



Pak Mun Dam, Thailand  
Photo: International Rivers

# Swindling the Mekong: RUN-OF-RIVER HYDRO

Hydropower projects described as run-of-river evoke images of unimpeded rivers delivering clean power without the environmental and social costs of traditional dams. And influential institutions like the World Bank tout the share of run-of-river projects in their hydro portfolios, suggesting such projects have few adverse impacts. However, the reality is often very different.

Run-of-river (ROR) hydropower schemes have become popular among dam proponents as a supposedly “low-impact” alternative to storage dams. Forbes Magazine declared that “Run of river just might be the ultimate in green power.” But while run-of-river projects may avoid some of the impacts commonly associated with storage dams, such as large reservoirs, their overall impacts can be even worse. ROR projects can be particularly detrimental to the ecology of rivers that provide vital services to people living downstream.

Given the trend among the hydropower industry, financiers and government officials to embrace ROR projects, it’s an important moment to take stock of what run-of-river projects are, and to revisit their often-unchallenged “green” credentials.

## WHAT DOES “RUN-OF-RIVER” MEAN?

The term “run-of-river” is misleading because it suggests harnessing a river’s natural flow and generating energy as it passes, but that’s not what run-of-river hydro does. All hydropower projects impound water and impact rivers. Most ROR projects withhold water either behind a dam or through diversion tunnels.

There is no common definition of what constitutes a run-of-river project. Generally, “run-of-river” refers to a hydropower project either with a small reservoir or no reservoir. They differ from traditional reservoir dams, which store great quantities of water during the wet season to allow year-round releases to generate power. Instead, because they have comparatively limited storage capacity, ROR projects are generally built on rivers with fairly consistent annual flows,





Photo: International Rivers

which are either naturally occurring or are regulated by a storage dam upstream.

In practice, the term “run-of-river” is used very loosely. This lack of specificity, and the claimed green credentials the term connotes, gives license to a wide spectrum of projects being indiscriminately referred to as “run-of-river.” The term ROR has been applied to everything from micro-hydro projects providing electricity in remote villages to the Belo Monte mega-dam in Brazil, the world’s third largest hydroelectric project, which will devastate an extensive area of the Brazilian rainforest, displace over 20,000 people, and threaten the survival of indigenous tribes that depend on the river.

While the term suggests otherwise, most run-of-river projects store water, though application varies widely. In some cases, the ROR label has been applied to dams that withhold water for weeks or even months. The World Bank generally uses the term to refer to dams that can store up to a day’s worth of a river’s flows – a definition that is stricter than most, though such projects are not without impacts, as discussed in subsequent sections.

## WHAT ARE THE DIFFERENT TYPES OF RUN-OF-RIVER PROJECTS?

1. **Strict run-of-river** projects do not regulate a river’s flow, and they generate power as water passes through turbines in the dam. Because they do not store water, these projects typically have fewer adverse impacts than other ROR projects, but they nevertheless disrupt river biodiversity and other river functions.
2. **Pondage run-of-river** projects provide daily or weekly regulation of flows by storing water behind dams, and the reservoirs are referred to as “pondage.” Commonly operated as “peaking plants,” water is passed through turbines in the dam to maximize power generation during times of peak energy demand. This results in drastic changes, even on an hourly basis, in a river’s flow. These projects can also be operated to deliver baseload power.
3. **Diversion run-of-river** projects divert a portion of a river through surface or underground tunnels that can stretch anywhere from a few hundred meters to dozens of kilometers to a powerhouse downstream. Once the water is run through turbines, it’s returned to the river. These types of projects often dewater long stretches of rivers. Tunnels are most commonly used in mountainous areas like the Himalayas, Canada and Switzerland.

## ENVIRONMENTAL AND SOCIAL IMPACTS OF RUN-OF-RIVER PROJECTS

Run-of-river projects are often presented as having few or no adverse impacts on rivers. The Clean Energy BC industry group in Canada describes run-of-river technology as a “continuous source of clean and green renewable energy with minimal environmental impact.” However, ROR projects can have severe impacts, particularly downstream. Some of these effects are inherent; others depend on how a dam is operated.

Run-of-river projects often have significant impacts on fish and other aquatic species. Their dams block the upstream and downstream migration of fish and other biota, and prevent sediment and nutrients from flowing to floodplains downstream. They often inundate important biodiversity hotspots, which tend to occur near the rapids that attract dam developers. These impacts can be exacerbated when a series of dams are built in a cascade.

### SOME OF THE IMPACTS DIFFER ACCORDING TO THE TYPE OF PROJECT:

**Dam cascades:** ROR projects are often built in a series, or cascade, along a river, since the construction of the first dam on a river regulates its flow, making the development of subsequent ROR projects downstream more economical. While this approach may maximize the hydro potential of a stretch of river, the cumulative effects of such projects are particularly pronounced. The cumulative impacts of dam cascades on river health cannot be measured by examining each project individually; as such projects can condemn a river to a “death by a thousand cuts.”

Dams always jeopardize a river’s health by fragmenting it, but connectivity is broken when river flows are impeded by several projects in a line. Cascades often pose impenetrable barriers to migratory fish and exacerbate the impacts on riverine ecology discussed above. Cascades also have a more pronounced effect on blocking sediment from traveling downstream, impacting both dam operation and, most critically, the ecosystems and fertility of floodplains downstream. These impacts can be felt all the way to the mouth of the river, and have significant impacts on coasts, intensifying erosion.

Despite the heightened risks associated with dam cascades, governments rarely require a basin-wide assessment of the cumulative impacts of several projects, or they conduct it too late to influence the siting of projects. ROR projects within a cascade are often built and operated by different private companies who are generally required only to assess and manage the direct impacts of their own projects. As a result, developers and governments often underestimate cumulative impacts, which has led to sharp declines in fertile floodplains and in productive river and coastal fisheries.

Governments and developers also rarely conduct baseline studies of the presence and abundance of aquatic species, including endangered species, before the dam is built. This gap makes assessing impacts difficult, and as a result the cumulative effects of dam cascades are understudied.

**Diversion dams:** By diverting water from the river channel, long stretches of river – often dozens of kilometers – are effectively dewatered, turning a river into a continuous series of pools and tunnels for much of the year. Many such projects can divert most or all of a river’s flows, causing changes in a river’s temperature, velocity and depth that can completely kill off the natural life in a river.

**Peaking power:** These projects can be incredibly disruptive to riverine ecology. While strict ROR projects should not change a river’s flows for generation, ROR dams with storage, or “pondage,” can time releases and generate power for those hours or days when energy demand is at its highest, or is “peaking.” However, by releasing an entire day’s worth of flows within the span of a few hours, they create daily fluctuations between flood and drought that can wash away or disrupt fish breeding grounds and aquatic biota that are critical to the food chain. Although referred to as run-of-river, projects operated in this manner create the opposite of a river’s natural flow. Peaking plants can also pose a significant safety risk to people living downstream, who can be exposed to unexpected dam releases.

Rather than serving as a low-impact alternative to large reservoir dams, run-of-river dams can have serious and long-lasting impacts, particularly on downstream ecosystems. These impacts have been overlooked and understudied because of the widespread assumption that such projects are benign, aided by the lack of any meaningful definition of the term. The term run-of-river is now being used by some dam proponents as a way to “greenwash” projects. However, decision-makers, planners and communities must pay the same scrutiny to run-of-river projects as any other dam.

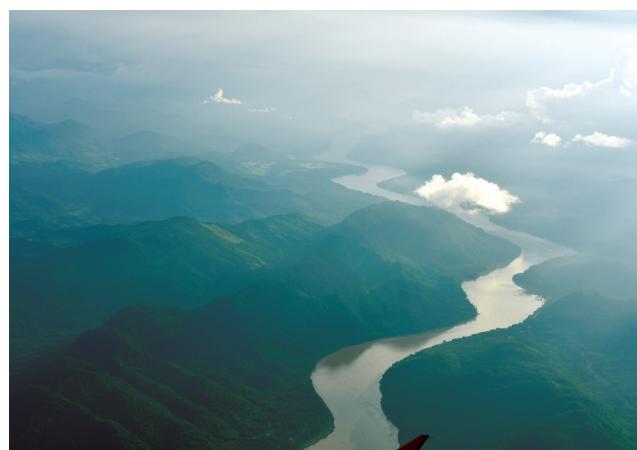


Photo: International Rivers

## RUN-OF-RIVER DAM CASCADE ON THE MEKONG RIVER MAINSTREAM



**Source:** MRC Strategic Environmental Assessment: ICEM, 2010

\*Initially proposed as a 3,300 MW project, 465 MW and 2,600 MW options have also been studied.



Photo: International Rivers

The cascade of 11 dams planned and under construction on the lower Mekong River mainstream – nine in Laos and two in Cambodia – are classified as run-of-river projects.

Project proponents are drastically understating the impacts, particularly the transboundary impacts, of lower Mekong River mainstream dams. They say that as these projects are run-of-river, the risks and impacts will be minimal. However, as noted above, there is no common definition of “run-of-river”, and the storage capacities, reservoir sizes and operational strategies of each of these projects will differ greatly. Some of the lower Mekong River mainstream dams have the capacity to retain flows for 2–3 weeks during an average dry season, and 1–2 weeks during an average wet season.

The Mekong River is also characterized by four distinct flood seasons which are vital for sustaining the river’s rich ecology, its vast freshwater fisheries, and a sediment and nutrient balance which is critical for the region’s agricultural productivity. Mekong dams will irreversibly alter the timing and duration of these flood seasons; block critical fish migration routes and sediment flow, with significant consequences to regional food security and livelihoods.

The Sanakham Dam, in Laos would have the longest potential retention time, which, in a dry year, could retain up to one month of flows. The Sambor Dam in Cambodia would have the largest reservoir which, at 620 km<sup>2</sup>, would displace more than 19,000 people.

If all eleven dams are built on the lower Mekong mainstream, 55% of the river would be transformed into a series of reservoirs according to a Strategic Environmental Assessment (SEA) conducted for the Mekong River Commission.

Planning and decision-making for the development of hydropower projects on the lower Mekong River mainstream, has to-date taken place on a project-by-project basis. The problems caused by this piecemeal approach are compounded by the absence of adequate

baseline data, transboundary or cumulative impact assessments for mainstream projects already under construction, and no comprehensive plans for long-term monitoring of project and basin-wide impacts.

## **LEGACY OF FAILED RUN-OF-RIVER DAMS: PAK MUN DAM**

Thailand’s Pak Mun Dam was built with \$24 million in financing from the World Bank. While the project’s proponents claimed its footprint would be limited as a run-of-river project, the dam was highly contested due to the predicted impacts on the rich and productive fisheries of the Mun River, the largest tributary of the Mekong River.

As a direct result of the dam, more than 20,000 people have been affected by drastic reductions in fish populations upstream of the dam site and other changes to their livelihoods. The dam has blocked the migration of fish from the Mekong River to the Mun River, where 265 fish species had previously been prevalent. A fish ladder, promoted by the World Bank’s fisheries experts to allow fish migration, has proved useless. After 20 years, local communities continue to demand the dam be decommissioned.

## **RISKY RUN-OF-THE RIVER PROJECTS: MEKONG MAINSTREAM DAMS**

### **XAYABURI DAM: A DANGEROUS TESTING GROUND**

While dozens of dams have already been built on the Mekong’s tributaries, when it is completed in 2019, the Xayaburi Dam in northern Laos will be the first on the Lower Mekong mainstream. According to the Lao government, the Xayaburi Dam is a test case and a “model for all dams on the mainstream of the Mekong River.”

The costs of this “test” will be borne by the millions of people who live along the Mekong. Proponents claim that as a run-of-river dam, Xayaburi will have a smaller wall that will allow water to pass beneath it. Researchers, however, contend that the concrete walls of the Xayaburi Dam will be tall enough to raise upstream water levels by between 30 and 65 metres, thereby blocking sediment and migrating fish.

Scientists expect that the dam will block critical fish migration routes for between 23 to 100 species, including the endangered Mekong Giant Catfish. The dam would also destroy the river’s complex ecosystems that serve as important fish habitats. It would block the flow of sediments and nutrients, affecting agriculture as far downstream as the Mekong Delta in Vietnam.

Despite enormous impacts to the region’s fisheries, the project’s developers have ignored scientific consensus and downplayed the severity of the threat by claiming that two fish ladders incorporated into the dam’s design

will mitigate fisheries impacts. Yet a group of globally renowned fisheries experts have unequivocally stated that fish ladders will not work due to the Mekong River's large biodiversity and its high number of fish. Even if the fish passages are designed for a few specific species, they warn that the Xayaburi Dam's height of 32 meters is higher than the maximum height at which fish ladders will work.

The Xayaburi Dam sets a dangerous precedent for dam building on the Mekong, relying on unproven technologies to mitigate any harm the dam might cause. As the project's environmental impact assessment examined impacts 10 kilometers downstream from the dam site, the full extent of the dam's potential impacts on the world's largest freshwater fishery remains unknown.

### DON SAHONG DAM: THREAT TO REGIONAL FISH MIGRATION

Project proponents have pointed to the fact that the Don Sahong Dam in Laos is a run-of-river project to argue that the project will not have significant transboundary impacts. However the dam's run-of-river design will do nothing to limit the project's impact on fisheries. Don Sahong Dam will block one of the most critical channels in the area for year-round fish migration. More than 100 species have been reported to migrate through the Hou Sahong Channel. Blocking the Hou Sahong Channel threatens the migration, feeding and breeding patterns of a diverse number of these fish species with potentially devastating consequences for the livelihoods and food security of hundreds of thousands of people. Fish catch is a critical component of the diet and livelihoods of Mekong River communities.

Between 40% and 70% of the region's animal meat protein comes from inland fisheries, and studies have shown that this number can increase to up to 80% for communities above and below the Khone Falls, where the Don Sahong Dam is located. The project is located less than 2 km from the Cambodian border, yet despite the close proximity, no transboundary impact assessment has been carried out. The Governments of Cambodia, Thailand and Vietnam have all called for further studies to be done to assess the impacts of the Don Sahong Dam.

### THE PAK BENG DAM: UNCHARTED WATERS

The project studies for the Pak Beng Dam, the third on the Mekong mainstream, acknowledged that the run-of-river project is likely to have serious on fish migration, including the endangered Mekong giant catfish. The developers propose measures to mitigate impacts on fisheries, yet these measures remain untested for the volume and diversity of fish species found in the Mekong. While the dam's turbines may allow for the survival of small fish, large fish such as the Mekong giant catfish



Photo: International Rivers

would have difficulty moving through the turbines without injury. The rapid transport of juvenile migratory fish downstream will be impeded by a 97 km long pool of slow-moving water behind the dam, causing them to be trapped and fall victim to predators. Experts predict that the resulting loss of long-distance migrants would affect the fish community in a large portion of the Mekong River and the food security of the entire region.

Furthermore, the "pondage" above the Pak Beng Dam will total over 7,000 ha, of which 4,178 ha comprises land and water resources used by local villagers, including 170 ha of lowland paddy fields. An estimated 800-1,100 people will need to be resettled.

An independent expert review of the Pak Beng Dam environmental impact assessment (EIA) cites a lack of understanding in the existing studies of the Mekong's complex ecosystem, an extremely limited picture of expected environmental and social impacts of the dam, and a failure to adequately assess the transboundary and cumulative impacts of the project. Mitigation and compensation measures are based on limited or outdated data, unproven and unrealistic assumptions, and are heavily reliant on models used for other large-scale hydropower projects in Laos that have largely failed to restore livelihoods or minimize environmental damage.

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