Strategic Environmental Assessment

for Sustainable Development of the Hydropower Sector

Five influential cases

India, Myanmar, Pakistan,
Rwanda, Viet Nam

Netherlands Commission for
Environmental Assessment

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May 2021

Strategic Environmental Assessment for More Sustainable Development of the Hydropower Sector

The Salween River
Myanmar

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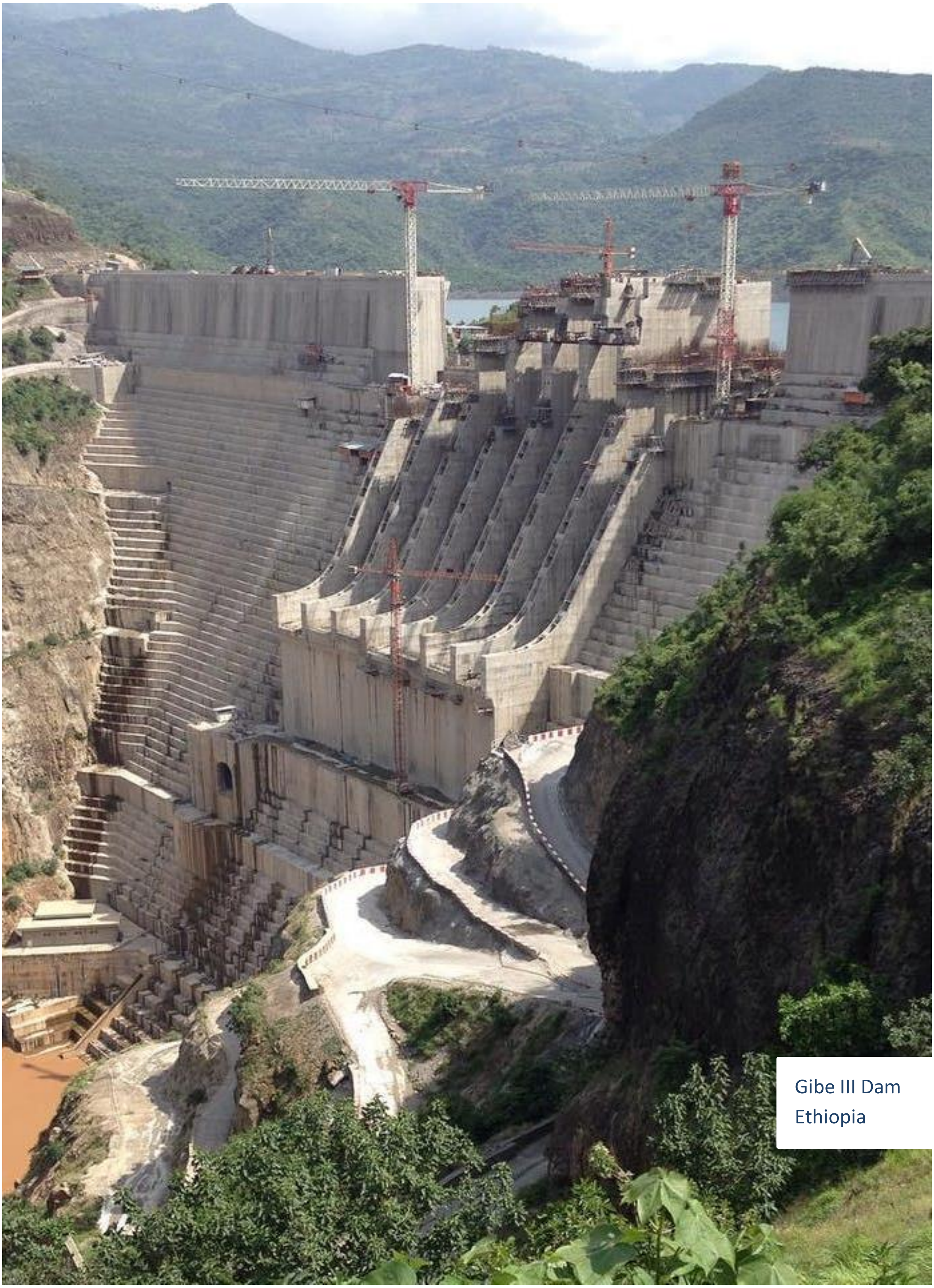


Gibe III Dam
Ethiopia

Summary for Decision-Makers

Towards a more sustainable hydropower development

Hydropower is expected to remain a dominant worldwide player in the energy sector, given the rapidly growing energy demand of low- and middle-income countries. The need for a transition towards climate neutral energy production, and the necessity for pumped storage and grid stability when highly fluctuating wind and solar power generation become prominent, further influence the role of hydropower.

Negative impacts of individual hydropower projects can (partly) be avoided, mitigated and compensated, and positive impacts can be enhanced, by making use of ESIA. However, most impacts are the result of the location of a hydropower project, for instance tributaries located in a national park may be more sensitive to the effects of a hydropower project, than those outside a park. Furthermore, cumulative impacts of a number of projects in a river basin can be considerable, which may go unnoticed in the ESIA for an individual project. Cumulative and negative impacts can be avoided or mitigated by applying SEA to support strategic planning for hydropower.

Strategic Environmental Assessment (SEA) is a decision support tool aiming to integrate environmental and social considerations into government policies, plans and programmes. Since 2019, SEA has been legally adopted in 106 countries and this number is expected to grow. Since 1995, globally, 37 SEAs have been conducted to support strategic planning and decision-making in the hydropower sector, mainly in low and middle-income countries, predominantly in Asia. Of this list, five cases in Pakistan, India, Myanmar, Viet Nam and Rwanda, have been analysed in detail.

Influence of SEAs evaluated

The evaluation showed that the five SEA cases have proven to be influential in the following areas:

- The SEAs contributed to more awareness on the environmental and social impacts of hydropower plans for all stakeholders: the general public as well as investors and planners of hydropower projects.
- The SEAs contributed to cooperation and exchange between different ministries, in particular those concerned with environment and energy.
- The SEAs provided clarity to project developers concerning go and no-go areas and the environmental and social issues associated with certain sites.
- The SEAs influenced decision-making profoundly and also had other important spin-off impacts such as new legislation or easing of social tensions. Examples are the exclusion of sensitive areas from hydropower development and avoidance of investments in hydropower projects at sites with high social and environmental risks.

In conclusion, SEA can be an effective and efficient tool to support more sustainable development of hydropower.

Lessons for future SEAs supporting hydropower development

The following lessons have been drawn that can be applied to future SEAs in support of the hydropower sector.

<u>Lesson 1 - Regulatory framework</u>

SEA can be applied in regulated and unregulated situations as sufficient international guidance and expertise is available.

<u>Lesson 2 - Plan or SEA in the lead</u>

SEA is generally applied in support of formal decision-making as part of a predefined policy, plan or programme. However, it can also be used to inform governments of potential development pathways in situations where no government policy, plan or programme is in place.

<u>Lesson 3 – Alternatives</u>

Developing and comparing alternatives are best practice in SEA; the type of alternatives to examine cannot be prescribed; they are case and context specific.

Lesson 4 - Stakeholder involvement

Stakeholder involvement is essential in SEA and is highly case and context specific. Scope and geographic range of the plan, issues at stake and legacy of earlier experiences determine the way stakeholders are involved.

Lesson 5 – Limited availability of data is no bottleneck

Methodologies can be adapted to available data, stakeholders can assist in filling gaps, access to former planning and assessment studies greatly facilitates new studies. Of course, it remains important to be transparent on gaps in information in the assessment.

Lesson 6 – Government commitment and funding required

Government commitment is a condition for influential SEA. In low-income countries external / international budget is required to implement good practice SEA.

Lesson 7 – Patience needed to see results

An overall observation is that it takes many years to be able to see the actual impacts of planning, assessment and decision-making processes. In this respect it is a pity that so little ex-post evaluative studies are being carried out for the hydropower sector. There is little information on the effectiveness of SEAs, CIAs and ESIAs to address sustainability of the sector.

Supporting the SEA agenda

Government decision-makers can support the application of SEA in the following manner:

- Develop guidelines for strategic planning of the hydropower sector, including SEA. To secure application, these guidelines should be adopted by platform organisations such as the International Hydropower Association, International Commission on Large Dams, International Association for Impact Assessment, and governments and international finance institutes.
- Provide river basin authorities with the necessary knowledge to use SEA jointly with Integrated Water Resources Planning and Management to balance different interests in a river basin management plan;
- Collect and share examples of how SEA can lead to economically efficient outcomes, while reducing environmental and social risks.
- Emphasise the importance of SEA to stakeholders as an effective tool for conflict resolution.
- Spend time on the evaluation of planning, assessment and decision-making processes to determine whether procedures, impacts and plan outcomes are according to expectations.


The Bhyundar Ganga project
India
SUPER HYDRO ELECTRIC PVT. LTD.
BHYUNDAR GANGA HYDRO ELECTRIC
PROJECT (24.3MW)
POWER HOUSE SITE

Summary for Dam Owners

Towards a more sustainable hydropower sector

Hydropower is expected to remain a dominant worldwide player in the energy sector, given the rapidly growing energy demand of low- and middle-income countries. The need for a transition towards climate neutral energy production, and the necessity for pumped storage and grid stability when highly fluctuating wind and solar power generation become prominent, further influence the role of hydropower.

Despite the positive aspects of new hydropower projects (hereafter referred to as 'project'), dam owners are increasingly confronted with opposition during preparation and implementation of projects. Two tools can subsequently be applied to get support for a project and reduce delays and reputational risk, namely Strategic Environmental Assessment (SEA) and Environmental and Social Impact Assessment (ESIA).

SEA: a relatively new and promising tool

Environmental and Social Impact Assessments (ESIAs) are known by dam owners as a legal requirement to obtain an environmental license. Application of ESIA by dam owners has become common practice. However, an ESIA does not always adequately answer questions raised by stakeholders. The main reason is that strategic decisions on the necessity of the project, on the type and size of the project and on the project location have already been taken before the final project definition and the start of the ESIA.

Strategic Environmental Assessment (SEA) is a relatively new tool that supports the above-mentioned strategic decisions that are not addressed by ESIA. SEA is led by the government and aims to integrate environmental and social considerations into government policies, plans and programmes. Up to 2019, SEA has been legally adopted by 106 countries and this number is expected to grow. Since 1995, globally, 37 SEAs have been conducted to support strategic planning and decision-making in the hydropower sector, mainly in low and-middle income countries, predominantly in Asia.

Influence of SEAs evaluated

This report is a first attempt to determine the influence of SEA on hydropower development. Information on the influence of these 37 cases has been gathered through desk review and by approaching members of the International Association for Impact Assessment (IAIA) involved in many of these SEAs. This resulted in a list of 15 SEAs with a moderate to high influence. Of this list, five cases in Pakistan, India, Myanmar, Viet Nam and Rwanda, have been selected and further analysed. The evaluation shows that the five SEA cases have proven to be influential in the following areas:

- The SEAs contributed to more awareness of the environmental and social impacts of hydropower plans for all stakeholders: the general public as well as investors and planners of hydropower projects.
- The SEAs contributed to cooperation and exchange between different ministries, in particular those concerned with environment and energy.
- The SEAs provided clarity to project developers concerning go and no-go areas and the environmental and social issues associated with certain sites.
- The SEAs influenced decision-making profoundly and also had other important spin-off impacts such as new legislation or easing of social tensions. Examples are the exclusion of sensitive areas from hydropower development and avoidance of investments in hydropower projects at sites with high social and environmental risks.

Advantages of SEA for dam owners:

- Better understanding of the cumulative impact of a series of individual hydropower projects (cascades), and preventing costly and unnecessary mistakes;
- Better insight in the trade-offs between environmental, economic and social issues, enhancing the chance of finding win-win options;
- Easier ESIAs because strategic decisions, for instance on locations and power generation capacity needs, have already been decided upon;
- Better alignment of decisions and information requirements lead to more efficient assessments;
- Enhanced credibility in the eyes of affected stakeholders, leading to swifter implementation;
- Easier access to funding from international development banks.

In conclusion, SEA is an effective and efficient tool to support the development of more sustainable hydropower projects. When SEA is applied by government agencies, which implies they are well prepared and know the issues at stake, it is an advantage to hydropower companies. Necessary regulatory instruments have been updated with relevant information. Clarity on roles and responsibilities for private companies and government agencies, contributes to effective investment and maximisation of benefits, for companies as well as society. The process takes place within transparent boundaries of sustainability and is established in collaboration with society stakeholders. If for whatever reason government does not implement an SEA, a company with large interests in a region can take the initiative for a regional SEA.

Role of dam owners in supporting SEA

Dam owners can support the application of SEA in the following manner:

- Request government or bank to adhere to an SEA and/or request an SEA to be conducted.
- Request government to do SEA for its energy policy to define the optimal energy mix.
- Request government to do SEA for its river basin management planning to provide clarity on water allocation and cumulative social and environmental issues.
- Request and support the International Hydropower Association and the International Commission on Large Dams to develop SEA guidelines for strategic planning of the hydropower sector.

Enguri Dam
Georgia

EXECUTIVE SUMMARY

Hydropower is expected to remain a dominant worldwide player in the energy sector, given the rapidly growing energy demand of low- and middle-income countries (LMCs). The need for a transition towards climate neutral energy production, and the necessity for pumped storage and grid stability when highly fluctuating wind and solar power generation become prominent, further influence the choice for hydropower.

Negative impacts of individual hydropower projects can (partly) be avoided, mitigated and compensated, and positive impacts can be enhanced, by applying ESIA. However, most impacts are the result of the location of a hydropower project, for example tributaries located in a national park are more sensitive to the effects of a hydropower project than tributaries outside such a park. In addition, the cumulative impacts of a number of these projects in a river basin can be considerable. Cumulative and negative impacts can (partly) be avoided or mitigated by applying SEA to support strategic planning of hydropower projects.

Strategic Environmental Assessment (SEA) is a decision support tool aiming to integrate environmental and social considerations into government policies, plans and programmes. Since 2019, SEA has been legally adopted in 106 countries and this number is expected to grow.

Since 1995, globally, 37 SEAs have been conducted to support strategic planning and decision-making in the hydropower sector, mainly in LMCs and predominantly in Asia.

Theoretically, SEA may save time and money, create broader public acceptance of decisions, avoid costly mistakes, can address dilemmas and conflicts in a neutral manner, create transparency on trade-offs between conservation and development, is able to address risks associated to climate change, put plans in the wider perspective of the sustainable development goals, create transparency in negotiations between states in transboundary river basins, etc.

This report is a first attempt to determine whether SEA lives up to its promises with respect to hydropower development. It aims to answer two main questions:

- How many SEAs have been conducted to support the development of the hydropower sector?
- What lessons can be learnt from a selection of five influential SEAs?

Inventory of cases

A global inventory of SEA studies supporting hydropower–related development of policies, plans and programmes resulted in a list of 37 SEAs that have been implemented. These SEAs are mainly applied for the following sectors:

- Energy sector, including hydropower (N = 16)
- Multi-sector (N = 5)
- Hydropower sector (N = 16)

Information regarding the influence of these 37 cases has been gathered through desk review and by approaching members of the International Association for Impact Assessment (IAIA) who were involved in many of these SEAs. This resulted in a list of 15 SEAs of moderate to high influence. Out of this list, five cases in Pakistan, India, Myanmar, Viet Nam and Rwanda, have been selected and further elaborated.

Influence of SEAs evaluated

The evaluation showed that the five SEA cases have proven to be influential in the following areas:

- The SEAs contributed to more awareness of the environmental and social impacts of hydropower plans for all stakeholders: the general public as well as investors and planners of hydropower projects.
- The SEAs contributed to cooperation and exchange between different ministries, in particular those concerned with environment and energy.
- The SEAs provided clarity to project developers concerning go and no-go areas and the environmental and social issues associated with certain sites.
- The SEAs influenced decision-making profoundly and also had other important spin-off impacts such as new legislation or easing of social tensions. A few examples are the exclusion of sensitive areas from hydropower development and avoidance of

investments in hydropower projects at sites of high social and environmental risk.

In conclusion, SEA is an effective and efficient tool to support more sustainable development of hydropower.

Lessons for future SEAs supporting hydropower development

The following lessons have been learnt and can be applied in future SEAs supporting sustainable development of especially, the hydropower sector.

Lesson 1 - Regulatory framework

SEA can be applied in regulated and unregulated situations; sufficient international guidance and expertise is available.

Lesson 2 - Plan or SEA in the lead

SEA is in general applied to support formal decision-making as part of a predefined policy, plan or programme, but can also be used to inform governments of potential development pathways in situations where no government policy, plan or programme is in place.

Lesson 3 – Alternatives

Developing and comparing alternatives is best practice in SEA but the kind of alternatives to examine cannot be prescribed; they are case and context specific.

Lesson 4 - Stakeholder involvement

Stakeholder involvement is essential in SEA and application is highly case and context specific. Scope and geographic range of the plan, issues at stake and legacy of earlier experiences determine the way stakeholders are involved.

Lesson 5 – Limited availability of data is no bottleneck

Limited availability of data does not seem to be a bottleneck for strategic assessments. Methodologies can be adapted to available data, stakeholders can assist in filling gaps, access to former planning and assessment studies greatly facilitates new studies. Of course, it remains important to be transparent on gaps in information in the assessment.

Lesson 6 – Government commitment and funding required.

Government commitment is a condition for influential SEA. In low-income countries external / international budget is required to implement good practice SEA.

Lesson 7 – More evaluation of hydropower planning

An overall observation is that it takes many years to be able to see the actual impacts of planning, assessment and decision-making processes. In this respect it is a pity that so little ex-post evaluative studies are being carried out for the hydropower sector. There is little information on the effectiveness of SEAs, CIAs and ESIAs to address sustainability of the sector.

Agenda for the future

All actors:

- develop guidelines for strategic planning of the hydropower sector, including SEA. To secure application, these guidelines should be adopted by platform organisations such as IHA, ICOLD, IAIA and governments.

Government authorities:

- provide river basin authorities with the necessary knowledge to use SEA jointly with IWRM to support balancing of different interests in a river basin plan;
- collect and share examples of how SEA can lead to economically efficient outcomes, and reductions in environmental and social risks;
- emphasise the importance of SEA to stakeholders as an effective tool for conflict resolution;
- spend more time on the evaluation of earlier planning, assessment and decision-making as well as whether this has resulted in the expected impacts.

Dam owners and investors in hydropower projects:

- require adhering to an SEA and/or request an SEA or CIA to be conducted.
- refer to SEAs where available, when the need for ESIA project is determined during the screening phase.
- request government to do SEA for its energy policy to define the optimal energy mix.
- request government to do SEA for its river basin management planning to provide clarity on water allocation and cumulative social and environmental issues.

Multilateral Development Banks:

- ask governments for SEAs on energy policy, hydropower plans, river basin plans and programmes for cascades of projects in a sub-catchment of a river basin;
- avoid confusion between application of SEA and CIA, and apply CIA to assess the cumulative impacts of one or more projects in a sub-catchment;
- should study cumulative impacts needs, to be studied as part of ESIAs;
- provide means for additional studies if required and support governments in developing SEA capacity.

SEA practitioners and scientists:

- present the outcomes of an SEA in an (visually) attractive summary. Decision-makers do not always need to read long SEA documents to be able to make informed decisions.
- evaluate methodologies and the incorporation of tools such as Hydropower by Design, Rapid Basin-wide Assessment tool, and the Cumulative Impact Assessment and Management Good Practice Handbook to improve effectiveness and efficiency of SEA.

Village meeting on the Vishnuprayag hydropower project India

1 INTRODUCTION

1.1 TOWARDS MORE SUSTAINABLE HYDROPOWER

Hydropower accounts for 16% of the global electricity generation. Globally, around 20% of the technical exploitable hydropower has been developed, mainly in Europe and North America. How much of the untapped potential especially in Asia, Africa and South America will be developed, depends on economic, social and environmental factors, including climate change. Technically, the most suitable sites have already been utilised and so new sites are much more challenging to select (ICOLD, 2019). The question arises as to how to develop new hydropower projects in such a way that these optimally contribute to the achievement of the Sustainable Development Goals?

To develop more sustainable hydropower, energy planning needs to move from a unilateral focus on project-level planning to a balance that puts more emphasis on strategic planning (NCEA, 2017). Because strategic planning at national level offers the opportunity to provide insight into the costs and benefits of hydropower in comparison with other energy sources (Moran et al., 2018). Both national and basin-level strategic planning provides information on

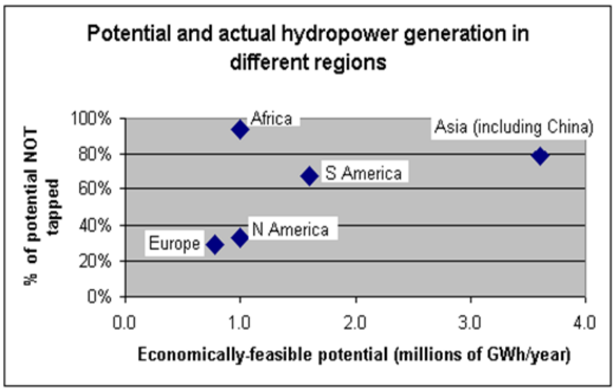


Figure 1: Potential and actual hydropower generation in different regions. Source: IEA, 2015

trade-offs between hydropower and other users, and this information can support balanced decision-making. Strategic Environmental Assessment (SEA) is one of the tools increasingly applied to support strategic planning in the hydropower sector. Other tools supporting the development of sustainable hydropower are listed in box 1. This study aims to provide more information on the use of SEA in the hydropower sector and its influence on strategic planning

Box 1

Tools supporting sustainable hydropower development

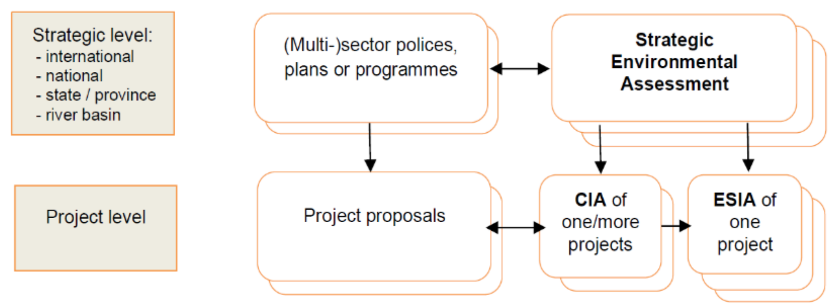
In addition to SEA and Environmental and Social Impact Assessment (ESIA), the following decision-support tools have been developed and applied in the past ten years, all aiming to support sustainable development of hydropower:

- Cumulative Impact Assessment
- Hydropower by Design
- Rapid Basin-wide Sustainability Assessment
- Hydropower Sustainability Assessment Protocol

A comparative assessment of these tools has not been conducted as yet and therefore, there is no insight into the effectiveness of these tools in comparison to SEA or whether they can be complementary to SEA. For a brief description of these tools and sources see Annex 1.

Sometimes, SEA and Cumulative Impact Assessment (CIA) are used synonymously which is understandable because of their similarities. However, this is incorrect since they serve different purposes. CIA supports decision-making of projects by assessing the cumulative impacts of one or more hydropower projects whilst SEA supports decision-making of government plans on hydropower, including assessment of cumulative impacts. Figure 2 shows the hierarchy between SEA, CIA and ESIA.

Figure 2: Hierarchy of SEA, CIA and ESIA supporting decision-making at strategic and project level



CIA = Cumulative Impact assessment, ESIA = Environmental and Social Impact Assessment, SEA = Strategic Environmental Assessment. CIA focusses on the combined impacts caused by one or more projects interacting with existing or planned projects. SEA also considers cumulative impacts but from a strategic perspective

Source: Adjusted to ICEM (2009)

To provide clarity on the use and influence of SEA supporting strategic planning of the hydropower sector, this report aims to answer the following questions:

1. How many SEAs have been conducted to support the development of the hydropower sector?
2. What lessons can be learned from a selection of five influential SEAs?

The methodology applied is described in section 1.2. In section, 1.3 and section 1.4 the first question is addressed. The second question is addressed in chapters 2, 3, 4, 5 and 6 where five influential SEA cases are described from Pakistan, India, Myanmar, Viet Nam and Rwanda. In chapter 7 conclusions, lessons learnt and an agenda are presented for further development of the hydropower sector by making use of SEA.

This publication is especially directed at:

- Government agencies responsible for planning and decision-making on hydropower investments in low- and middle-income countries. For example, energy and environment authorities.
- Multilateral development banks funding hydropower projects and
- private sector investors in hydropower[1].

Low- and middle-income countries have the greatest potential for hydropower development (see figure 1) and are expected to see the fastest development of hydropower while being confronted with limited experience and low government capacity to manage these rapid developments[2].

1.2 Methodology

To answer the key questions the following method was applied.

Question 1: To identify all hydropower related SEA cases, a web search was conducted, and twenty SEA practitioners were approached primarily via the network of the International Association for Impact Assessment. Because of unclear demarcation between SEAs and CIAs by practitioners the latter were included in the search. All gathered SEAs and CIAs were assessed against the definition of SEA and CIA, see box 1. As a result, two CIAs were included in the list of SEAs and one SEA was listed as CIA. This resulted in 37 SEAs divided into three groups. SEAs supporting energy sector planning, including hydropower (N=16); SEAs supporting multi-sector planning within a river basin context, including hydropower (N=5) and SEAs supporting hydropower sector planning (N=16). (See Appendix 2 for an overview of these SEAs[3]). In total 18 CIAs were gathered but these are not further considered in this report. (See Appendix 3 for a brief overview of these CIAs).

Question 2: The level of influence of the 37 SEA cases was assessed by using scientific and grey literature, and through contacting resource persons. For 14 cases the available information was insufficient to determine their level of influence. A simple four-point scale was used to indicate the level of influence of the remaining 23 cases resulting in the following score: unknown (N= no influence (N= 1), low influence (N=7), moderate influence (N=8), and high influence (N=7).
From the 15 cases with moderate to high influence, five SEA cases were selected for more in-depth analysis and

[1] IEA states that hydropower could double its contribution by 2050; the bulk of this growth would come from large plants in emerging economies and developing countries.

[2] Dam removal rather than construction has become the norm in North America and large parts of Europe (Moran et al., 2018; https://www.damremoval.eu).

[3] SEAs may have been missed, due to difficulties accessing SEAs, only available in local language. This will definitely be the case for China where SEA is legally required for government plans and programmes, but also for countries such as Brazil where SEAs are known to be carried out voluntarily for energy sector planning (Malvestio, A.C. & M. Montaño, 2013).

description (the number of cases being defined by available budget). The following case selection criteria were applied:

1. if possible, a minimum of one case per planning situation, i.e. energy sector planning, including hydropower, multi-sector planning and hydropower sector planning;
2. if more than one case in a country, preference goes to a high-influence case;
3. focus on low- and middle-income countries;
4. public availability of SEA study.

The following five cases were selected:

- Hydropower sector:
  - SEA Pakistan
  - SEA India
  - SEA Myanmar
- Energy sector:
  - SEA Viet Nam
- Multi-sector:
  - SEA Rwanda

The authors of the SEA case studies were closely involved with the SEAs in various roles: lead government expert (Pakistan, Rwanda), advisor to the government (Viet Nam), lead researcher (India), and leading expert of the funding agency (Myanmar).

1.3 CHARACTERISTICS OF SEA

What is SEA?

Strategic Environmental Assessment (SEA) can be defined as a range of “analytical and participatory approaches that aim to integrate environmental considerations into policies, plans, and programmes and evaluate the interlinkages with economic and social considerations” (OECD, 2006). It is a tool to:

- structure public and government debate in the preparation of policies, plans and programmes (PPPs);
- feed this debate through a robust assessment of the environmental and, where needed, social and economic consequences;
- ensure that the results of assessment and debate are considered during decision-making and implementation.

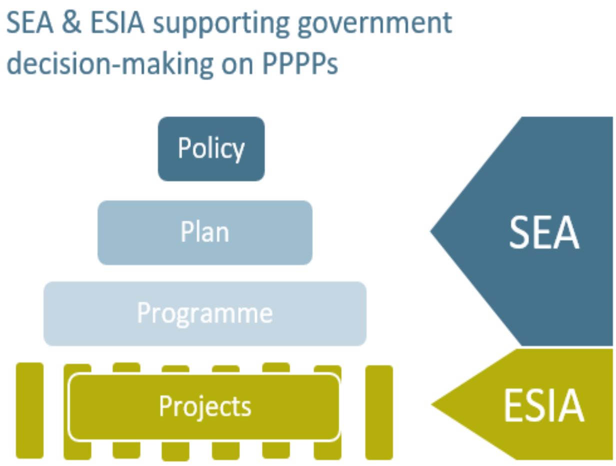
The purpose of SEA, broadly stated, is to ensure that environmental and social considerations are integrated into strategic decision-making in support of environmentally and socially sound and sustainable development (UNECE, 2012).

The applicability of SEA is wide. It aims at better strategies, ranging from legislation and country-wide development policies, to more specific sectoral and spatial plans.

In 2019, 106 countries legally established SEA and this number is expected to increase considerably in the next decade. In countries where no legal basis exists, SEA is applied as a voluntary tool and process.

The potential of SEA to support strategic planning of hydropower is acknowledged by a large number of institutions such as the United Nations, International Finance Institutions such as the World Bank, International Finance Corporation, the Asian Development Bank, Inter-American Development Bank, the European Investment Bank and the European Bank for Reconstruction and Development, the Mekong River Commission and international NGOs such as The Nature Conservancy, World Wildlife Fund, and, International Union for Conservation of Nature.

Figure 3: SEA supporting government decision-making on policies, plans, programmes and ESIA supporting projects (OECD-DAC, 2006)



What are the advantages of SEA?

According to the literature SEA has the following advantages[4] :

- better insight into the trade-offs between environmental, economic and social issues, enhancing the chance of finding a win-win situation;
- warns decision-makers and the public about unsustainable development options, which helps prevent costly and unnecessary mistakes, as well as conflicts around natural resource use;
- a better understanding of the cumulative impacts of multiple smaller developments, and the opportunity to improve the coherence between projects;
- enhanced credibility of government decisions, leading to more public trust in the planning process and more support for plan implementation;
- easier ESIA at the project level, because strategic decisions, for example for locations, have already been addressed in the SEA process;
- SEA can provide an important arena for regional cooperation between countries to address difficult issues concerning, for example, shared protected areas, waterways, transport connections and transboundary pollution.

What does an SEA process look like?

The SEA process can be divided into phases consisting of various steps to be taken. However, an SEA should always be tailored to the specific planning process that it is supporting. That means it needs to be applied in a flexible manner. In box 2 a 'good practice' sequence of steps is shown and should be adapted to specific country context, and to the dynamics of the respective policy, programme or plan.

Box 2:
Good practice SEA steps according to the OECD-DAC (2006)

Phase A: Establishing the context for SEA
- Screening: decide on the need and role of SEA.
- Identify the stakeholders and plan their involvement.
- Develop, with the stakeholders, a shared vision on the key (environmental) problems, objectives and alternatives for the policy or plan.

Phase B: Implementing SEA
- Scope the content for the SEA, including a look at synergies or conflict with existing policy objectives.
- Collect baseline data.
- Assess alternatives.
- Identify how to use opportunities/mitigate impacts.
- Assure quality through independent review and public involvement of draft reports.
- Document results and make these available.

Phase C: Informing and influencing decision-making
- Organise dialogue among stakeholders on SEA results and make recommendations for decision-making.
- Justify the (political) choices that have been made in the finally adopted policy or plan.

Phase D: Monitoring and evaluation
- Monitor the implementation of the adopted policy or plan and alignment with the SEA.
- Evaluate the alignment of the SEA with the outcomes of the policy or plan.

[4] OECD-DAC (2006): Applying Strategic Environmental Assessment. Good Practice Guidance for Development Co-operation. UNECE (2012): Resource Manual to Support Application of the Protocol on Strategic Environmental Assessment

Table 1: SEA applied for policies, plans or programmes in the energy and hydropower sector or for multiple sectors

Energy sector, including the hydropower	**Hydropower sector**	**Multiple-sectors, incl. the hydropower**
• International • National • State/ provincial	• International river basin • National • State/ provincial • River (sub-)basin	• International river basin • National river basins

Table 2: SEAs for energy sector, multi-sector and hydropower sector, arranged from Annex 1, for regions (columns) and type of PPPs (rows) for the period 1995-2019

Type of PPPs per sector*	**Asia**	**Africa**	**Europe**	**Americas**	Total
Energy sector, including hydropower					
International	1	1			2
National **)	5	4	4		13
State / Provincial				1	1
Sub-total	*6*	*5*	*4*	*1*	*16*
Hydropower sector					
International river basin	1				1
National **)	6		1		7
State / Provincial **)	3		1		4
River (sub-)basin	3		1		4
Sub-total	*13*		*3*		*16*
Multiple sectors, including hydropower					
International river basin		1		1	2
National river basin(s)**	2	1			3
Sub-total	*2*	*2*			*5*
Total	**21**	**7**	**7**	**2**	**37**

*) All SEAs applied for PPPs in the energy sector at international, national and state level have been included in the inventory. In two of these SEAs hydropower is not included as an energy source. All SEAs applied for PPPs in multi-sectoral PPPs are included, in which hydropower is considered. All SEAs applied in the hydropower sector are included in the inventory.

**) Selected cases: National energy plan Viet Nam; National hydropower plan Myanmar; State level hydropower plan India and Pakistan; Multi-sector River basin plan Rwanda.

SEAs supporting strategic planning of hydropower development

To better understand the wide application of SEAs, one must look at the variety of PPPs dealing with hydropower development. Table 1 shows that SEAs are supporting energy sector PPPs at international, national and state/ provincial level. An issue typically considered in an SEA for the energy sector is the development of alternative fuel mixes with more or less hydropower, to develop and secure future energy generation. SEAs are also directly supporting hydropower sector PPPs at different levels: international river basin, national, state/provincial, river (sub-)basin. These SEAs typically support decision-making by categorising areas that are more or less suitable for the development of hydropower projects. SEAs applied for the third group of PPPs, dealing with multiple sectors in international or national river basins, support balanced decision-making between all stakeholders with different interests such as hydropower, irrigation and nature conservation.

1.4 Inventory of SEAs

The results of a global inventory of SEAs implemented, supporting the development of hydropower is presented in table 2. In total 34 SEAs have been conducted in the period 1995 – 2020.

A closer look at the cases in table 2 leads to the following conclusions:

Sectors

- **Limited number of SEAs for energy sector.** In total 16 cases have been conducted of which 2 are dealing with international power planning and 13 are applied for national planning in which hydropower is part of the national fuel mix.
- **SEA for hydropower on the rise**. There is a significant increase in the application of SEA for hydropower over the years: one case from the 1990s, 4 cases from the first decade of this century and 11 from the second decade.
- **Few SEAs for river basin planning, including hydropower.** In total 5 cases were carried out for river basin planning. In these cases, hydropower was assessed jointly with other water-dependent sectors within a river basin.

Type of PPPs

- **International co-operation.** In 4 cases SEA has supported coordination of planning and decision-making between two or more countries.
- **Majority of SEAs support national plans.** The majority of cases, in total 20, support national plans, 5 cases support plans at sub-national (state/provincial) level and 5 cases support development of basin plans at national level.

Geographic distribution

- Asia in the lead. Most SEAs, 21 in total, have been carried out in Asia, predominantly in South Asia and Southeast Asia, followed by Europe and Africa.

In the next chapters the five cases are described.

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Ranganadi Dam
Arunachal Pradesh
India

2 SEA FOR HYDROPOWER DEVELOPMENT IN AZAD JAMMU KASHMIR STATE PAKISTAN

David Annandale

Authorities	Azad Jammu Kashmir (AJK) State – Planning and development department
Type of plan	Hydropower development plan AJK State
Scope of SEA	All HPPs in AJK State
Key SEA issues	Ranking of 62 HPPs (~9,000 MW) in different stages of development, based on cumulative assessment of ecological and socio-economic impacts
Stakeholder engagement	Consultation with private actors in the hydropower sector and relevant AJK authorities
Duration and year	12 months; 2014
Influence of SEA	• Set up of hydropower coordination committee preparing a coordinated AJK hydropower development plan • Proposed Gulpur reservoir project (100 MW) located in most sensitive sub-basin was changed into a run of the river project and a National Park was established
Link to SEA report	https://www.commissiemer.nl/docs/mer/diversen/pos722-sea-hydropower-development.pdf

2.1 INTRODUCTION

The Strategic Environmental Assessment (SEA) examined the cumulative impacts of approximately 60 hydropower projects proposed for Azad Jammu and Kashmir state (AJK), which is a nominally self-governing jurisdiction administered by Pakistan. The study developed a detailed methodology for cumulative assessment and resulted in conclusions and recommendations related to the ecological and social sensitivity of river segments, and institutional reforms that could improve the way hydropower projects are planned.

Figure 1: Provincial map of Pakistan

2.2 BACKGROUND: CONTEXT AND ISSUES

The SEA was undertaken in 2014, as part of the National Impact Assessment Programme. The study was financially supported by the Embassy of the Netherlands, with technical support from the Netherlands Commission for Environmental Assessment, and with administrative management provided by IUCN Pakistan. Field work and analysis was undertaken jointly with a Pakistan consulting company known as Hagler Bailly. Given Pakistan's relative infancy with respect to the implementation of SEA, this exercise was considered to be an important pilot project.

At that time, Pakistan was facing an acute shortage of electric power. Power outages were a common occurrence, and public frustration had resulted in the issue becoming an important tipping point in the national election of 2013. With nearly 9.000 MW of available capacity, the hydropower sector in AJK was a natural focus of interest for federal energy planners. Figure 1 shows the geographical position of AJK.

No overall hydropower development plan existed in AJK, although four separate proponent agencies had plans for developing a total of around 60 projects. Depending on their size and siting, these projects may not necessarily result in significant adverse environmental or social impacts when they are assessed individually. However, when looked at as a whole, their cumulative impact could be significant. Before embarking on wholesale development of these projects, an assessment was required to enable decision-makers to fully understand the implications of such a large-scale development plan.

Through the SEA Task Force established by the National Impact Assessment Programme, the Government of AJK volunteered its de facto hydropower plan as a focus for a pilot SEA study. Because it was not exactly clear where each of the proposed hydropower projects (HPPs) would be sited, and nor were the specifics of their designs well-defined, this SEA pilot focused on the overall cumulative impacts that may result from implementation of the hydropower plan as a whole.

The objectives of the SEA of the hydropower plan were to:

- Develop an understanding of the state of hydropower planning in AJK;
- Assess the potential environmental and social risks associated with the hydropower plan;
- Assess the potential environmental and social benefits associated with the hydropower plan;
- If necessary, suggest alternative plan options that better optimise economic, environmental, and social outcomes; and,
- Assess the institutional and policy constraints to mainstreaming environmental and social considerations into AJK hydropower planning and development and provide recommendations on how these constrains might be addressed.

2.3 Approach and Methods Used

Figure 2 outlines the methodological approach taken in this study. It consisted of eight steps. These were designed to match the "basic stages" of SEA presented in the OECD DAC SEA Guidance document[1].

In step 1, the proponent agencies were identified as the Water and Power Development Authority (WAPDA), the Hydroelectric Board (HEB), the Private Power Infrastructure Board (PPB), and the Private Power Cell (PPC). Each proponent had its own project development plans. These made it possible to map proposed HPPs and set objectives for the SEA. This step also undertook a process to identify relevant stakeholders.

Step 2 outlined the structural design features of a selection of proposed HPPs of differing generation capacity. With this background material it was possible, in step 3, to define the generic drivers of potential environmental and social impacts. Categorising HPPs into different types based on the drivers of impacts helped to identify the key issues that became the focus of the study and the recommendations that resulted from it.

Step 4 began to make the link between drivers and actual potential impacts by outlining the expected effects from HPPs of different generation capacities.

Step 5 was time-intensive and focused on environmental and social "baseline" conditions on specific stretches of rivers and streams that will likely see HPP development taking place. Based on ecological contiguity, the rivers and streams of AJK were divided into nine zones. The ecological sensitivity of each river zone was assessed and discussed followed by a determination of the sensitivity of river sections to the development of HPPs. A similar analysis of socio-economic conditions was undertaken. The socio-economic sensitivity of river/stream segments was determined and rated as Least, Moderate or Highly sensitive to HPP development.

Knowing the sites of possible HPPs, the drivers of potential impacts, and the environmental and social baseline conditions, it was possible in step 6 to delineate "cumulative impact zones". Based on the possible extent and severity of cumulative impacts, these zones were categorised into Moderately Critical, Highly Critical, or Extremely Critical.

[1] OECD 2006, Applying Strategic Environmental Assessment: Good Practice Guidance for Development Cooperation

In step 7, the Cumulative Impact Zones identified earlier were superimposed on the ecologically and socioeconomically sensitive segments of rivers and streams. This allowed the HPPs listed in the hydropower development plan to be ranked according to their overall cumulative impact potential.

Finally, step 8 consisted of communicating the SEA outcomes to decision-makers, in an attempt to influence decision-making.

2.4 Results and Lessons Learnt

Cumulative impacts in ecologically and socio-economically sensitive zones

Superimposing the Cumulative Impact Zones onto the ecologically and socio-economically sensitive segments of rivers and streams helped to rank the HPPs based on their cumulative impact potential. Figure 3 and Figure 4 present maps of the HPPs proposed by the four AJK proponent agencies, and their ranking based on their ecological and social impact.

Figure 2: SEA study methodology

Outcomes of the HPP ranking

A clear outcome from the cumulative impact assessment was that the area of most concern, both from ecological and socio-economic perspectives, is the Poonch River and its feed-in streams from the Line of Control down to the Mangla Dam. The nine proposed HPPs (in total 474 MW) all rank highest for potential ecological and social impact. If government resources are limited, it was recommended that the main focus of environmental assessment should be the nine proposed HPPs in the “Poonch segment”.

Need for detailed studies

River segments with threatened fish species found nowhere else should be classified as critical natural habitats and, ideally, would receive high level protection from dams or other potentially damaging civil works. The Poonch River, for example, is located in an environmentally sensitive area. It is home to an endangered fish species Mahseer (Tor putitora) and is a declared national park.

It was suggested that further detailed studies should consider hydrological data at a level of resolution that is relevant to ecological communities and should consider any subsistence use of the river. In the process, thresholds should be identified beyond which cumulative change will be considered a concern. These should be expressed in terms of goals or targets, standards and guidelines, carrying capacity, or limits of acceptable change. One of the most important thresholds to determine will be the environmental flows required downstream of each diversion structure.

Keeping in view the high ecologically sensitivity of the Poonch River and its tributaries, it was recommended that all hydropower projects planned for that river should use holistic approaches for determination of downstream environmental flow.

Maximising synergistic project development

Where more than one project is being built in close proximity of the same tributary or river section, developers have the opportunity to coordinate with each other and to redesign projects based on a synergistic approach. This can help maximise positive impacts and mitigate adverse environmental impacts. For example, if there are a number of projects being planned on the same tributary, the one highest upstream could have a storage wall designed that would regulate flow for all of them, thereby preventing the need for each downstream project to individually store water. This may also help ensure environmental flows downstream, especially during the dry season.

Another relevant example relates to transmission lines from the powerhouse to the local grid. These lines can have a significant impact on project costs. A remote site may require considerable investment in transmission infrastructure to connect the project to the local grid. However, with strategic planning, this cost can be shared over more than one project if several HPPs are developed in close proximity. Similar efficiencies could be obtained with access points, construction sites and work camps.

Coordinated mitigation measures can be incorporated into the design and operation plans to mitigate expected cumulative impacts at the watershed level. It was therefore recommended that, where there are HPPs in close proximity to each other, either on a main river, or on tributary streams, proponents should be required to consult about project design to enable synergistic development. Such consultation should be required even if project initiation schedules are not synchronised.

Figure 3: Proposed HPPs and their ranking based on their cumulative ecological impact

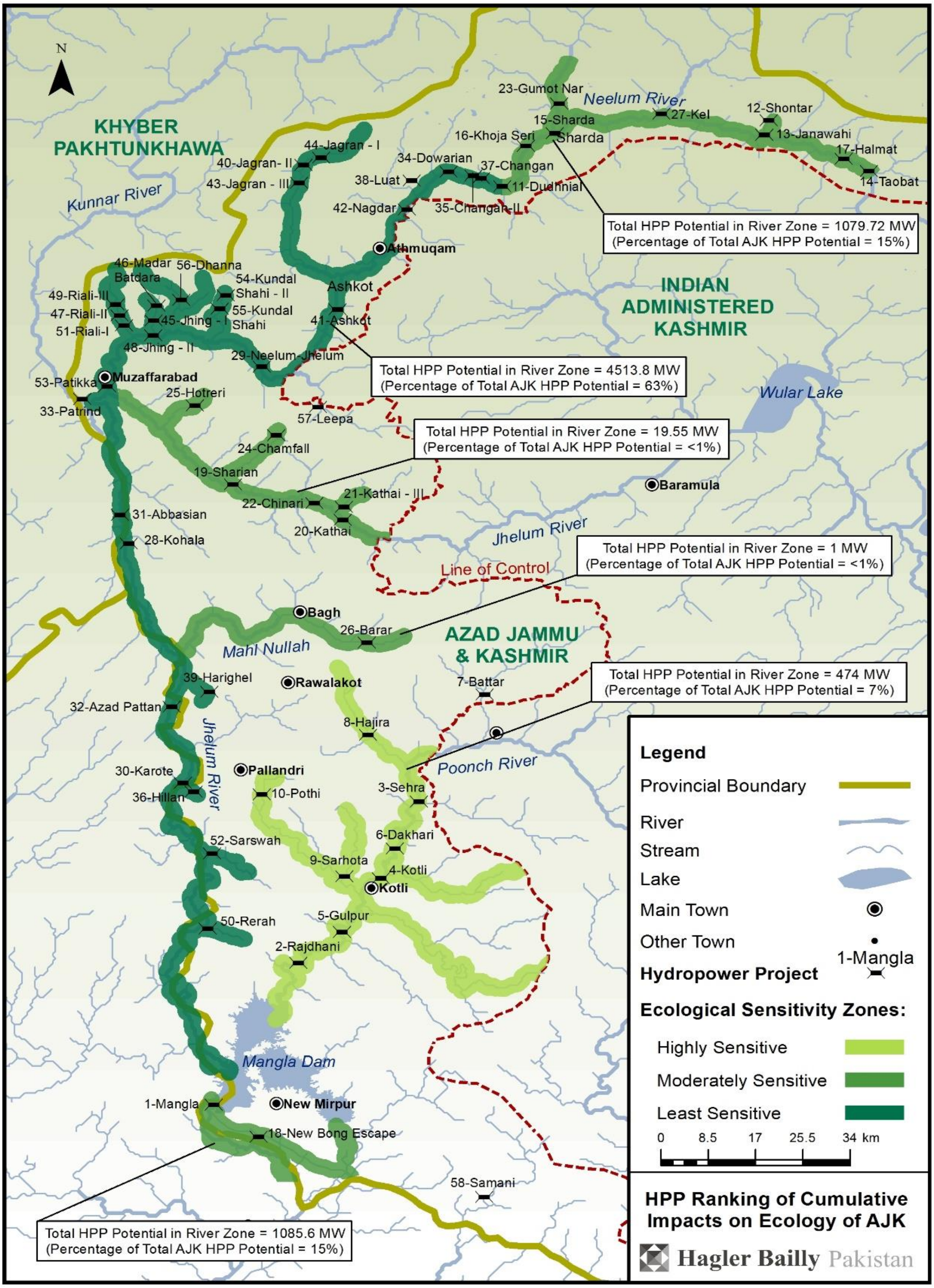
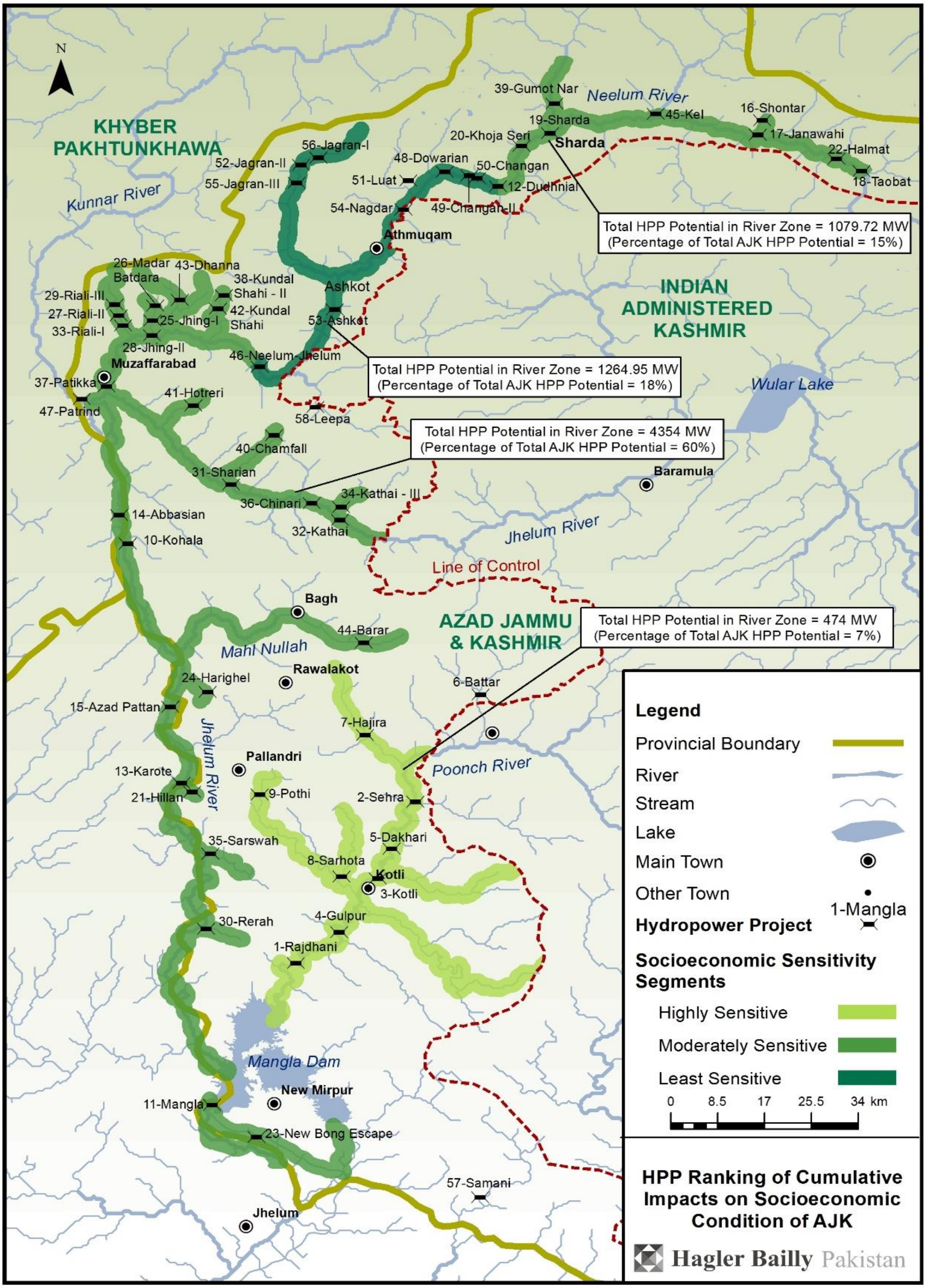


Figure 4: Proposed HPPs and their ranking based on their cumulative socio-economic impact



Institutional coordination and revising the hydropower plan

What the maps do not show is that the development of specific HPPs is not coordinated across the different agencies whose projects make up the overall hydropower plan. For example, it is not possible to easily revise the whole hydropower plan to minimise negative impacts, because different agencies may be responsible for different HPPs, even on the same stretch of river or stream.

In order to maximise benefits and minimise adverse cumulative environmental and social impacts from the development of HPPs, both the AJK and federal agencies should use the maps and associated ranking tables to coordinate the development of different projects. The current hydropower plan for AJK is in a de facto state. It consists only as a collection of project proposals developed by the four proponent agencies, WAPDA, HEB, PPIB, and PPC.

By screening projects and their locations, these agencies should ideally propose a timetable for the development of new projects based on environmental and social considerations. If required, policies and legislation may need to be introduced and/or amended to ensure that following the timetable becomes a mandatory requirement.

Moreover, coordination between the different regulatory agencies also provides an opportunity for identifying joint capacity building goals and objectives for managing the cumulative impacts of the hydropower plan. It was recommended that a comprehensive hydropower plan or basin development plan needs to be developed and "owned" by all four agencies. It should allow for the timed, synergistic development of individual projects.

Guidelines for IEEs and EIAs

At the time, environmental assessment regulations specified that only HPPs over 50 MW required the production of full environmental impact assessments (EIAs). Those with generation capacities less than 50 MW required only initial environmental examinations (IEEs). According to the regulations, projects over 50MW "are generally major projects and have the potential to affect many people. They also include projects in environmentally sensitive areas. The impact of such projects may be irreversible and could lead to significant changes in land use and in the social, physical and biological environment". Projects less than 50MW "include those where the range of environmental issues is comparatively narrow, and the issues can be understood and managed through less extensive analysis. These are projects not generally located in environmentally sensitive areas or smaller proposals in sensitive areas".

An examination of HPP rankings based on their critical cumulative impacts on ecologically and socioeconomically sensitive zones showed that the majority of the top 20 HPPs in both ranking tables are less than 50 MW in size. This suggests that using the 50 MW generation capacity figure as the main determinant of environmental assessment standard is misguided. HPPs with capacities less than 50 MW but located in ecologically and socioeconomically sensitive zones do not necessarily exhibit a narrow range of environmental issues, and nor can the potential individual and cumulative impacts of these projects be understood and managed by the limited scope of analysis of IEEs.

In the SEA it was argued that the 50 MW benchmark should not be the main screening criterion used to determine required level of environmental assessment. It was recommended that AJK Environmental Protection Agency (EPA) should use Figure 3 and Figure 4, along with associated ranking tables, to determine whether a HPP should require an IEE or EIA. It was also recommended that AJK EPA should develop "zone specific" guidelines for IEE and EIA studies that are not tied to installed capacities of HPPs. This could be of significant benefit to proponents. In addition, Terms of Reference for full EIA studies associated with relevant HPPs should include cumulative assessment requirements.

Provision of information

The SEA stated that due to limited government funding and resources, AJK EPA could examine the possibility of sharing some of its monitoring responsibilities with the people most likely to be affected by the HPPs. Local representatives could be made a permanent part of the monitoring body of the AJK EPA.

Activities could be planned with nearby schools and universities to monitor the HPPs during the construction and operation phases. One example of a monitoring activity is the periodic review of environmental flows downstream of diversion structures. It was also suggested that Figure 3 and Figure 4, along with other maps contained in the final report, could be digitalised and hyperlinked, so that interested proponents and members of the public could click on the name of a HPP, or a general location, and obtain information about the sensitivity of the area and required guidelines.

2.5 Measuring the influence of the SEA

The influence of an SEA can be measures in terms of its outputs, outcomes, and impact. Outputs are usually understood to be the SEA report itself, and the process used to produce it. In this case, the SEA applied the internationally accepted OECD SEA good practice guidance and extended it by developing a detailed approach to cumulative assessment. It applied a rigorous methodology to the assessment of the cumulative impacts emanating from 62 proposed projects. It took project development plans from four different government agencies and mapped all proposed short-and-medium term proposals for the first time. The output of this work was a set of easy-to-interpret maps that enables decision-makers to understand the relative ecological and socio-economic sensitivity of different river and tributary stretches.

The outcomes of an SEA process lie in the way it influences decision-making. The SEA study resulted in a number of important outcomes. First, it is worth noting that the maps produced during the study were of significant value. The two main maps that superimposed cumulative impact zones onto environmentally and social sensitive river/stream segments were used as the focus for discussions with public officials in AJK, who often do not have enough time to read long, technical reports. At consultation meetings with government officials, the maps engendered spirited engagement that clearly led to real organisation learning. Second, the original plan for the SEA allowed for a limited programme of public participation. However, due to the delicate security situation in AJK, it was not possible to undertake anything like a comprehensive consultation programme. Instead, the consulting team produced a detailed “stakeholder mapping” exercise which at least pointed to the interests and values held by different groups.

Finally, the impact of an SEA process can be measured by examining its direct implications, in terms of improved overall planning and capacity. Possibly the most significant impact was the formation of an AJK Hydropower Coordination Committee, which brought the four different HPP proponents together for the first time and led to the development of a coordinated hydropower plan. For the first time, it is now possible for government officials to think holistically about the planning of specific projects across river basins in the State. Zones that are most sensitive may require a great focus from proponents during EIA study. In addition, regulators may now be able to encourage proponents to plan their projects in a synergistic fashion.

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About the author

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Ranganadi Dam
Arunachal Pradesh
India

3 SEA FOR HYDROPOWER DEVELOPMENT PLANNING IN ALAKNANDA AND BHAGIRATHI BASINS, UTTARAKHAND STATE

INDIA

Asha Rajvanshi

Authorities	Planning agency of Uttarakhand State
Type of plan	Energy / hydropower development plan Uttarakhand State
Scope of SEA	All HPPs in two river basins in Uttarakhand State (~40% State hydropower potential)
Key SEA issues	Assessment of four scenarios of developing HPPs ranging from min. 2,308 to max 10,685 MW, based on cumulative assessment of ecological impacts and power production
Stakeholder engagement	Informing relevant authorities; MoEFCC, National Ganga River Basin, Planning agency of Uttarakhand; hydro development agencies, conservation community and religious leaders
Duration and year	12 months; 2013 - 2014
Influence of SEA	• Of the 39 planned HPPs (6001 MW) in total 24 of the ecologically most sensitive HPPs are stopped (2611 MW). • Environmental flow secured for sensitive sections of the river basin. • Policy adopted; E-flow for river basins (2018)
Link to SEA report	https://www.researchgate.net/publication/324471805_Assessment_of_Cumulative_Impacts_of_Hydroelectric_Projects_on_Aquatic_and_Terrestrial_Biodiversity_in_Alaknanada_and_Bhagirathi_Basins_Uttarakhand

3.1 INTRODUCTION

Energy Plan of the State of Uttarakhand

Himalaya, also known as the water tower of the earth (Valdiya, 1997; Bandhopadhya, 2013), provides water to a larger part of the Indian subcontinent. The State of Uttarakhand with 8.5 million inhabitants is one of the smaller states that form a part of the Indian Himalaya Region. This state uniquely endowed with glaciers and rain-fed monsoonal rivers, has a combined hydropower potential of 27,189 Megawatt (MW) in all the six river basins that include Alaknanda, Bhagirathi, Ganga sub-basin, Ramganga, Sharda and Yamuna (SANDRP, 2013). Against this projected potential, only about 3,598 MW equalling to about 14% has been utilized so far from all basins including in Alaknanda and Bhagirathi basins (Table 1). Since hydropower is one of the most important strategic assets of the state for the development of the economy (World Bank, 2011), the energy plans of the state are being developed to ensure that the State of Uttarakhand ultimately becomes the future energy state of India (Joshi, 2007). Based on the current energy plan of the state, as many as 70 hydropower projects are to be concentrated in Alaknanda and Bhagirathi river basins to utilise the combined hydropower potential of over 10,000 MW of these two basins. Among the various allotted hydropower projects in these two basins, 17 are commissioned

Table.1 Hydropower utilisation (MW) in Uttarakhand State

River basins Uttarakhand	Commissioned projects	Projects under construction	Projects planned	**Total Hydropower potential**
Alaknanda and Bhagirathi river basins	2,398	2,376	6,001	**10,775**
Other river basins	1,191	2,0	15,619	**16,812**
Total	**3,589**	**2,378.**	**21,620**	**27,587**

Figure 1. Hydropower projects in Alaknanda and Bhagirathi Basins within Uttarakhand state of India (Source Rajvanshi et al, 2012)

hydropower projects with total installed capacity of 2,308 MW; 14 projects of 2,376 MW capacity are in the advanced stage of construction and 39 projects with installed capacity of 6,001 MW are proposed for construction in future (Figure 1).

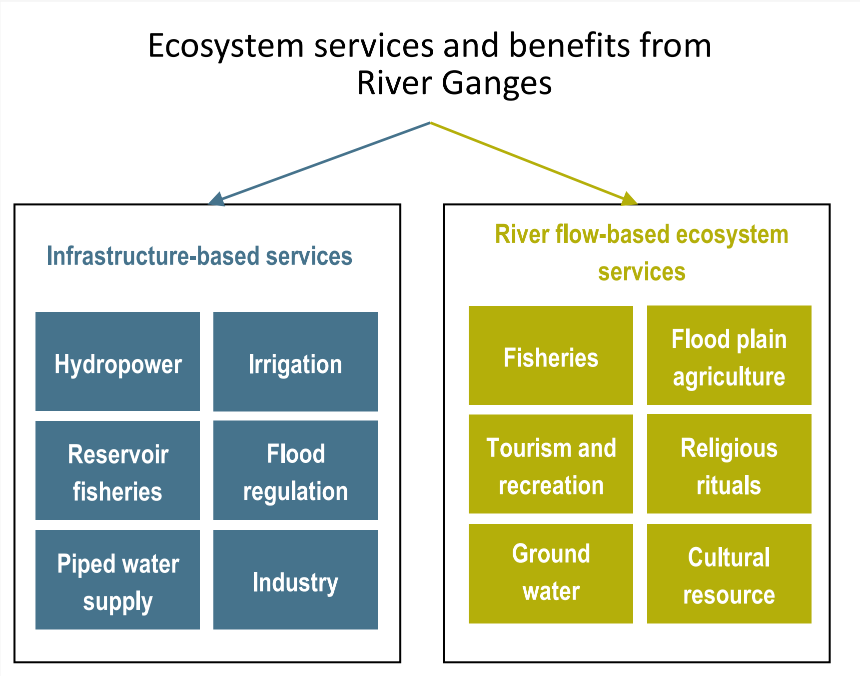
Environmental concerns associated with the implementation of the energy plan

These projects are planned on the two major headstreams, Bhagirathi and Alaknanda of the River Ganges. The River Ganges has not only been the cradle of the Indian civilisation but has commanded a great spiritual, cultural, economic and symbolic significance in Hinduism since times immemorial. It is revered as a Goddess, life giving and life sustaining succour for the environment, ecology and socio-economic wellbeing of the people of India. A large number of pilgrims assemble on the banks of the river and ponds to take holy dips (Kumar, 2009). For this purpose, certain minimum depths of flow and good water quality must be maintained, particularly during the lean season. Flowing through five major states of the country, (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal) and due to the perennial nature of the river, the riverbanks have become locus points for many major cities, agriculture, intensive industries, leather tanneries and religious tourism. The Ganges is truly a lifeline of over 40% population of India because of the wide range of ecosystem services and benefits it provides see figure 2.

Concerns about the hydropower projects in the upper reaches of the Ganges have increased because of their future anticipated impacts that may threaten the status of the entire Ganges river system. This issue has become more serious given the listing of the Ganges among the world’s ten most endangered rivers at risk based on the WWF’S global study (Wong et al. 2007). Furthermore, the dam-induced impacts of a reduced flow of the river would have major implications of its use for cultural and religious purposes by a large section of society.

From the biodiversity standpoint, Alaknanda and Bhagirathi Basins support rich biodiversity, both

Figure 2. Key ecosystems services and benefits of the River Ganges for people of India



terrestrial and aquatic. Over 35 mammal, 350 bird and 1000 plant species have been reported in the sub-basins. Out of these, five species of mammals and five of birds, as well as 55 plant species are Rare, Endangered or Threatened (RET). The forest types of these basins include Himalayan subtropical scrub at lower elevations, temperate broad-leaved forests in the middle elevations to subalpine oak and conifer forests at 'tree line' at the higher elevations. The courses of Bhagirathi and Alaknanda support several forest formations that are typically riverine in nature. These riparian areas play a critical role as corridors and migration pathways for several RET species of fauna including the Himalayan brown bear, Asiatic black bear, snow leopard, common leopard, Himalayan musk deer, Himalayan tahr, blue sheep and serow (Rajvanshi et al, 2012).

Of the 76 fish species found in the Alaknanda-Bhagirathi basins, threatened species including golden mahseer and snow trout, breed in this landscape and require the riverine habitats as well as the floodplains for their breeding.

Concerns are associated with land clearing and water withdrawals for meeting the state's energy and irrigation demands that may cause decimation of forested areas, alterations of river systems and receding wildlife habitats. These changes may ultimately become compounding factors for threatening resources that sustain biodiversity and socio-economic well-being of the people.

The State Government of Uttarakhand submitted proposals to the federal nodal agency, Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, to grant environmental and forestry clearances for construction of various hydropower projects. The MoEFCC assigned to Wildlife Institute of India (WII) the task of executing environmental assessment studies of all the proposed projects to support informed decision making.

Focus of this case study

The conjunctive and competing uses of water resources of the Ganges are varied and involve use by a wide range of stakeholders. The conflicting goals of maximising water withdrawal (for meeting the demands for industries, irrigation, harnessing energy) and at the same time, maintaining the continuity of the river flow for conserving biodiversity and sustaining the cultural and religious services for people, pose a major challenge for managing the sustained use of the water resources of the Ganges. The challenges of maintaining the environmental flow become further compounded by the imbalance between water demand and seasonal availability. More than 80 % of the annual flow in the River Ganges occurs during the 4 monsoon months (June, July, August and September), resulting in widespread flooding. During the rest of the year, irrigation and power generation potential, and ecosystem services are affected because of water scarcity. The lean season flows can become significantly affected by the hydropower projects in the upper reaches of the Ganges[6]

The impact assessment study was premised on the assumption that the changes in the length of two free-

[6] According to the Brisbane Declaration (2007, p. 1), "environmental flows (EFs/e-flows) are the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and wellbeing that depend on these ecosystems"

flowing headstreams of the Ganges and the direct loss of terrestrial habitats would be the key factors leading to the aggregated impacts of multiple dams planned on Alaknanda and Bhagirathi rivers. These direct impacts may result in compounding effects on a range of receptors including- aquatic and terrestrial species and on the flow of ecosystem benefits for the range of stakeholders.

The aims of the impact assessment study were identified as follows:

- safeguard priority areas for conservation of terrestrial and aquatic biodiversity in the two basins;
- provide a 'risk forecast' of dams-induced changes in environmental flows at the basin level that may impair the longitudinal connectivity of riverine ecosystems supporting rare and endangered fish fauna;
- prioritise to what degree the aquatic and terrestrial biodiversity values and habitats should be protected and what ecosystem services would have to be maintained in the event all developments proceed as proposed in the state energy plan.

Therefore, four different scenarios depicting changes associated with different scales of hydropower development were generated. These scenarios helped capture the distinctions in the range of impacts on the river flow and biodiversity elements associated with different scales of development for decision-makers to identify. As a result, alternative energy plans were reviewed to identify that plan that can best help in aligning the goals of energy planning with those goals of biodiversity conservation and societal welfare.

This impact assessment study commands significant merit as the country's first-ever assessment of cumulative impacts of developments at a river basin level. It highlights 'the acceptable limits of change' for making strategic level decisions to regulate and realign actions associated with future developments that are part of the state energy plan.

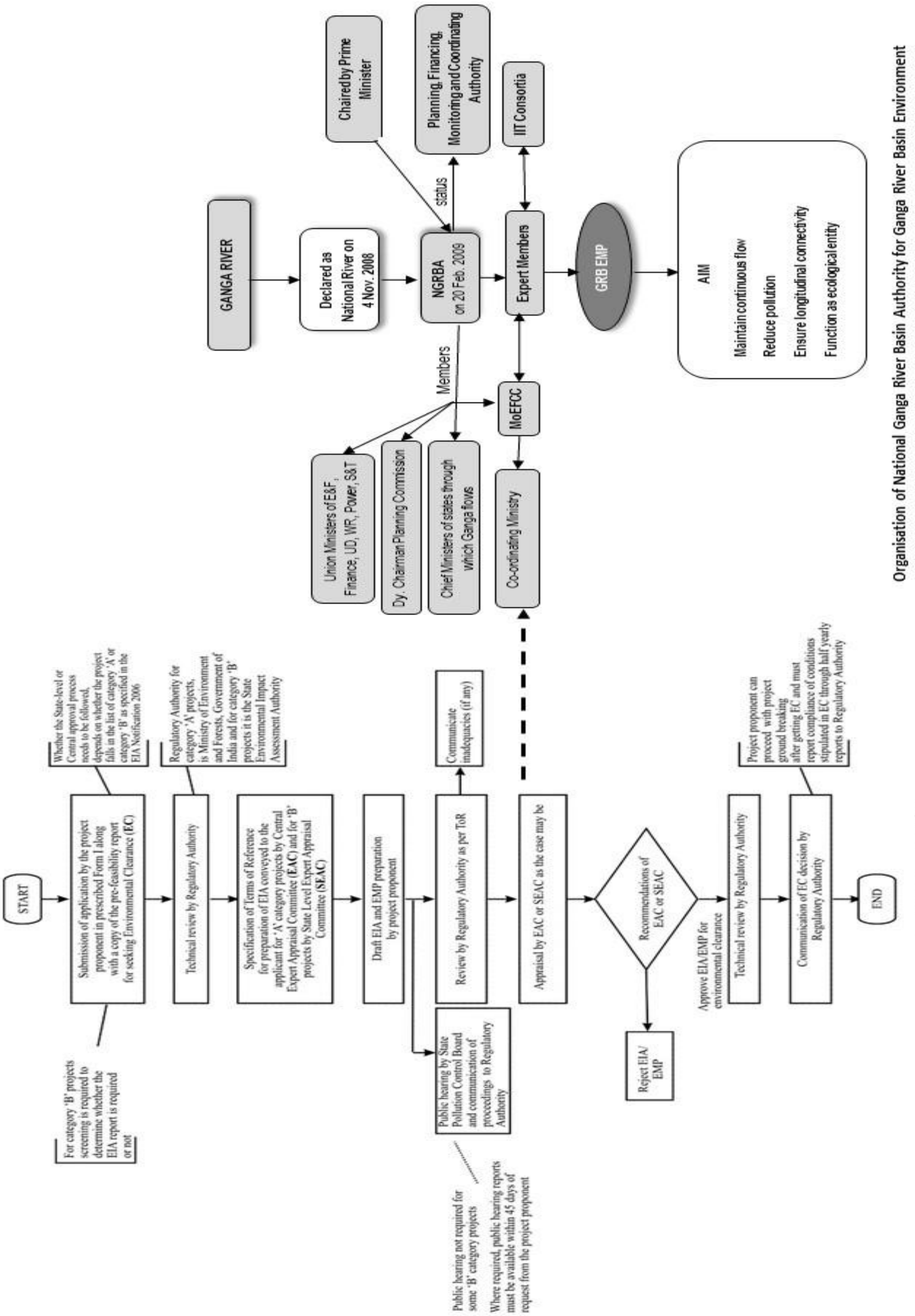
3.2 Background: Context and Issues

Governance situation; social and environmental setting

Triggered by the declaration of the River Ganges as a national river on 4 November 2008, the National Ganga River Basin Authority (NGBA) was constituted as empowered planning, financing, monitoring and coordinating body in 2009 to adopt a river basin approach for managing the environmental sustainability of the river. This apex level authority is chaired by the Prime Minister of India and has members represented by Union Ministers of 6 key ministries (Environment, Forest and Climate Change; Power; Finance; Water resources; Urban Development and Science and Technology) and the Chief Ministers 2016, this Authority renamed as National Council for River Ganga (Figure 3) has among other things, the overall responsibility for the superintendence of pollution prevention and rejuvenation of the River Ganga Basin.

India also has a well laid down legal and an institutional framework (MoEFCC, 1994; 2006) for conducting environmental impact assessment (EIA) of all individual projects. The Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, is the nodal agency for grant of Environmental Clearance for all major projects defined under Category 'A' of the EIA Notification (MoEFCC, 2006). These two independent governance systems for decision-making and planning of development projects in general, and environmental management of the Ganga River Basin together established the clear need for conducting the environmental assessment of all 70 dams in different phase of development on the two headstreams of the Ganges in Uttarakhand.

Figure 3. Governance systems for decsion-making related to dams in Ganga basin, India



Apart from these regulatory bodies, governance system at the central and state levels and judiciary plays an important role in overseeing the implementation of constitutional provisions and procedures.

Nature of SEA, scope and influence

The timing of the study (ex-post and ex- ante), its scope to capture basin-wide impacts and the objectives to guide strategic planning of developments envisaged under the state's energy plan imposed the need to adopt an innovative and hybrid approach for this assessment.

The existing EIA process as defined under the legislative framework could not be applied to the series of projects planned on the upper reaches of the Ganges, as this would have failed in capturing the impacts of multiple dams that are invariably more complex and greater than the simple sum of their direct impacts. The project level EIAs would not have unscrambled the more specific impacts of multiple projects or those resulting from other indirect perturbations in a landscape (e.g. fragmentation of wildlife habitats or alteration of river morphology and longitudinal connectivity). The fact that some of the projects have already been commissioned, while others are in advanced stages of construction and more are planned in future, limited the scope for subjecting the partially implemented plan to an ex-ante Strategic Environmental Assessment.

A hybrid approach was therefore adopted consisting of Cumulative Environmental Impact Assessment (CEIA) and SEA. This involved a basin-wide assessment employing central properties of CEIA for determining incremental, spatial and temporal dimensions of impacts of past, present and future hydropower developments on terrestrial and aquatic biodiversity values. The results of CEIA/SEA can contribute to planning of energy projects in locations within the basin that are least disruptive to key ecological processes and operating them in ways that protect biodiversity and maintain key ecological services. CEIA/SEA can sign-post the requirements for more project specific EIA resulting in 'green decisions' which are more environmentally sustainable and more favourable for biodiversity conservation. This approach (Figure 4), therefore had significant departures from traditional approaches and also from the provisions under national legislations.

The approach adopted was also in sync with hybrid approaches to stream the benefits of SEA in other regions of Asia (Victor and Agamuthu, 2014). Bragagnolo and Geneletti, 2012 have also demonstrated SEA supporting better management of cumulative effects arising from local-level spatial planning decisions.

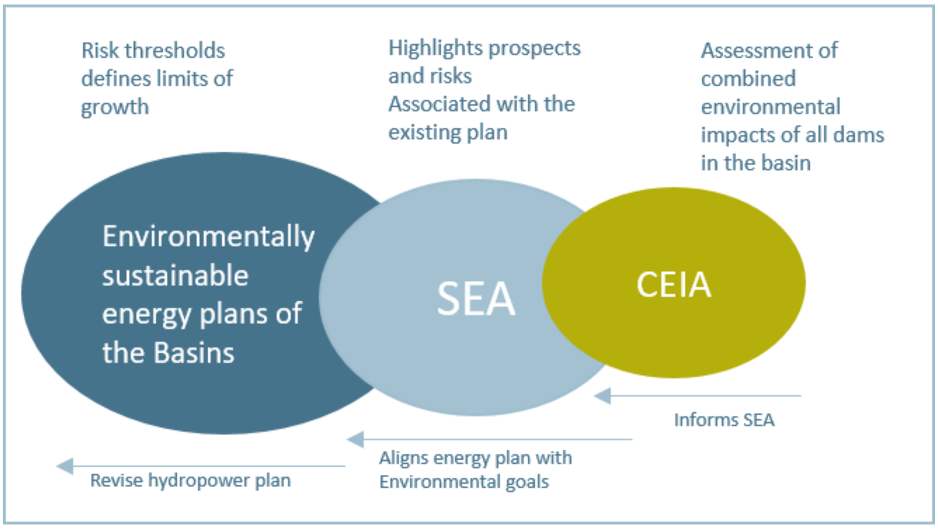
3.3 APPROACH AND METHODS USED

Selection of issues and indicators

A total of 18 sub-basins were delineated within the study area for assessing the cumulative impacts of all dams on targeted receptors. These include several RET species of mammals, birds and plants that have flagship values and keystone effects and are highly sensitive to changes in the habitat and intensity of disturbance in their habitats. Similarly, RET species of fishes were included to represent the aquatic system.

Scores were generated to reflect the relative biodiversity values of the sub-basin based on criteria such as richness and rarity of species that are well recognised for evaluating the significance of natural areas for conservation (Smith and Theberge, 1986). These scores were then converted into percentages

Figure 4. CEIA aided SEA approach adopted for the study



based on proportion of total RET species in the basin that were found in each of the sub-basins. This resulted in characterisation of biodiversity values as low, medium, high and very high.

Growing awareness of the relevance of flow regimes as a key factor shaping the ecology of rivers (Sparks 1995; Ward et al, 1999; Bunn and Arthington, 2002; Poff and Zimmerman 2010) and importance of natural riparian zones as important corridors for movements of animals in natural landscapes (Forman and Godron 1986; Malanson 1993) aided in the selection of stress indicators. Profiling of the impact on biodiversity values considered the following two most relevant and well-recognised criteria for evaluating stress factors:

I. River length affected (river dryness and submergence): The length of river that would be deprived of water because of the diversion through head/tailrace tunnel and the area lost to submergence.
II. Forest area loss: The location, extent and nature of forest area cleared and submerged due to hydroelectric projects construction and operation.

The scores were given for each of the two criteria (river length affected, forest land diverted for clearing and submergence) as the determinants of the changes in habitat size and quality and impacts of river flow on aquatic and terrestrial biodiversity at the sub-basin levels in each basin.

Impact analysis

The CEIA/SEA provided the context for a systematic examination of development choices for decisions based on the review of plan alternatives. Four scenarios were developed (Fig. 5) to explore various trajectories of change that may lead to a broadening range of plausible alternatives for securing and safeguarding priority biodiversity values.

- Scenario 1 (N=17): Exclusive impacts of only commissioned projects (N=17) to assess their influence on the true biodiversity baseline of the basins in the 'no dam' scenario.
- Scenario 2 (N=31): Assessment of the combined impacts of all commissioned projects (N=17) and those under different stages of construction (N = 14) on biodiversity values.
- Scenario 3 (N=70): Evaluating the cumulative effects of all projects including commissioned projects (N=17) those under progressive stages of construction (N=14) and those that are still in the form of proposals for consideration (N=39).
- Scenario 4 (N=39): Presenting the incremental impacts of the proposed projects by targeting only the proposed projects.

These scenarios provided a clear visualisation of the impacts based on inclusion and exclusion of past, present and future projects to profile impacts on biodiversity of the two basins. These scenarios highlighted the significant overlap in the spatial expansion of the critically important habitats of terrestrial and aquatic biodiversity with locations of existing and proposed hydropower projects in Alaknanda and Bhagirathi Basins.

Of the 39 planned projects (scenario 4), 24 planned projects have the potential to impact areas with high biodiversity values (both aquatic and terrestrial) and critically important habitats for RET (rare, endangered or threatened) and IWPA (Indian Wildlife Protection Act) protected species in different sub-basins in the two larger landscape units, the Alaknanda and Bhagirathi basins. One of the sub-basins harbours areas of outstanding universal values in the Nanda Devi UNESCO World Heritage Site.

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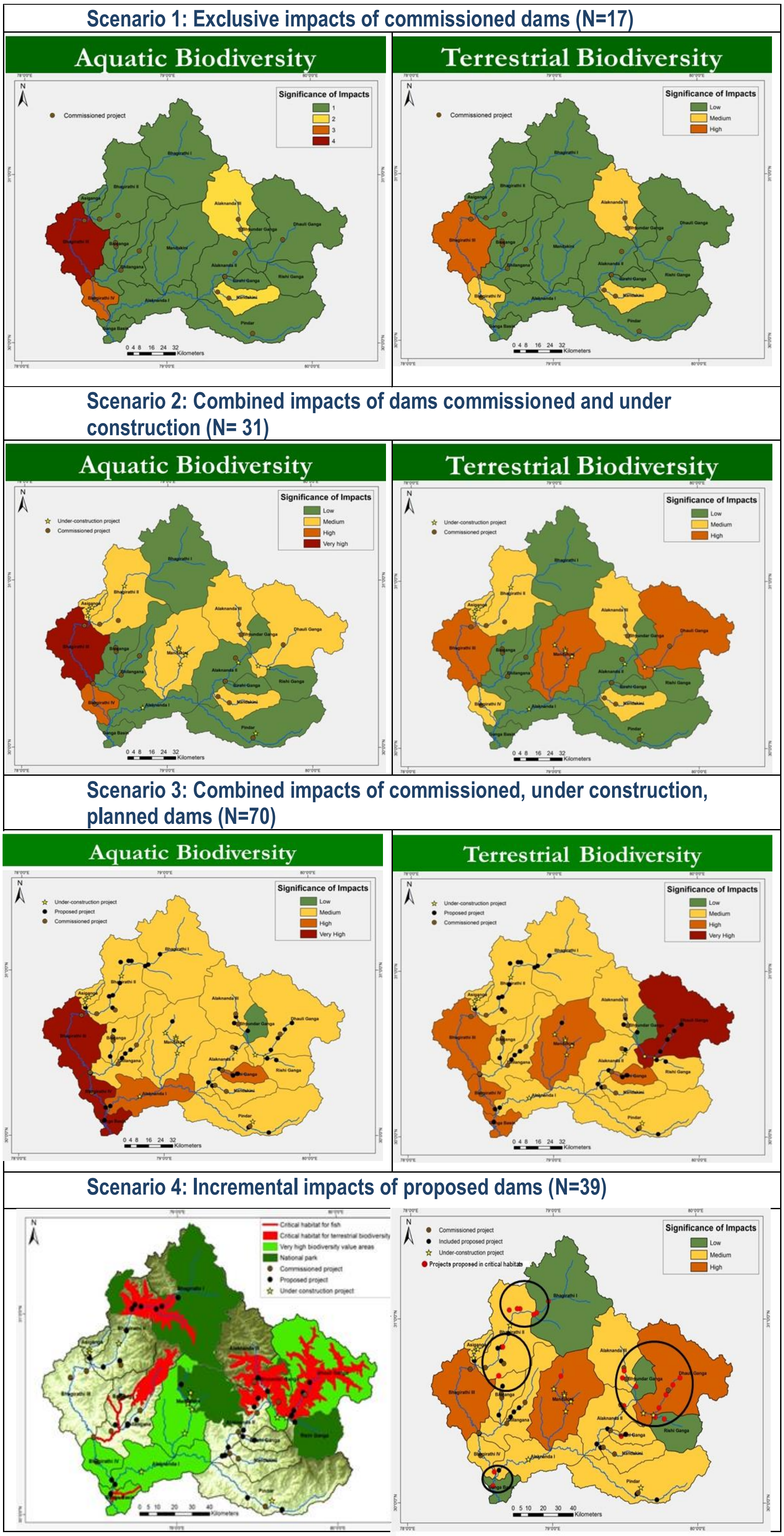
Figure 5. Four different scenarios to explore various trajectories of changes in impacts on biodiversity



SEA driven alternatives for energy planning

Based on the significance of existing and future impact potential of all dams, three alternatives for promoting development were presented for making decisions with respect to energy planning in the state. The analysis of scenarios provided the estimates of overall gains and losses for biodiversity and power production in the event of developments proceeding as planned or when regulated by proposing exclusion of some dams to optimise benefits for conservation and power development.

Figure 6. Alternatives for developments under the State Energy Plan

ALTERNATIVES ENERGY PLANS TO REVIEW THE SCALE OF IMPACTS		
Alternative 1 (= scenario 1) Proceed with commissioned projects only (N=17; 2308MW)	Alternative 2 (= scenario 2) Proceed with commissioned projects and those under construction (N=31; 4684 MW)	Alternative 3 Proceed with planned projects (N=15; 3390 M) ** Of the 39 projects planned (6001 MW – scenario 3 and 4) in total 24 projects are excluded (2611 MW)*
• Commissioned projects have already impacted the biodiversity • Prospects of conserving biodiversity likely to be further compromised by projects under construction Decline in population of Golden Mahaseer, an endangered fish in upstream stretches of Bhagirathi River has already occurred due to construction of a major reservoir based Tehri Dam	• 47% river stretch would be additionally affected by all projects under different phases of construction • 87% fish species would be affected by changes in the environmental flow of rivers already influenced by commissioned projects and by the development of dam in progress Diversion of 1700 ha of forest area for dams would lead to a loss of critical habitats of many RET species	• 37% reduction in river length would be affected • 21.71% decrease in the total forest land required (9494.68 ha) • 27% reduction in planned power generation capacity • Power deficit by improving the efficiency of existing projects can be effectively compensated Reduction in the transmission loss that currently accounts for 40% of total power generated could reduce the need for projects

Outcomes for decision-making

The projected changes in the reduction of the river flows in the different scenarios of dam construction yielded a hierarchy of more strategic decisions about river flow requirements and biodiversity issues linked to land diversion rather than a one-off decision based on piecemeal assessment that would have failed to consider the broader context of sustainable and equitable water allocation. The results of the simulation of the combined effects contributed to the following key strategic decisions in a transparent manner:

- Exclusion of 24 proposed projects (2611 MW) from the list of proposed future projects in Uttarakhand state's energy plan was recommended.
- The Government of India recognised the importance of protecting river ecosystems for conserving biodiversity through a shift in the existing water management policies (GoI, 2012) that were largely driven by concern of food security, livelihoods and economic growth. It was made implicit that such a shift in the policy for managing biodiversity would also help to maintain the cultural and religious services they provide for human well-being.
- A recommendation was made for retaining 21.8% of Mean Seasonal Runoff (MSR) in the golden mahseer and snow trout zones and 14.5 % of MSR for river stretches in the 'no fish zone'.

3.4 Results and Outcomes

Contribution to decision-making

These strategic decisions were documented and shared with MoEFCC, the key environmental regulator and with the National Ganga River Basin Authority (NGRBA). These SEA outcomes were also shared with a range of stakeholders including the hydro development agencies, Government of Uttarakhand as the planning agency, conservation community, and the religious leaders. The decision-making became more complex with developers aspiring to proceed as per the plan for harnessing energy; spiritual leader and conservation community bargaining for better management of environmental flows in the rivers and environmental regulators trying to achieve balance between conservation goals and economic benefits (Figure 7).

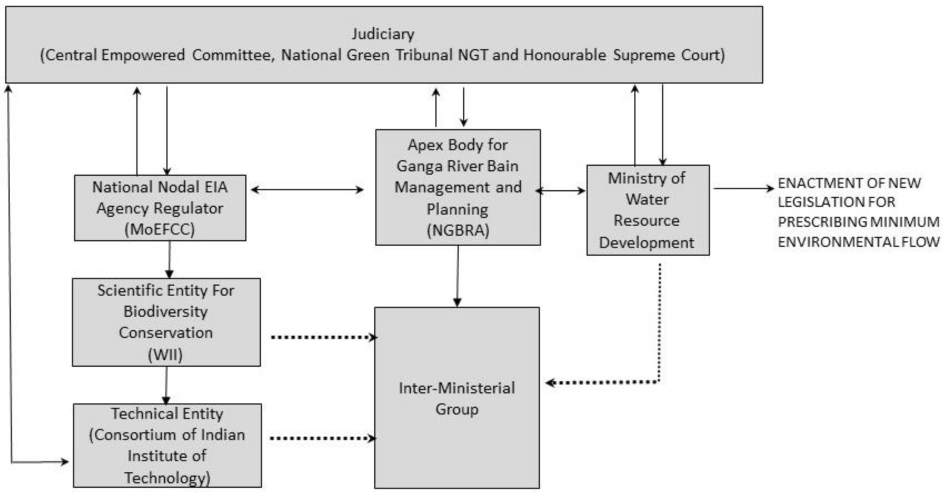


Figure 7. Complex Governance Mechanism for Decisions on Ganga River Valley Projects

Insufficient coordination among regulators and other key entities both laterally and vertically led to the delays in decisions favouring basin-wide management and planning of future hydropower developments in Uttarakhand. Consequently, the Central Empowered Committees (CEC) of the judicial regulator provided directives to the national level scientific and technological bodies (WII and Consortium of IITs) with support from the two governance systems to review the grant of moratoriums on future dams. The objectives of Hon'ble Supreme Court of India's directive were to review which future projects would significantly impact the ecologically sensitive habitats and impair the environmental flow regimes of the rivers especially during the lean season and how the technical and design consideration can improve the prospects for Ganga River Basin Management Planning (GRBMP) and for energy generation.

Contribution to policy and legislative reforms

While the dilemma and uncertainty delayed decision-making with respect to acceptable limits hydropower development, the outcomes of the scenario analysis already provided a strong argument for environmental flow considerations to be moved up in the decision hierarchy to policy and planning levels, if the concerns linked to changes in environmental flow are to be addressed at the project-level investments.

The Ministry of Water Resources, River Development and Ganga Rejuvenation (Government of India), which is represented on the NGRBA and the Inter-Ministerial Group responded to this urgency of moving environmental flow up in the decision hierarchy by enacting a new legislation (GoI, 2018) before the individual dams were approved for implementation as a part of the future programme. This notification stated 20%, 25% and 30% in the lean, non-monsoon and monsoon season respectively of e-flows are to be maintained in all the tributaries in the Upper Ganges Basin starting from the glaciers, finally meeting at Devprayag and in the main stem of the Ganges flowing through to the holy city of Haridwar. These stipulated e-flow levels are higher than those earlier recommended (AHEC, 20111; WWF, 2011) and also higher than the levels recommended in the CEIA study by WII (Rajvanshi et al. 2012). The GOI Notification (2018) also states:

"maintenance of uninterrupted flows along the entire length of the river would be ensured without altering the seasonal variations." The notification further states that "the existing projects, which currently do not meet the norms of these environmental flows, shall also have to comply and ensure that the requirements of stipulated environmental flow are met within a period of three years from the date of issue of this notification."

Major influence of outcomes

The e-flows notification provides the limits of the agreed environmental flows to be delivered through specific releases of water from the storages at the right times to mimic some of the natural patterns of flows. The regulation incorporates the larger policy provisions for maintaining the longitudinal connectivity and plan-level or project-level environmental flow.

With this recent regulation, India is among the few countries that are global leaders in developed (Australia, EU, and Florida in USA) and developing (South Africa and Tanzania) countries (Hirji and Davis, 2009) in integrating environmental flow provisions into their water resources policies.

This SEA study commands special interest because of the two key reforms that it could bring in influencing the decision-making at all levels from plans to the levels of individual projects. It created a strong ground for reorienting policies to upstream e-flow considerations in decisions on dams. The new legislation stepped up the decision-making process that was considerably delayed because of the conflicting interest of the key stakeholders. The new legislation could also directly influence the strategies to improve the energy plans at the basin level, which would finally influence the decision-making at the project level (Figure 8).

This case exemplifies that if hydropower planning is supported and driven by good governance and influenced by outcomes of appropriate assessments, development planning can be directed to deliver ecological, social and economic securities linked to power generation.

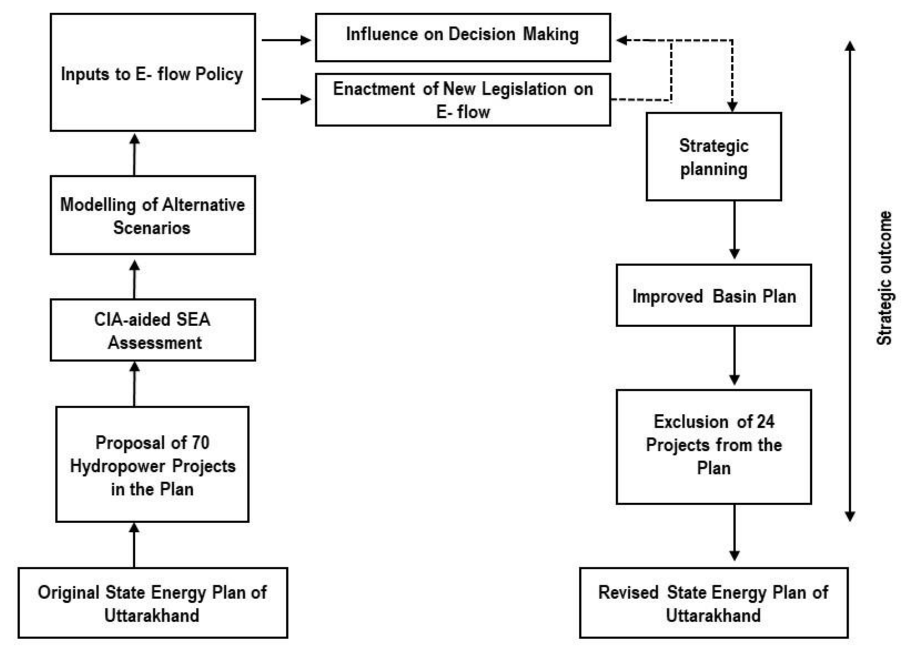


Figure 8. Hierarchy of outcomes influencing project-level planning

Another important insight gained from this case study is that India should proactively encourage SEA to become formally linked to the decision-making process rather than just serve as a voluntary conflict resolution tool. A well-designed institutional support and a major shift in policy is urgently needed to make SEA an effective approach for assisting with the implementation of policy and sector reforms that foster sustainable development.

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About the author

Asha Rajvanshi (PhD) has over three decades of professional standing as a teacher, trainer, EIA practitioner and the reviewer of EIAs on behalf of the federal Government of India. She has played the lead role in developing and encouraging mainstreaming tools for integrating biodiversity in impact assessment in India and the region. She has been also credited to promote Strategic Environmental Assessment (SEA); Cumulative Impact Assessment; sustainable land-use planning; Smart Green Infrastructure and mitigation planning for promoting wildlife friendly transportation projects. She has made significant contribution to Impact Assessment through her global level training initiatives, scholarly writings, academic mentoring of young researchers and publication of training manuals/best practice guides, which are being extensively used by students, researchers and IA practitioner's worldwide. She has created several knowledge products and learning platforms to promote EIA and SEA. Asha has provided professional support in EIA and SEA initiatives led by UNEP, the World Bank, IUCN, IAIA, CBD, GIZ, and ADB. She has served as one of the experts on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), for the Regional/sub-regional assessments on biodiversity and ecosystem services for Asia and Pacific region. She is presently also the member of the IPBES Task Force for Capacity Building and Scoping expert for biodiversity and business assessments. Asha is a recipient of the prestigious Lifetime Achievement Award from IAIA for the year 2019. asharajvanshi@gmail.com

Reservoir Nam Ngum 1 Dam
Lao

4 SEA FOR THE HYDROPOWER SECTOR
MYANMAR

Matthew Corbett & Kate Lazarus

Authorities	Ministry of Electricity and Energy and Ministry of Natural Resources and Environmental Conservation
Type of plan	National planning framework for HPP site selection
Scope of SEA	All HPPs >10MW in Myanmar
Key SEA issues	Categorising 69 planned HPPs (43,848 MW) in different stages of development, based on cumulative assessment of ecological and socio-economic impacts
Stakeholder engagement	Consultation with all identified stakeholders such as relevant authorities at national and regional level, representatives of local organisations, ethnic armed organizations, and affected communities
Duration and year	19 months; 2016 – 2018
Influence of SEA	• Myanmar is divided in three zones: low, moderate and high risk • CIA is carried out for optimisation and E&S risk management of cascade of HPPs
Link to SEA report	https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/hydro+advisory/resources/sea+of+the+hydropower+sector+in+myanmar+resources+page

4.1 INTRODUCTION

Myanmar, a country with substantial water resources, is considering how to best develop hydropower to help meet the country's large power supply shortfall whilst maintaining river basin process and values that support critical ecosystem services, underpinning the livelihoods of millions of people. Given that the hydropower sector is in the early stages of development, the opportunity exists to sustainably develop the industry by balancing energy generation with environmental and social outcomes.

Current hydropower planning in Myanmar follows conventional planning based on the assessment of individual projects as they are proposed. Early project site selection focuses on engineering and economic factors, with little if any consideration of cumulative environmental and social impacts on the river basin. This project-centric planning approach has resulted in significant cumulative basin impacts in other countries in the region that were not recognised until substantial degradation had resulted. In light of these planning limitations a strategic environmental assessment (SEA) was prepared to guide hydropower development at the basin scale over the next three decades and beyond, establishing a planning framework for project site selection that balances development with basin health.

The SEA was jointly prepared by the Ministry of Electricity and Energy (MOEE) and Ministry of Natural Resources and Environmental Conservation (MONREC), with the assistance of the International Finance Corporation (IFC) and its development partner, the Government of Australia.

Sustainable hydropower development recognises the interdependent processes, functions, and values of a basin and seeks to maintain basin health and ecosystem services, while developing hydropower to help meet the substantial energy needs of the population. This can be achieved by retaining high value intact tributaries while developing lower value rivers as "workhorse" watercourses. In basins and on rivers that are already highly regulated the adverse effect of adding additional projects may be far less than the impact of developing intact rivers. This pathway avoids dispersed projects being built on many tributaries with viable hydropower sites without due consideration of natural resource values.

The primary output of the SEA is the sustainable development framework (SDF) - a project siting tool that balances hydropower development with basin health by considering environmental and social factors at the basin scale prior to project site selection. The scope of the SEA covers all projects of 10 MW capacity or greater in Myanmar. The vision for development was set as:

Sustainable hydropower development based on integrated water, land and ecosystem planning, balancing a range of natural resource uses and priorities to achieve economic development, environmental sustainability and social equity.

This is supported by six objectives:

- maintain natural river basin processes and functions that regulate and maintain river health and ecosystem services;
- retain unique and important biophysical and cultural sites and values, as well as representative environmental values;
- avoid unacceptable social, livelihood and economic impacts;
- recognise, understand and avoid or manage conflict risks;
- provide development benefits to project affected people, communities and regions; and
- generate adequate, reliable and affordable hydropower energy for domestic consumption.

SEA planning was not tied to achieving a national target for installed hydropower capacity, but instead recognised the substantial number of proposed projects and assumed that medium and large-scale hydropower will play an important role in supplying affordable and reliable energy in Myanmar. Planning was responsive to the natural resource values of basins, letting these values guide sustainable development.

4.2 BACKGROUND: CONTEXT AND ISSUES

Myanmar has extensive, largely unregulated river systems that support a broad range of aquatic ecosystems and livelihoods. Most notably, two of the last remaining major intact[7] rivers in Southeast Asia flow through Myanmar: the Ayeyarwady and Thanlwin. An estimated 70% of Myanmar's 55 million population lives in rural areas, with many having a high dependency on riverine resources. Freshwater ecosystem services consist of: (i) Provisioning: fish production, irrigation, and domestic water supply; (ii) Regulating: flow regulation, water purification, natural hazard (flood) regulation, maintenance of coastal landforms, and marine nutrient supply; and (iii) Cultural: cultural landscapes, recreation, and tourism. But the health of river resources is under threat from hydropower development that has the potential to greatly expand over the next 2-3 decades.

Myanmar has a substantial power shortage, with only 40% of the population supplied - the lowest grid connected electrification rate in Southeast Asia (MOEE,2018). Rapidly growing electricity demand is estimated to rise at an average annual rate of 11 percent until 2030 and peak demand is expected to reach 12.6 GW by 2030 (WB, 2019). Investment is expected to require US$2 billion per year to meet the country's needs. The future national energy mix was prepared under the National Electricity Master Plan (NEMP) and covered conventional and renewable energy generation, indicating that hydropower is likely to play an important role in this mix. Medium and large-scale projects are capable of generating substantial renewable energy, while helping to stabilise the grid as intermittent power generation from other renewable sources such as solar and wind comes online.

[7] Rivers largely unaffected by human-made changes to its flow and connectivity. Water, silt, and other natural materials can move along unobstructed. Animals, such as river dolphins and migratory fish, can swim up and downstream at will. (WWF, 2020).

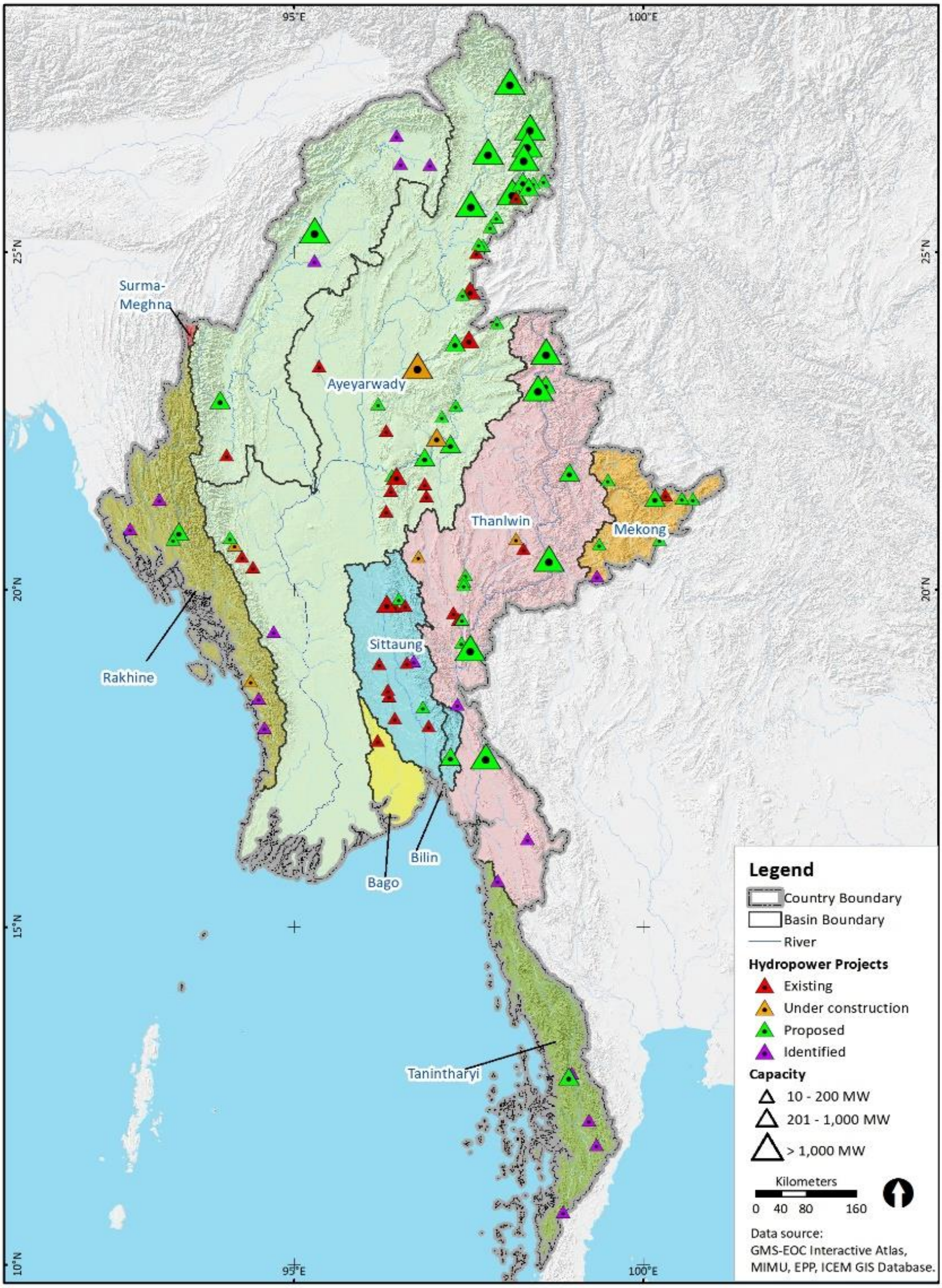


Figure 1: Status of hydropower development in Myanmar

Relatively limited hydropower development has occurred in Myanmar to date compared with estimates of potential total capacity. The total installed capacity of projects 10 MW and greater (29 projects – Figure 1) is 3,298 MW, accounting for 58% of national energy supply in early 2018. A further 1,564 MW capacity is under construction (6 projects), but several of these projects are stalled or taking far longer to complete than scheduled. Of these projects 80% has been developed in cascade arrangements, driven by load centre locations and limited transmission grid coverage, coupled with suitable sub-basin hydrology, topography and geology. The Ayeyarwady river basin accounts for 64% of total installed capacity, with the Sittaung river basin contributing 25%. This low overall level of development is partly a function of the country's political and economic isolation between 1988 and 2011, but now there is considerable international interest in the sector.

Sixty-nine projects are proposed, totalling 43,848 MW capacity (Table 1), with their stages of development ranging from initial identification through to various agreements in place with the government. Very large projects (>1,000 MW) account for 80% of proposed capacity, with most of these proposed on mainstem rivers.

Table 1: Proposed hydropower projects – by installed capacity (December 2018)

Project Capacity (MW)	Number of Projects	Total Capacity (MW)	% of Total Proposed MW
>2,000	6	25,100	57.3
1,000-2,000	7	10,060	22.9
500-1,000	5	3,020	6.9
100-500	28	4,823	11.0
10-100	23	845	1.9
Total	**69**	**43,848**	**100**

The current level of geographically restricted hydropower development presents a window of opportunity to sustainably develop the sector before dispersed, high impact projects are built.

Over the past decade public opposition to large projects has risen. Stakeholder objections have variously been attributed to insufficient project transparency and stakeholder engagement, the legacy issues of past projects, conflict affected areas and political shifts. Projects proposed on major rivers have received the most objections, leading the government to suspend the Myitsone, Tamanthi and Tanintharyi HPPs, totalling 7,800 MW capacity.

Hydropower planning in Myanmar has to contend with limited natural resource and socio-economic data on key themes (river hydrology, geomorphology, aquatic ecology, social and livelihoods), although some current river basin studies such as the Ayeyarwady Integrated River Basin Management Project (AIRBMP) are starting to fill some of the gaps (Hydro-Informatics Centre, 2017).

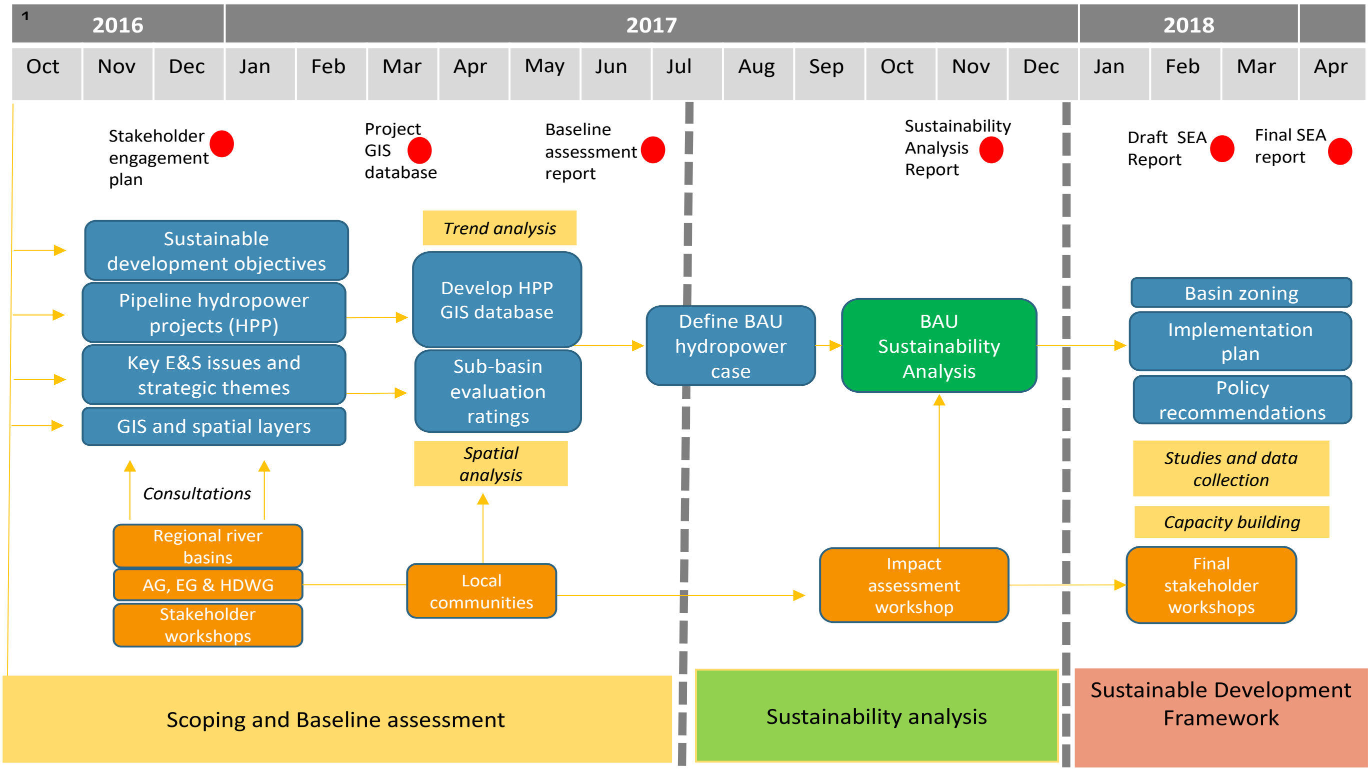
Box 1: The importance of basin health and fish production

Basin health is critical to maintaining freshwater and marine fish production, an important sector of the Myanmar economy. Changes to seasonal flows, water quality, and river geomorphology all degrade natural freshwater habitat. Outflows from Myanmar's major rivers into the sea provide nutrients for marine life and help maintain natural coastal processes essential to coastal fisheries production.

National fish production in 2014 was 5,048,000 metric tons, accounting for around 3% of the world's reported fish production. This consisted of 27.3% from inland fisheries, 53.5% from marine fisheries, and 19.1% from aquaculture. National fish production supports the livelihoods of an estimated 3.2 million people employed in the fisheries sector (800,000 full-time, 2.4 million part-time), and is the fourth largest contributor to Myanmar's GDP and source of foreign exchange earnings. Estimated average annual fish consumption per person is 30 kg.

Source: Fisheries Statistics 2014, Department of Fisheries Myanmar.

Figure 2: SEA methodology and outputs



4.3 Approach and Methods Used

SEA preparation involved six main activities (Figure 2):

- issue scoping;
- stakeholder engagement;
- management unit definition and hydropower GIS database preparation;
- evaluation of baseline environmental, social and conflict conditions and trends;
- hydropower business-as-usual (BAU) sustainability analysis;
- sustainable development framework (SDF) preparation

4.4 Issue Scoping

Stakeholder engagement with government, civil society organisations (CSOs), and hydropower companies were undertaken at the commencement of SEA preparation to canvass broad views on basin values, development, protection and management. Key environmental and socio-economic issues and concerns raised were analysed under seven strategic themes for analysis:

- hydropower;
- geomorphology and sediment transport;
- terrestrial biodiversity;
- fisheries, aquatic ecosystems, and river health;
- economic development and land use
- social and livelihoods;
- peace and conflict.

The main hydropower impact issues raised were: changes in water flow and water quality, sedimentation and riverbank erosion, flooding, deforestation, biodiversity loss, food security and nutrition (e.g. loss of agricultural land, riverbank gardens, orchards, and capture fisheries), loss of livelihoods, land grabbing, conflict, and social welfare issues (e.g. drugs and mental health). The benefits of hydropower were identified as: access to electricity, improved access to services (health, education, and transport), socio-economic development and higher living standards, opportunity for irrigation (multi-purpose projects), local employment, and opportunities to develop small and medium enterprises.

Stakeholder engagement

Stakeholder engagement was a core component of the SEA process, aiming to solicit the views and concerns of different stakeholders, whilst building broad awareness of existing and proposed hydropower development, basin values, likely cumulative BAU adverse impacts, and sustainable development principles.

An SEA Advisory Group and six technical Expert Groups were convened to guide the SEA, identify the best available information, review draft findings and help engender a commitment to the SEA vision. These groups consisted of local and international specialists covering different technical fields, from government agencies, non-governmental organisations, the private sector, development partners, multi-lateral agencies, academic institutions, ex-government officers and independent researchers.

A Stakeholder Engagement Plan was developed identifying key groups with an interest in hydropower development and river basin management and outlining consultation and communication activities. Stakeholders included Union and state/region governments, national and local CSOs, ethnic armed organisations (EAOs), political parties, local communities, the private sector, development partners, international and local NGOs, universities, multilateral development agencies, and banks. More than 55 stakeholder engagement events were held across Myanmar to capture views from as many states/regions where hydropower is planned as possible, commencing during issue scoping. The events involved:

- **Regional river-basin consultations**: workshops with civil society organisations (CSO) and state/region governments to identify basin environmental and social issues, carry out visioning exercises, and opportunities during scoping, and to review and provide feedback on draft SDF recommendations;
- **Multi-stakeholder workshops**: open to all stakeholders including representatives from Union and sub-national governments, international and local NGOs/CSOs, universities, and the private sector during all phases of the SEA;
- **Local community consultation**: key informant interviews and focus group discussions with villages affected by the Upper Paunglaung, Lower Yeywa, Bawgata, Shwe Gyin, and Baluchaung 1, 2 and 3 HPPs to validate actual village-level environmental and social impacts and broader concerns with sector developments;
- **Consultation with ethnic armed organisations (EAO) and political parties**: consultations with EAOs, political parties, and CSOs in Mytikyina, Taunggyi, and Kyauk in Myanmar as well as Mae Sot and Chiang Mai in Thailand as part of the conflict and peace assessment;
- **Discussions with the Hydropower Developers' Working Group (HDWG) cum Myanmar Hydropower Developers' Association (MHDA)**: presentations and discussions with hydropower companies and consultant firms working in the sector;
- **Information sessions**: presentations and discussions at a range of conferences and workshops starting from the development of the SEA Terms of Reference to reach broader audiences and garner additional inputs into the process;
- **Government briefings**: multiple briefings were provided to government Ministers and agencies from MOEE and MONREC, as well as to the Parliament and the National Economic Coordination Committee (NECC) during and following the completion of the SEA.
- **Training**: GIS training was provided to MOEE and MONREC to provide them all the data produced during the SEA and for these agencies to be able to use it in their assessments and decision-making, along with the formal reports.

Informal discussions were also held with numerous individuals and organisations to share information and receive inputs throughout the SEA preparation.

Management units and GIS database

Eight basins cover the entire country, consisting of six river basins (Ayeyarwady, Thanlwin, Mekong, Sittaung, Bago and Belin) and two coastal basins composed of small watersheds grouped together for analysis purposes (Tanintharyi and Rakhine) (Table 2). Two natural management units with related but discernibly different functions were defined within the basins: mainstem rivers and sub-basins.

Basin	Total Basin Area[a] (km^2)	Basin Area within Myanmar (%)	Basin Area in Other Countries (%)	Land Area of Myanmar (%)	Total Main River Length (km)	Number of Sub-Basins
Ayeyarwady	412,500	90.4	China – 5.4 India – 4.2	55.5	2,170	27
Thanlwin	283,335	45	China – 48 Thailand – 7	19.0	2,400	11
Mekong	824,000	2.7	China – 21 Lao PDR– 24 Thailand – 23 Cambodia – 20 Viet Nam – 8	3.3	3,469	4
Sittaung	34,913	100		5.2	450	3
Bago	10,261	100		1.5	220	1
Bilin	3,056	100		0.5	160	1
Tanintharyi	44,876	100		6.7	400	3
Rakhine	71,700	77	Bangladesh & India – 23	8.2	280	7

Table 2: River and coastal basins in Myanmar 2

Source: Basin areas taken from GIS HydroSHEDS/HYBAS LAKES data apart from the Thanlwin basin. Note: Barak sub-basin (792 km2) lies in the Surma-Meghna basin, outside Myanmar's eight main basins.

Mainstem rivers provide unimpeded system connectivity for flows, sediment, and aquatic ecosystems between sub-basins and the sea, maintaining essential basin processes and functions. Mainstem rivers were identified in five basins, defined as being a Strahler Order 4 or greater river and having an average annual flow rate of more than 1,000 m3/s (apart from the Sittaung mainstem with a lower discharge).

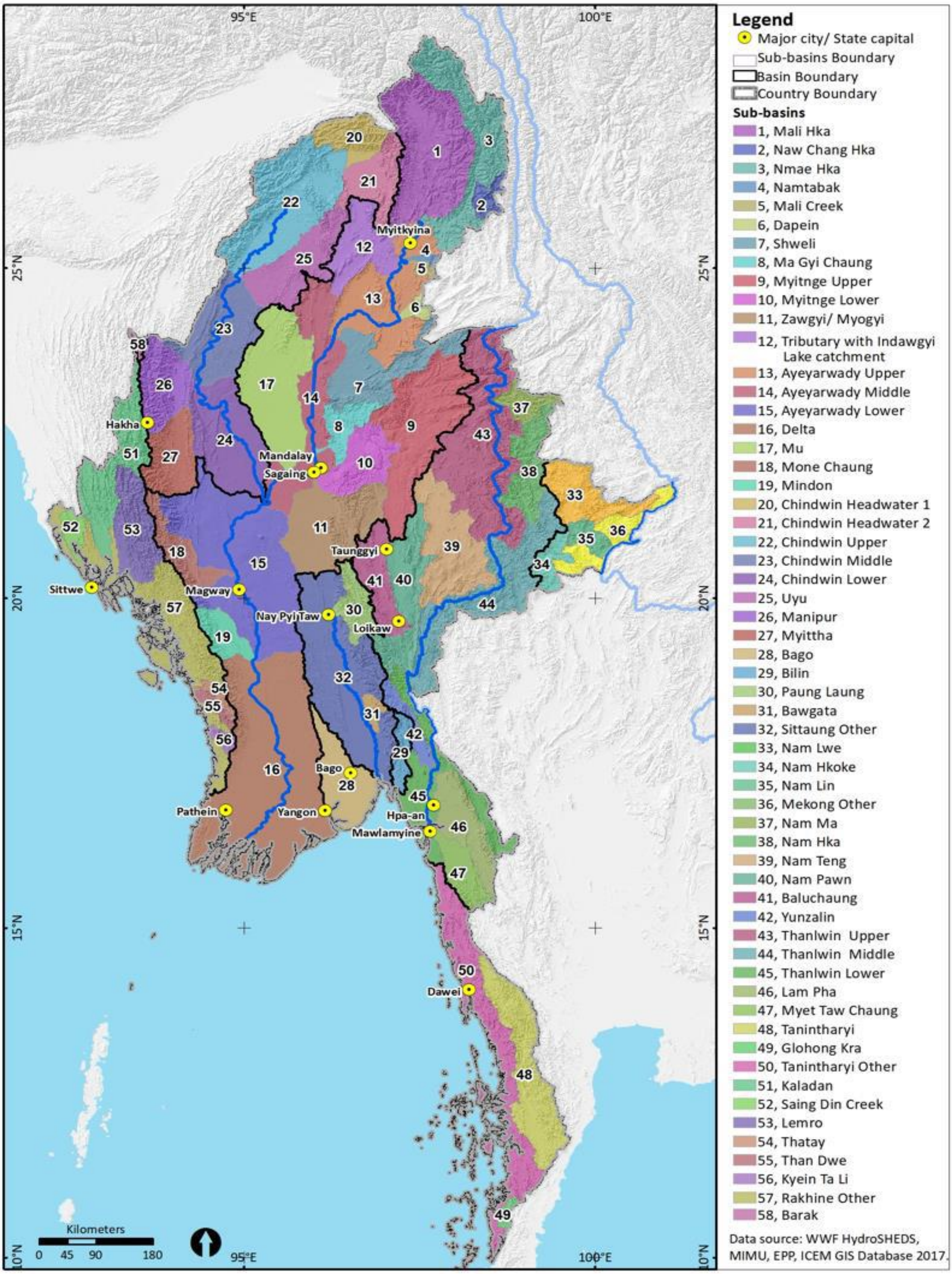
Sub-basins are discrete natural catchment areas that either drain directly into the mainstem river/main basin tributary or into the sea. They provide the primary land/water interface, where physical, chemical, and biological processes influence the ecological functioning of the basin. Fifty-eight sub-basins were identified using HydroSHED[8] levels (Figure 3). Most sub-basins (43) were selected using HydroSHED Level 6 boundaries, with the remaining sub-basins defined based on either Level 7, 8 or 9 drainage areas (especially where large hydropower projects or cascade projects exist or are planned), or combined to create sub-basins of a suitable area for strategic analysis.

A national GIS database of existing and proposed hydropower projects of 10 MW capacity and greater was prepared. The location of each project was plotted and key project information recorded on ownership and development status (developer, type of investment, stage of development, year the project is scheduled to be commissioned), baseline conditions (catchment area, rainfall, mean annual flow) and project technical details (installed capacity (MW), type of project (e.g. run-of-river, storage, multi-purpose), dam type and height, reservoir surface area and storage volume, average water retention time, powerhouse location, annual generation (GWh/year), use of power (domestic/export %)[9].

[8] Hydrological data and maps based on Shuttle Elevation Derivatives at multiple scales.

[9] The Hydropower Database. (at IFC). GIS shapefiles are available upon request to IFC.

Figure 3: Sub-basins.



Baseline conditions

Baseline conditions and trends were identified in each basin, covering:

- hydropower;
- geomorphology and sediment transport;
- terrestrial biodiversity;
- fisheries, aquatic ecology, and river health;
- economic development and land use;
- social and livelihoods;
- peace and conflict.

Sub-basin evaluation was then undertaken for five strategic themes that hydropower is either likely to affect or be affected by.

Conditions were evaluated using the best available information, including published research and spatial data, expert opinion, and stakeholder views. Directly relevant indicators for each theme were evaluated, or where such information was not available a proxy indicator was used:

i. geomorphology and hydrology – river connectivity and delta/coastline stability; potential sediment production; river flow;
ii. aquatic ecology and fisheries: river reach rarity (WWF, 2014); presence of endemic species, key biodiversity areas, Ramsar sites and important wetland areas, confluences, karst geology, presence of threatened fish and aquatic organisms;
iii. terrestrial biodiversity: percentage of protected area/key biodiversity area; percentage of intact forest (≥80% crown cover);
iv. social and livelihoods: social vulnerability; dependence on natural resources – indicated by % of 'own account workers as % of workforce' in townships within sub-basins (2014 township Census data); poverty - indicated by % of households owning a television (Census 2014);
v. conflict[10]: presence and status of ethnic armed groups; historical population displacement; recent conflict incidents and estimated battle deaths (2012-17).

Each of the five themes scored between 1-5 for each sub-basin by combining the scores for each evaluated criterion to provide an overall 'value' for that theme. A rating of 1 indicates a "low" value and 5 a "very high" value. Baseline information and theme scores were then summarised on sub-basin datasheets, with the scores for each sub-basin used to generate national theme maps illustrating the distribution of baseline values.

Business-as-usual basin sustainability analysis

The cumulative impact of BAU hydropower development on each basin's processes and values was assessed to identify the extent and significance of losses and degradation. Recognising these losses enables a sustainable development framework to be developed to avoid them, thereby maintaining basin health and ecosystem services.

BAU development was assumed to be the installation of the 69 proposed projects over the next 30 years, providing a 'best estimate' development scenario indicative of the scale and distribution of projects likely to be built. BAU development would result in the Ayeyarwady and Thanlwin basins having 28,000 MW (53%) and 21,000 MW (40%) of total national hydropower capacity respectively, with other six basins adding a further 3,134 MW capacity, ranging between 20-1,220 MW total capacity per basin. Mainstem development would consist of a single large project on the Ayeyarwady and Chindwin rivers, and five large projects on the Thanlwin River.

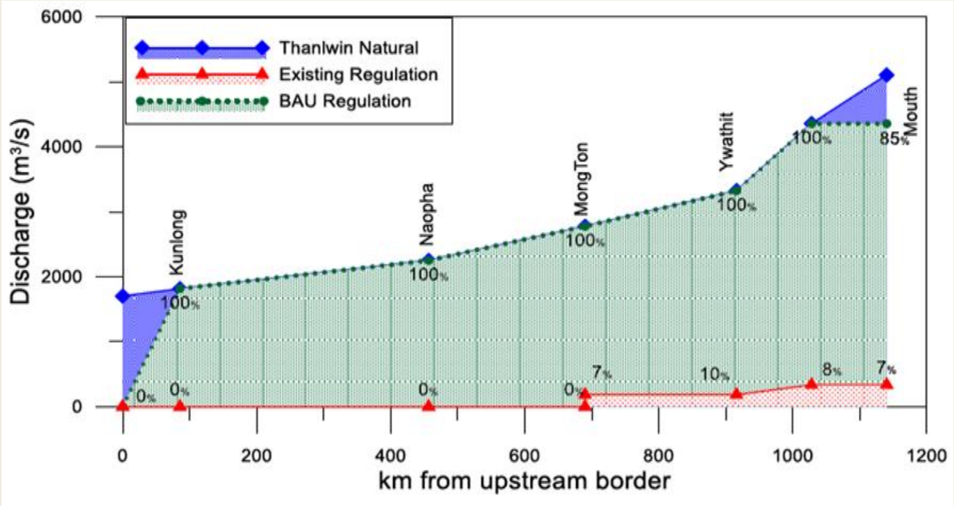
Key biophysical and socio-economic impacts from BAU development in each basin were evaluated using the same five themes and indicators assessed to determine baseline conditions. The analysis found that BAU development would triple the total catchment area regulated by hydropower within Myanmar from 14.4% at present to 45%, with most hill and mountain catchments fragmented, resulting in broad-scale biophysical changes to Myanmar's rivers and significant social impacts that are predicted to include:

- altered seasonal and daily river flows in most river basins - increased dry season flows and reduced wet season flows from storage projects, daily flow fluctuations from peaking generation, a delay in the onset of monsoonal river flows when large reservoirs refill, and a potential decrease in flood

[10] Link to the Baseline reports and sub-basin evaluation (at IFC)

flows. Figure 4 illustrates natural, existing and BAU Thanlwin River flows;

Figure 4: Thanlwin River average natural and regulated flows – by distance downstream of Myanmar-China border



- changes to water quality caused by the seasonal retention in reservoirs;
- reduced downstream sediment loads, altered sediment size distribution, and increased bank erosion resulting in changes to river and delta geomorphology;
- aquatic habitat fragmentation, with most dams and altered flow conditions preventing fish, larvae, and egg movement upstream and downstream;
- terrestrial habitat fragmentation and reduced biodiversity from the construction of reservoirs, roads and transmission lines, and potential illegal forest harvesting by the project workforce and camp followers;
- loss of riverine and terrestrial natural resources;
- large scale resettlement and the loss of livelihoods from reduced access to natural resources;
- exacerbation of conflict in some areas.

In the Ayeyarwady and Thanlwin basins, which combined cover three-quarters (74.5%) of the country, major irreversible basin-scale changes would occur to river flows and geomorphic and ecological processes and functions. Most significantly, large scale projects on the Ayeyarwady, Chindwin and Thanlwin mainstem rivers would cause substantial impacts on system connectivity and basin processes. For example, BAU development would raise the percentage of the Thanlwin basin within Myanmar that is longitudinally disconnected from the sea from 12.9% at present to 80.6%, while the Ayeyarwady would be raised from 16.1% to 38.6%.

Sustainable development framework

The 'sustainable development framework' (SDF) was prepared to balance the maintenance of critical basin processes and ecosystem services with the generation of reliable and affordable hydropower. The framework is based on Basin Zoning Plans that recommended areas for: (i) reservation from hydropower development due to high values, and (ii) potential development - lower value areas potentially suitable for hydropower development. The Plans identify mainstems and sub-basin management zones and controls for new hydropower projects.

Mainstem zoning defines the extent of each basin's mainstem recommended for reservation, where hydropower development and other major structural water resource developments (e.g. irrigation dams) are recommended to be excluded to maintain unimpeded mainstem connectivity with the sea. By leaving the mainstem intact, decisions on sub-basin utilisation can be made based on sub-basin values, uncompromised by the loss of downstream connectivity.

Mainstems recommended for reservation were identified in five basins based on their significant system connectivity value. These reaches total 4,100 km: Ayeyarwady (1,500 km), Chindwin (900 km), Thanlwin (1,200 km), Mekong (200 km) and Sittaung (300 km) rivers.

Sub-basin zoning (Figure 5) was defined by combining the scores for the three biophysical features evaluated in the assessment of baseline conditions: geomorphology and hydrology, aquatic ecology and fisheries, and terrestrial ecology. Socio-economic sub-basin scores were not applied as the level of detail available was considered a poor indicator of the value of features likely to be adversely affected by hydropower. Similarly, the status of armed conflict was also not applied to determine sub-basin zoning as conflict is dynamic and variable across a sub-basin. Instead, conflict zoning is applied as an additional screening layer for proposed projects by developers early in the project feasibility analysis to evaluate the related risks.

The scores for the three biophysical factors were totalled and scaled to determine one of three sub-basin zones (See Table 3 for zone distribution by basin):

Table 3: Zone distribution by basin

Basin	% of Myanmar Basin Area[1]		
	High	Medium	Low
Ayeyarwady	20.9	28.6	50.5
Thanlwin	15.9	57.9	26.2
Sittaung	-	82.2	17.8
Mekong	29.8	15.5	54.7
Bilin	-	-	100
Bago	-	-	100
Tanintharyi	97.8	2.2	-
Rakhine	24.6	66.8	8.6
Surma-Meghna	-	-	100
Total	**24.2**	**37.3**	**38.5**

- **high** - provides an important contribution to basin processes (such as high flows or a large sediment load), and/or has unique natural values for at least two biophysical factors;
- **medium** - no high conservation value features over a notable area for at least two biophysical factors, although may contain notable values for a single factor or pockets of such values for multiple factors;
- **low** - no high conservation value features over a notable area for any biophysical factor, although may contain pockets of high value.

Ten high zone sub-basins (see Table 4 for high zone sub-basin scores) with critical biophysical processes and values were defined, covering 24% of Myanmar. Hydropower development in these areas is recommended to be limited to smaller scale projects with low environmental and social risks that cumulatively will not unduly degrade the reserved values. Five of the high zone sub-basins form a contiguous block in the headwaters of the Ayeyarwady basin, covering 78,900 km2 (21% of the basin area within Myanmar), contributing an estimated 47% of total basin discharge and a substantial volume of sediment.

This area contains high value aquatic habitats and notable terrestrial ecosystems in Hkakaborazi National Park, four Wildlife Sanctuaries and numerous key biodiversity areas, containing 35% of all remaining intact forest (>80% crown cover) in Myanmar. Two other high zone sub-basins were defined in Tanintharyi basin, while one each is located in the Thanlwin, Mekong, and Rakhine basins.

Twenty-one medium zone and 27 low zone sub-basins were identified as being potentially suitable for hydropower development, covering 37% and 39% of Myanmar respectively. These sub-basins are recommended to be considered by government for potential hydropower development, subject to environmental and social impact assessment. Over time, as new data is obtained and projects are approved, it is recommended that the government consider trade-offs within this group of sub-basins to achieve a balance between developed and reserved catchments.

Table 4: High zone sub-basin scores

Basin	Sub-Basin	Geomorph. and Sediment	Aquatic Ecology	Terres-trial Ecology	Total Score
Ayeyarwady	Mali Hka	5	5	5	15
	N'mai Hka	5	4	5	14
	Chindwin Headwater 1	3	4	5	12
	Chindwin Headwater 2	2	5	5	12
	Chindwin Upper	5	3	4	12
Thanlwin	Thanlwin Middle	5	4	3	12
Mekong	Mekong Other	4	5	2	11
Tanintharyi	Tanintharyi	5	5	5	15
	Tanintharyi Other	5	3	4	12
Rakhine	Kaladan	5	4	2	11

The adoption of the basin zoning plans to site projects will achieve the underlying principle of sustainable development: maintain high value intact mainstems and sub-basins to drive basin health while permitting development in "workhorse" sub-basins, thus avoiding the construction of projects in many intact sub-basins. Developing projects in cascade arrangements versus dispersed projects can lower the overall magnitude of impact per unit of energy generated and increase power generation per unit of water regulated by running stored water through multiple powerhouses. The development of low and medium zone sub-basins, assuming all BAU projects are installed om the two zones, would raise the total Myanmar catchment area regulated by hydropower from 14.4% to 23.5%, considerably less than 45% that would be regulated under BAU.

A three-year implementation plan was proposed to support the introduction of sustainable hydropower, incorporating:

- the establishment of a joint government planning committee consisting of MOEE and MONREC;
- development of a national Sustainable Hydropower Policy;
- development of a Basin Zoning procedure for Government of Myanmar implementation;
- recommended sustainable project design criteria;
- recommended improvements to environmental and social impact assessment and management planning including inclusion of conflict assessments;
- enhanced stakeholder engagement; and
- critical baseline data collection and research.

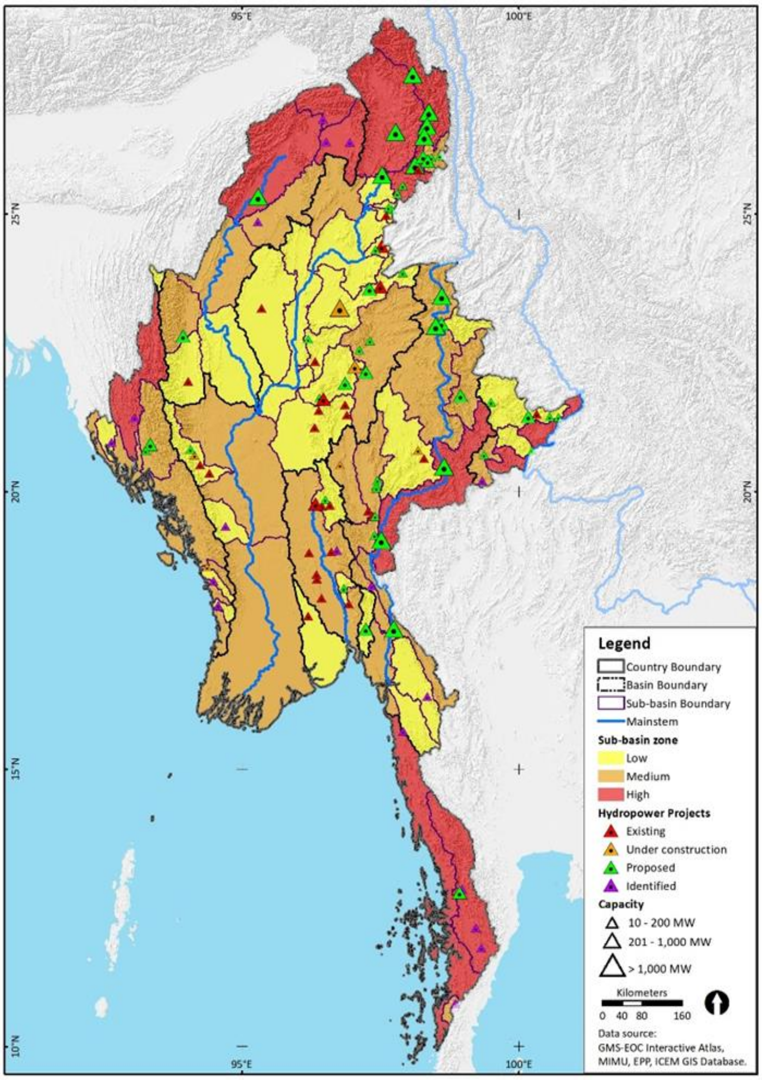
As a first edition plan, it is recommended that the framework be reviewed and revised three years after the commencement of implementation, based on new, more detailed information and implementation findings.

4.5 Results and outcomes

The SEA had the difficult role of defining a sustainable development pathway for hydropower: balancing hydropower development to support the power needs of Myanmar with the maintenance of river basin health, ecosystem services and the livelihoods they support. Through the SEA process the conversation about hydropower development has started to fundamentally shift, from a debate about the merits and localised impacts of individual projects to a more informed discussion about how best to achieve a balance between power generation and basin health into the future.

The SEA has promoted this shift by informing stakeholders about system complexity and interdependent processes. The divergent views of different stakeholder groups have been recognised, ranging from villagers who are focused on their traditional natural resources, to developers who are promoting projects. The project GIS identifies the location, type and main features of all existing and

Figure 5: Sub-basin zoning



proposed hydropower projects for the first time, allowing the extent of development to be clearly seen. The snapshot of baseline biophysical and socioeconomic conditions and threats at the sub-basin level across the entire country, as well as information on basin processes and ecosystem services, has brought to light each basin's resources and values. The assessment of the main cumulative impacts of BAU development sets out the previously unrecognised adverse basin impacts of conventional development on largely intact river systems. And importantly, the SEA provides a rationale planning tool for sustainable development and sets out clear actions required to support its implementation.

The SEA is being supported by the implementation of a program of actions to operationalise sustainable hydropower development, maintaining the planning momentum initiated by the SEA. These activities include further briefings to Ministers and government agencies, translating the SEA summary into six local and regional languages, providing SDF and GIS training to MONREC and MOEE staff, releasing data (GIS files) to the public to enable uptake by other agencies and researchers, and the cumulative impact assessment of cascade hydropower and other renewable energy options in the modified Myitnge sub-basin.

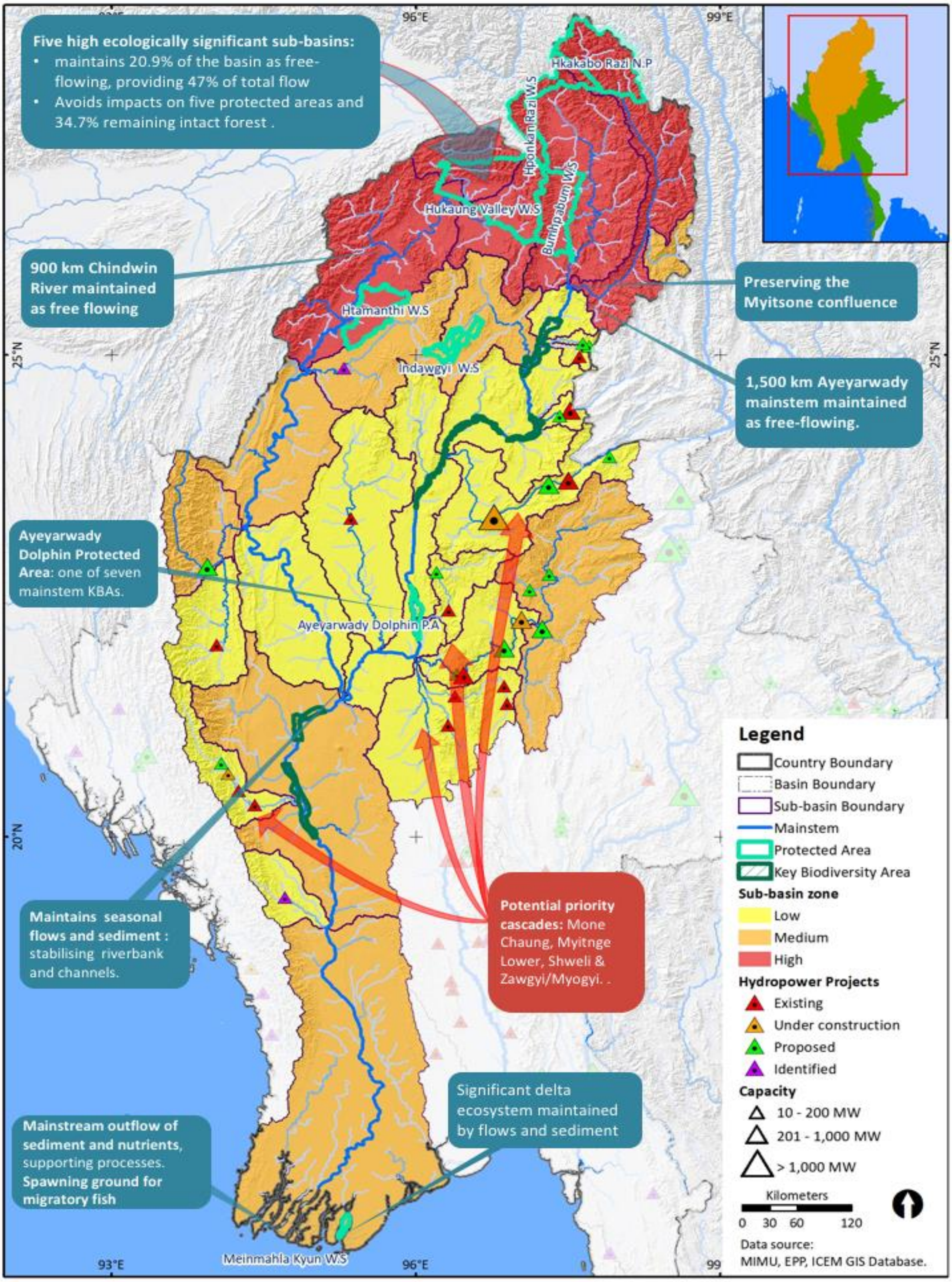
SEA basin-level planning will de-risk hydropower projects by identifying development risks early in the project development cycle and providing solid justification for project siting from a basin sustainability perspective, something that multi-lateral development banks are starting to place greater importance on. The likelihood of projects sited in accordance with the basin zoning plans attracting broad public opposition and subsequently stalling and not being granted planning approval should be greatly reduced. It also provides a first set of key information for prospective project proponents when they enter the country and consider investment in the sector.

In summary, implementation of the 'first edition' basin zoning plans, supported by project design guidelines, will move the hydropower sector to sustainable development before BAU development results in significant basin regulation and degradation. Decision-makers and developers have clear planning guidance on the appropriate siting of projects. The outcomes that this change in approach is expected to deliver are:

- the maintenance of healthy basins and the ecosystem services that they provide over the next 100 years and beyond;
- the initiation of meaningful stakeholder engagement during project development, thereby improving project design and increasing stakeholder acceptance of well-planned projects as well as greater recognition of legacy issues and conflict-affected areas;
- improved access to international financing by avoiding/reducing basin-wide cumulative impacts; and
- the establishment of substantial hydropower generation, providing affordable and reliable renewable energy that will drive local and national development.

By creating the nexus between hydropower development and natural resource protection, the SEA has shown that development and protection are both achievable through basin-level planning. Substantial hydropower generation can be delivered at a far lower 'cost' to natural resources, ecosystem services and river-dependent communities and businesses. The expected outcomes of sustainable hydropower development in the Ayeyarwady basin are illustrated in Figure 6.

Figure 6: Ayeyarwady Basin sustainability



4.6 Lessons learnt

An SEA is a great planning instrument to comprehend, assess and plan complex system-level natural resource and development issues. It has the capacity to combine a science-based assessment with an understanding of the often-conflicting values of multiple resource users and other stakeholders, to enable complexity to be understood and rationale long-term planning to be developed. This usually involves a trade-off between resource use and protection to develop a broadly acceptable plan to guide sustainable sector development.

Establishing the vision and objectives for the SEA early in the process is critical in developing a focused methodology and conveying its direction to stakeholders. The SEA methodology should be flexible, allowing it to be modified as planning progresses. This is particularly true where there is limited understanding of the conditions at the start, but even the best planned SEA will reveal unexpected conditions that have to be adapted to.

The SEA process is often as important as its findings as it initiates a conversation with stakeholders about future management options and outcomes, the first step in gaining stakeholder buy-in to the planning direction. To achieve this there is no substitute for extensive and transparent consultation with all stakeholder groups, involving the canvassing of views and informing stakeholders about the issues. A transparent process underpinned by ongoing communications and information disclosure is also important. For the hydropower SEA this involved developing an SEA website, releasing information via newsletters, engaging stakeholders through meetings/workshops/briefings, and translating information into multiple languages.

The hydropower SEA commenced with strong government support in the form of a tripartite agreement between the Myanmar power and environment Ministers, to establish joint decision-making and build a shared understanding. Stakeholder engagement also involved other government agencies, resource users, developers and NGOs. Divergent views were respected and considered during the SEA preparation. By demonstrating this, even when a different course is eventually taken, a greater understanding and degree of ownership of the planning is more likely. The use of an Advisory Group and Expert Groups made up of decision-makers, technical specialists and NGOs can be particularly useful, not only to canvass their views but also as a sounding board for evolving ideas.

An SEA often has to contend with limited baseline information, but it is far better to develop a 'first edition' plan, that acknowledges and works with these limitations rather than delaying planning that permits sub-optimal development to continue. An initial SEA also clearly identifies information gaps and the priority actions based on its analysis. The hydropower SEA was viewed as the 'first edition', to be periodically updated as implementation occurs and new information to keep pace with current conditions.

There are many approaches and methodologies for carrying out SEAs. The hydropower SEA provides insights into an approach based on limited data and extensive stakeholder engagement that was contextualised for Myanmar. It provides better understanding as to how this may be applied for other sectors or geographic areas in future.

In conclusion, SEA is valuable in supporting long term planning of the hydropower sector at country level providing clarity about risks of investment to all key stakeholders.

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Workshop on dams and indigenous rights Brazil

Construction of the Bujugali Dam Uganda

5 Mainstreaming Environment into Power Planning: SEA for the Power Development Plan VII

Viet Nam

Lothar Linde

Authorities	Ministry of Energy and Trade, Institute of Energy, Min. of Natural Resources and Environment, Prime Minister's office
Type of plan	National power development plan 2011-2020
Scope of SEA	National future energy supply
Key SEA issues	Assessment of alternatives concerning fuel mix, including hydropower
Stakeholder engagement	Consultation of private actors in the energy sector and all relevant authorities at national and provincial level
Duration and year	24 months; 2009 - 2011
Influence of SEA	• Most sustainable alternative is selected through a major cut in coalfired power generation (-22,000 MW) and a seven-fold increase in the amount of planned renewable energy, including hydropower • Policy adopted; Payment of ecosystems services included (2010)
Link to SEA report	https://gms-eoc.org/resources/two-seas-on-power-development-planning-in-viet-nam

5.1 Introduction

Power generation in Viet Nam currently relies on three main primary energy sources: hydropower, coal, and oil and gas. Electricity is distributed through a high voltage transmission line system running from the North to the South of Viet Nam.

The Viet Nam Power Development Plan VII provides a long-term strategic framework to guide the development of the power sector for the period 2011-2020. Guided by the 2006-2010 Socio-economic development plan (SEDP), the 2011-2015 SEDP, and the Viet Nam 2020 Vision, it analyses future economic and social development trends *(=economic growth scenarios)*, summarises related energy requirements *(=energy demand scenarios),* and evaluates the cost and benefits of a preferred supply option *(=power development scenario or "base case")*.

To date, Viet Nam has developed seven Power Development Plans. The geographic scope of the PDP is national and the temporal scope 10 years forward with an outlook for another 10 years. Revisions are usually done every 5 years, mainly focusing on reviewing which economic growth scenario has come true and if that has repercussions on the energy demand scenarios and supply choices previously selected and followed.

Focus of this case study

Strategic Environmental Assessments (SEA) for the PDP have been applied since the PDP VI (2006-2015), after SEA became a legal requirement in Viet Nam in 2005. At that time, the PDPs were not sufficiently developed in the following three areas:

- no systematic accounting of environmental and related social costs into cost-benefit analysis of thermal power plants (TPP), hydropower projects (HPP), and distribution infrastructure (transmission lines);
- focus on a narrow energy mix (fossil fuel, hydro) with limited consideration for other supply options (renewables – small hydro, wind, solar);
- little consideration of demand side management (DSM) options in energy demand and power development scenarios.

5.2 Background: context and issues

Governance situation; social and environmental setting

To ensure Viet Nam's energy security for the coming decades, the Power Development Plan has to respond to a wide range of national and sector strategies and their implications on power demand and development. The most important orientation for the PDP is the Socio-Economic Development Plan for the period 2011-2020 with 2030 vision. Growth trajectories in other key development sectors are studied to inform the PDP growth and energy demand scenarios, including urban plans, land use plans, industrial park development, Transport Development Strategy, tourism plans, conservation plans, Regional Multipurpose Water Resources Management Plans, etc. Lastly, the PDP needs to be aligned to the energy sectors' own strategies and sub-plans: a) the National Energy Development Strategy until 2020 with 2050 vision, b) the National Program for Energy Efficiency and Conservation, c) the Master Plan for the Development of the Coal Sector in Viet Nam until 2015 and vision to 2025, and d) the Master Plan for the Development of the Oil and Gas Industry until 2015 and direction to 2025.

Despite the countries size and diversity, a few common environmental and socio-demographic characteristics can be identified:

- Viet Nam's N-S coastline and the Red River and Mekong Delta are largely flat, dominated by agriculture, industry and urban development, and hold most of the countries' population. Consequently, the country's major energy demand falls into these areas, supplied by TPPs concentrated in the area (which are also there for short distances to import and distribution hubs for coal, oil and gas).
- Viet Nam's North and Centre region features large mountain ranges with much lower population density, infrastructure and productive assets, but a dominance of forest resources and environmental tourism sites. These areas not only focus on hydropower development and distribution into the coastal areas and deltas but are also critical for water supply and regulation for the downstream areas (agriculture, disaster protection).

For the purpose of baseline analysis, the PDP sub-divides the country into seven geographic regions with distinct (and distinctively different) environmental and socio-economic features and characteristics. These are: 1) North-West, 2) North-East, 3) Red River Delta, 4) North Centre and South-Central Coast, 5) Central Highlands, 6) South-East, 7) Mekong Delta. Comprehensive environmental and socio-demographic profiles were developed for each of these regions to identify and compare environmental and social issues.

Role of the SEA and how it is linked to the decision-making process

The requirement to conduct SEA in Viet Nam's strategic planning was included in the Law on Environmental Protection 2005 and reaffirmed in the law's update in 2014. That makes Viet Nam the first country in South-East Asia that has made SEA mandatory for over 15 years now.

While the legal requirement for SEA was in place since 2005, SEA implementation capacity was not. Systematic institutional capacity building on SEA did not start before it was becoming a legal requirement, leaving many government organisations struggling with fulfilling their SEA obligations without SEA-trained/experienced staff nor additional/dedicated financial resources for conducting SEAs.

Consequently, Viet Nam government organisations turned to international agencies, in particular the Asian Development Bank (ADB), the World Bank, GIZ, Dutch RIVM/PBL, the Netherlands Commission for Environmental Assessment and others to provide on-the-job SEA capacity development.

In the case of the PDP, the first full SEA exercise was conducted by the ADB on the PDP VI. This SEA was an ex-post assessment with a focus on the national hydropower sub-plan. Although the influence of the SEA of the PDP VI on the plan was very limited due to its ex-post nature, it was fundamental in building conceptual understanding, appreciation and commitment with the involved government agencies. In response to that IoE requested support for the preparation of the SEA of the PDP VII, the first ex-ante SEA of the PDP in Viet Nam.

Box 1 Legal requirements SEA

Framework law: Law on Environmental Protection 2005 (update in 2014).

Additional legal and guiding documents informing SEA implementation are:

a) Government Decree No 80/2006/ND-CP of dated 09th Aug 2006 on Instruction of the Law of Environmental Protection (LoEP) implementation,
b) Government Decree No 21/2008/ND-CP dated 28th Feb 2008 on amendment to Decree 80/2006/ND-CP and
c) Circular No 05/2008/TT-BTNMT dated on 08th Dec 2008 of MONRE on Instruction of EIA, SEA and Environmental Protection Commitment implementation. The latter is the main guiding document to SEA.

5.3 Approach and methods used

Institutional setting

There are four main actors related to SEA of the PDP in Viet Nam:

1. the Ministry of Industry and Trade, in charge of developing the Power Development Plan, for which it set up a PDP working group;
2. the Institute of Energy, a subsidiary of MoIT, which is tasked with the implementation of the SEA of the PDP, for which it set up an SEA working group;
3. the Ministry of Natural Resources and Environment, which assesses the SEA throughout the process and the end results in close collaboration with IoE (and the SEA working group);
4. the Prime Minister's office, which issues the final decision on both SEA and PDP.

The SEA working group consisted of 25 members from different backgrounds, including environment, economics, electricity etc. The SEA working group was the main body to steer the design and implementation of the SEA. It was composed of three groups of contributors:

1. IoE staff taking a supervisory and steering role and acting as the main link with the MoITs PDP working group;
2. National experts from IoE, line ministries and independent consultants, providing important national knowledge and analytical inputs;
3. International experts, including staff of the Greater Mekong Subregion (GMS) Environment Operations Centre supported by ADB, providing SEA process guidance and selected technical inputs and capacity building.

Five members of the SEA group were also members of the PDP VII working group. The SEA working group was headed by the Director of the IoE, who is also the chairman of the PDP VII.

The SEA working group engaged closely with a wide range of additional organisations for data and knowledge support, including electricity consulting companies, Electricity of Viet Nam, National Petroleum Corporation, Viet Nam Coal & Mineral Resources Corporation, Forestry Bureau, Institute of Strategic Development (under Ministry of Planning and Investment), Institute of Ecology and Biological Resources, Ministry of Natural Resources and Environment, and of course the Institute of Energy itself.

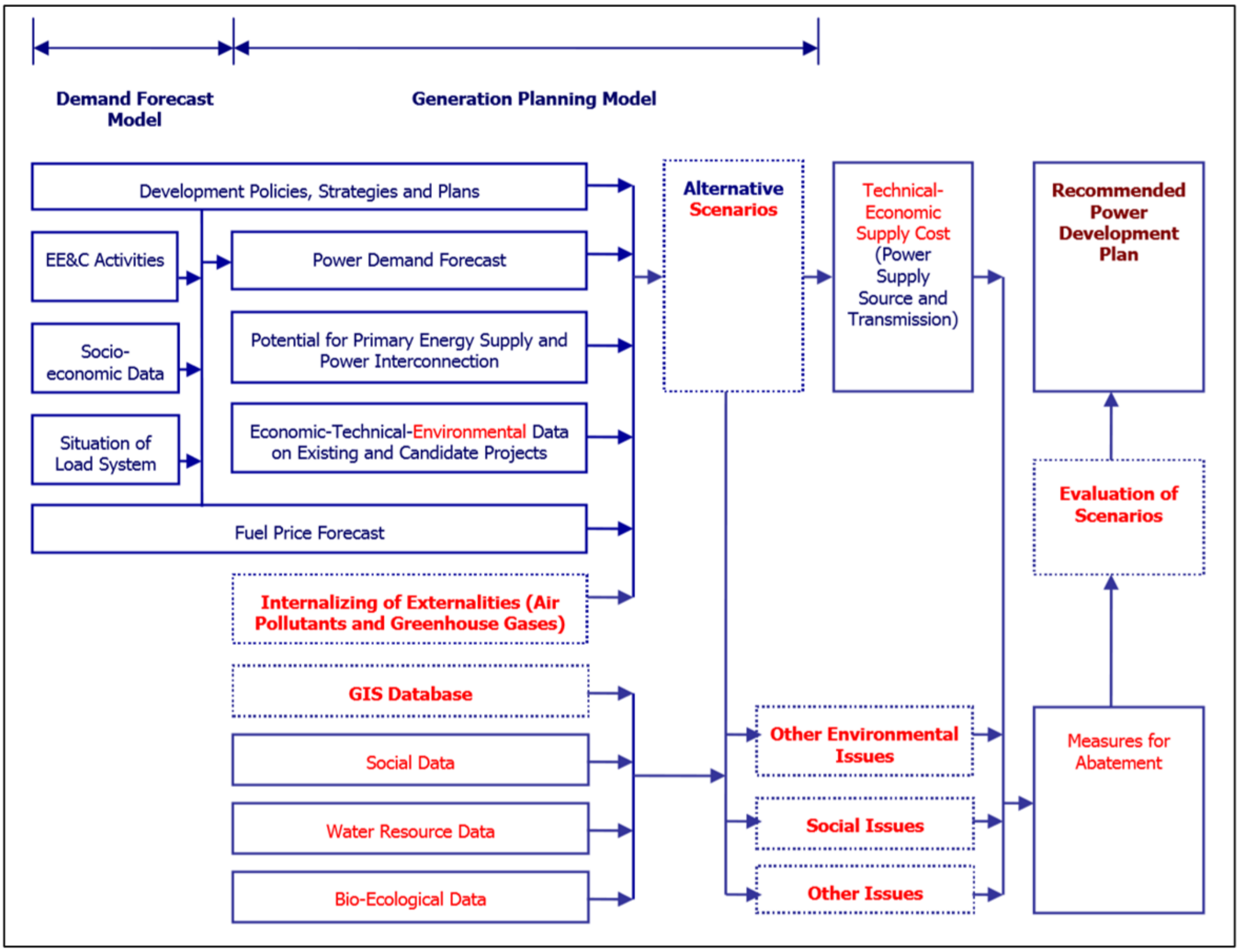
The SEA process

The SEA of the PDP VII followed the commonly recognised SEA steps.

The analytical framework (step 1) was developed during an inception workshop held in Qui Nhon city in July 2010. Key socio-economic and environmental issues relevant to the sustainability of the PDP were identified and form the basis for the impact analysis later.

Data collection and definition of the baseline analysis (step 2) started soon after that inception workshop. Data that was still valid from the SEA of the PDP VI – in particular, the GIS analysis on HPPs – was reused. For other aspects added to the analysis of the SEA PDP VII, new statistical and spatial data was collected, and criteria identified.

Figure 1: Overview of the PDP process (solid boxes) and the contributions of the SEA (dotted boxes).



Stakeholder consultations happened regularly throughout the SEA (parallel process – not really a separate step 3). This comprised of official workshops (inception workshop, final workshop), coordination between the SEA working group with the PDP working group, and the individual engagement of SEA working group members/SEA technical staff with line agencies for data and knowledge (one-to-one meetings and interviews). A broad summary of stakeholders engaged is provided in chapter 3.1 and 3.7.

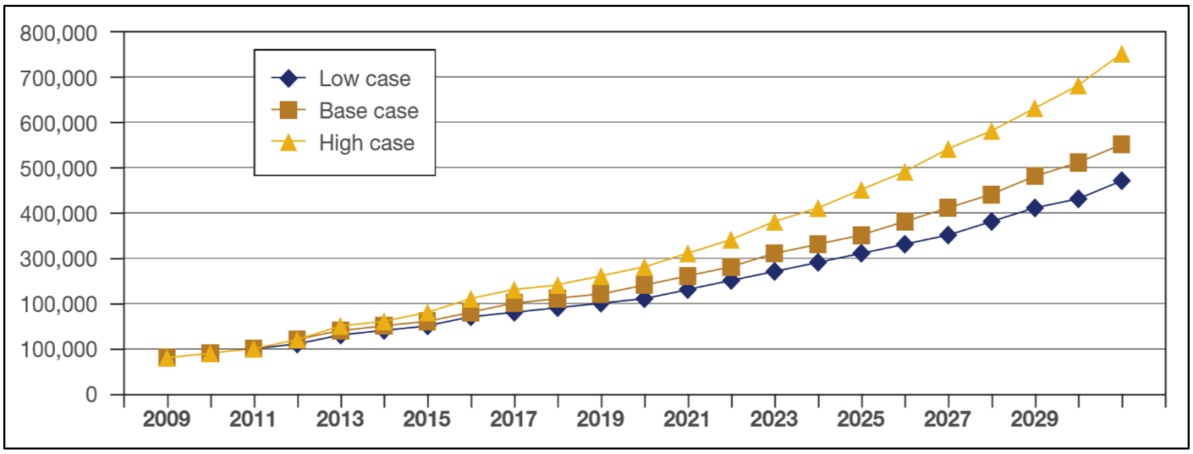
The impact analysis and weighting (step 4) were complex given the variety of factors involved and related data gaps and compatibility constraints. Regardless, it did follow four key steps a) a quantitative analysis of the physical quantities of different impacts – e.g. how many pollutants emitted, how much forest lost, how many people exposed, b) an economic valuation of these impacts, and c) the weighing of each impact according to its influence on sustainability of a power supply scenario, and d) the comparison and ranking of the three power supply scenarios (base case and two alternatives) (ref chapter 3.6).

For residual impacts of the optimal scenario, options for **mitigation and compensation (step 5) were discussed** – e.g. polluter pays, payment for ecosystem services etc. – and reflected in the SEA's conclusions and recommendations submitted to MoIT and the Prime Minister's Office (step 6), which concluded the SEA exercise (ref. chapter 3.6). The SEA was officially approved on 22 April 2011 (document No. 615/TCMT-TD).

Development of alternatives

Based on national and sector growth forecasts, the Power Development Plan developed three energy demand forecasts: base case (growth following past trend), high case (higher than expected growth), and low case (lower than expected growth) – Figure 2.

Figure 2: Power demand forecast until 2030 (MW)



Based on these power demand scenarios, the PDP developed a power development scenario (supply options). This scenario was sent to the SEA working group for assessment and analysis, forming the starting point for the SEA.

The SEA working group's analysis of the PDP power development scenario revealed several concerns of this initial power development scenario:

1. Strong focus on thermal power and related fuel imports challenges Viet Nam's energy security (market price fluctuation, political dependence);
2. Shift from oil/gas to coal further worsens the environmental footprint of thermal power production;
3. Location of TPPs in high population areas increases risk of environmental and social impacts.

Accordingly, the SEA working group proposed adjustments to the power development scenario, which - after endorsement by the PDP working group - became the new base case scenario. Key adjustments were:

1. Maintain and expand (instead of reducing) gas fired TPPs and look for LNG import sources;
2. Increase share of renewable energy to 4%, mainly from small hydro;
3. Add three additional nuclear power plants.

While this adjusted scenario was now considered the PDP base case scenario, the SEA working group and the PDP VII working group continued to consider more possibilities to optimise the base case scenario, leading to two alternatives scenarios being analysed by the SEA (Table 1).

These alternative scenarios tried to capture additional optimisation options not yet fully captured in the base case scenario, in particular: 1) increase energy efficiency in power production, 2) reduce energy loss in power distribution (transmission grid) and 3) increase share of renewable energy.

Table 1: Overview of main characteristics of SEA alternative power development scenarios

Scenario	Measure (compared to base case)	Expected results by 2030
Alt. 1	Increase energy efficiency to 5-8% by 2030 compared with 1-3% in the base case scenario (in production and distribution)	• Reduce energy loss of the whole system to <7% through upgrade to high efficiency thermal and development of super-voltage transmission lines (1000-1100kV) • Saves approx. 56.3 mil, tons of coal imports • Estimated avoided env/social cost: 3.893 mill USD
Alt. 2	Increase the rate of renewable energy to 8-10% by 2030 compared with 3,8-4% in the base case scenario.	• Further increase the ratio of gas turbine instead of coal fire TPP • Reduction of 6200MW from coal, saving about 9 coal fired TPPs and approx. 10,6 mill tons of coal, • Estimated avoided env/social cost: 1.868 mill USD

Table 2: Overview of key issues and related impact indicators, by generating source

Generating source	Type of env. and social issue	Impact indicators
Thermal	Climate change	Total tonnes of GHG emissions
	Acidification of soils and water	Ph values of vulnerable water bodies Total SO2 & NOx emissions
	Human health impacts	Number of people exposed to health risks from atmospheric pollution (SO2, NOx, PM) Total disease-adjusted life years lost because of pollution impacts
	Habitat loss & displaced people	Total area of valuable ecosystems lost (ha) Number of people resettled
	Cooling water impacts	Area of valuable ecosystems vulnerable exposed to cooling waters
	Solid waste disposal	Tonnes of waste products from power generation
Hydro	Resettlement of displaced people	Number of people resettled
	Social & livelihoods impact on local people	Number of people affected by hydropower projects
	Forest & habitat loss	Total area of forest lost (ha) Protected areas land lost (ha)
	Hydrological impacts	Reduced water availability to downstream water users Length downstream of aquatic ecosystems affected (km) Minimum environmental flow not maintained
	Biodiversity loss	Area of valuable ecosystems vulnerable to impacts
Nuclear	Disaster vulnerability	Impacted extent and numbers of radiation exposed people
	Management of radioactive materials	Infrastructure & regulations for radioactive material management not in place
	Cooling water impacts	Area of valuable ecosystems vulnerable exposed to cooling waters
Renewable energy	Land area lost for generating sites	Total area of forest & valuable ecosystems lost (ha)
	Noise & visual pollution	Noise level and height of wind turbine towers
Transmission lines	Forest & habitat loss	Total area of forest lost (ha)
	Ecosystem fragmentation	Number & total area of protected areas fragmented by transmission lines
	Land area lost for transmission lines	Total area lost for clearing for transmission lines (ha)

Selection of issues and indicators (scoping)

All three power development scenarios – optimised base case scenario and two alternative scenarios – were subject to impact analysis. For the impact analysis, relevant socio-economic and environmental issues were identified during the inception/scoping.

Impact analysis: methods and tools

Besides the use of national and provincial summary data for a broader assessment of environmental and socio-demographic state and trends, the impact analysis of the SEA of the PDP was characterised by two main innovations new to SEA in Viet Nam and the GMS at that time:

- extended use of spatial analysis to quantify different environmental and socio-demographic assets (proxies for impact indicators) within the perimeter of the TPPs, HPPs and transmission lines;
- application of cost factors/coefficients (US$ per impact unit) to translate statistics into economic values broadly compatible with cost-benefit analysis.

For TPPs, an Euclidean distance buffer (straight line distance) was applied to each TPP subdivided into 3 zones of impacts around the plant site (Figure 3). While this approach does not model an exact plume at a certain time and wind direction, it is a deliberate and valid abstraction given the long analytical horizon (20 years), the lack of detailed atmospheric data for such a time horizon, and the strategic nature of the assessment.

For transmission lines, an Euclidean distance buffer was used to calculate impacts with regard to forest/ecosystem loss and fragmentation (Figure 3).

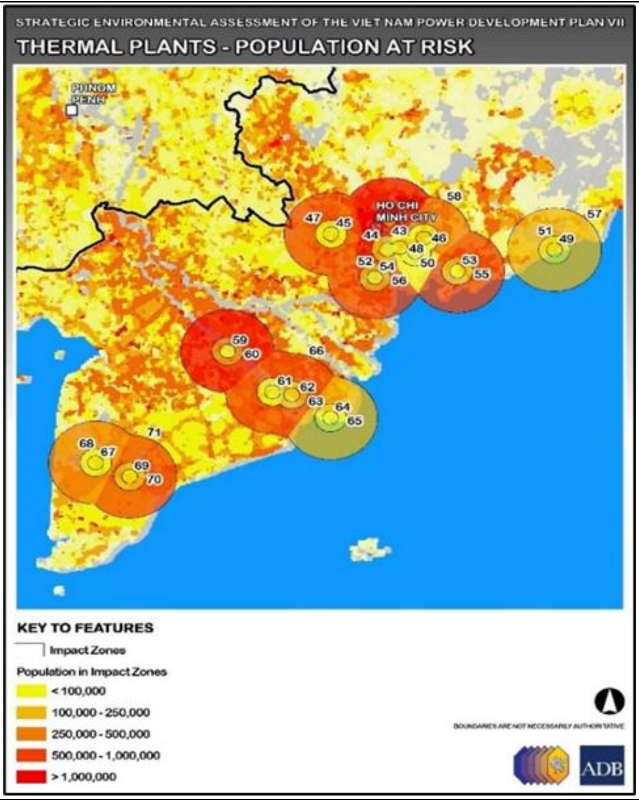
workshop (July 2010) and following individual consultations with and by the SEA working group. The result is a list of strategic environmental and social issues and related indicators, constituting the assessment framework of the SEA of PDP VII. A brief summary is given in Table 2

For HPPs, a slightly different approach was used. The dam inundation areas were calculated using a "bathtub approach" with the base elevation and the average water level (height) at dam site as benchmarks to extract the approximate reservoir from a digital elevation model. Further impacts around the dam site are expected through dam construction (incl. necessary support infrastructure, in-migration (laborers)) and the ecological changes triggered by the same (e.g. changes in hydrology). This was recognised through creating a second, wider outline (zone of influence) around the dam site based on accessibility (Least-cost path calculation). Both inundation zones and zones of influence were overlaid on relevant indicator layers for a zonal summary of the assets within (e.g. population density map, forest map etc) (Figure 4).

In a final step, the statistical data produced by the government and from the GIS analysis were multiplied with cost coefficients to arrive at values compatible with the cost-benefit analysis.

As a result of this accounting each individual power plant (thermal, hydro) and distribution infrastructure (transmission line, by section) could be transparently ranked and compared for its costs and benefits. This led not only to the reduction in number of coal-gas fired TPPs but also the suspension of two HPP falling into protected areas.

Figure 3: Left: GIS-bases TPP zone of influence around a TPP site overlaid on population density map, Right: transmission lines overlaid on PA and forest areas (% showing size of fragments compared to original patch without transmission line).



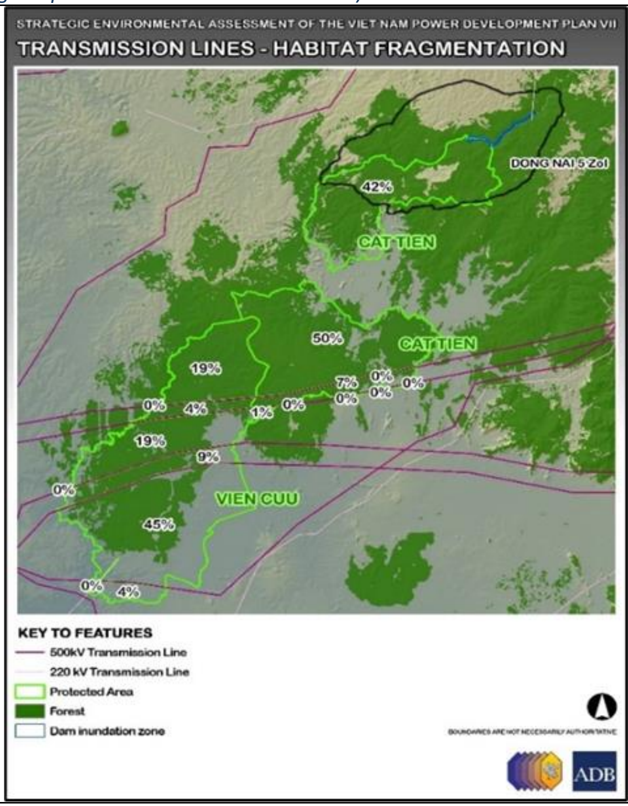
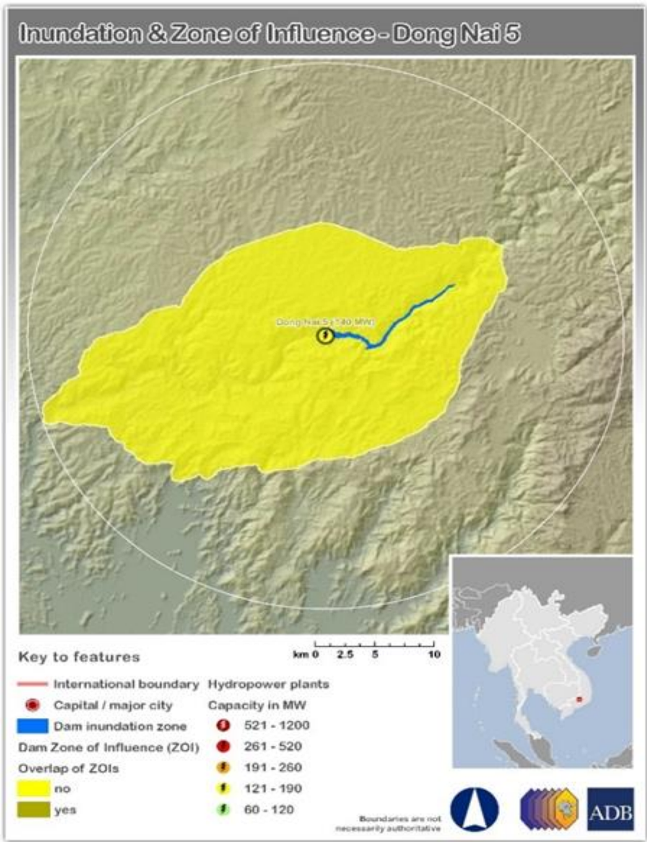
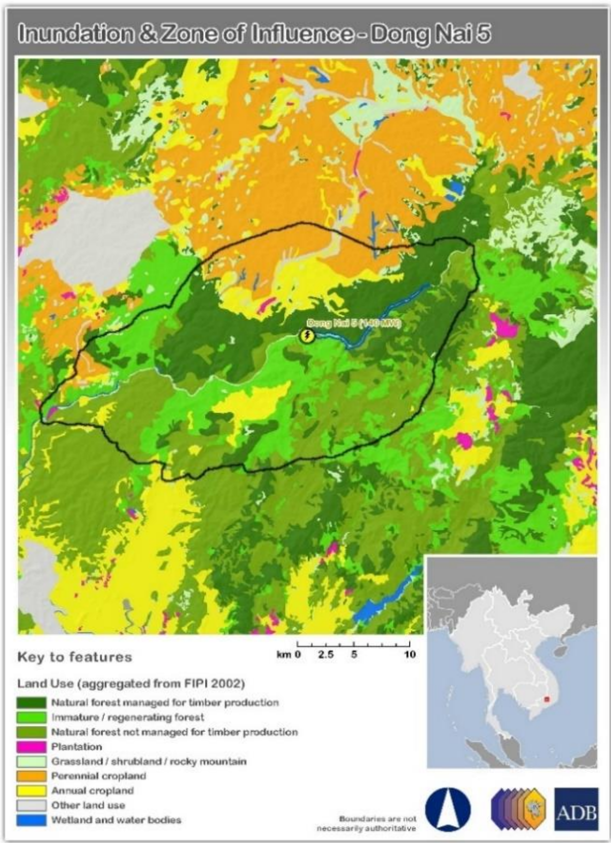


Figure 4: Above: GIS-based inundation zone (blue) and zone of influence (yellow) around a dam site, Under: overlay on land use to identify assets at risk (zonal statistics).





Comparison of alternatives: how, criteria, who was involved

The impact analysis of the SEA of the PDP VII strongly pushed to provide reliable and relevant quantitative data to the cost-benefit analysis as the foundation of the comparison of the power development scenarios (comparison of alternatives). It was established that both alternative scenarios (Alt 1 - energy efficiency, Alt 2 – more renewables) are reducing the environmental and social impacts compared to the base case scenario. Examples of the impacts of both scenarios are provided in Figure 5 and 6.

Figure 5:

Results of alternative scenario 1 (INCREASED ENERGY EFFICIENCY) compared to base case: TOP: Reductions in demand for coal 2011-2030, MIDDLE: Reductions in atmospheric pollution (Unit: ton, CO2: 1,000 tons), BOTTOM: Reduction in health costs (Unit: million US$)

Year	**2011**	**2015**	**2020**	**2025**	**2030**
Coal (10^6 tons)	10.90	28.2	57.9	89.6	135.1
Domestic	10.60	26.2	39.8	53.2	69.5
Imported	0.34	2.0	18.1	36.4	65.6
Coal reduction (10^6 tons)	**0.60**	**3.8**	**19.2**	**26.9**	**56.3**

Year	**2011**	**2015**	**2020**	**2025**	**2030**
PM	312.91	995.04	3,552.45	4,933.26	9,873.90
SO_2	4,538.23	5,837.31	22,184.68	32,609.93	72,868.86
NO_x	12,140.97	113,65.97	20,593.53	29,154.38	41,291.30
CO_2	6,921.10	115,08.16	39,806.59	49,275.07	104,685.02

Year	**2011**	**2015**	**2020**	**2025**	**2030**
PM	-45.05	9.72	73.19	101.65	203.47
SO_2	13.19	17.21	65.59	96.41	215.45
NO_x	31.55	36.14	66.38	93.97	133.09
CO_2	644.4	791.7	1,578.7	2,195.8	3,348.1

Figure 6:

Results of alternative scenario 1 (EXPANDED RENEWABLE ENERGY) compared to base case: TOP: Reductions in demand for coal 2011-2030, MIDDLE: Reductions in atmospheric pollution (Unit: ton, CO2: 1,000 tons), BOTTOM Reduction in health costs (Unit: million US$)

Year	**2011**	**2015**	**2020**	**2025**	**2030**
Coal (10^6 tons)	11.20	31.9	75.8	111.9	177.5
Domestic	10.80	29.9	46.2	61.9	64.8
Imported	0.38	2.0	29.7	50.0	112.7
Coal reduction (10^6 tons)	**0.00**	**0.1**	**1.2**	**4.6**	**10.6**

Year	**2011**	**2015**	**2020**	**2025**	**2030**
PM	-7.03	35.23	223.81	849.02	1,941.73
SO_2	377.61	818.72	940.08	4,865.65	13,575.04
NO_x	12,356.55	11,253.20	10,166.70	13,561.26	14,575.81
CO_2	7,440.86	6,635.29	7,056.78	14,736.98	26,264.91

Year	**2011**	**2015**	**2020**	**2025**	**2030**
PM	-57.42	-15.65	4.59	17.48	40.00
SO_2	0.87	2.34	2.76	14.37	40.12
NO_x	31.33	35.43	32.77	43.71	46.98
CO_2	638.50	694.20	938.80	1,472.50	1,739.90

Despite their potential reduction of impacts, residual impacts remain for both. Consequently, the SEA team proposed to consider development of a range of power source specific mitigation and compensation options as summarised in table 3. Particularly the nationwide upscaling and adoption of Payment for Forest Ecosystem Services was recommended by the SEA and prioritised by the government in the following years. In addition, investing in science & technology to reduce emission, and improving the collaboration of inter-area power development through the Regional Power Trade Coordination Committee was proposed as source-independent measures.

Table 3: Overview of proposed mitigation and compensation options

Generating source	Proposed mitigation or compensation option
Thermal	Introduce polluter pays for emissions and waste discharges
	Promote renewable energy and energy efficiency to reduce dependence on coal-fired generation
Hydro	Reduce deforestation through introduction of Payment for Forest Environmental Services
	Strengthen the management of and awareness on Protected Areas
	Aquaculture development to mitigate fisheries losses
Nuclear	Careful site selection for deposit of radioactive waste to minimise environmental and social impacts
	Develop infrastructure and management systems for handling radioactive materials
Renewable energy	Careful site selection to minimise environmental impacts (e.g. bird migratory routes, proximity to protected areas)
Transmission lines	Transmission line routes to minimise environmental impacts and avoid protected and residential areas
	Develop super voltage transmission lines (1100kV)

Public participation and quality review

During the SEA, 2 national conferences were organised with the participation of about 70 experts from various ministries, relevant government management agencies, and businesses in the electricity sector, consulting companies, and provincial Departments of Natural Resources and Environment and Departments of Industry and Trade. The provincial departments played an important role in making the SEA consultation a success. They provided technical information and data, as well as their expertise opinions to complete the SEA.

One shortcoming of the consultations was the lack of direct involvement of local communities. Despite this, especially provincial authorities were aware of the environmental and social risks and raised them explicitly, therefore raising many concerns that local communities and non-governmental organisations would have brought forward.

Quality control of the SEA happened by 3 separate groups: the PDP working group, the MONRE SEA appraisal team (working directly with the SEA working group and not through the PDP working group), and the Prime Minister’s office.

Monitoring and follow up

The GMS Core Environment Program was only mandated to support the SEA preparation and implementation until approval. Consequently, the activity ended with the approval and the consultant team (not EOC core staff) disbanded after April 2011.

While the expert team did not stay beyond the completion of the SEA, the EOC core team continued to engage with IoE and MoIT after the end of the SEA exercise. In the case of the SEA of the PDP VI, this ex-post engagement helped to further deepen the appreciation and commitment to SEA resulting in the request for ex-ante support of the PDP VII. In the case of the SEA of the PDP VII, the ex-post engagement was critical to request for advice for the revision of the PDP VII, leading to even more ambitious energy efficiency and renewable energy targets and SEA “champions” at IoE.

The SEA did not develop or support the development of an ESMP for the PDP. However, the SEA recommended that environmental management plans for individual hydropower projects "should specify environmental water releases, including for dams owned or operated by the private sector". Since the ESMP is "traditionally" an instrument of EIA, which Viet Nam also has a legislation for, this was not considered a priority under the SEA.

However, the need for thorough SEA "aftercare" remains an important topic. While the strong commitment of MoIT and IoE to the SEA of the PDP meant that in this case it was not a critical component, there are many SEA cases in Viet Nam and elsewhere in the GMS where there is less commitment which – due to a common lack of clear accountability mechanisms in with regard to SEA – promotes SEA reports and their results being "shelved" instead of being used.

Expertise, duration & costs

ADB supported mainstreaming environmental and social concerns into the PDP over a period of 12 years stretching over three SEA's: the SEA of the PDP VI, the SEA of the PDP VII and the revision of the PDP VII. The support period also includes continued engagement with the Regional Power Trade Coordination Committee (RPTCC) which continues to date.

Overall, the "average" cost of the SEAs has reduced significantly over that period. Reason for this is growing commitment and capacity of IoE and MoIT, allowing the stepwise reduction of international inputs. At this point the SEA is led by IoE staff with international support is only taking an advisory role. Because of the increase in scope, analytical depth and impact of the SEA of the PDP VII (ex-ante) compared to the SEA of the PDP VI (ex-post), the costs were slightly higher for the first, but in terms of "value for money" (impact on PDP), the costs was arguably lower. A brief comparison of the duration, costs and key expertise in the three SEAs is provided in table 4.

Table 4: Comparison of duration, cost and key expertise between SEAs for PDP

SEA	PDP VI	PDP VII	PDP VII revision
Duration	2006-2007	2010-2011	2015
Total cost in US$*	500,000	<500,000	
Man-months (intl./natl.)*	~140 days intl./~200 days natl.	~90 days intl./~200 days natl.	~30 days intl.
Key expertise (intl.)	Team leader SEA, environment specialist, env. economist, hydropower specialist, GIS	Team leader SEA, energy economist, GIS	SEA advisor

** The numbers provided in this section are broad estimates.*

5.4 Results and Lessons Learnt

Contribution to decision-making

The contributions of the SEA of the PDP VII should not be viewed individually, but in combination with the previous SEA of the PDP VI and the following SEA advice to the Revision of the PDP VII.

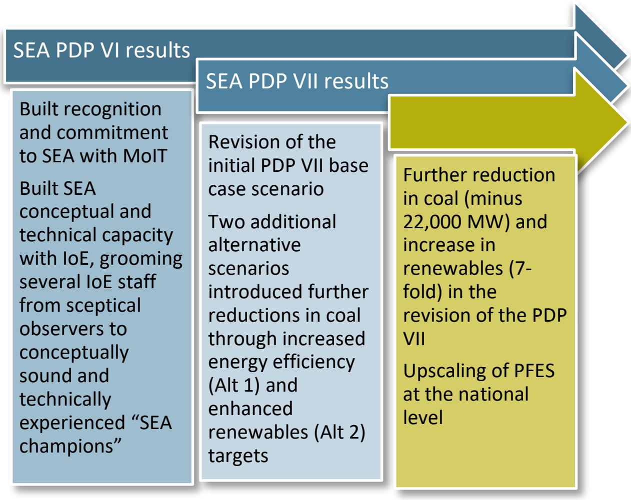
Through this continuous engagement during and between SEAs it was possible to trigger decisions that culminated in a significantly more sustainable PDP (PDP VII revision), in particular through:

a) a major cut in coalfired power generation (-22,000 MW) and
b) a seven-fold increase in the amount of renewable energy (table 5).

Table 5: Generation mix of Viet Nam's PDP VII and revised PDP VII (MW)

Source	PDP VII 2011	Revised PDP VII 2014
Coal	77,160	55,252
Natural gas and oil	17,465	19,078
Hydropower and pumped storage	21,125	21,871
Other renewable energy (incl small hydro)	4,829	27,199
Nuclear	10,700	4,600
Imported	6,109	1,508
Generation capacity 2030	137,388	129,508

Figure 7: Sequence of SEA's for Viet Nam's PDP VI and VII and their individual (and accumulated) achievements.



These changes alone account for a reduction greenhouse gas emission of 100 million tons of CO2 equivalent a year by 2030, and a cost-saving of about $1 billion a year, based on the price of $10 a ton of CO2 equivalent price used in the revised PDP VII.

In addition, from 2006 to 2012, IoE staff had grown from SEA sceptics to active promoters of SEA in 2012, attending and presenting in the IAIA 2012 in Porto. In 2014, the PDP VII revision was executed entirely by IoE – except for a few select advisory services by ADB – and resulted in revisions that made the PDP VII even more sustainable (ref. Table 5). Indirectly, the SEA process contributed to nationwide upscaling and adoption of Payment for Forest Ecosystem Services.

The government is further integrating SEA in its PDP process with the currently ongoing SEA of the PDP VIII for 2021-2030 (with a vision to 2045). It builds on the commitment and capacity built through the previous SEAs (PDP VI, VII and revision of VII) and deepens it through the introduction of additional and new methods and technologies, for instance to assess the impact of solar and wind, cost of GHG emission (shadow pricing), and revisions of coefficients for air pollution impacts on health, to name a few. The SEA of the PDP VIII has also advanced the stakeholder consultation process compared to previous SEAs of the PDP. This latter SEA is currently being finalized.

Conclusions for SEA good practice

The SEA support to the PDP VI, VII and VII Revision yielded a few important lessons to be considered in designing future SEA exercises in Viet Nam and in other low- and middle-income countries:

1. The SEA should be developed jointly with the target plan and support the development of feasible alternatives in this plan.
2. SEA should carefully balance between SEA good practice requirements and the flexibility to adjust to case-specific context and needs. A rigidly executed SEA might not get the support of the ministry responsible for the plan, while too much adjustment and customisation might undermine the value of the SEA.
3. Hands-on capacity development and ownership of the process and its results is important to establish and sustain true commitment to SEA in the target ministry.
4. Continuous engagement covering several consecutive rounds of SEA might be essential to arrive at a level of skill and trust that makes significant changes to target plans possible.
5. Making SEA a legal requirement also requires the government to set aside sufficient resources (capacity building, additional staff, funds) to get the task done timely and effectively. In practice that is often not done, relying not only on the conceptual and technical, but also the financial support of international agencies.
6. Even with the legal tools, funds and staff capacity for SEA in place, there is often no formalised process for quality control and related accountability mechanisms. That allows less committed ministries to fulfil their SEA requirement "for the record" only, without considering or building SEAs recommendations into their plan(s). Amending SEA legislation with clear quality control, accountability and monitoring procedures is therefore instrumental for SEAs being able to perform as intended.

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- *Ministry of Industry and Trade Viet Nam (2011): "Strategic Environmental Assessment of the National Plan for Power Development for the Period 2011-2020 with Perspective to 2030 (PDP VII)", Hanoi, Viet Nam.*

About the author

Lothar Linde (MSc) is an Environment and Spatial Planning Specialist with over 20 years of research and work experience. He holds a MSc degree in Geography and Landscape Ecology from the University of Leipzig, Germany. Between 2002 and 2006 he worked as a researcher on joint projects of the University of Leipzig and the Helmholtz Centre for Environmental Research (UFZ), and the United Nations Environment Program (UNEP) Reginal Resource Center for Asia and the Pacific. Since 2006 Lothar has worked as an independent expert on over 20 long and short-term projects of the Asian Development Bank, UNDP, the World Bank, and the African Development Bank. Lothar has been involved in over 10 Strategic Environmental Assessments in the Greater Mekong Subregion, supported the environmental analysis for the Greater Mekong Subregion Regional Investment Framework 2012-2022, and lead the development and piloting of several innovative spatial decision support tools on land use change projection, pollution estimation, and spatial multi-criteria evaluation for sustainable investments. Lothar is currently also pursuing a PhD at the Center for Development and Environment of the University of Bern, Switzerland. lothar.linde@yahoo.de

Penstocks Tarraleah Hydropower Tasmania

6 SEA FOR MANAGEMENT PLAN OF UPPER NYABARONGO CATCHMENT RWANDA

François Xavier Tetero

Authorities	Ministry of Environment
Type of plan	River catchment plan of Upper Nyabarongo catchment
Scope of SEA	Integrated river basin approach including all types of land and water use
Key SEA issues	Integrated analysis of the causes and solutions of the main problem in this catchment identified, namely soil erosion. Soil erosion affects the present hydropower capacity of 51.5 MW and the opportunities for new hydropower projects.
Stakeholder engagement	Consultation of all relevant stakeholders, public sector and private sector
Duration and year	24 months; 2016 - 2018
Influence of SEA	The SEA presented four integrated alternatives. Implementation of the preferred alternative started in 2020 consisting amongst others of a series of measures to avoid or minimise soil erosion. A governance structure was legally established to secure the development of future catchment plans by making use of SEA.
Link to SEA report	https://waterportal.rwb.rw/sites/default/files/2019-04/Upper%20Nyabarongo%20Catchment%20Plan_0.pdf

6.1 INTRODUCTION

The purpose of this paper is to describe how SEA supported the development of the Upper River Nyabarongo Catchment Plan, in which different interests including hydropower were approached in an integrated manner. The application of SEA for the river catchment plan was the first SEA in Rwanda.

Rwanda has adopted the Integrated Water Resources Management (IWRM) approach in 2011 by accepting the first National Policy on Water Resources Management (2011). This was followed by the Development of the National Water Resources Master Plan (NWRMP) which was approved by the Cabinet of Ministers in 2015. This master plan divided the country into nine level one catchments (see figure 1).

After the completion of the NWRMP and as a result of the Water for Growth Programme, the Ministry of Environment initiated the development of six-year management plans for four priority catchments which include Upper Nyabarongo (nr. 3) which is the focus of this case study.

The Upper Nyabarongo Catchment Plan was developed in the period 2016-2018 by taking into consideration the following national policies Vision 2020, Vision 2050, the National Strategy for Transformation and the nation's Green Growth and Climate Resilience Strategy.

6.2 BACKGROUND: CONTEXT AND ISSUES

Integrated situation analysis

The Upper Nyabarongo Catchment is within the Nile Basin and runs south to north in the western part of Rwanda. It has a total surface area of 3,348 km², representing 12.7% of the total surface area of Rwanda (26,338 km²).

The Nyabarongo Rivers starts from the confluence of the Mwogo and Mbirurume Rivers and run to the confluence with the Mukungwa River from where it continues as the Lower Nyabarongo on its way to the Akagera River and Lake Victoria. The catchment is

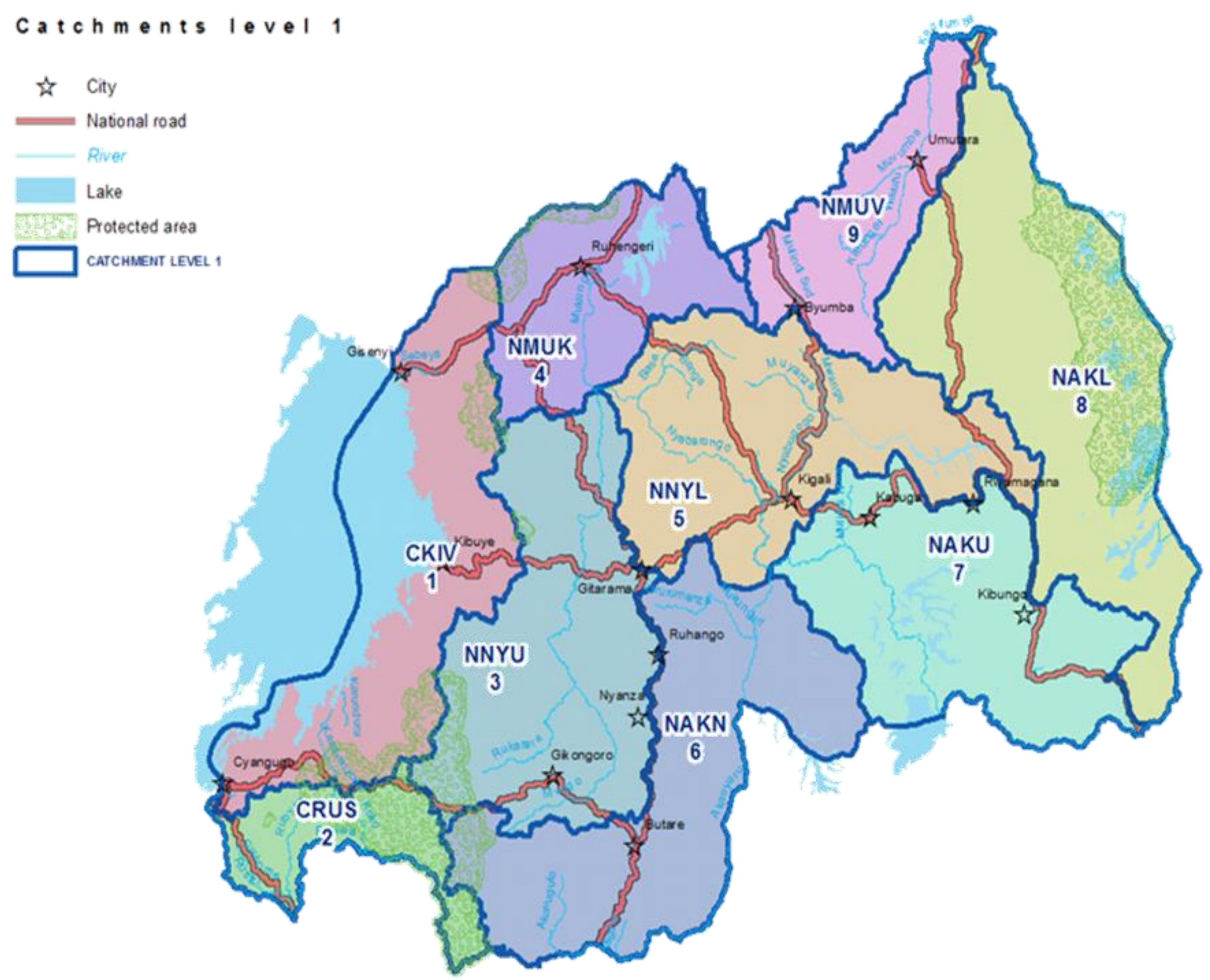


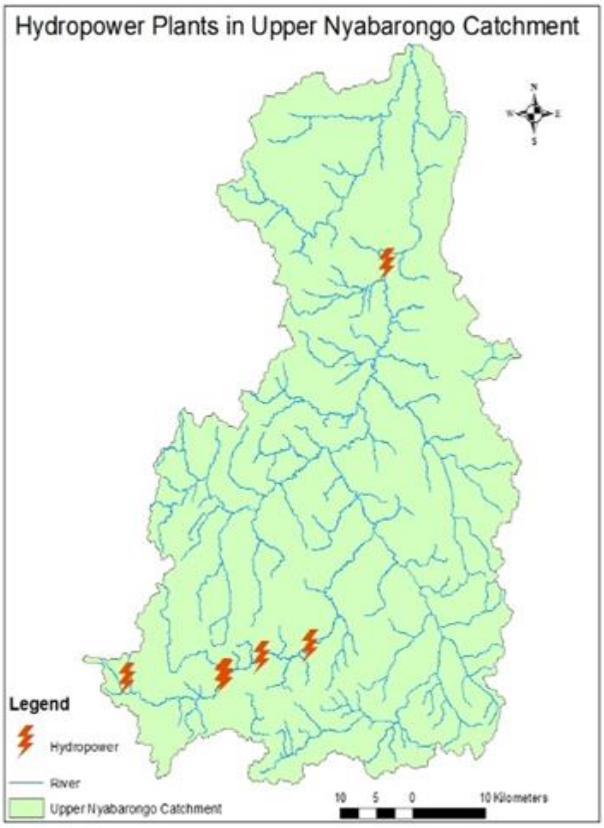
Figure1: Rwanda level one catchments *Explanation of the abbreviations of the nine level one catchments: CKIV- Congo Kivu Catchment,(ii) CRUS Congo Rusizi Catchment, (iii) NNYU Nile Nyabarongo Upper Catchment, (iv) NMUK Nile Mukungwa Catchment, (v) NNYL Nile Nyabarongo Lower Catchment, (vi) NAKN Nile Akanyaru Catchment, (vii) NAKU Nile Akagera Upper Catchment, (viii) NAKL Nile Akagera Lower Catchment, (ix) NMUV Nile Muvumba Catchment*

renowned as Rwanda's 'water tower' and has a significant number of large tributaries, such as the Mwogo, Rukarara, Mbirurume River, Munzanga and Satinsyi Rivers. The source of Rukarara River is considered the furthest source of the Nile River.

Upper Nyabarongo is considered a strategic catchment in Rwanda. It has abundant water resources with an average annual rainfall above 1600 mm and an elevation ranging between 1,460-2,950 meters. The predominance of steep slopes and high rainfall within this catchment make it highly potential for hydropower development. Currently, 5 hydropower plants are operational on the Nyabarongo River with a total capacity of 51.5 MW (Figure 2). These include Rukarara I (9 MW), Rukarara II (2.2 MW), Rukarara VI (10 MW), Mushishito/Rukarara V (2.3 MW) and Nyabarongo I (28 MW).

The Upper Nyabarongo Catchment is strongly reliant on rainfed agriculture and produces traditional cash crops like coffee and tea, along with new ones, like honey and horticulture. The main food crops growing in this area are maize, beans, potato, wheat, cassava, banana, fruits and rice. Approximately 70% of households are also engaged in livestock rearing with the most commonly owned species being cattle, goats, pigs, rabbits and chickens. Fish farming is already practised in the Huye and Nyanza Districts and there is a shift to increase productivity in this sector through construction of small dams and fishponds. Agroforestry and forest plantations have been promoted as appropriate land use management systems in the catchment. Mining and quarrying for and of granite, tin, wolfram, colombo-tentalite (coltan) and cassiterite are important sources of revenue and employment. In Rutsiro, Ngororero, Nyamagabe, Muhanga, Karongi

Figure 2: Map showing the location of hydropower plants in the Upper Nyabarongo Catchment



and in the Nyungwe Forest. Non-regulated artisanal mining is commonly practiced. Tourism opportunities around the natural forests in Nyungwe, Mukura, Gishwati and Busaga exist, but are still largely underexploited.

The total number of people living within the catchment is around 1.2 million (7% urban, 93% rural). The population density in the catchment is high, with the highest density areas in Muhanga and Nyamagabe and Huye (900 – 1,500 inhabitants/km2). Another densely populated area is Ngororero (600 – 900 inhabitants/km2). Poverty rates in the catchment area are still very high, with approximately 41% classified as poor and 16% as extremely poor. The cause of poverty has often been linked to high population growth and declining soil fertility in a largely agrarian-based economy.

The main sources of pollution of surface water are from soil erosion of hillside agriculture, resulting in high to extremely high river sediment loads and inappropriate mining. The former has an adverse impact on, and high removal costs for, drinking water intakes, as well as turbines and related infrastructure for hydropower stations. Both hydropower and drinking water intakes often need to shut down during periods of extreme sediment loading and operations also suffer regular interruptions as a result of the need to undertake sediment removal from settling basins associated with the intakes. Mining may also lead to contamination with heavy metals from mine ores, or with substances used in ore processing posing a human health risk. The floods are recurrent in the Upper Nyabarongo Catchment, specifically in the Mwogo and Kiryango Sub Catchments. Deforestation is also a threat in the Upper Nyabarongo Catchment as it reduces soil cover and increases siltation of rivers. Inappropriate settlement leads to generation of liquid and solid wastewater without any prior treatment.

Figure 3: Map showing soil erosion risk areas in the Upper Nyabarongo Catchment

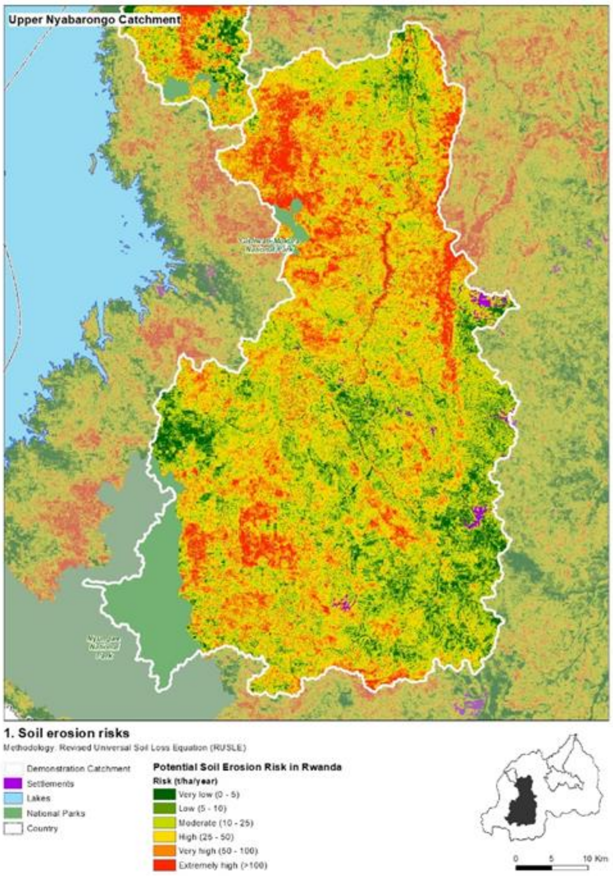
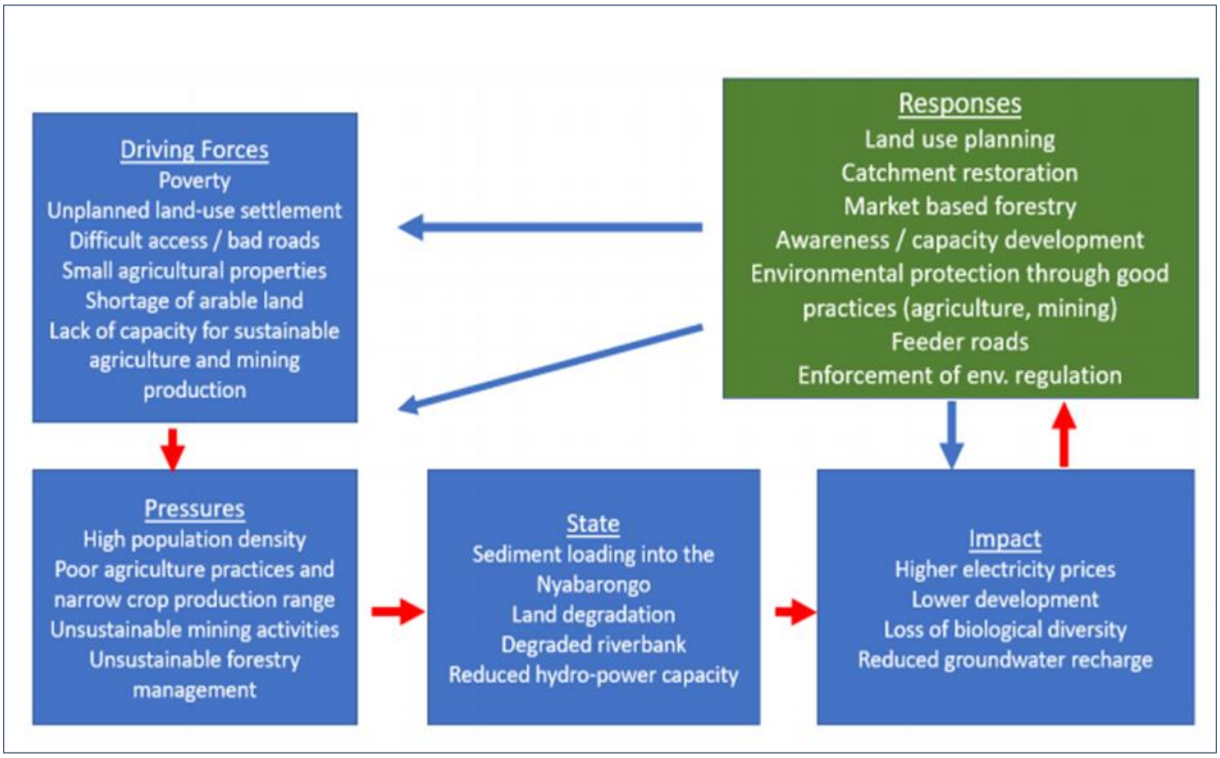


Figure 4 illustrates an analysis of the causal relations in the catchment and it shows how the reduced hydropower capacity is the direct result of high sediment load in the Nyabarongo River. This also effects the lifetime of the Nyabarongo I Hydropower Project that is located in the catchment, see box 1.

Figure 4: Analysis of problems and responses in the most degraded areas of Upper Nyabarongo



Moreover, the high shutdown time of the hydropower facilities is also an important reason for the relatively high electricity prices.

Objectives of the plan

The above-mentioned challenges hinder the sustainable use and further exploration of the opportunities for development. That was the main reason for the development of this Management Plan.

The main objective for the development of the river catchments' plan is to "Effectively manage land, water, and related natural resources, to contribute to sustainable socio-economic development and improved livelihoods. Taking into consideration environmental flow, downstream water demands and resilience to climate change, and minimise water related disasters."

The specific objectives were mainly to:

- improve water quality and quantity in water bodies considering resilience to climate change in the catchment;
- reduce the pressure on natural resources by diversifying alternative livelihoods;
- ensure equitable allocation of available water resources for rural and urban users of current and future generations;
- strengthen the water governance framework to ensure effective implementation of integrated programmes.

Achievement of the specific objectives are conditional for optimisation and lifetime of the present hydropower capacity and further development of new capacity. However, specific objectives for hydropower have not been set. Box 1 provides a brief description of the characteristics of the hydropower sector in Rwanda.

Box 1: Hydropower in Rwanda

The total installed power generation capacity is about 228 MW, hydropower contributing 48% of it. Nearly all operational hydropower projects are medium size and most of these are run of the river type of projects. Scattered though the country micro and mini hydropower project are operational and nearly all are connected to the national grid (see table 1). There are also pico-hydropower plants in the range of 1-10 kW which are either publicly owned or operated by the local communities or entirely private. They are not included in the table.

Rwanda is planning to expand its power generation capacity up to 556 MW in 2024 and hydropower is expected to contribute 74% to it. Therefore, shared regional hydropower projects will be developed with neighbouring countries and many micro and small hydropower projects will be developed with an estimated capacity of 8 MW.

Table 1: List of operational and proposed hydropower plans in Rwanda in 2020.

Hydro-electric station	River	Type	Capacity (MW)	Year completed
Operational – medium				
Mukungwa	Mukungwa	Reservoir	12 MW	1982
Mukungwa II	Mukungwa	Run of river	3.6 MW	2010
Ntaruka	Mukungwa	Reservoir	11.5 MW	1959
Rugezi	Mukungwa	Run of river	2.6 MW	2011
Rwaza-Muko	Mukungwa	Run of river	2.6 MW	2018
Nyabarongo I**	Nyabarongo	Run of river	28 MW	2014
Rukarara I**	Rukarara	Run of river	9.5 MW	2010
RukararaII**	Rukarara	Run of river	2.2 MW	2014
RukararaVI**	Rukarara	Run of river	10 MW	2016
Mushishito(Rukarara V)**	Rukarara	Run of river	2.3 MW	2019
Rusizi I*	Rusizi	Run of river	4.1 MW	1958
Rusizi II*	Rusizi	Run of river	12.0 MW	1989
Gisenyi	Sebeya	Run of river	1.7 MW	1957
Gihira	Sebeya	Run of river	1.8 MW	1984
Keya	Sebeya	Run of river	2.2 MW	2011
Giciye I	Giciye	Run of river	4.0 MW	2014
Giciye II	Giciye	Run of river	4.0 MW	2016
Operational – mini / micro			4.5 MW	
Total operational			118.6 MW	
Proposed – medium				
Rusumo *	Kagera	Run of river	80 MW	2021
Nyabarongo II	Nyabarongo	Reservoir	120 MW	2024
Rusizi III *	Ruzizi	Reservoir	147 MW	2026
Rusizi IV *	Ruzizi	Run of river	200 MW	2028
Proposed – mini / micro			8 MW	2024
Total			555 MW	

*) Developed with neighbouring countries, the capacity indicated is available for Rwanda.

**) Rukarara I, II, V & VI and Nyabarongo I are located in the Upper Nyabarongo Catchment while Nyabarongo II will be located in the Lower Nyabarongo Catchment. Sources : ESSP 2014 ; SEA 2015 ; https://www.mininfra.gov.rw/index.php?id=79

6.3 APPROACH AND METHODS USED

As this concerns a Strategic Plan, carrying out a Strategic Environmental Assessment (SEA) was obligatory according to the Rwandan Organic Law on the Environment (2005). A tailor-made approach was developed supported by the Netherlands Commission for environmental Assessment (NCEA), that advised on integration of plan development and SEA requirements (See table 2).

Table 2: Overview of SEA steps and the integrated approach based upon IWRM and SEA steps

SEA process steps		Integrated approach - IWRM & SEA
Screening 1. Reach consensus on the need for SEA and its link to planning		n.a.
2. Find stakeholders and announce start of the plan process		**Situation analysis:** Develop catchment characterisation report with analysis of important aspects of the catchment: • Physical characteristics; • Water resources characteristics; • Socio-economic analysis; • Stakeholders analysis (of SEA step 2) Consistency analysis of existing policies, plans, programmes (SEA step 4).
Scoping 3. Do a consistency analysis for relevant policies that have consequences for the plan 4. Develop a shared vision on problems & opportunities …		**Vision development:** Creating a vision for the medium to longer term future (SEA step 3) with the Catchment Task Force, kicking off in a joint scoping workshop, and developing ToR for the plan development and assessment (SEA step 5)
…define plan objectives and draft alternatives to reach these objectives 5. Set ToR for the technical assessment, based on scoping results		**Integrated planning: Develop** Catchment Plan considering competing land and water interests and comprising: • water allocation; • water resources protection/conservation; • land use / catchment rehabilitation. Assessment of development alternatives (SEA step 6).
Assessment 6. Assess impacts of alternatives and document this. 7. Organise (independent) quality review (involving stakeholders)		**Independent quality assurance** of documentation by the Catchment Task Force and representatives of key Agencies and Ministries (SEA step 7). Participatory decision making involving local and central levels (SEA step 8)
Formal decision-making 8. Discuss with all stakeholders the preferred alternative 9. Motivate the (political) decision in writing		n.a.
n.a.		**Coordinated implementation**: the implementation of the sector and agency plans respects the time schedules and designs formulated in the integrated plans
Monitoring 10. Monitor the implementation and discuss the results		**Monitoring** of implementation is assured by stakeholders in the catchment, together with regular monitoring procedures of implementing organisations, resulting in annual catchment plan implementation M&E reports (implementation of SEA step 10).

Organisational structure

An organisational structure for the development of catchment plans was set up at national and at catchment level. The lead agency is the Water Resources Management Department (WRMD) of the Rwanda Water and Forestry Authority (RWFA) responsible to guide the development of the plans with the support of a team of experts from the Water for Growth Programme. A steering committee was established, chaired by the Permanent Secretary of the Ministry of Environment and senior representatives of key ministries and agencies namely the Ministry of Local Government (MINALOC), the Ministry of Infrastructure (MININFRA), the Ministry of Agriculture and Animal Resources (MINAGRI), the Ministry in charge of Emergency Management (MINEMA), a representative of Non-Governmental Organisations (WATER AID) and the representative of the Embassy of the Kingdom of The Netherlands (EKN) in Kigali which funded the Water for Growth Programme. The steering committee was responsible for approval of catchments' management plans. They were supported by a technical team of experts from their respective institutions which was called the Focal Group.

Stakeholder engagement

Adoption of a participatory approach is one of the characteristics of the integrated approach applied. In order to ensure a better representation of stakeholders at catchment level, a task force was established for the catchment known as the Catchment Task Force (CTF). The composition of this task force included:

1. the Vice Mayor in charge of Economic Affairs from each district covered by the catchment (one of them was to be elected as the Chair of the CTF);
2. officers in charge of environment from each district covered by the catchment;
3. a representative of the women council from each district;
4. a representative of the private sector from each district;
5. a representative of the youth council from each district; and
6. a representative of Civil Society Organisations (CSOs) from each district.

The consultation process also included representatives of key agencies and ministries like those in charge of agriculture, energy, water and sanitation, mining and disaster management. The members of the task force and the representatives of key agencies and ministries were consulted at each step of the planning process.

Scenarios and alternatives

As a result of the planning process, a programme of measures for the catchment was formulated which consisted of a list of projects or interventions to be undertaken in order to enhance catchment management. Considering that the catchment plan was developed in the context of integrated water resources management and development, such measures were derived from a broad range of technical and non-technical areas and the main focus was on catchment restoration, water allocation and water governance.

As part of catchment restoration, the main objective was to reduce the sedimentation of the rivers which is a serious threat for hydropower use and development. The proposed measures included afforestation on very steep slopes, terracing on agriculture land, protection of buffer zones of rivers.

The other key component of the catchment plan was the development of a water allocation model in order to manage water availability and demand for the current situation and projections in the future. For that purpose, three scenarios were developed:

1. low economic development, low population growth and limited climate change impacts;
2. moderate economic development, moderate population growth and moderate climate change impact;
3. high economic development, high population growth and high climate change impact.

For each of the three development scenarios, the water allocation model assessed the availability of water compared to the demand which was the basis for selecting the best scenario against which management alternatives were to be compared. Through a series of consultations with the Catchment Task Force and the expert group (Focal Group), it was agreed to use scenario number 2 as the reference scenario against which four management alternatives were compared.

The four management alternatives assessed for the catchment were:

A. increased water storage;
B. increased water storage + sustainable land management;
C. increased water storage + sustainable land management + water use efficiency;
D. increased water storage + sustainable land management + water use efficiency + reduced irrigation.

In selecting a preferred alternative, the merits of the two most ambitious alternatives number C and D were compared to each other. Considering the importance of irrigated agriculture for food security in Rwanda and the fact that water availability was found not to be a limiting factor in the Upper Nyabarongo Catchment (even if the full hydropower potential is exploited especially under the selected medium scenario of population growth, economic development and climate change), alternative C was selected as the preferred alternative.

This plan was translated into water allocation plans for all sub-catchments. This alternative has the desired effect of balancing the need for energy security by maximising the potential for hydropower development with food security, whilst avoiding local water shortage. This can be achieved by combining the development of water storage, sustainable land management, and enhanced water use efficiency in all sectors especially in irrigation.

The selected alternative and related Programme of Measures by the Catchment Task Force and the group of experts from key national agencies (Focal Group) was endorsed by the Steering Committee.

Programme of measures

A Programme of Measures was developed for the Upper Nyabarongo Catchment Plan, primarily for the implementation period 2018-2024.This plan consists of four main components:

1. landscape restoration
2. water allocation
3. water governance and
4. knowledge management

1. <u>Landscape restoration</u>

The focus is on reduction of soil erosion and improvement of land and water productivity. It was found that an estimate of 55,000 ha in the Upper Nyabarongo Catchment will be rehabilitated. The following measures are applied to restore the physical status of the catchment: construction of terraces, agroforestry and afforestation, and gullies rehabilitation.

2. <u>Water allocation</u>

This refers to water demand and management measures that need to be implemented. These measures ensure that the amount of water available in the catchment, meets future demands for e.g. agriculture, industry, public water supply and hydropower. The preferred alternative C, was translated into water allocation plans for all sub-catchments, per month, per water user, and for the planning of 2024, 2030, and 2050. These then formed the basis for water permits and operational water resources management following a prioritisation 'ladder', as follows:

- first priority was given to domestic water supply, followed by;
- livestock;
- environmental flow (to provide water to ecosystems and downstream water users);
- industrial water demand (due to its very limited size and the fact that demand is constant throughout the year and independent of rainfall); and
- irrigation.

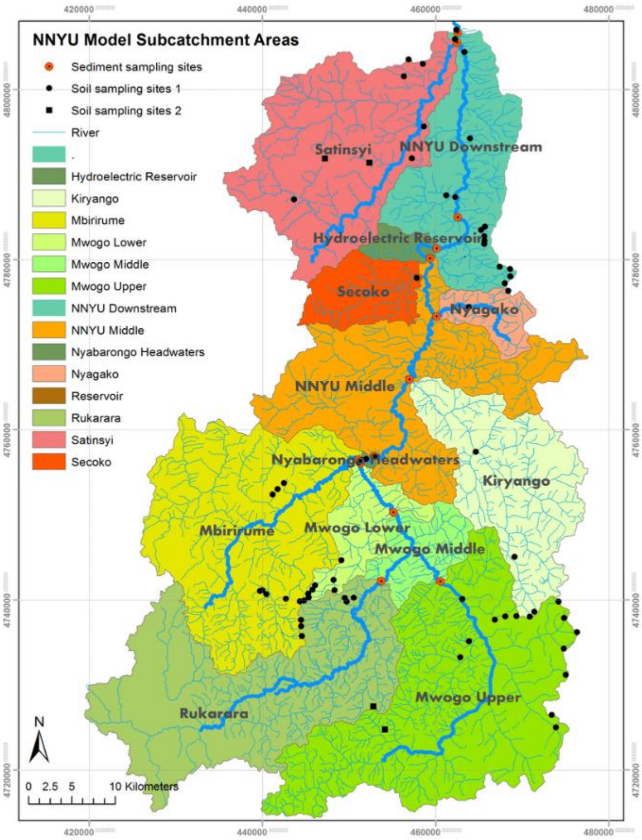
3. <u>Water governance</u>

This refers to institutional, policy and legislative measures that need to be implemented to ensure implementation of all other measures. It refers to the way in which a catchment is 'governed', by whom and how and under which framework. A Catchment Task Force was established to represent catchment stakeholders in the development of this Catchment Plan, within the Water for Growth Programme. The New Water Law (2018) stipulates the creation of Catchment Committees. Following ministerial order, these committees will be established and operationalised.

4. Knowledge management

This refers to the measures needed to manage, store and effectively use information, data and 'knowledge', including practical and intellectual capacities that are required for effective catchment management. Because catchment planning is a form of spatial planning, it will be important to enhance GIS (Geographic Information System) skills to produce spatial information, and to strengthen capacities of decision makers to interpret and use maps in their management tasks.

Figure 5: Map illustrating the results from the sediment fingerprinting study in Upper Nyabarongo Catchment



Implementing the Catchment Plan

This Catchment Plan is a joint plan of many stakeholders, each with their own mandate and interests. The plan was, however, the starting point for joint sector and agency planning and subsequent coordinated implementation. As of 2020, feasibility studies for a series of IWRM packages have already been completed and are implemented. In order to prioritise where to concentrate efforts considering the fund's limitations, it was decided to prioritise the upstream part of the Nyabarongo Hydropower dam I. A sediment finger printing study was conducted to determine the sub-catchments that most contributed to the siltation of the Nyabarongo River with special focus on the Nyabarongo dam I. Secoko Sub Catchment was found to be the most contributing one. Its detailed rehabilitation plan which was subsequently developed, is currently implemented.

Figures 5 and 6 illustrate the outcomes from the sediment fingerprinting study and the detailed rehabilitation plan for the Secoko Sub-Catchment.

Figure 6: Detailed rehabilitation plan for the Secoko Sub Catchment which is under implementation.

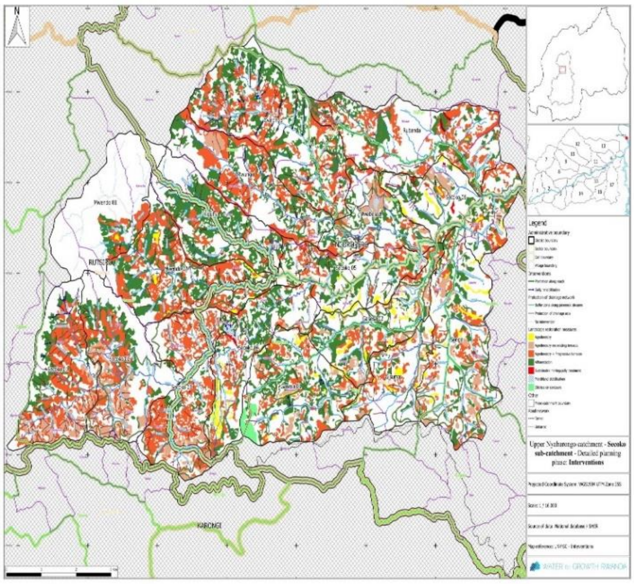


Figure 7: Picture illustrating the rehabilitation works in the Secoko Sub-Catchment with terraces.

Many stakeholders are involved in implementing the Catchment Plan, that requires coordination at catchment level to ensure consistency of individual projects that fall under the Upper Nyabarongo Catchment Plan. A provision for establishing

Catchment Management Committees was included during the revision of the law determining the use and management of water resources in Rwanda in 2018. A ministerial order governing these committees has been drafted awaiting its publication in the official gazette.

The development of Upper Nyabarongo Catchment plan provided an opportunity for all stakeholders to learn about IWRM, SEA and spatial planning. Lessons learnt will be applied in the development of the next series of catchment plans, for 2024-2031 and 2031-2038.

Indirect effects

The integrated SEA – IWRM approach supported the development of four catchment plan simultaneously. The plan for the Upper Nyabarongo catchment was one of these plans. Based upon this experience a manual was prepared by the ministry of water resources how to develop a catchment plan by making use of SEA-IWRM. Presently, catchment plan supported by SEA-IWRM are under preparation in the remaining five category 1 catchments.

6.4 Results and lessons learnt

The Upper Nyabarongo Catchment plan was together with three other catchment plans, the first which were prepared in Rwanda in a truly participatory manner. Innovative was the integration of the SEA process steps into IWRM-based catchment planning approach. Another innovation brought by the SEA was the development of inter-district collaboration around natural resources, based on catchment boundaries, and by establishing a Catchment Task Force comprising of district vice mayors, district technical staff, and representatives of NGOs, National Women Council, National Youth Council and the Private Sector Federation. Innovations were also made at the technical level. GIS was used to map spatial information that is usually only shared through text and tables (information on key features, issues, opportunities, projects, etc.), and surveys were held to collect geo-referenced data on water users.

Considering that the most pressing issue in the catchment is soil erosion which is negatively impacting hydropower development as well as the development of domestic water supply systems; an innovative tool named "Catchment Restoration Opportunity Mapping and Decision Support System" was developed in order to locate areas prone to soil erosion and to define appropriate control measures. This tool was later upscaled at national scale and is now widely used for planning and reporting on soil erosion control interventions primarily by district but also central government agencies.

In addition, as a result of the planning process and SEA, a water allocation model was developed in order to ensure equitable water resources allocation and therefore preventing water use conflicts among competing uses water utilities and hydropower developers.

The preparation of the catchment plan by making use of the integrated SEA inclusive IWRM approach resulted in the following four lessons for future use:

1. IWRM and SEA are both participatory processes. Both are equally valuable in shaping the participatory process. SEA secures quality in the development and approval of catchment plans and has the potential to enhance buy-in of stakeholders at an early stage.
2. The structured process allowed for plan development in a participatory manner, with representatives of national and local government, and of NGOs, the National Women Council, and the Private Sector, with the local level brought together in the Catchment Task Force. Furthermore, primary beneficiaries (the population and businesses in the catchment) participated at field level in the areas where projects were implemented or under preparation. At all levels, the opportunity to participate from the earliest stages of plan and project development was appreciated by stakeholders.
3. The use of GIS and map development is still limited, certainly at district level. Much of the data is only available in tabular or textual form or can only be obtained verbally or on site. Sharing of (spatial) information is not formalised, and in practice often tedious and incomplete. Availability of this information is a condition integrated spatial planning, such as catchment planning.
4. The integrated approach to the catchment development plan resulted in a set of measures that will stop and prevent soil erosion which is necessary to (i) secure the utilisation of the existing hydropower capacity and (ii) find investors who

are interested to develop new hydropower projects.

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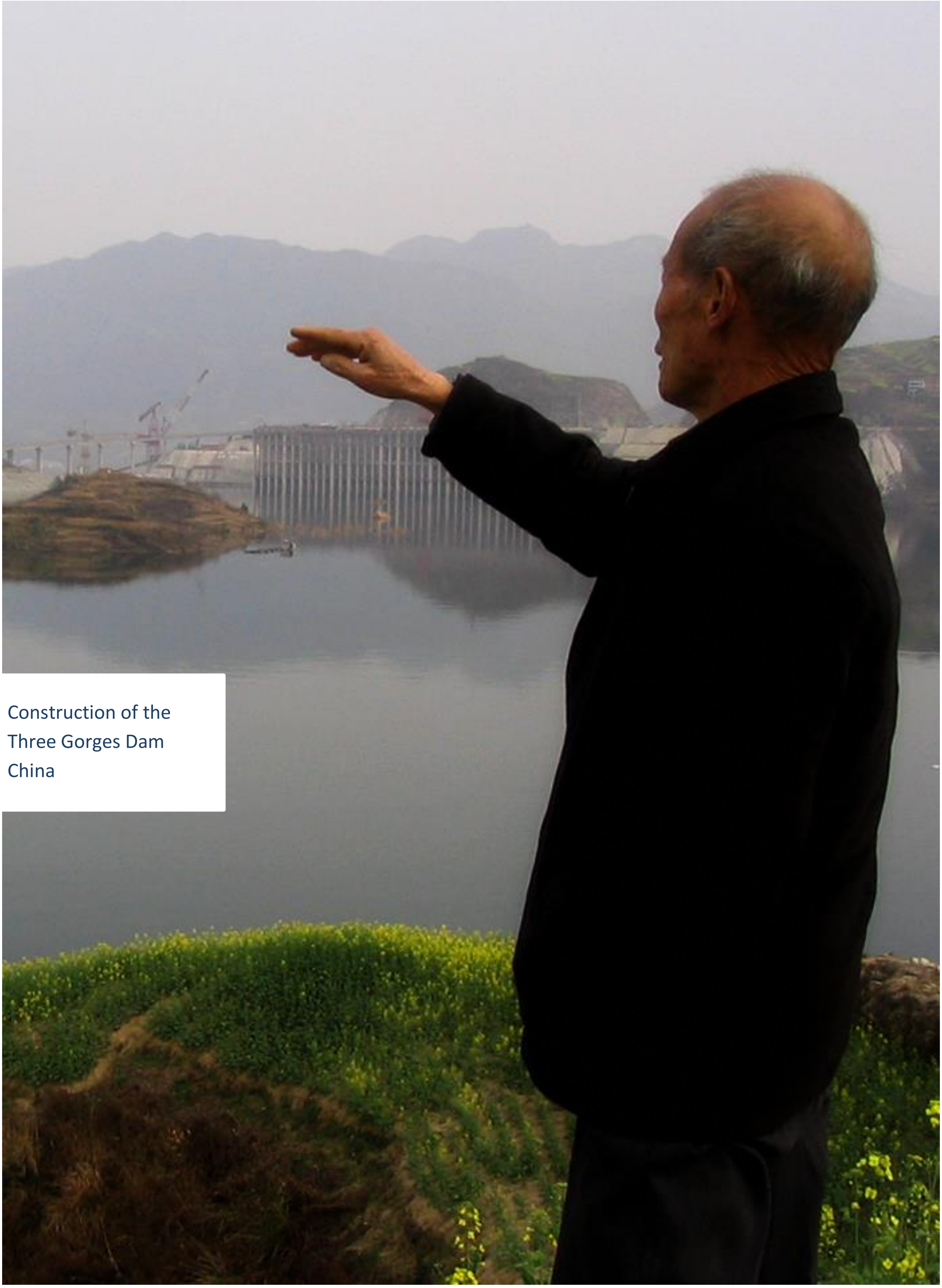

Construction of the
Three Gorges Dam
China

7 SEA's INFLUENCE ON DECISION-MAKING AND LESSONS LEARNT

In this chapter the following question will be answered: *How influential were these five SEA's and what lessons can be learnt?*

To start with SEA's influence, we see three main areas where the SEAs played a crucial role: awareness of the impacts by the key actors, cooperation between government authorities and providing a reference for lower level assessments such as CIA and ESIA. These three areas influenced decision-making, ultimately contributing to more sustainable development. In Annex 6 the results of the five cases are presented in a table by making use of criteria describing the output, outcome and impact.

7.1 Main areas of influence

Awareness of impacts
The SEAs contributed to a broader awareness of the impacts of energy and hydropower plans. Information on the impacts of different scenarios such as the areas affected, possible risks, and related costs was very useful for planners and project developers, decision-makers and affected communities at large.

SEA aims to provide information for stakeholders and the general public in a transparent manner. SEA enables a heightened level of awareness of risks at an early stage of planning. In the Azad Jammu and Kashmir State case, the assessment and its resulting maps enabled hydropower planners to fully understand the cumulative implications of large-scale developments; Myanmar has a history of conflict and protest against hydropower development. SEA was used to raise awareness amongst all stakeholders, utilising different tools and approaches and the SEA summary was translated into 6 local languages resulting in broader understanding in the States and Regions of the findings and recommendations. In Rwanda, the SEA provided insight in the causes of the underutilization of present hydropower projects through the execution of an integrated multi-sector analysis with all main stakeholders.

Government cooperation
The SEAs contributed to cooperation and exchange between government authorities.

Multi-sectoral co-operation through SEA was new for the energy authorities in all five countries. In Azad Jammu and Kashmir State four separate government agencies proposing HPPs collaborated for the first time and in the end created the AJK Hydropower Coordination Committee. In Myanmar, in response to the SEA, the government took measures to improve coordination between ministries by inter-ministerial committees. The Viet Nam case was a cooperative effort by the Ministry of Industry and Trade, its subsidiary, the Institute of Energy, Ministry of Natural Resources and Environment and the Prime Minister's Office. In Myanmar the SEA built horizontal collaboration in national government, but also vertically, namely the collaboration between national and lower tiers of government. The SEA case in India was one of the first processes lead by the in 2016 established River Ganges Basin Authority chaired by the prime minister. This basin authority secured horizontal and vertical coordination with other relevant authorities, including the federal energy authorities and the Uttarakhand authorities. In Rwanda the agency responsible for the plan and SEA is the Water and Forestry Authority (RWFA). A steering committee consisting of representatives of relevant authorities chaired by the Ministry of environment was set up at national and basin level to secure horizontal and vertical coordination between authorities and other stakeholder groups.

Reference framework for lower-level assessments
The SEAs provided a reference for lower level planning and assessment studies, both from a regulatory perspective and in the provision of information.

The information collected by the Azad Jammu and Kashmir State SEA was extensively used in a CIA associated with a single dam in the Poonch river, one of the sub-basins. In Myanmar a CIA of Mytinge Basin, recommended in the SEA as a priority follow up, started in January 2019. The Myanmar environmental authorities use the SEA as a review framework for environmental assessment of risk and eventual decision-making of hydropower projects. In Viet Nam the baseline assessment, database and GIS system have informed three other strategic planning studies. The SEA contained specific recommendations for lower level ESIAs and ESMPs.

Influence on decision-making
The SEAs influenced decision-making and had other important spin-off impacts.

In the India and the Viet Nam cases the SEA had profound influence on decision-making. In Viet Nam it resulted in significant changes in the revised power development plan, which was more ambitious with regard to hydropower and other renewables, while significantly reducing coal-fired thermal power. This is the 'classical' way SEA can influence planning. In India, the outcome of the SEA resulted in a new law on environmental flows in the Ganges Basin. This law had far-reaching consequences for all dam projects in the Ganges Basin, including existing ones that have a three-year period to adjust to the new situation. It solved the delay in decision-making for individual projects since it created clarity about the future of 39 planned projects of which 24 were stopped. As a result, it calmed down the social tensions regarding the planned projects. The Myanmar case resulted in a sustainable development framework for the hydropower sector to support decisions about project locations; it is too early for a final judgement. The SEA did result in a follow up cumulative impact assessment in one river basin that was categorised as low conservation value and findings incorporated into NGO studies on specific river basins. Members of the Myanmar Hydropower Developers' Association were able to utilise the information for their own internal decision-making around specific assessments to be carried out. The Azad Jammu and Kashmir State case was a pilot case without linkages to formal decision-making, but with significant effects on awareness raising and eventual decision-making through the establishment of a Hydropower Coordination Committee. In Myanmar the upcoming decisions on hydropower projects will determine to what extent the SEA influences decisions for these projects

7.2 Lessons learnt

We have identified seven lessons that can be learned from these cases. These lessons are applicable for all SEAs supporting strategic planning of the hydropower sector.

Lesson 1 - Regulatory framework
SEA can be applied in regulated and unregulated situations; sufficient international guidance and expertise is available.

Apart from the Viet Nam case, the other four cases worked without a formal regulation steering the SEA process. This did not hinder effective implementation of SEA because there is international understanding on what constitutes good practice SEA. In all cases international acknowledged good practice guidance was used (OECD-DAC, 2006; UNECE, 2012).

Lesson 2 - Plan or SEA in the lead
SEA is in general applied to support formal decision-making as part of a predefined policy, plan or programme, but can also be used to inform governments on potential development pathways in situations where no government policy, plan or programme is in place.

In most cases an SEA is linked to formal strategic decisions on new policies, plans and programmes. Yet, only the Viet Nam and Rwanda cases had a formal plan as a starting point, i.e. respectively the seventh national energy development plan and a river basin plan. The integration of SEA in river basin planning in Rwanda provided quality and efficiency gains in the development and approval of the catchment plans. For the other cases it was the prospect of uncoordinated development of multiple hydropower projects that triggered the need for a strategic level assessment. The SEA was leading and demonstrated the need for other planning, licensing, or legal processes.

According to good practice, SEA and planning processes should start simultaneously and should be carried out in an integrated manner to be most effective. Again, this only applies to the Viet Nam and Rwanda cases, in the other three cases the SEA proactively assessed consequences of planned hydropower projects and it was reactive to existing HPPs or those under construction. This might be explained by the fact that these cases were the first SEA applied in the sector and the authorities were not yet aware of the benefits of aligning the SEA and the formal planning process.

Lesson 3 – Alternatives
Developing and comparing alternatives are best practice in SEA but the kind of alternatives to examine cannot be prescribed; they are case and context specific.

All cases developed alternatives to be able to compare potential consequences of different development pathways. The way alternatives were formulated varied widely and were highly case and problem specific. The defining variable in India, simply was the number of dams to be developed. In Myanmar the sensitivity of sub-basins was used to categorise the suitability for development of hydropower projects. In Azad Jammu and Kashmir state the sensitivity of river stretches was the defining variable. In Viet Nam fuel mix and energy efficiency defined the alternatives. In Rwanda four alternatives were elaborated representing different measures to combat underutilization of power capacity.

Lesson 4 - Stakeholder involvement
Stakeholder involvement is essential in SEA and application is highly case and context specific. Scope and geographic range of the plan, issues at stake and legacy of earlier experiences determine the way stakeholders are involved.

In Azad Jammu and Kashmir State, four government HPP proponents working in the same river basin collaborated for the first time. The security situation hindered broad consultation. Instead a stakeholder mapping exercise provided relevant information. In Myanmar the legacy of existing hydropower projects in areas with severe social tensions and even armed conflict led the SEA team to adopt the principle that there should be no surprises in the final report, so stakeholders had to be involved in each step. It resulted in 55 stakeholder engagement events nationwide and incorporated a conflict lens in the assessment and recommendations. In India, stakeholders involved came from public and private sectors, science and the NGO community, while in Viet Nam the broad national scope of the planning exercise (energy planning at national level) made the SEA teamwork with formal stakeholder organisations only. The SEA conducted in Rwanda also benefited from extensive consultation with representatives of all affected stakeholder groups during each step of the process.

Lesson 5 – Limited availability of data is no bottleneck
Limited availability of data does not seem to be a bottleneck for SEA. Methodologies can be adapted to available data, stakeholders can assist in filling gaps, access to former planning and assessment studies greatly facilitates new studies. Of course, it remains important to be transparent on gaps in information in the assessment.

In India significant biodiversity baseline data was available due to the high biodiversity values of Uttarakhand state. This was enough to map out the direct cumulative impacts of the combined hydropower projects. The indirect impacts on the downstream reaches of the Ganges were closely linked to the upstream biodiversity values and provided a sufficiently detailed way to define the minimally required environmental flows. In Azad Jammu and Kashmir State, the consultants were fortunate to have access to baseline data for rivers, collected earlier for an environmental study. Consequently, the SEA's access to data was adequate. In Viet Nam data from the 6th power development plan was still valid or updated where needed. The impact analysis introduced an innovation by combining extended use of spatial analysis in GIS with the application of cost factors per unit of impact. Given the strategic nature of the plan and the long-time prospect of the assessment (20 years) exact modelling exercises were not needed, and available national statistics provided sufficient data. In Rwanda and Myanmar, the SEA process made optimal use of the limited data available. As a result of the SEA process in Rwanda, a water allocation model was introduced and will be operational to be ready for the development of future catchment plans. In Myanmar, GIS was predominately used to fill gaps and show a layered approach to risks and impacts. On the other hand, the Vietnam case showed that quantification / monetization of benefits and costs using appropriate statistical and spatial models supported the government to accept the recommendations made in the SEA.

> **Lesson 6 – Government commitment and funding required.**
> Government commitment is a condition for influential SEA. In low-income countries external / international budget is required to implement good practice SEA.

The Viet Nam and India cases show that ownership, shared between plan-owning departments and environmental departments, leads to effective implementation and significant results. In Viet Nam local capacity gradually increased and external inputs could be reduced. India shows that commitment and available in-country capacity leads to full ownership and complete funding of the instrument. Four cases have been implemented with international support, both in terms of budget and international expertise. Only the India case was completely owned, implemented, and funded by Indian experts, institutions, and project planners. In Viet Nam strong commitment of both energy and environmental departments allowed for a stepwise reduction of international inputs over a period of ten years even though budget support was still available.

> **Lesson 7 – More evaluation of hydropower planning**
> An overall observation is that it takes many years to be able to see the actual impacts of planning, assessment and decision-making processes. In this respect it is a pity that so little ex-post evaluative studies are being carried out for the hydropower sector. There is little information on the effectiveness of SEAs, CIAs and ESIAs to address sustainability of the sector.

7.3 Agenda for the coming years

This report showed the added value of SEA supporting strategic planning of the hydropower sector. SEA is increasingly acknowledged by the key actors involved in the development of a more sustainable hydropower sector. However, the use of SEA is still underutilised and therefore the authors of the five cases and the two editors present the following agenda. The objective of this agenda is to provide 'practical' starting points to increase the application of SEA. The actions are specified for the main actors.

<u>All actors:</u>

- develop guidelines for strategic planning of the hydropower sector, including SEA. To secure application, these guidelines should be adopted by platform organisations such as IHA, ICOLD, IAIA and governments.

<u>Government authorities:</u>

- provide river basin authorities with the necessary knowledge to use SEA jointly with IWRM to support balancing of different interests in a river basin plan.;
- collect and share examples of how SEA can lead to economically efficient outcomes, and reductions in environmental and social risks.
- emphasise the importance of SEA to stakeholders as an effective tool for conflict resolution.
- spent more time on the evaluation of earlier planning, assessment and decision-making as well as whether this has resulted in the expected impacts.

<u>Investors in hydropower projects:</u>

- require to adhere to an SEA and/or request an SEA or CIA to be conducted.
- Refer to SEAs where available, when the need for ESIA project is determined (screening phase).

<u>Multilateral Development Banks:</u>

- ask governments for SEAs on energy policy, hydropower plans, river basin plans and programmes for cascades of projects in a sub-catchment of a river basin;
- avoid confusion between application of SEA and CIA, and apply CIA to assess the cumulative

impacts of one or more projects in a sub-catchment;

- need to study cumulative impacts needs to be studied as part of ESIAs;
- provide means for additional studies if required and support governments in developing SEA capacity.

SEA practitioners and scientists:

- present the outcomes of an SEA in an (visually) attractive summary. Decision-makers do not always need to read long SEA documents to be able to make informed decisions.
- evaluate methodologies and the incorporation of tools such as Hydropower by Design, Rapid Basin-wide Assessment tool, and the Cumulative Impact Assessment and Management Good Practice Handbook to improve effectiveness and efficiency of SEA.

Morning catch
Siphandone river
Lao

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ANNEX 1: BRIEF DESCRIPTION OF OTHER TOOLS SUPPORTING HYDROPOWER DEVELOPMENT

1. INTRODUCTION

In this Annex the following tools are briefly described:

- Cumulative Impact Assessment (CIA);
- Hydropower Sustainability Assessment protocol (HSA protocol);
- Hydropower by Design (HbD);
- Rapid Basin-wide Hydropower Sustainability Assessment Tool (RSAT).

Environmental Impact Assessment (EIA) is a tool that is not described as it assumed to be well-known as a legal decision-support tool that is mandatory in all countries. Increasingly, the term ESIA is used because social issues are included as well.

For each tool, the following information is presented:

- Description and objective;
- Application in hydropower development;
- Key references.

Moreover, a comparative assessment of the characteristics of these tools are presented in table 1 and figure 1.

2. CUMULATIVE IMPACT ASSESSMENT (CIA)

Description and objective

Cumulative Impact Assessment (CIA) is also known as Cumulative Effects Assessment (CEA). CIA has been a key element of good-practice impact assessment for more than 40 years in countries such as the United States and Canada. It is now implemented widely in many countries. The International Finance Corporation (IFC, 2013) of the World Bank defines CIA as: “The process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen [valued component] over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risks to the extent possible.”

In summary CIA supports decision-making of projects by assessing the cumulative impacts of one or more hydropower projects. A CIA can be conducted as part of an ESIA or as a separate study.

Application in hydropower development

The International Finance Corporation (IFC, 2013) ‘Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets’ is commonly accepted as the standard for CIA supporting hydropower development. IFC is one of the financial institutes frequently asking for CIAs to assist primarily companies but sometimes also governments to consider the cumulative impacts of planned and existing hydropower projects from a broad, basin-wide perspective that includes upstream and downstream developments, not directly related to hydropower development. IFC has mainly applied CIAs as a voluntary tool supporting funding decision of hydropower projects in South and South-East Asia. In Appendix 5 a list is presented of all finalised CIAs (N=16) that have been identified through a web search.

Key references

Besides the IFC (2013) publication, country-specific guidelines for CIA supporting hydropower development have been made by Turkey, Lao and Nepal.

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3. The Hydropower Sustainability Assessment Protocol (HAS-Protocol)

Description and objective

The HSA-protocol is developed by the International Hydropower Association (IHA, 2018). It is a tool that promotes and guides more sustainable hydropower projects. It provides a common language that allows governments, civil society, financial institutions and the hydropower sector to talk about and evaluate sustainability issues. The Protocol offers a way to assess the performance of a hydropower project across more than 20 sustainability topics. Assessments are based on objective evidence and the results are presented in a standardised way, making it easy to see how existing facilities are performing and how well new projects are being developed. The Protocol has many uses each with a distinct value, such as: review of sustainability issues, guiding sustainability issues, comparison with international best practice, communication with stakeholders, facilitating access to finance, preparing clients to meet bank requirements, increase awareness on SHD at all levels of decision making and reducing risk of investment opportunities. It has an 'Early-Stage Tool' concerned with the strategic environment from which proposals for hydropower projects emerge and the early identification of project risks and opportunities. The stages in the assessment process, including demonstrated demand, options assessment, legal and regulatory framework, institutional capacity, technical, social an environment risks, all sound very much parts of the content of an SEA study except that in this tool it is not always applied in a transparent way like SEA.

Application for hydropower development

This tool is exclusively developed to support the development of more sustainable hydropower. The tool has been applied about 30 times (personal communication by IHA). In the majority of these applications the findings are not publicly available. Application of the tool in the Zambesi resulted in a report that is included as a key reference.

Key references

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- World Bank, 2018. . World Bank, Washington, DC.

4. Hydropower by Design (HbD)

Description and objective

Hydropower by Design (HbD) has been developed by The Nature Conservancy (TNC, 2017). HbD is a voluntary approach that provides decision makers with energy development options, able to meet their demands at the time of energy growth with similar or even lower financial costs, while avoiding or greatly reducing social and environmental conflicts and consequences that would result from traditional approaches. HbD is a framework that utilises participatory processes and a suite of analytical tools to integrate environmental, social, economic, and energy considerations into alternative project siting and operations options. It incorporates effects of reservoirs, project sites, roads, transmission lines, and downstream flow alteration with energy generation, costs, and financial performance of different combinations of sites and operations. It illustrates the potential trade-offs for stakeholders across the range of alternative scenarios and identifies those options that achieve energy goals while best addressing the collective concerns of stakeholders engaged in or affected by hydropower planning decisions. HbD can be complementary to SEA. This approach is suitable to develop and assess alternatives that can be used in SEA. See the publication (TNC and NCEA, 2019) included as a key reference for more information.

Application for hydropower development

This tool exclusively supports the development of more sustainable hydropower. The tool has been applied several times, a description of these applications are presented in the publication; The Power of Rivers, a business case (TNC, 2017). Jointly with a consortium led by Manchester University, TNC is building on HbD and developing Energy by Design. A tool that supports strategic planning of energy system development in an integrated manner, also including water, food and environmental interests at system scale.

Key references

- The Nature Conservancy (TNC) 2017. The power of rivers, a business case.
- TNC, 2018. Hydropower by Design: A Guide - A System-scale Approach to Hydropower Planning and Management.
- The Nature Conservancy and the Netherlands Commission for environmental Assessment, 2019. A Strategic Approach to Hydropower Development. Applying Hydropower by Design within the context of Strategic Environmental Assessment to achieve hydropower goals in a sustainable and equitable manner.

5. The Rapid Basin-wide Hydropower Sustainability Assessment Tool (RSAT)

The Rapid Basin-wide Hydropower Sustainability Assessment Tool (RSAT) has been developed since 2010 by the Mekong River Commission (MRC) in collaboration with World Wildlife Fund (WWF) and Asian Development Bank (ADB) (RSAT, 2016). Trials were tested in Lao, Thailand, Cambodia and Vietnam. The RSAT is a voluntary multi-stakeholder dialogue and assessment tool designed to consider hydropower sustainability issues in a river basin context. It is focussed on the Mekong Basin. Placing hydropower in a basin-wide context requires looking beyond individual projects to take a broader integrated approach to planning and management.

Application for hydropower development

Application of RSAT can assist to identify development strategies, institutional responses and management measures that can be deployed to optimise the benefits of hydropower development and reduce the risks. The authors emphasise RSAT cannot replace SEA but can be complementary. WWF assesses the value of applying RSAT within an SEA context (MRC, 2018).

Key references

- Mekong River Commission (MRC), ADB & WWF, 2016. Rapid Basin-wide Hydropower Sustainability Assessment Tool.
- Mekong River Commission (MRC) 2018. The Rapid Basin-wide Hydropower Sustainability Assessment Tool; 2016 Edition; 2nd reprint 2018.

In table 1, the five tools described are compared by making use of selected criteria. In figure 1, these tools are positioned on a continuum from strategic planning on the left side towards project planning on the right. Moreover, the main decisions taken in the development of hydropower are also linked to the project–strategic planning continuum.

6. Comparison between tools

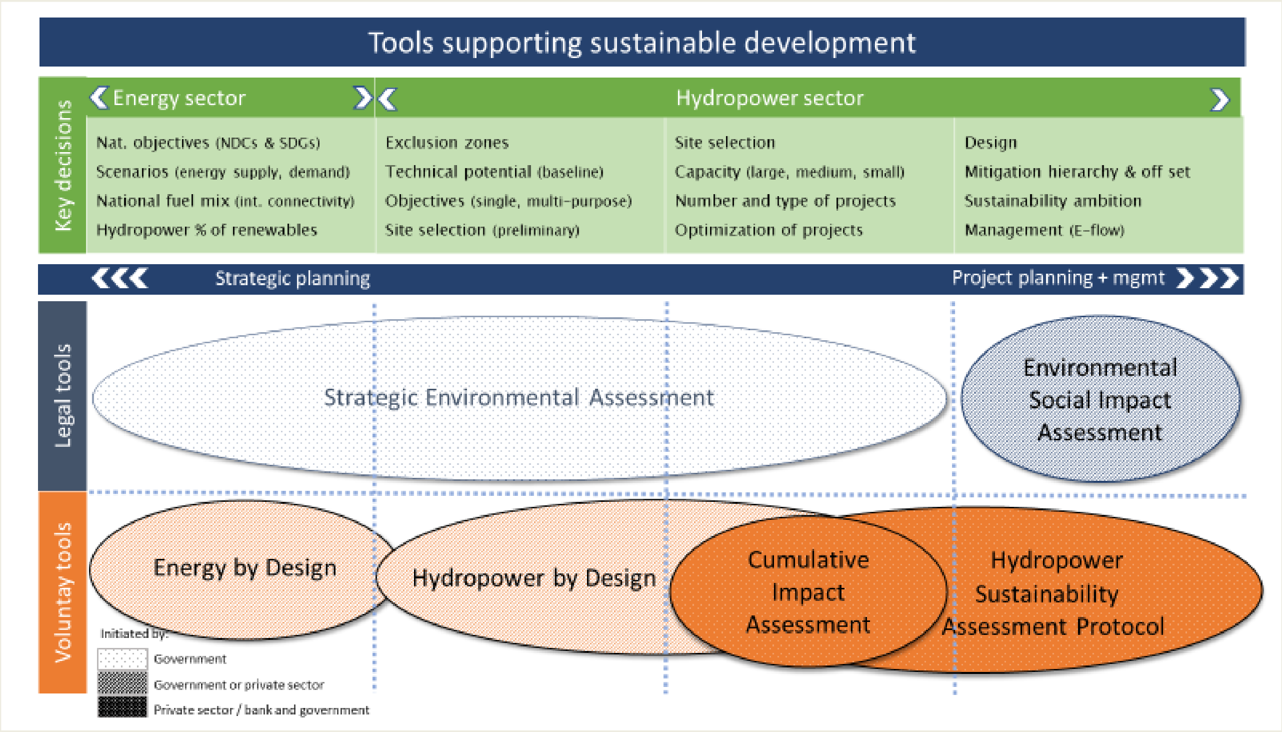
In table 1, the five tools described are compared by making use of selected criteria. In figure 1, these tools are positioned on a continuum from strategic planning on the left side towards project planning on the right. Moreover, the main decisions taken in the development of hydropower are also linked to the project–strategic planning continuum.

Table 1: Characteristics of approaches supporting development of hydropower

	SEA*	CIA **	IHA protocol	HbD	RSAT
Legal status	~106 countries	No	No	No	No
Responsible	Government	Private Banks	Private	Government Private	Government NGOs
Purpose	Balanced future development	Evaluation related projects	Project evaluation	Optimisation of interests	Optimisation stakeholders benefits
Scope	Policies Plans (basin, (national) Programmes	Projects	Project	Plans (basin) Programmes Projects	Plans (basin)
Outcome	Alternative sites, types, purposes, sizes	Cumulative env soc impacts Mitigating measures	Sustainability impacts Scorecard & mitigating Measures	Alternative sites, types purposes, sizes	Stakeholder commitment, alternatives, mitigating measures
Number	37	16	~ 30	5	4

*) All SEAs as listed in Annex 2, 3 and 4.
**) All CIAs are listed in Annex 5.

Figure 2: Tools supporting sustainable development of hydropower sector



Source: This figure is prepared by the following organisations, during meetings between December 2019 and March 2020: The Nature Conservancy, International Hydropower Association and The Netherlands Commission for Environmental assessment.

ANNEX 2: LIST OF SEAS APPLIED FOR POLICIES, PLANS OR PROGRAMMES IN THE ENERGY SECTOR, INCLUDING HYDROPOWER

Strategic Environmental Assessment for the Energy sector, including hydropower*						
Cases (with hyperlink to documents if available)		**Country**	**Scale / Basin**	**Year / status**	**Subject of SEA**	**Level of influence**
1	SEA or Energy Policy. SEA case description available on request*.	Slovak Republic	National	1997 and 2000	Energy policy	Moderate
2	SEA for Energy Policy. SEA case description available on request*.	Czech Republic	National	2002	Energy policy	No
3	Strategic/Sectoral, Social and Environmental Assessment of Power Development Options in The Nile Equatorial Lakes Region SEA report available.	Nile Equatorial Lakes Region	International	2007	Energy policy	Low
4	SEA for National Energy Policy. SEA case description available.	Ghana	National	2008	National energy Policy	Low
5	SEA for Power Development Plan VII. SEA report available: https://gms-eoc.org/resources/two-seas-on-power-development-planning-in-viet-nam	Viet Nam	National	2011	Power development plan VII (ex-ante)	High
6	SEA for Saskatchewan electricity planning. SEA report not available.	Canada	State / province	2012	Electricity supply plan	Unknown
7	SEA for National Energy Development Strategy by 2030. Summary and review of SEA available: http://www.greenhome.co.me/fajlovi/greenhome/attach_fajlovi/eng/main-pages/2013/07/pdf/Review_Of_The_SEA_For_The_Draft_Energy_Development_Strategy_In_Montenegro_By_2030.pdf	Montenegro	National	2013	Energy strategy	Unknown
8	SEA for Revised Power Development Plan VII. SEA report not available.	Viet Nam	National	2014	Revised power development plan VII	High
9	SEA for Energy Sector Development Strategy. SEA report available: https://mingor.gov.hr/UserDocsImages/UPRAVA-ZA-PROCJENU-UTJECAJA-NA-OKOLIS-ODRZIVO-GOSPODARENJE-OTPADOM/Spuo/29_08_2017_SPU_POS_Strategija_RS.pdf	Serbia	National	2015	Energy strategy	Low
10	SEA for GMS power planning SEA report available.	Greater Mekong subregion 6 countries	International	2015	Power development plan	Unknown
11	SEA for National Energy Sector Policy SEA report available.	Rwanda	National	2015	Energy sector policy	Unknown
12	SEA for National Power Policy*. SEA case description available on request.	Taiwan	National	2015	National power plan	Moderate
13	SEA for National Strategy of Renewable Energy. Summary of SEA report available: https://unece.org/fileadmin/DAM/env/greeneconomy/Lea/EaP/SEA_Azerbaijan.pdf	Azerbaijan	National	2016	Nat. renewable energy strategy incl. hydropower	Unknown
14	SEA for Power Development Master Plan. SEA report available on request.	Angola	National	2018	Power development master plan	Unknown
15	SEA for Master Plan Study on National Power system development. SEA report available as part of master plan. https://africa-energy-portal.org/sites/default/files/2019-	Nigeria	National	2019	Power development master plan	Unknown

	07/Master%20Plan%20Study%20for%20Power%20Sector%20System%20Development%20in%20Nigeria.pdf					
16	SEA for National Power Power System Master Plan 2040. SEA report available as part of master plan. https://openjicareport.jica.go.jp/pdf/12326856_01.pdf	Bhutan	National	2019	Power development master plan	Unknown
17	SEA for National Power Plan. SEA report not yet available.	Cambodia	National	On-going	Power development plan	…
18	SEA for Power Development Plan VIII. SEA report not yet available.	Viet Nam	National	Ongoing	Power Development Plan VIII	…

*) SEA in which hydropower is not considered

ANNEX 3: LIST OF SEAS APPLIED FOR POLICIES, PLANS OR PROGRAMMES OF THE HYDROPOWER SECTOR

Strategic Environmental Assessment Hydropower sector						
	Cases (with hyperlink to documents if available)	**Country**	**Scale / Basin**	**Year / status**	**Subject of SEA**	**Level of influence**
1	Nepal medium hydropower SEA. SEA report not available. Source: SEA in the World Bank 2012	Nepal	National	1997	Policy selecting suitable sites for HPPs 10-300 MW	High
2	Strategic Environmental Assessment for Hydropower. SEA report not available. Source: SEA in the World Bank 2012	Lao PDR	National	2004	National plan assessing 22 planned HPPs 2004-2022	Unknown
3	SEA for Long-term Plan for dam construction. SEA report not available. Source: SEA for Long-Term Plan for Dam Construction (various purposes)	South Korea	National	2007	National 10yr dam construction plan assessing existing and planned sites and selecting new sites for dams incl. HPP	High
4	SEA for Quang Nam province Hydropower Plan. SEA report available: SEA of the Quang Nam Province Hydropower Plan for the Vu Gia-Thu Bon River Basin	Viet Nam	Province (Quang Nam) Vu Gia – Thu Bon basin	2008	Hydropower development plan for the 2006-2010 assessing 40 HPPs	High
5	SEA for Hydropower Master Plan. SEA report available: Strategic Environmental Assessment Of The Hydropower Master Plan In The Context Of The Power Development Plan VI	Viet Nam	National	2009	Hydropower master plan as part of National Power Development Plan VI	Moderate
6	SEA for Mainstream Dams. SEA report available: https://www.mrcmekong.org/assets/Publications/Consultations/SEA-Hydropower/SEA-Main-Final-Report.pdf	Lao, Thailand, Cambodia Viet Nam	International Mekong basin	2010	Policy assessment of 11 HPPs in mainstream of the lower Mekong river	Moderate
7	SEA for Moraca rivee basin. SEA report not available. Source: SEA of Morača River HPPs	Monte-negro	Morača basin	2010	Spatial plan assessing 4 HPPs	Low
8	SEA small hydropower plants. SEA report available: https://www.yumpu.com/en/document/read/11592648/strategic-environmental-assessment-small-hydropower-plants-	Georgia	Agravi basin	2010	Site selection of projects < 13MW	Moderate
9	SEA for Local spatial plan. SEA report not available. Source: SEA for Special Purposes Plan for HPPs Brodarevo 1 and 2	Serbia	Municipality Lim river (reservoir trans-boundary with Monte-negro)	2011	Spatial plan assessment of two HPPs	Low
10	SEA for Punasangchu river basin. SEA report available on request.	Bhutan	Punasang-chu river basin	2011	Assessment of 5 mega-HPPs in one basin	Unknown
11	SEA for Hydropower development in Uttarakhand. SEA report available: http://www.indiaenvironmentportal.org.in/content/352274/assessment-of-cumulative-impacts-of-hydroelectric-projects-on-aquatic-and-	India	State (Uttarakhand) and Alaknanda and Bhagirathi	2012	Hydropower development plan assessing 70 HPPs in varying development phases	High

	terrestrial-biodiversity-in-alaknanda-and-bhagirathi-basins-uttarakhand/		basins (upstream Ganges)			
12	SEA for National hydropower master plan. SEA report available as part of masterplan: Nationwide Master Plan Study on Storage-type Hydroelectric Power Development in Nepal.	Nepal	National	2014	HP master Plan select 10 reservoir type HPPs	Unknown
13	SEA for Hydropower development in AJK. SEA report available:	Pakistan	State (Azad Jammu and Kashmir)	2014	Hydropower plan 62 HPPs in varying development phases	High
14	SEA for Hydropower development Sutlej river basin. SEA report available on request.	India	Sutlej basin (Himachal Pradesh)	2014	Assessing cumulative impacts of 38 HPPs	Moderate
15	SEA of small hydr power development policy. SEA report available: SEA of Small Hydro Power Development Policy	Albania	National	2018	Policy on small HP	Unknown
16	SEA for National hydropower development. SEA report available: SEA of the Myanmar Hydropower Sector	Myanmar	National	2018	Hydropower Policy	Moderate
17	SESA od river plans and hydropower masterplans. SEA report not yet available.	Nepal	National	On-going	SESA of river basin plans and HP master plans	…

ANNEX 4: LIST OF SEAS APPLIED FOR MULTI-SECTOR POLICIES, PLANS OR PROGRAMMES, INCLUDING HYDROPOWER

Strategic Environmental Assessment Multi sector (water / river basin plan including hydropower)						
Cases (with hyperlink to documents if available)		**Country**	**Scale / Basin**	**Year / status**	**Subject of SEA**	**Level of influence**
1	SEA Rio Madera. SEA case description available on request.	Bolivia	International river basin	2012	Regional planning	Low
2	SEA Mara river basin. SEA report available on request.	Kenya Tanzania	International river basin	2012	Integrated planning	Low
3	SEA for River basin plans. SEA report available as part of plan (4x): https://waterportal.rwb.rw/publications/catchment_plans	Rwanda	National, 4 river basins	2015	Integrated planning	Moderate
4	SEA National Water Strategy. SEA report available: strateska_studija.pdf (gov.hr)	Serbia	National	2015	Water wide	Unknown
5	SEA for River basin plan. Summary of SEA report available on request.	Croatia	National, all river basins	2016	Integrated planning	Unknown
6	SESA of Integrated Water Resources Management and Development Plan for six water basins	Tanzania	Six of the in total nine basins	On-going	Integrated planning	…

ANNEX 5: LIST OF CIA STUDIES APPLIED FOR HYDROPOWER DEVELOPMENT

Cumulative Impact Assessment					
Case (with hyperlink to documents if available)		Country	Scale / Basin	Year / status	Subject of CIA
1	Report available: Cumulative Impact Analysis And Nam Theun 2 Contributions	Lao PDR	Nam Theun 2	2004	One dam
2	Report available: Rampur Hydropower Development (Cumulative EA)	India	Satluj basin	2006	Basin-wide HPPs; inter-basin water transfer
3	Report available: https://www.adb.org/sites/default/files/project-document/66414/40514-lao-tar.pdf	Lao	Nam Ngum river basin	2007	One dam in cascade of five dams
4	Report is not available: Integrated Kafue River Basin Environmental Impact Assessment Study -	Kafue river, Zambia	Kafue river basin	2008	Two dams
5	Report available: Cumulative Impact Analysis - Alto Maipo Hydropower	Chile	Maipo river upper basin	2011	Unknown
6	Report available: CIA OF KABELI-A HYDROELECTRIC PROJECT	Nepal	Kabeli basin	2011	Six HPPs in one basin
7	Report available: Integrated Environmental Assessments for hydropower projects in 12 river basins (= cumulative impact assessments)	Brazil: various states	14 river basins	2007 - 2012	12 CIAs for HP projects
8	Report is not available: Evaluation Régionale Stratégique (ERS) des options de développement hydroélectrique et des ressources en eau dans le bassin du fleuve Sénégal	Senegal basin authority (OMVS)	International river basin	2013	Four dams
9	Report is not available: CIA Alto Maipo hydropower project	Chili	River basin	2013	One dam
10	Report is available: Cumulative Impacts and Joint Operation of Small-Scale Hydropower Cascades	Northwest Viet Nam	6 river basins	2014	Small HP cascades
11	Report is available: Gulpur hydropower Cumulative Impact Assessment	Pakistan	Poonch river	2014	One dam
12	CIA report is not available.	Lao	Nam Ou river basin	2016	Cascade 7 dams
13	Study on the Sustainable Development and Management of the Mekong River Basin, including Impacts by Mainstream Hydropower Projects. Report avaiable: Cumulative Impact Assessment Key Findings Report. (*The Council Study)*	Mekong River Commission	International Mekong river basin	2017	Mainstream dams
14	Report available: Nenskra hydropower project Supplementary Environmental and Social (E&S) Studies	Georgia	Nenskra and Enguri basins	2017	Dam, transport lines and inter-basin transfer
15	SEA Rufiji dam project. Report is not available.	Tanzania	Part of river basin	2019	Assessment of cumulative impacts of one HPP
16	Report available: CIA and management: hydropower development in Trishuli river basin	Nepal	Trishuli river basin (transboundary with Tibet)	2020	Renewable energy, mainly HPP and some irrigation
17	CIA Sekong river basin. Brief note is available: https://www.ifc.org/wps/wcm/connect/00f538c1-f5ae-47d5-82af-2a108eaf7b23/CIA+one+pager+FINAL+-+Eng+version.pdf?MOD=AJPERES&CVID=mlAxe17	Lao PDR	Sekong river basin	ongoing	Renewable energy options, including HPP

18	ToR is available: Cumulative Impact Assessment and Management of Renewable Energy Development in the Mytinge River Basin	Myanmar	Mytinge river sub-basin	ongoing	11 dams

ANNEX 6: OUTPUTS, OUTCOMES AND IMPACTS OF SEA IN FIVE CASE STUDIES

Criterium	Pakistan	Myanmar	India	Viet Nam	Rwanda
Outputs: quality of SEA					
SEA process complete	Followed OECD-DAC approach with additional methodology for cumulative impact assessment	SEA was the first in Myanmar (demonstration pilot). SEA was more a planning instrument rather than an impact assessment, providing a plan that moves the SEA from a report into implementation.	Not guided by legislation. Independent CIA, initiated as to address a requirements under EIA legislation for 70 HP projects. Partially ex ante, partially ex post resulted in hybrid approach.	SEA mandatory since 2005. Process steps based on international common practice	SEA followed OECD-DAC approach
Alternatives	HPPs ranked; suggested maximising synergistic potential of dams, transmission lines and related infra works.	Business as usual (uncoordinated project by project development), tested against Sustainable Development Framework (no HP in mainstem rivers; sub-basins differentiated: protection or development).	Three alternative development options: (i) commissioned projects only, (ii) commissioned and under construction, (iii) exclude 24 projects.	Three PDP energy demand forecasts; SEA suggested more sustainable base case scenario, adopted by PDP. SEA group added 2 alternative scenarios.	Four alternatives studied ranging from one to four measures to tackle soil erosion in river catchment.
Risks addressed	Social and environmental baseline, drivers and sensitivity mapped for river stretches; overlay with cumulative impact zones provides ranking of c.i. potential of HPPs.	Significant new information on low, medium and high-risk sub basins for HP development, conservation, (aquatic and terrestrial), local livelihoods, and conflict resolution.	Conflicting goals of maximising water withdrawal while maintaining the continuity of the (downstream) river flow in River Ganges. Interests of upstream aquatic and terrestrial biodiversity values coincide with downstream cultural and religious ecosystem services .	Specific impact indicators developed for each energy source.	No specific risks addressed.
Stakeholders involved	Direct HP project developers for the first time in one room. Security situation hindered broad consultation, but stakeholder mapping exercise provides relevant information.	Government, NGOs, private sector, development partners. Stakeholder engagement plan was first output. SEA team adopted the principle that there should be no surprises in the final report; stakeholders involved in each	National Council for River Ganga combines 6 ministries and ministry of environment in the lead; hydropower agencies, priests and hermits, local people and conservation community were also involved.	The SEA working group engaged closely with a wide range of organisations. Consultations throughout the process.	Catchment Task Force established consisting of representatives from all districts: authorities, private sector and CSOs.

		stage. 55 stakeholder engagement events nationwide.			
SEA integrated in plan process	No overall HP plan existed; SEA was first time ever look at the overall impacts of 60 HPPs.	Electricity master plan was under revision, environment policy was being drafted , river basin assessment had just started. So SEA assessed existing pipeline of 80 HP projects in the absence of any formal policy or plan.	India'first-ever cumulative impact assessment at basin level. Stand alone. Highlight limits of acceptable change for strategic decision-making to regulate and realign future actions.	Closely coordinated with simultaneous development of PDP VII. Both processes under working groups with 5 members participating in the other group.	SEA and Integrated Water Resources Management approach, new approach supporting river catchment plan.

Criterium	Pakistan	Myanmar	India	Viet Nam	Rwanda
Outcome: influence on decision-making					
Formal Decision taken	No formal plan or decision-making	SEA provides a Sustainable Development Framework for the HP sector to support decisions about project locations.	Decision-making on projects was delayed by the conflict. Gov of India speeded up a decision on environmental flow and enacted new legislation in 2018, before approval of new dams. E-flow levels were even higher than recommended in the SEA	PDP VII adopted in 2011, revised version in 2014. Both significantly influenced by SEA (22,000 MW reduction in coal fired capacity, shift from coal to oil, seven-fold increase in renewables with focus on small hydro, commitment to upscaling PFES as measure for mitigation/benefit-sharing).	The management plan of Upper Nyabarongo catchment adopted. Implementation of the plan started in 2020.
SEA recommendations taken into consideration in the plan		SEA process started a conversation on hydropower to shift fundamentally, from merits and localised impacts of individual projects to an informed discussion about how to achieve a balance between power generation and basin health	Resulted in new legislation	During the plan development process adjustments were already made to the plan. Later a formal revision resulted in even more ambitious energy efficiency and renewable energy targets.	During the development of the plan adjustments were made to the plan.
Support/awareness of plan improved	Assessment enabled decision-makers to fully understand the implications of large scale developments	History of conflict and protest against HP development. The SEA is supported by a program of actions, including briefings to Ministers, translating the SEA		Two national conferences with 70 experts, business and government representatives.	Frequent involvement of all relevant stakeholders during the process resulted in wide support

		summary into six local languages, providing training to staff, releasing data (GIS files) to public.			for the measures identified in the plan.
SEA resulted in change of plan or decision	SEA resulted in the creation of a coordinated hydropower plan for the state	SEA basin-level planning will de-risk hydropower projects by identifying development risks early in the project development cycle and providing solid justification for project siting from a basin sustainability perspective	Significant influence on Decision-making, even influencing existing HP projects	In revision of plan SEA outcomes influenced the plan significantly towards less coal-fired thermal, more renewables (notably small hydro) and promotion of PFES to mitigate residual impacts.	SEA is fully integrated in the development of the river catchment plan.
SEA resulted in better alternative incorporated		Basin Zoning Plans recommends areas for: (i) refrain from from hydropower development due to high values, and (ii) areas potentially suitable for hydropower development.	Resulting legislation enforces even stricter e-flow requirements.	Yes.	Not relevant as the SEA is fully integrated in the plan process.
SEA provided reference for future ESIAs	Information base and recommendations considered in Poonch river CIA.	CIA of Myitnge basin, recommended by SEA as a priority follow up, started in Feb. 2019.	Very clearly defined requirements for e-flows in complete Ganges Basin		Not yet but that could become the case.
Appropriate mitigation included in the plan		Many suggestions for improved planning (high risk, high value basins, methodology to integrate biodiversity into development planning, understanding of socio-economic, biodiversity and conflict issues in relation to HP planning		Power source specific mitigation and compensation measures recommended.	Zoning of areas that are more or less vulnerable to soil erosion. Measures linked to the identified zones.
Stakeholders concerns addressed in plan; stakeholder acceptance of plan		Stakeholder concerns were important inputs in the creation of the sustainable development framework.		Yes. Pragmatic choice of only formal government stakeholders only, given the national policy scope.	Yes.
Government cooperation facilitated	4 separate government agencies proposing HPPs sat together for the first time	In response to SEA government tries to improve coordination between ministries (inter-ministerial committees)		Cooperative effort by Ministry of Industry and Trade, its subsidiary Institute of Energy, Ministry of Natural Resources and Environment and the Prime Minister's Office.	Cooperation and coordination at basin level between the districts and between the basin committees and the relevant national sector authorities.

Institutional arrangements in place			Recommendation to proactively encourage SEA. SEA regulations not in place yet.	Strong commitment of both energy and environmental departments allowed for a stepwise reduction of international inputs; budget support was available.	SEA is mentioned in framework law, no SEA regulation yet.

Criterium	Pakistan	Myanmar	India	Viet Nam	Rwanda
Impacts in real life					
Changes in plan result in concrete measures	AJK Hydropower Coordination Committee created.		Existing projects that do not meet the E-flow norms shall have to comply within a period of three years.	Highest national policy level so concrete results are unclear.	Yes, the adopted plan identified measures that are implemented since 2020.
Influence on other levels of planning or decision-making	Poonch river CIA, the most critical catchment.	SEA built horizontal and vertical collaboration in government. Baseline assessment and database have informed three strategic planning studies.	New E-flow legislation stepped up decision-making on new plans.	Specific recommendations for lower level ESIA's and ESMPs.	Awareness that an integrated SEA – IWRM approach is beneficial for all catchments in Rwanda. Therefore SEA is applied in all four major catchments supporting the development of the respective plans.
Capacity improved	Process resulted in organisational learning.	SDF and GIS training to MONREC and MOEE staff, releasing data (GIS files) to the public to enable uptake by other agencies and researchers.	Federal institutions step in where state level institutions cannot solve the issue.	First SEA was an ex post on PDP VI; a decade of learning was fundamentally important for ownership and effective implementation of PDP VII SEA.	Capacity of the ministries of water and environment is improved.
Other (indirect) impacts	Two easy to read maps facilitate discussion on HP plans	Improved access to international financing by avoiding/reducing basin-wide cumulative impacts			A guidelines is developed providing guidance to develop a catchment plan by making use of an integrated SEA – IWRM approach.

N.B: Criteria developed by the Netherlands Commission for Environmental Assessment.

Colophon

Citation: Netherlands Commission for Environmental Assessment (ed. A.J. Kolhoff and R.Slootweg) *Strategic Environmental Assessment for Sustainable Development of the Hydropower Sector. Five influential cases: India, Myanmar, Pakistan, Rwanda, Viet Nam*. 106 p. April 2021, Utrecht, The Netherlands.

Photography

Please note that the photo's are selected for their illustrative value and do not correspond in anyway with the cases in this publication.

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