptation response to increased variability in stream-flow as it will maintain energy outputs from hydropower during periods of low flow.
- Construction of multipurpose impoundment dams in the Indus Basin provides an opportunity for water storage and the managed release of environmental flows throughout the year.

Hydropower Program Optimisation

- 'No Project' option is not a feasible due to the severe social and economic consequences of current power and water shortages and lack of alternatives.
- A non-optimised HPP program developing all or most of the identified projects will provide power and water storage capacity far in excess of projected requirements.
- Optimising the HPP program to include projects that just meet projected power generation and water storage requirements significantly reduces impacts.
- HPP program optimisation is considered to be the most effective way to mitigate cumulative impacts at the system scale.

RECOMMENDATIONS

The findings of the SSESA identify the need for a number of planning initiatives to address the requirement for reforms in hydropower planning policy and development of enabling basin-wide plans and programs to address cumulative impacts. As the existing planning framework is relatively immature it is anticipated that

sweeping changes will be necessary to achieve the desired outcomes in the relatively short timeframe available.

When identifying the level of the planning process at which reforms should be focussed it became apparent that it was at the program and planning stages that the largest gains in terms of sustainability were to be made, with gains at the project level largely confined to the local receiving environment (Figure 2).

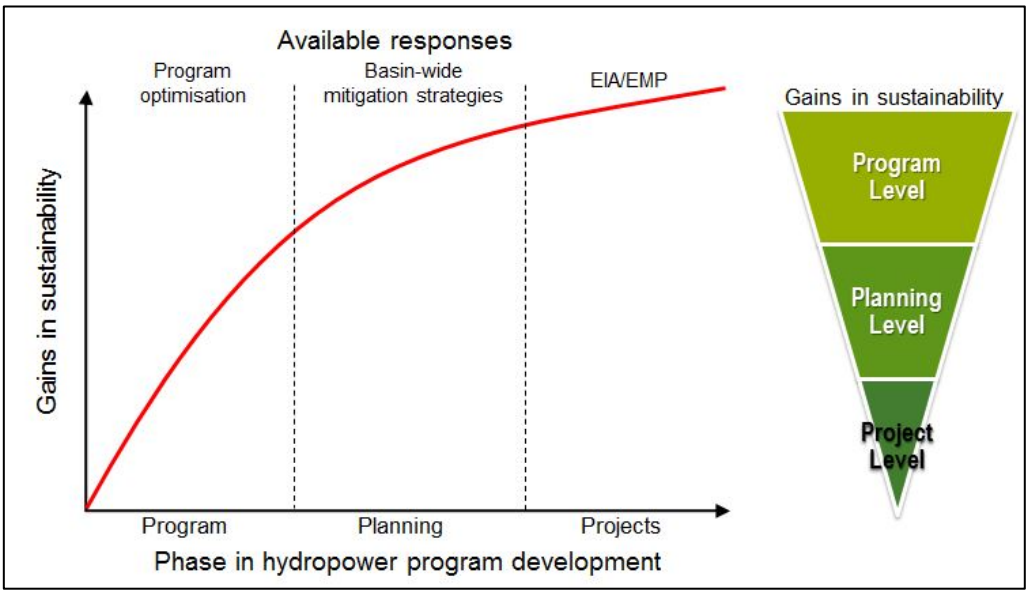

Figure 2. Gains in Sustainability at Different Levels of Intervention

Implementation of the recommended reforms will require the formation of new administrative body tasked with representing hydropower related interests. The legislative and planning tools that will be necessary to achieve these goals constitute one of the following five strategies. Each strategy will be comprised of existing, modified or new Policy, Plans and Programs (PPPs) which will be designed to implement the recommendations of the SSESA. The proposed strategies are:

1. National Water and Power Strategy

- Government of Pakistan Policy for Hydropower Development
- National Environmental Flows Policy
- Hydropower Development Program, including:
  - Interim and Long-Term Power Generation Targets
  - Interim and Long-Term Water Storage Targets
  - Long-Term Hydropower Contribution Target
  - Optimised Project Portfolio
  - Optimised Planning Schedule
- Project Funding Plans
- Supporting Infrastructure Plans
- Labour and Procurement Plans

2. ***Integrated Water Resources Management (IWRM) Strategy:***

- Telemetry Program
- Flood Management Plans
- Catchment Management Plans
- Climate Change Adaptation Plans
- National Environmental Flows Framework

3. ***Regional Biodiversity Conservation Strategy:***

- Biodiversity Offsets Plans
- Aquatic Resources Management Plans
- Data Collection Program and Central Database
- Project Level Mitigation Guidelines

4. ***Regional Resettlement and Compensation Strategy:***

- Public Consultation Program
- Land Acquisition and Compensation Policy and Guidelines
- Social Infrastructure Plans
- Cultural Heritage Conservation Plans
- Economic Development Plans
- Local Employment Guidelines
- Grievance Redress Policy
- Benefit Sharing Policy

5. Policy and Implementation Reform Strategy

- Policy Reform Plans
- Capacity Building Programs

LONG-RANGE STRATEGIC PLANNING

The SSESA provides a framework for a long-range strategic planning model that is specific to hydropower development in the Indus Basin. It is intended that planners use this framework along with the tools and methods provided in the SSESA to develop an optimised program and supporting system-wide mitigation strategies. The tangible benefits of this approach will be:

- Improved capacity to identify cumulative impacts that cannot be addressed by project-based approaches alone, allowing system-wide mitigations to be developed.
- Increased opportunities for optimisation of the overall hydropower program by selecting high performance projects and realising synergistic operational efficiencies.
- A planning framework that is capable of meeting generation and storage requirements and minimising environmental and social impacts within the context of a single comprehensive program.
- Environmental regulatory agencies will have greater capacity to achieve basin-wide, long-term environmental objectives than a project-by-project approach.
- A mechanism for proponents to contribute towards system-scale initiatives to address cumulative impacts that cannot be attributed to individual projects.
- Proponents and donors will have greater certainty and lower risk of delay or cancellation by facilitating 'social license' for a specific project.

- Project Affected Persons will have a degree of certainty of the timing and extent of dispossession and resettlement, affording them more time to plan accordingly.
- Hydro-engineers will have the opportunity to optimise generation by planning cascades of successive generators to exploit peak river flows as they progress downstream.
- Facilitates coordination of the development of supporting infrastructure such as access roads and transmission which could help proponents realise potential synergies.

CONCLUSIONS

A system-scale approach is recommended to address the issue of sustainability of the proposed "Vision 2025" hydropower development program. Tackling cumulative environmental and social issues at this level can identify potential conflicts earlier than project-based approaches alone and allows for greater flexibility to find alternatives.

For a given level of energy development, the system-scale approach has a much greater probability of producing a portfolio and configuration of HPP projects that accommodates the maintenance of other values, including other water-management benefits and environmental and social values.

If this approach is incorporated in to a strategic long-term planning framework, planners will be able to anticipate risks and develop or adapt management systems to respond to them before the impacts are realised.

The SSESA provides a framework and tools to implement the sweeping changes to the existing legislative, assessment and management systems that are necessary to integrate sustainability into the upcoming era of unprecedented hydropower construction.

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