Children jumping into the Tapajós River in Brazil. Photo: Brent Millikan

The Value of Rivers

Rivers, floodplains, wetlands and water bodies provide a number of key climate and ecosystem services, including protection against flooding, enhancement of water resources, and capturing carbon, to name just a few. The world's major tropical rivers also support forests that act as critical carbon sinks (although the triple threat of climate-induced droughts, fires and land changes that lead to deforestation threaten to turn some tropical carbon sinks into carbon sources). Rivers maintain forest ecosystem health by depositing soil along the entire length of a river network, from source to delta. When it reaches the ocean, soil deposition supports marine food chains, contributes to the ability of oceans to absorb carbon dioxide (CO_2), and builds coastal ecosystems that naturally aid in reducing the risks of major storms.

Some major rivers – including the Amazon, Congo and Mekong – play a surprisingly large role in helping tropical oceans absorb carbon. The vast flow of major river basins delivers phosphorus, iron and other nutrients far offshore, where they are consumed by certain forms of sea life such as phytoplankton. These microorganisms "fix" or take carbon out of the atmosphere. The organisms eventually sink, taking carbon with them to the deep seafloor.

Dams could change the delicate workings of this ecosystem service by holding back the river-borne and nutrient-rich sediment that feeds this cycle. Scientists predict that damming these high-flow, high-sediment rivers in warm-ocean areas could reduce their ability to mitigate climate change. For instance, a 2009 study on Africa's biggest proposed hydropower project, the Grand Inga Dam on the Congo, says that "plans to divert, store or otherwise intervene in Lower Congo River dynamics are truly alarming" and "ignore the river's significant influence on the equatorial Atlantic, which, in turn, is central to many climate change models."[2]

The wealth of ecological services provided by river systems that sustain life on earth are rarely given much weight in water and energy planning processes, however, even though they are of critical importance for adapting to climate change. The 2005 Millennium Ecosystem Assessment concluded that efforts to reduce rural poverty and eradicate hunger are critically dependent on ecosystem services such as those provided by rivers, particularly in Sub-Saharan Africa.

THREATS TO RIVER SERVICES

Large water infrastructure projects – including storage and large run-of-the-river dams, basin transfer schemes, and river channelization – can cause considerable harm to ecosystem services and livelihoods by altering the hydrological cycle. When the impacts of climate change combine with these infrastructure-related impacts, the scenario becomes a "perfect storm" for the world's fisheries, forests, critical natural habitats, and agriculture,[3] while creating or worsening tensions between various water users upstream, alongside and downstream of infrastructure projects.

Despite these risks to river services, countries are planning and building major diversion projects intended to deliver water from water-rich regions to distant arid regions, such as China's South-North Water Transfer Scheme and India's controversial river linking project. The environmental and social impacts of these massive engineering projects, especially for downstream water users, have been largely ignored – as have the impacts of climate change on the reliability of river flow in the now-wetter regions.

In addition, the construction and operation of large dams and diversion projects can irreversibly harm a community's right to a healthy environment, to human health, to food, to religious practices, and to culture. They can also result in forced displacement and all the turmoil that brings, and violate indigenous peoples' rights to land and natural resources.

PROTECTING RIVERS AND RIVERINE COMMUNITIES

Thus far, traditional development strategies that have depended on technological fixes and top-down approaches have had little success in reducing poverty and preparing vulnerable populations for weather-related disasters. As the impacts of climate change become more urgent each day, it has become clear that cross-cutting approaches that combine community-based development, disaster-risk management and climate adaptation are more important than ever.[4] Healthy rivers are critical for helping vulnerable communities adapt to a changing climate – protecting them now is a community's health insurance policy for the future.

Community-Based Adaptation

One of the more sustainable ways of protecting riverine communities and river resources from climate impacts is through community-based adaptation (CBA). CBA is a process that is meant to empower people to plan for and cope with the impacts of climate change from the ground up. As its name suggests, it is also firmly based in a community's priorities, needs, knowledge, vulnerabilities and capacities. It asks the questions: (1) how do you include everyone in the community during the planning, assessment, design, implementation and evaluation stages of an infrastructure project, and (2) what tools and sources of information are available to ensure that projects are the most effective for meeting community needs? Using a CBA approach to address the risk of increasing floods, for example, might involve the community mapping out areas that are most prone to flood damage, creating a local disaster management plan, and developing green infrastructure projects such as restoring degraded floodplains so that they can better store flood water and recharge streams and aquifers.

In the long term, in order to effectively implement CBA activities and connect community-based decisions with broader regional and national decision-making, government institutions and programs must be strengthened, and capacity building for local communities and civil society activists must occur. At the same time, while the CBA approach acknowledges the important role that outside expertise and skills can play in developing climate-resilient projects or programs that minimize negative environmental and

social impacts, it is grounded in local participation and community knowledge. By operating under this fundamental principle, a chosen project or program is much more likely to meet local needs now and in the future. (See Chapters 3 and 4 on **assessing** and **addressing** climate risks as part of the CBA process.)

RIVER BASIN PLANNING SOLUTIONS

Unlike engineered river systems, free-flowing streams have tremendous capacity to adjust to changes in water discharge and inflows of sediments (both of which are expected to change in many areas under future climate scenarios). This concept is critical for understanding how to reduce climate risks in a changing climate. River basin planning and management strategies at the national and international policy levels that seek to protect free-flowing rivers or ensure well-planned "environmental flows" from dammed rivers can increase the resilience of riverine ecosystems and populations that are especially vulnerable to climate change.

River basin planning that restores or preserves a river's natural features not only contributes to overall ecosystem resilience, but also produces important benefits for people. Riparian wetlands and floodplains help store water and thus reduce flooding, while also helping to recharge groundwater, which means more water will be available in the river and for people during dry periods. To accomplish this, government planners may need to give the river more room to flood by removing infrastructure from floodplains and allowing vegetation to grow back. According to many water experts, such practices can save both money and lives if enacted now rather than after a flood or other climate-related disasters occurs.[5]

China Dams the Upper Mekong River

The Mekong River, known as the *Lancang Jiang* in China, is the heart and soul of mainland Southeast Asia. While countries in the lower stretch of the river have yet to complete a dam on the mainstream Mekong, China already has over 20 planned and seven existing large dams on the Upper Mekong. Despite concerns over water security, fish migrations, climate change and sedimentation, China has yet to release any significant information about its dams to its downstream neighbors.

Since the early 1990s, academics have linked changes to the Mekong River's daily hydrology and sediment load to China's dams. These dams have begun to drastically change the river's natural flood-drought cycle (the "flow regime") and block the transport of sediment, which is expected to affect ecosystems and the livelihoods of millions living downstream. Impacts on water levels and fisheries have already been recorded along the Thai-Lao border.

In addition, climate change is expected to increase tensions among the various stakeholders of this critically important river. Hydrological changes that will affect rivers and dams include a reduced seasonal snowpack in the Tibetan Plateau, shifts in winter precipitation and timing of snowmelt, and increased evaporation in reservoirs. Extreme rainfall events, an increase in intensity and frequency of floods and droughts, and a continued deterioration of water quality are all expected to occur. The unstable changes in the intervals of floods and drought

The 1,750 MW Jinghong Dam on the Lancang River was completed in 2009. Photo: International Rivers

will have severe impacts on regional economic activities, not to mention increase pressure on China to store more water upstream for its own use.

As a result of these concerns, NGOs in China and Southeast Asia are calling for more transparent transboundary basin management and smarter energy and water resources planning in China that does not sacrifice its rivers.

For more information, see:
www.internationalrivers.org/node/2318