

Dam controversy: Remaking the Mekong



Damming the Mekong River could harm millions who rely on migratory fish, such as the fishermen in this floating village in Kandal, Cambodia. *H. Sinith/AP*

This summer, a crew of strangers arrived in the tiny village of Pak Lan along the Mekong River in northern Laos. They sat around in shorts, examining technical drawings, and then surveyed the area, measuring the height of the riverbank, the size of the rice paddies and even the number of pigs.

The tally is necessary because Pak Lan may soon disappear. The government will need to move it and 18 nearby villages, because they will be partially or fully submerged if a highly controversial dam, called the Xayaburi, is built. The US\$3.5-billion project will create a 60-kilometre-long reservoir and generate 1260 megawatts of power, which will earn between \$3 billion and \$4 billion a year for the developer, CH Karnchang Public Company of Thailand.

Somchit Tivalak, village chief and representative of the ruling communist Lao People's Representative Party, is not quite sure what a hydroelectric dam is or how it will work, but he is convinced that good things are on the horizon. He says that his village will move to a place where it will have roads and

electricity, as well as a reservoir teeming with fish.

Many others, however, are deeply worried. The lower Mekong, which winds through Laos, Thailand, Cambodia and Vietnam, is one of the last big untamed rivers in the world. Nearly 60 million people depend on its rich fisheries for their survival. If the Xayaburi dam is built, it will set a precedent for 10 other hydropower dams proposed for the main stem of the river. If all those proceed, nearly 55% of the river will be converted to slow-flowing reservoirs.

Predicting the effects of such massive changes is impossible because the Mekong is one of the most poorly studied major rivers in the world. Taxonomists know so little about the fish there that they are discovering new species at an unparalleled pace. And governments do not consistently monitor water and sediment flows along the river.

In the case of the proposed Xayaburi dam, some scientists say the environmental impact assessment (EIA) conducted for the builder is seriously flawed because it does not consider the wider effects of the dam. "The EIA of the Xayaburi dam is the worst EIA that I've ever seen," says Ian Baird, a professor of geography at University of Wisconsin–Madison who has studied the region for decades.

Cambodia and Vietnam, which researchers say will receive a disproportionate share of the harm from the dam, have both objected to it. And a scientific panel hired by the Mekong River Commission — a regulatory body made up of government representatives from Thailand, Laos, Cambodia and Vietnam — last year recommended a 10-year delay on damming the river so that



[Download a PDF of this article](#)

researchers could gather the needed data. But the Laotian government, which will receive up to 30% of the revenue, says that it will push ahead.

So scientists are rushing to assess how the dams will affect the Mekong's fisheries and the flow of sediment that helps to sustain its vast delta. "The problem is, dams are coming very fast and are going to deeply modify the environment in a very short time frame," says Eric Baran, fisheries researcher at the World Fish Center in Phnom Penh. "And the countries are not equipped to deal with that yet."

Calming the waters

From its origins in the Tibetan plateau, the Mekong winds 4,800 kilometres down to the South China Sea, making it the longest river in Southeast Asia. At least 781 species of freshwater fish ply its waters, including four of the largest freshwater fish species in the world. The biggest of them, the endangered Mekong giant catfish (*Pangasianodon gigas*), can grow to be as long as a car.

Years of war, lack of investment, and drastic variations in flow between the wet and dry seasons have held back hydropower development and helped to keep the lower reaches of the river wild. But in the 1990s, Chinese engineers began a project to build eight dams and reservoirs on the Upper Mekong, which have evened out the flow (see '[Taming a river](#)').



[Click for full map](#)

With the Mekong suitably subdued and with the demand for electricity rising in the region, the Laotian government and private developers are now racing to put up dams, and Xayaburi is the first one to near construction. If it is completed,

eight more are likely to spring up in Laos and along its border with Thailand, according to International Rivers, an environmental non-governmental organization based in Berkeley, California.

The EIA found that Xayaburi's effect on fish, water flow and erosion would be minimal. Instead of creating a large standing reservoir behind a massive concrete wall, Xayaburi will have a smaller wall that will allow water to pass beneath it in what is called a run-of-the-river design. According to the EIA, the dam will "improve the overall natural fish production capacity on the Mekong River in the project area, especially in the dry season".

But researchers have challenged that conclusion, noting that Xayaburi and most of the dams proposed for the river's main stem will have concrete walls tall enough to raise upstream water levels by between 30 and 65 metres. Although smaller than conventional reservoir dams, the walls would still block sediment and migrating fish, says Tarek Ketelsen, a hydrologist at the International Centre for Environmental Management in Hanoi, Vietnam, which evaluated the Xayaburi EIA.

Critics also object to the fact that the EIA considers the potential effects only for a "downstream area about 10 kilometres from the barrage site", according to the document. That is a remarkably small stretch of the river, say researchers. The EIA was conducted for Karnchang by TEAM Group of Companies, a conglomerate of consulting firms based in Bangkok. When contacted by *Nature*, TEAM said it could not discuss the EIA because of the terms of its contract with Karnchang. Karnchang did not respond to calls or e-mails requesting comment.

Fishing for trouble

Toun Neang, 52, gets up at 4 a.m. every day to go fishing on the Tonlé Sap Lake, which connects to the Mekong River in Cambodia. When he arrives, he

offers incense, rice and beer to the spirit in the river. "If we forgot to ask permission or make an offer, that day we will not be able to catch even a single fish," he says.

A fisherman since childhood, Neang has a keen eye for the migration cycles that bring fish into and out of the lake from the Mekong. Adult fish lay eggs far upstream, and then flooding during the rainy season brings those eggs and juveniles to the Tonlé Sap, he says. He worries about dams. "If the water is blocked, how can fish migrate downstream? And how can fishermen like us live if there are no more fish?"



Fisherman on the Tonlé Sap haul in *trey riel*. Garrison Photographic & MRC

The future of the fishery matters because the Tonlé Sap — one of the world's most productive inland fisheries for its size — provides half of the protein consumed in Cambodia. "It is hard for people in Europe or North America to imagine the role that freshwater capture plays in terms of food security, economically and even culturally," says Kirk Winemiller, a fisheries researcher at Texas A&M University in College Station.

"You start putting dams along the river there, it will stop migration for the fish."

Modelling the effect of Xayaburi and other dams on this fishery is difficult because researchers lack baseline data about most fish in the Mekong. Around 229 species live upstream of the proposed Xayaburi site, and 70 of them are migratory. In terms of biomass, about 60% of the total catch in the Tonlé Sap is made up of species that migrate long distances, some from as far up as the Xayaburi area, more than 1,500 kilometres upstream.

Many dams have built-in fish ladders that allow some migrating fish to pass. But researchers say the two ladders in Xayaburi's design are not enough for the number of fish and the diversity of migratory species there.

Among them is the Mekong giant catfish, the river's best-studied species and longest-distance swimmer. Zeb Hogan, fisheries researcher at the University of Nevada, Reno, spent years collecting fish and extracting calcified ear bones, called otoliths, from their heads. The otoliths grow a new layer each day, incorporating elements from the water, which creates a chemical record of a fish's travels.

Otolith studies have shown, for example, that the tropical Asian catfish *Pangasius krempfi* makes an epic migration ([Z. Hogan et al. *J. Fish Biol.* **71**, 818–832; 2007](#)). It starts life in the higher reaches of the Mekong, then drifts down to the coastal flood plains during the monsoon season. Adult fish live in the brackish waters of the delta and the South China Sea, but they fight their way back upstream to spawn at the beginning of the rainy season every year.

Michio Fukushima, a fisheries scientist at the National Institute for Environmental Studies in Tsukuba, Japan, and his colleagues at Ubon Ratchathani University in Thailand are trying to adapt otolith analysis to other species that migrate within the Mekong. Many of these species are commercially important, particularly the Siamese mud carp (genus *Henicorhynchus*), known as *trey riel* in Cambodia. This 15-centimetre-long fish is a major food source for larger carnivores. It is an important ingredient in fish paste and in feed used in aquaculture, and it is the most-harvested species in the Mekong.



Rings in a fish's ear bone record its Mekong travels. *M. Fukushima*

Fukushima's work has so far traced some of the *riel*'s migration routes. The fish he captured from the Songkhram, a Mekong tributary in Thailand, seem to mature in the main stem of the Mekong before returning to the tributary.

Baird says that the *riel* may become threatened in the Mekong as dams are built. "You start putting dams along the river there, it will stop migration for the fish," he says. "It is hard to say exactly — will it wipe it out all together or reduce it in number? We haven't faced this situation with such a highly abundant species."

Even less is known about other fish in the Mekong. Fukushima and Baran are now creating an atlas of fish distribution, and Baran and others are modelling the effects of dams on fisheries. Preliminary runs suggest that if all the proposed main-stem dams are built, the region's annual catch of 2.1 million tonnes will drop by somewhere between 600,000 and 1.4 million tonnes. "Six hundred thousand tonnes represents the whole annual freshwater fish production in West Africa", says Baran. "That's huge."

Sedimental journey

The proposed dams will also exacerbate the Mekong Delta's ongoing battles with the sea. The delta, home to 17 million people in Vietnam and 2.4 million in Cambodia, seems to be losing coastal land, says James Syvitski, a geologist at the University of Colorado at Boulder.

Sea levels there are rising by 6 millimetres a year because of a combination of global ocean swelling and local changes. And the destruction of mangrove forests has left the delta prone to devastating floods and typhoons. In a study of deltas around the world, Syvitski and his colleagues declared the Mekong Delta "in peril", noting that an area of nearly 21,000 square kilometres is already less than two metres above sea level ([J. P. M. Syvitski *et al.* *Nature Geosci.* **2**, 681–686; 2009](#)).

The proposed dams are projected to accelerate the sinking by blocking the flow of sediment that would otherwise nourish the flood plains and build up the delta. Mathias Kondolf, a fluvial geomorphologist at the University of California, Berkeley, estimates that the dams in China and on the lower Mekong will block about half of the river's sediment, which could be disastrous for the delta.



Road construction near the Xayaburi dam site. *El Ali/Focus/eyevine*

Some dam designs reduce the problem by incorporating wide, low-lying outlets that allow sediment to pass through. But these can compromise power generation, and might not let through the heavy sediment loads that would accumulate far upstream near the start of a 60-kilometre-long reservoir, says Ketelsen.

All these unknowns explain why the team of consultants assembled by the Mekong River Commission (MRC) last year called for a 10-year delay in building the Xayaburi dam, recommending that Laos start with smaller dams on tributaries. The MRC did not take a stand on the proposed moratorium and would not have the power to enforce it. But scientists say that the MRC does have the clout to influence the design of dams.

"Hydropower is important for the development of a country like Laos, and it does have a right to develop," says Ketelsen. "However, when it comes to a river like this, which has a global significance in terms of biodiversity, you don't have to start with the most high-impact projects". The idea of waiting has gained some international support. The Asian Development Bank in Manila, for example, says that building dams on the main stem of the Mekong is premature because too little is known about the environmental and social

costs.

Last April, Laotian authorities agreed to delay construction of Xayaburi until after conducting another project review, the results of which are due to be submitted to the four nations of the MRC in a final meeting in the next few weeks. But officials have said recently in media reports that they have completed the review and plan to go ahead with construction. The MRC is keeping silent, waiting for the Mekong nations to meet. Near the Xayaburi site in northern Laos, it does not look as though construction crews are waiting for the final meeting. Trucks are paving mud roads with asphalt — a necessary first step towards dam construction.

Downriver in Ubon Ratchathani, Thailand, Fukushima gets on a speedboat to collect fish, water and sediment samples from a dam on a Mekong tributary. For the past two years, he has travelled through Cambodia, Laos and Thailand by boat and by motorcycle twice a year to collect data. When he captures a fish, he performs a rough surgery, slicing open its head to extract otoliths for later analysis in his lab.

ADVERTISEMENT

Fukushima says that before the dams become a reality, he wants to establish a baseline of environmental and ecological conditions and to try to work with developers so that future dams will cause the least amount of harm. He remains cautiously hopeful that science can make a difference. Looking out over the water, he says, "there must be some way we can move towards a better future".

Gayathri Vaidyanathan is a reporter with Greenwire in Washington DC. She was previously an International Development Research Center fellow at Nature.