Appendix 3: Table of Key Questions for Assessing Climate Risks of River Projects

For communities dealing with planned and existing dams and diversions on their rivers, asking the right questions to project developers and government planners and decision-makers can help guide them evaluate the potential climate risks and the possible impact a project will have on a community's climate resilience. Asking these questions can prompt decision-makers to develop a climate risk assessment to inform SEAs and EIAs, or even reconsider or revise project plans. These questions should be raised at all stages of a project's life cycle.

SOCIAL IMPACTS

KEY QUESTIONS	DATA SOURCES NEEDED
WATER RESOURCE AVAILABILITY	
With some dam storage or water diversion projects, water users may experience benefits such as increased reservoir storage in preparation for droughts or greater delivery of water from water-rich regions to arid regions. However, there is also the risk that they may experience diminishing resources during droughts, as well as conflicts between reservoir storage and hydroelectric production. Increasing precipitation in certain areas can bring several benefits, including increased agriculture yields and lengthened growing seasons.[3] However, the risks of variable precipitation rates include the threat of drought and/or floods, poor timing of rains in relation to growing seasons, loss of livelihoods, damage to ecosystem, and reduced reservoir storage.	
■ How will the project affect the community's access to clean water? What will be the impact on existing sources, including groundwater? Will new sources be provided if existing sources will be compromised? ■ Does the project take a systemic watershed approach and analyze cumulative impacts of all dams in the basin? ■ Does the project incorporate management techniques that will limit the disruption of natural flows downstream? ■ Is the management of the project creating reserves to help provide for local populations in times of drought? ■ What is the quality of hydrological data? Are projects being planned with changes in precipitation in mind? ■ Have flood safety measures or drought risk management plans been developed and put in place? ■ Do relocation sites have sufficient access to natural resources and are there adaptive management plans for high or low precipitation scenarios?	■ Drought and flood season measurements at gaging stations ■ Water level measurements at gaging stations ■ Project SEIAs or master plans ■ Measurement of water levels in reservoirs at gaging stations ■ Amount of precipitation measured by national weather offices

KEY QUESTIONS	DATA SOURCES NEEDED
LIVELIHOODS	
While there may be some benefits from large dams and river engineering projects such as hydropower, irrigation, navigation, and water supply, there is also a high risk that large infrastructure projects can decrease climate resilience and threaten livelihoods because they lead to a loss of cropland and forests, displacement, and damage to fisheries and wetlands.	
■ Are there traditional food systems or livelihoods that have been or may be altered, and are the changes a result of climate change? ■ How are livelihoods or loss of livelihoods considered in the development of the project? Are direct and indirect impacts considered (for example, an indirect impact would be the influx of migratory workers and their demand on local resources)? ■ What are the main effects of climate change for the community and have they been addressed in the project's social impact assessment? ■ What kinds of activities are being carried out in the community to adapt to the changing climate?	■ Household surveys regarding local benefits from the project in terms of economic stimulation, employment, infrastructure, etc. ■ Stakeholder consultation and social impact assessment reports
HEALTH	
Construction of large reservoirs can increase health risks from a number of waterborne diseases, including *schistosomiasis*, malaria, and river blindness. Dams also worsen problems of water pollution and water scarcity, and damage ecosystem services, all of which have their own health risks.[4]	
■ Has a health impact study been done? Have local public health agencies been involved? ■ What types of strategies are being proposed or implemented to avoid or mitigate waterborne diseases? What will be the role of local public health agencies? ■ Have the health impacts of a large migratory construction crew on the local population been addressed? (e.g., sexually transmitted diseases) ■ What health services will be provided to deal with health impacts from the project? How are these services being paid for? ■ Will the project have a negative impact on water quality, and if so, what is being proposed to address this issue? ■ Will the project reduce habitat for medicinal plants?	■ Community surveys about local access to healthcare, and strong involvement by local health professionals and agencies ■ Sampling of water sources for waterborne diseases along the river and the reservoir ■ Plans to control the spread of HIV/AIDs and other STDs ■ Budget for building and staffing clinics. ■ Plan to eliminate sources of pollution in the reservoir watershed and upstream. ■ Survey with community health workers to determine species disruption. Plan to restore lost resources in resettlement areas.

KEY QUESTIONS	DATA SOURCES NEEDED
GOVERNANCE	
Given the uncertainties of climate change, a governance structure and decision-making process that is flexible, transparent, and participatory will more likely succeed in improving climate resilience.	
■ Have strong local paths of engagement been incorporated in government-led assessment processes? Do they occur early in the project assessment stage and throughout the project development process? ■ Is there a disaster risk management plan and preventive measures in place to deal with droughts and floods? ■ Is there a Cumulative Impact Assessment and does it include climate impacts? ■ Is there an adaptation plan in place to help mitigate the negative impacts of dams on river basin communities under different scenarios? ■ Are there accountability mechanisms in place and a means of enforcement that hold developers accountable for meeting projected water and energy needs without destroying key environmental services? ■ Is an assessment of climate risks required during dam relicensing processes, and is it robust and participatory? Where licenses have been given for perpetuity, will they be re-assessed for climate impacts?	■ Government or financial institutions' policies and laws on participation by project-affected people ■ National legal mechanisms to compensate for appropriation of resources ■ Water and energy development plans. ■ Environmental and/or energy agency mission statements ■ Company sustainability or corporate social responsibility guidelines. ■ National adaptation plans

ENVIRONMENTAL IMPACTS

SOIL EROSION IN WATERSHEDS AND COASTAL DELTAS	
Dam building increases the risk of biodiversity and livelihood loss due to the withholding of nutrient-rich sediments, which can lead to habitat erosion and a reduction of coastal delta productivity. Deltas and areas experiencing more severe floods will see increased erosion.	
■ Does the river basin experience high precipitation and is precipitation expected to increase? (Higher precipitation will mean greater erosion.) ■ What is the extent of erosion in the watershed? ■ How will sedimentation be managed at the proposed or existing dams? ■ What rehabilitation or watershed management projects (such as afforestation or improved farming practices) have been proposed in the watershed? What are their costs and have they been accounted for in project assessments? ■ What are the impacts of the loss of sediment transport on downstream ecosystems and floodplain agriculture?	■ Soil erosion rates (EIAs) ■ Projected flood scenarios and precipitation models

KEY QUESTIONS	DATA SOURCES NEEDED
RIVER FLOWS	
Building large dams can mean storage for irrigation, domestic or industrial use, and possibly some flood control. However, the risks include changes to the magnitude, duration, timing, and frequency of high and low flows, which can devastate the migration and spawning of fish species and the productivity of riparian agriculture.	
■ How will climate change affect a river's natural flow (e.g. increase or decrease magnitude, duration, timing, and frequency)? How have expected precipitation and flow changes from climate change been addressed in plans for environmental flows? ■ How will the project change the river's natural flow and water quality, and how will this alter or disrupt surrounding river vegetation, floodplain agriculture, and fisheries? ■ What will be the economic impact of losses caused by altered flows? Are these costs fully accounted for in the cost-benefit analysis for new river infrastructure? ■ For run-of-river projects, how long will the reservoir be able to store flows? How will the storage time of water affect aquatic life and other natural processes? ■ Have food security impacts been quantified? Has this information been vetted by the local people? ■ What is the plan for calculating and incorporating environmental flows into the design of a project or into the operation of existing projects? ■ What ecosystem values are the environmental flows plan intended to protect or preserve? ■ What is the plan for environmental flows in times of drought? ■ What role will local communities be allowed to play in the maintenance and refinement of the environmental flows plan? Are there transparent mechanisms for monitoring that the public can use? ■ How will the environmental flows plan be enforced? ■ For transboundary rivers, will an environmental flows plan be developed between all nations that share the river?	■ Seasonal storage, annual storage, and multiple year storage data (project design documents) ■ River basin management plans and EIAs ■ Hydrology data for local rivers

KEY QUESTIONS	DATA SOURCES NEEDED
DEFORESTATION	
Building new large water and energy projects in heavily forested areas often brings large-scale logging to make way for the project and/or transmission lines. The negative effects of deforestation can include harm to the ecology and hydrology of rivers, loss of species habitat, compromised water quality, increased flood risks, and loss of nutrients from terrestrial sources. In addition, forests act as important carbon sinks in the global carbon cycle, and deforestation reduces those important sources of carbon regulation. Fragmentation of forests, reduced transpiration, and reduced soil water availability combined with warming temperatures from climate change can also contribute to drier conditions and the potential for more wildfires.	
■ Does the project account for GHG emissions of associated deforestation? ■ In the case of a project constructed as a low carbon energy option, will deforestation turn the project into a net carbon emitter? Does this disqualify the project from receiving clean energy or mitigation funding? ■ How will current climate change trends worsen problems caused by deforestation? ■ What impacts will climate change and deforestation have on local livelihoods and resource availability? What measures are in place to address these impacts?	■ Project's projected rates of deforestation (EIAs) ■ UN Food and Agriculture Organization national data, remote sensing data, measurements of carbon stocks using default values or ground-based measurements (tree height, rate of deforestations).[5] ■ Data on climate change interaction with deforestation impacts, such as moisture loss (regional studies)
GREENHOUSE GAS EMISSIONS	
All water and energy projects will have a carbon footprint during construction, and for some, during operation as well, especially if you consider the materials used in building and operating the project. Dams in particular have the potential to add to global warming through their methane emissions, which is a greenhouse gas (GHG) that is 25 times more potent than carbon dioxide. Dams in the tropics are particularly polluting when it comes to GHG emissions. Data for GHG emissions is limited but may be available if the project is participating in the Kyoto Protocol's Clean Development Mechanism.	
■ Are emissions being accounted for in the full life cycle of the project, including construction, deforestation, and materials used? ■ For dams, are degassing, ebullition, and diffusion at the reservoir surface, turbines and spillways and immediately downstream all accounted for as part of the GHG measurements? ■ For proposed dam projects, what GHG emissions research is available for similar reservoirs in the same region? ■ Are decommissioning costs included for dam projects with short life spans and high GHG emissions (since even non-functioning reservoirs will continue to emit GHGs)?	■ Emissions calculations for above-water biomass, reservoir surface, turbines and spillways, and loss of living forest (sources and sinks) in EIAs or research studies. ■ Projected emissions from project construction in EIAs or research studies.

ECONOMIC AND SAFETY IMPACTS

KEY QUESTIONS	DATA SOURCES NEEDED
ECONOMIC FEASIBILITY	
An increase in extreme weather events and changes in climate and precipitation will have varying impacts on a project's long-term economic viability, as well as adding to project costs for managing and mitigating climate-related disasters.	
■ Does the project have a disaster risk management plan and is it funded? Which government agency will be responsible for it? ■ Are the costs of potential impacts from climate change on project operation (such as water shortages during times of drought) incorporated into overall project costs? ■ Is dam decommissioning one of the options to deal with poor project economics? ■ Before new projects are planned, have existing projects been assessed for reoperation or rehabilitation?	■ Risk management plans ■ Cost-benefit analysis and economic feasibility plans
ELECTRICAL OUTPUT	
Greater precipitation could lead to an expansion of electrical power generation for hydropower dams, while greater hydrological variability and decreased rainfall could lead to decreased or a complete loss of electrical power generation and subsequent impacts on local and national economies. Climate-related disasters could also affect the electrical output of other types of energy projects and energy grids, most often leading to blackouts.	
■ How will countries compensate for a potential decrease or a complete loss of electrical power generation? What alternative back-up energy systems exist in-country if an energy project is not generating power? ■ What are the electrical output differences between the rainy and dry seasons? ■ Does the project's economic analysis take into account climate change scenarios?	■ National energy and disaster risk management plans ■ Precipitation data (regional climate models and studies) ■ Past records of hydropower production
STRUCTURAL INTEGRITY & DAM SAFETY	
Dams and levees can provide protection from flooding if well managed. However, failure to adapt water management strategies to a changing climate provides the potential for dams to break under more extreme floods, as in places where Glacial Lake Outburst Floods (melting of ice dam from water pressure) is a real risk. Building large infrastructure projects for climate adaptation in seismic zones can also increase the risk of structural failure, with negative downstream consequences.	
■ Are different climate change scenarios (e.g. glacial outbursts, flooding, high intensity precipitation, silt inflows, downstream drought, and subsidence) considered in the safety assessments for and design of the dam? ■ Do water management and dam safety plans include climate change considerations? ■ Are downstream impacts assessed and accounted for?	■ Streamflow and climate data for predicting flood hazards ■ Paleo and historic flood data for understanding long term flood trends