Using the Mitigation Hierarchy for Hydropower Projects in the Pacific Island Countries & Territories

Guidance note

The mitigation hierarchy is an iterative best-practice approach to limiting and managing negative impacts of hydropower projects, helping to balance environmental and social needs with development priorities.

Hydropower in the Pacific region – an overview

Renewable energy is an important part of the energy strategy in the Pacific Island Countries and Territories because of the need to increase energy security while reducing carbon emissions and reducing dependency on expensive imported oil[1]. Hydropower developments are economically feasible on mountainous islands that have high rainfall and large enough areas for rainfall collection. Papua New Guinea currently has the most installed capacity (234 MW), followed by Fiji (125 MW), New Caledonia (78 MW), French Polynesia (47 MW) and Samoa (12 MW)[2], with potential for development in Solomon Islands and Vanuatu.

Location of the Tina River Hydro Development Project reservoir, Solomon Islands—see case study (TRHDP ESIA)

What are the potential impacts of hydropower development on biodiversity?

There are numerous advantages and benefits of hydropower, primarily its renewable source (i.e. minimal operational costs), low greenhouse gas emissions and rapid delivery of energy to the grid. It is also possible to use hydropower development as a means of flood control and regulating water levels. However, there is potential for significant adverse impacts to biodiversity and to ecosystem services which many people may depend upon. Direct impacts are linked to the development itself, such as the land lost when a reservoir is flooded, and dams creating barriers to the movement of riverine species, which may no longer be able to feed and reproduce. The flooding of a reservoir can also mean the displacement of people living in that area. Run-of-river projects, if poorly planned, can have serious impacts on downstream flow.

Indirect impacts are those induced by the development of the project, such as in-migration – where large numbers of people move near to the construction area in the hope of work. More resources are then needed to support the increased population, which in turn increases pressure on local natural ecosystems (e.g. forest and rivers) as well as infrastructure (e.g. roads and public services). New roads to the dam can increase access to natural resources and lead to increased gardening (or other community-scale agriculture), over-hunting, fishing or gathering of natural products, and increase the risk of forest fires.

[1] International Renewable Energy Agency 2013 Pacific Lighthouses – Renewable Energy Road mapping for Islands

[2] International Hydropower Association 2018 Hydropower Status Report

Using the mitigation hierarchy to limit impacts of hydropower projects on biodiversity

What are the potential impacts of hydropower development on biodiversity?

Some of the impacts of hydropower development on the environment are given below:

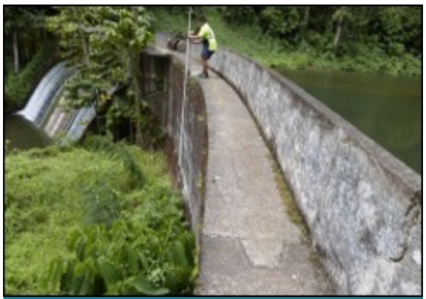
Habitat loss and degradation

This is a major impact of hydropower projects involving a large reservoir, affecting both terrestrial and riverine habitat. A large area upstream of the dam is flooded, potentially extending for kilometres upstream. Habitat not flooded can also become degraded, e.g. through general construction activity. Indirect impacts from in-migration can also result in significant loss of habitat and overexploitation of fauna and flora.

Construction of Nadarivatu dam in Fiji. Image © efl.com.fj

Accidental Mortality

Flooding to create a reservoir can lead to mortality of species living in the area. It can also change the community of freshwater species if they cannot adapt from river conditions to reservoir conditions. Hydropower turbines can lead to fish mortality if they are drawn into the water intake.



Fuluasou Dam in Samoa. Image © adb.org

Barrier effects

Hydropower dams can present a physical barrier to fish species at all stages of their life cycle (e.g. migrations for spawning or movement for feeding).

Downstream impacts

If there are any periods of low or zero flow downstream of a dam during construction or operation, there can be significant impacts on biodiversity that relies on a continuous water flow. Dams can also reduce the sediment supply downstream, with implications for the physical riverbank structure as well as nutrient flow.

Construction of Wainisavulevu Weir Raising in Fiji. Image © efl.com.fj

Introduction of invasive species

Non-native species for example of fish or aquatic plants can be accidentally or deliberately introduced to a reservoir leading to declines in native species or infestations in water courses.

Indirect impacts

Roads and access tracks along power transmission lines can open access to logging, other habitat degradation, hunting, and invasive weeds.

Using the mitigation hierarchy to limit impacts of hydropower projects on biodiversity

0. Enhance Positive Impacts → **1. Avoid** → **2. Minimise** → **3. Restore** → **4. Offset**

Applying the steps of the mitigation hierarchy to a hydropower project

As described in the separate Guidance Note, the mitigation hierarchy is a four-step tool used to limit the negative impacts of projects. Steps 1, 2 and 3, **Avoid**, **Minimise**, and **Restore**, are designed to reduce the significance and extent of residual impacts. **Offsets** are a last resort, used to manage any residual impacts that are still significant after Avoidance, Minimisation and Restoration. An additional first step is to enhance any positive impacts.

The mitigation hierarchy is the global best practice standard for impact management, and is a funding requirement of the IFC, World Bank, and 94 other financial institutions in 37 countries that have adopted the Equator Principles[3]. The negative impacts of hydropower projects can lead to loss of public and government support for a project, resulting in delays, increased costs, and reduced investment. Applying the mitigation hierarchy throughout the project life cycle not only ensures good environmental performance, but improves the likelihood of a 'social license to operate' and increases project cost-effectiveness overall.

As a general rule, there are fewer options and higher costs associated with the later steps of the mitigation hierarchy, so particular emphasis needs to be given to avoidance and minimisation. Furthermore, restoration options for hydropower developments are often limited because dams are rarely decommissioned, and offset possibilities are complex. Early and repeated application of the mitigation hierarchy across the lifespan of a project helps to ensure the residual impacts are as low/small as possible, thereby minimizing the scale and cost of any offset actions required.

Some key mitigation options for impacts associated with hydropower development are given below:

Avoid	• Locate the project in an area of low biodiversity and ecosystem services value • Locate the project on rivers that have already regulated water flows and that have low down-stream biodiversity and ecosystem services value • Locate any quarries inside the footprint of the planned reservoir
Minimise	• Minimise the size of construction facilities, including access roads and areas cleared for transmission lines • Optimise dam height and flow regulation to balance energy output with habitat loss and degradation • Use fish-friendly turbines and where appropriate consider the use of fish passes/ladders • Insulate transmission pylons and use bird flight divertors if there are collision risks • Ensure minimum environmental flows are maintained and where possible mimic natural and seasonal flow patterns • Consider the installation of silt-trap fences to minimise effects of reduced sedimentation • Ensure that access roads do not open-up intact forest to logging, hunting, and invasive species • Clear high biomass vegetation in the reservoir if there are eutrophication risks • Engage authorities and communities to develop actions to minimise and manage in-migration
Restore	• Restore temporary work areas to their pre-construction state or better • Consider designing the reservoir for multiple uses including biodiversity conservation and sustainable fishing
Offset	• Restore the condition of natural habitat in the catchment of a nearby site • Prevent new hydropower development or other flow regulation in rivers with similar biodiversity • Prevent clearance or degradation of natural habitat in the catchment (conserving catchment vegetation improves the volume and quality of water in-flows)

[3] Equator Principles Association Members and Reporting (Aug 2018)

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Case Study— the Tina River Hydro Development Project, Solomon Islands

Project details	• Located 30 km SE of the capital, Honiara, in the Solomon Islands • An Independent Power Producer will build and operate the hydropower infrastructure, and sell electricity to the state-owned power utility • 15 MW project • 53 m high concrete dam at 122 m above sea level and 30 km from the sea • Reservoir extending 2.6 km upstream with an area of 0.28 km^2 • 3.3 km tunnel to divert water from reservoir to a powerhouse and a tailrace at 73 m above sea level.
Project biodiversity standards	• Project aligned with IFC PS6 and ADB Safeguard Policy Statement requirements for projects located in areas of Natural and Critical Habitat.
Biodiversity values	• The project is located in natural habitat which has been commercially logged and used for subsistence by local people • No IUCN Critically Endangered or Endangered species found within project-affected areas, or globally significant numbers of migratory or congregatory species • There are restricted-range and endemic species, but the project-affected area is a small portion of these species' habitat • Old-growth forest above 400 m around the project qualifies as Critical Habitat because this ecosystem is globally restricted and has a unique assemblage of species. However, the project footprint impacts <3% of the catchment, and directly impacts a very small area of Critical Habitat
Potential impacts on biodiversity	• Clearance of 115 ha of natural vegetation including 9.5 ha undisturbed forest, 50 ha disturbed forest, 15 ha riparian and 15 ha cliff vegetation • Short-term impacts during construction from increased sediment downstream and risk of spills of fuel, washwater and chemicals • Long-term impacts of reduced flooding of small downstream wetlands • Barrier to the upstream and downstream migration of fish • New aquatic and wetland habitats at the reservoir

Mitigation

Avoidance

- Align road to avoid environmentally sensitive areas

Minimisation

- Use good international practice forest clearance to minimise impacts.
- Control access to undeveloped areas and the upper catchment
- No lighting or low lighting (directed downwards)
- Construct fauna underpasses in stream culverts along access road
- Construct sediment traps and fuel tank bunds
- Maintain an environmental flow of $1m^3/s$ along the 5.7 km between the dam and tailrace to allow fish passage and maintain aquatic habitat
- Maintain a minimum $2.4m^3/s$ flow from the powerhouse (even when power is not being generated) to maintain downstream flow
- Operate a trap-and-haul system at the dam and the powerhouse to enable fish to move upstream
- Release water over the spillway if fish are congregating
- Construct fish screens or barriers at the water intake and tailrace

Restoration

- Investigate fish farming in the reservoir using native species
- Rehabilitate about 10 ha of existing modified habitat

Predicted Residual Impacts

- Loss of 105 ha of natural vegetation
- Reduced flooding of small downstream wetlands
- Partial barrier to the upstream and downstream migration of fish

Offset

- Determine the feasibility of a protected area in the upper catchment
- Protect the remaining Natural Habitat within the Core Area

For further information, please go the website www.tina-hydro.com, and access the project ESIA

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More information:

- The Cross Sector Biodiversity Initiative (CSBI) Timeline tool provides a framework to help coordinate schedules of project development, biodiversity impact assessment, and financing.
- A Cross-Sector Guide by The Cross-Sector Biodiversity Initiative (CSBI) provides practical guidance on MH implementation.
- The Biodiversity Offset Design Handbook and Appendices by BBOP can guide the offset planning process.
- To check investments made against offset plan, the Biodiversity Offset Cost-Benefit Handbook by the BBOP can provide useful information.
- Good dams and bad dams published by the World Bank provides a framework for comparing between potential project sites based on environmental and social criteria.

Specific to the PICTs region:

- Under the *Restoration of ecosystem services and adaptation to climate change (RESCCUE)* project, stakeholders have identified provisional roadmaps for strengthening mitigation hierarchy and offsets implementation in the region, based on a systematic review of the national offset policies and practices that exist to date.
- SPREP's Strengthening environmental impact assessment: Guidelines for Pacific Island Countries and Territories.

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