

WORLD RIVERS

REVIEW

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Citizen Science Supports a Healthy Mekong

By Kirk Herbertson

The Mekong is not a one-size-fits-all river. One of Asia's longest rivers, it begins in Tibet and flows through China, Burma, Laos, Thailand, Cambodia, and Vietnam. Ask someone in one of these countries how they depend on the Mekong River, and you will get a unique answer that reflects the local realities of the village, city, or culture you are visiting. More than 60 million people live and work here. For the poorest villagers, local knowledge of the river may be their most valuable asset. Millions make a living by understanding the behavior of fish and animals that provide food, the local farming conditions, and the annual cycles of flooding and dry season. Countless people's lives are closely intertwined with the river.

This is why dam building has become such a concern for local communities living in the Mekong region. China has already built several large dams on the upper part of the river. Now governments propose to build 11 dams on the lower part of the river, nine of them in Laos. The purpose of the dams is to create electricity, but they could come at high cost to the people who use the river. Together, the dams would dramatically change the lives of millions of people, flooding more than half of riverbank gardens, reducing fisheries catch by 26-42%, and reducing the flow of sediments and



Mapping the Mekong: In 2011, villagers mapped fishing grounds, river-bank farmland, river morphology and sub-ecosystems. Photo: TERRA

nutrients to agricultural areas in the Mekong Delta.

Most of the Lower Mekong governments have laws in place to compensate and resettle communities that are affected by dams and other large development projects, but too often these laws do not stave off poverty for project-affected people. The decision to build dams is most often made behind closed doors. By the time communities find out they will be affected, they have had no opportunity to contribute to the debate. Often they learn with only short notice that they will be moved from their homes. Compensation is determined by consultants who conduct an inventory of the market-value of families' trees, houses, and crops. After the communities are moved, local knowledge of the

river is lost, and the risk of impoverishment is high.

Under such difficult conditions, "citizen science" is becoming a powerful tool for communities to ensure their voices are heard in the debate over dams. Traditionally, governments in the region have depended on consulting companies to assess environmental and social impacts of projects. The quality of these assessments can be poor because the companies have an incentive to portray the project in a favorable light to their clients. By systematically documenting the ways that they depend on the river, communities are improving their ability to provide governments with accurate information about the risks and benefits of projects. As efforts continue to build Lower Mekong dams, citizen science

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Commentary

KNOW THY RIVER

At International Rivers we're known for our effectiveness at critiquing and campaigning against destructive dam schemes. This important, frontline work defending rivers in solidarity with dam-threatened communities is crucial and courageous. Yet, our end-goal lies well beyond stopping short-sighted dam projects.

Ultimately, we seek proactive solutions that take the long view in recognition of living rivers as a necessary component of a viable, thriving Earth: solutions to propel truly sustainable energy pathways; solutions for watershed practices that restore landscapes and resuscitate river functions, and solutions that empower river-based communities to continue to derive livelihoods from their watersheds.

Of the many solutions that dig below the superficial and move toward the rooted resilience, "citizen-led river monitoring" and "community-based watershed management" hold great promise in transforming the way that society interacts with, derives value from, and reciprocates for the ecological services provided by healthy watersheds and functional rivers.

In this issue of *World Rivers Review*, we highlight approaches and case studies from around the world for how communities have asserted themselves in the monitoring and management of their rivers. One profile comes from a California watershed organization, SYRCL, an innovative and solutions-oriented group that I was privileged to lead for six years before joining International Rivers. When I arrived at SYRCL, I inherited what was on its way to becoming one of the largest citizen-led river monitoring programs in the country, with about 100 volunteers conducting a range of water-quality monitoring tests and aggregating the data on a monthly basis. SYRCL continued to innovate and expand the program to include monitoring of other indicators of watershed health, such as meadow function, aquatic insects, and of course the alteration of river flows downstream of dams.

Ultimately, as the State of California teetered on insolvency in 2008-09, I came to appreciate a new dimension of "resilience." At SYRCL we began to recognize that a core impediment to restoring healthy rivers was rooted in existing governance structures that simply were not equipped to support such goals. We asked ourselves, what would citizen-led watershed governance look like? And in wrestling with this question we began organizing our river monitoring volunteers into "guilds" – groupings of neighbors drawn together by the commonality of their local stream and committed to working together to improve the baseline measurement for their environment: the quality of the water flowing through the landscape. The volunteers began to work together to assess the factors that were compromising watershed health and articulate an action plan for collaboratively addressing these problems.

The process of working together, as neighbors living on a shared part of the planet, in itself became a solution. Drawing upon the results of our citizen-led river monitoring program, the traditional ecological knowledge of the people indigenous to the Yuba River, and the practical experience gained from experimentations with community-based resource management, we articulated a vision and goals for community-driven watershed governance into a document we called "A 21st Century Assessment of the Yuba River Watershed" that SYRCL published in 2010.

My experience in a rural region of California may have little site-specific replicability to the contexts where International Rivers and our partners are most deeply engaged. My point in sharing this illustrates just one way that our global movement for rivers is evolving. And evolve and adapt as a movement we must.

International Rivers will keep fighting to stop destructive dams, because for dam-threatened peoples, everything is on the line. We'll become increasingly sophisticated in transforming the policies that incentivize the destruction of rivers, because the industrial appetite for electricity is driving the hydropower boom. And we should also encourage experimentation with entirely new ways of organizing communities to safeguard our watershed assets, because building resilience around our waterways in the face of economic and climatic uncertainties is both pragmatic and visionary. In my own experience, and in the experiences captured in these pages, citizen science and community-based watershed planning are key ingredients for advancing solutions for healthy rivers that support resilience in many forms.

Jason Rainey

MAKING WAVES

In the News

“Laos is playing roulette with the Mekong, and trying to pass its studies off as legitimate science,” Southeast Asia policy coordinator, Kirk Herbertson, told the BBC. ”

“Laos approves Xayaburi mega-dam on Mekong,” BBC News, Nov. 5, 2012

“Large-dam hydropower poses economic and adaptation risks. Africa has been referred to as the continent most at risk of being negatively affected by climate change. We need to act now to protect our rivers as sources of livelihoods and food security,” says International Rivers Africa programme director Rudo Sanyanga. ”

“Proposed Zambezi hydropower dams pose some risks, expert warns,” Engineering News (South Africa), Oct. 12, 2012

Justice for victims of Chixoy Massacre

For more than 20 years, the Maya-Achi people displaced by the Chixoy Dam in Guatemala have sought justice for the massacre of their husbands, wives and children that took place during that nation’s civil war in the early 1980s. On October 19, their years of effort were finally recognized when the Inter-American Court on Human Rights found Guatemala guilty of violating human rights of the communities of Rio Negro.

“After so many years struggling to seek justice, we have found a ray of hope for the community of Rio Negro,” said Juan de Dios García, Director of the Association for the Integral Development of the Victims of the Violence of the Verapaces, Maya Achi.

The Rio Negro and 32 other communities affected by Chixoy Dam are seeking reparations from the State of Guatemala, and the World Bank and Inter-American Development Bank, the dam’s financiers. Their reparations plan has been stymied by political and economic interests, which continue to put obstacles in the way of legalization and implementation of the plan. International Rivers and other groups and experts are putting pressure on the World Bank and Inter-American Development Bank to address their outstanding debt to the Maya-Achi communities, and hold Guatemala responsible for these crimes.



A cross of remembrance at the Chixoy Massacre site.

Malaysia dam protests keep the heat on

Since Sept. 26, Penan tribal chiefs and villagers have kept up a steady protest and road blockade against the Murum Dam, the first of 12 dams that the Sarawak government plans to build on indigenous lands as part of a scheme to attract industry to the state. Local people for weeks were able to prevent trucks and equipment from reaching the dam site.

The controversial project, now under construction in the rainforests of Sarawak, one of two Malaysian states on the island of Borneo, is being built by China’s Sinohydro, and managed by China Three Gorges Project Company – the first overseas dam for the company, which built China’s Three Gorges Dam.

For the past year, the SAVE Rivers network of Sarawak NGOs and indigenous leaders has traveled to indigenous communities in Sarawak to raise awareness about the dams’ impacts and to share experiences from resettlement for the Bakun Dam.

In addition to the local actions at a strategic bridge near the dam site, a group of Malaysian NGOs went on a week-long “Reclaim Sarawak Environmental Rights Road Show” in October to raise awareness with urban Malaysians about the dam’s impacts on the environment and indigenous people.

So far, a handful of international NGOs (including International Rivers) are supporting the campaign, but few peninsular Malaysian NGOs have taken up the fight.

Seeking justice on dams in Mexico

For the second time in recent years, Temacapulin, Mexico became the convergence point for dam-affected communities and activists from around Mexico, who came to the small dam-affected town to testify at a hearing of the Permanent People’s Tribunal (PPT) on environmental destruction caused by dams. International Rivers’ Latin America campaign coordinator, Monti Aguirre, was one of seven judges at the hearing; others included the Ex-Special Rapporteur for Housing Rights of the UN and the President of the Council of Canadians, among other experts.

The PPT is an international non-governmental tribunal that examines the violation of the fundamental rights of the people. While the PPT does not pass legally binding judgments, it presents the findings of its research and hearings to the public for their own opinion to be given. For the next three years, the PPT in Mexico will delve into and judge the crimes against humanity committed by the Mexican State.

The hearing in Temacapulin specifically examined the construction of dams and reservoirs in Mexico. Judges reviewed documentation, watched videos and heard testimony from dam-affected or threatened peoples from El Zapotillo, Cerro de Oro, Paso de la Reina, La Parota and El Naranjal dams. Participants gave accounts of human rights violations, and lack of compliance with judges’ rulings. The results of these hearings will be presented at a final hearing in front of the Tribunal in Mexico in early 2014. Organizers hope that the process of people coming together to hold their government accountable is another step in the direction of protecting a healthy environment, free-flowing rivers, and human rights.

US Rivers Get a Boost from Citizen Science Projects

by Haven Livingston

Rivers in the US have been under siege since the age of industrialization began. They've been dammed (the US is the second most dammed nation in the world, with 5,500 large dams), dewatered for large-scale agriculture, deforested and polluted. This wide scale destruction brings urgency to the need to understand the health of entire river systems in order to protect and rehabilitate them. The best way to gain this understanding is to measure the vital signs of a river through the whole watershed. But monitoring thousands of miles of river is a gargantuan task, one that could never be accomplished by government agencies alone.

Over the past decade, citizen scientists in the United States have increasingly played a critical role in large-scale data collection to benefit their rivers. From monitoring water quality and quantity, to species research and climate-change impacts, data collected by citizens is creating windows into the health of our waterways. One result is that more riparian systems are being preserved, protected and restored. A secondary result, which may prove to be even more valuable in the long term, is that citizens are connecting with their local landscapes and becoming better stewards of their own watersheds.

While often prompted by the need to meet national and state standards and occasionally funded by government grants, citizen science projects are most often put into action by citizens' groups or environmental organizations. Here are a few examples from the US West.

Citizen SYRCL

The South Yuba River Citizens League (SYRCL) in California's Sierra foothills is a rural, grassroots campaign which formed in 1983 to defend the South Yuba River from proposed hydropower dams, and has since become a force for protecting and restoring the entire Yuba watershed. For more than a decade, SYRCL has trained and coordinated the work of more than 400 volunteers in various citizen science efforts. Volunteers conduct ongoing water quality monitoring along more than 200 miles of the river and its tributaries.

Plans to develop a monitoring program evolved from concerns community members had about the health of the river. The region had once been a hotbed for hydraulic mining, resulting in heavy metal and other pollutants entering the water and river sediments. The river also has multiple dams whose reservoirs have concentrated the toxic sediments behind them.

"People want to know that the water they swim in is clean and that the river is healthy," said Gary Reedy, River Science Director at SYRCL. "They want to know the condition of the aquatic ecosystem in light of hydropower changing the flow, the legacy of toxic mining, and a variety of other potential impacts from land use."

The willingness of concerned citizens to volunteer enabled development of a monthly monitoring program. The purpose of the

program is to inform protection and restoration actions through the collection of quality data that can be used to better understand the river's condition. Funding for initial program activities came from the federal Clean Water Act and the State Water Resources Control Board, but those funds are now reserved for the most heavily polluted waters of California, and the Yuba did not qualify. Citizens concerned for the Yuba were undeterred, and funded the program over the past six years mostly with private grants, donations, and membership dues, and a few government grants. Keeping costs down is paramount. SYRCL has partnered with the national AmeriCorps program to recruit, train and host a new member each year as the River Monitoring Coordinator.

The group's water quality monitoring follows five parameters: dissolved oxygen, pH, water and air temperature, turbidity and conductivity. These are important because much of the biota living in a freshwater system is dependent on particular chemical and

physical environments to survive. This includes temperature, which affects how much oxygen the water can hold and has an effect on chemical reactions such as those involving pH. Water also holds heat longer than air, so when rivers warm they will remain warmer for longer, reducing availability of oxygen for fish and other species. Turbidity and conductivity measure the suspended particulates (clarity of the water) and the speed at which the water conducts electricity (salt content), respectively.

Results are routinely compared to water quality objectives set by the state. Volunteers are prepared to collect water quality data with four hours of

training and a chaperoned first site visit. All measurements can be made in the field with relatively inexpensive equipment except turbidity, in which a water sample is returned to the SYRCL office for measurement. As funding allows, water samples collected from various sites are sent offsite for analysis of various pollutants.

SYRCL has partnered with a state agency conducting a "Safe to Swim" study. SYRCL identifies sites at risk and collects samples, while the state conducts laboratory analysis. Volunteers also collect a variety of environmental observations at their site, including the presence of invasive species or unusual changes to the water, such as cloudiness or oil sheens. These observations have proven useful in conducting follow-up investigations and planning restoration projects.

Water samples were originally tested for heavy metals, but this was largely ineffective compared to testing sediments. SYRCL has since partnered with institutions that can perform the more expensive tests. "Our citizen-based program is not suited to all types of monitoring and assessment, but having our program in place is proving valuable for developing partnerships that can perform targeted monitoring and analysis," Reedy said.

Continued opposite



Jessica Hayes of The Nature Conservancy shows what it takes to do citizen science. Photo: TNC

When a section of river fails to meet the water quality objectives for an extended length of time, potential causes are scrutinized. Sites that repeatedly fall outside of acceptable levels may be listed as impaired under the national Clean Water Act, a classification that commits the state to formal assessment and the development of an action plan. SYRCL's data has contributed to several such listings. Most recently, the South Yuba River was listed as impaired by high water temperature. Future actions resulting from this listing are expected to improve the suitability of the river for recovering salmon by increasing stream flows downstream of dams, and improving riparian canopy. Data are being used as evidence for a need to change flow regimes when negotiating hydropower dam relicensing permits.

Columbia River citizen monitoring

The Columbia Riverkeeper runs a citizen science program similar to SYRCL to monitor water quality of the Columbia River at 100 sites in Oregon and Washington. Like many river monitoring programs, retention rate for volunteers is high. Most volunteers return for at least two years and a number have been with the program since it began in 2006.

"It's a great way to get people out on the river to be our eyes and ears. If we hear of some emergency, we can call on them to respond to their site and check things out," said Lorri Epstein, Water Quality Director at Columbia Riverkeeper. On one occasion, a volunteer saw an oily sheen on the water at a site and reported it quickly enough for a response team to set up effective containment and trace the oil back to a fuel station.

In addition to the standard parameters measured by SYRCL, Columbia's program also collects monthly samples for bacteria testing. This testing's usefulness was proved when it successfully detected a massive influx of bacteria at one site; the cause – a crack in a nearby sewer pipe – was quickly repaired.

Volunteers collect weekly bacteria samples at five popular recreation sites in the Columbia Gorge. The results are published on a Swim Safe website and also on a smart phone application. This sampling is partnered with the City of Hood River in monitoring the effectiveness of their nearby wastewater treatment plant.

The data collected in the Riverkeeper program matches state standards and follows a state approved protocol. This ensures the data will maintain standing in court. "We publish annual reports available online and share the data with the State Department of Environmental Quality and other researchers who want to study a specific issue, such as a particular population of fish," said Epstein.

Recently, the US Forest Service requested stream temperature data from the Columbia Riverkeepers for a regional database and modeling project. This project is compiling data from multiple sources to develop a comprehensive regional database that will serve as the foundation for statistical models. These models will be used to predict future stream temperatures and assess the vulnerability of sensitive fish species and other aquatic resources in the Northwestern US.

San Pedro River wet/dry mapping

When scientist Holly Richter came to work in Arizona for The Nature Conservancy, she heard conflicting answers to the question, "Has the water level in San Pedro River changed?" Water users claimed that there had been no change. Some community members believed the river was drying up. The variation in replies from regional land owners and community members made a clear case for research. "There was a lot of conflict and controversy over the river," said Richter. "I wondered what could be done to build con-

sensus in the community and get an understanding of what's going on. I thought, let's go out and see how wet it is."

In 1999, the first wet/dry mapping day occurred along Bureau of Land Management property of the San Pedro River. The plan was to take a one-day snapshot of where there was water in the riverbed during the driest time of year and repeat annually. When examined in conjunction with other studies in the watershed, the project could eventually show trends in water level.

Richter not only turned to river users for help, she invited city council members, teachers, realtors and others to get a representative group from the community to help collect data. Field teams were intentionally mixed with scientists, environmentalists and lay people to give more credibility to their data and invoke trust between volunteers. "I had to look at this as a social science issue as much as scientific research," Richter said. Richter emphasizes that you should start with the end in mind: know what the question is, why you need to answer it and for whom.

She also notes that citizen science methods must be simple, and instruction given in a clear and concise way. Training volunteers involves the use of the equipment and a practice course before the field day. Data was originally collected on GPS units purchased by The Nature Conservancy, but now many partner groups purchase their own. Volunteers walk or ride horseback on reaches of the river ranging from 2-12 miles long. They mark where water starts and stops along the way. Over the years, team members became intimately familiar with their reaches of the river. Richter observed that when this happens, the volunteers gain a greater appreciation for the value of the river and the need for its sustainability.

Now in its fourteenth year, the wet/dry survey has grown to include 120 volunteers and over 250 miles of mainstem river and tributaries. The project spans into Mexico toward the river's head-

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Scientific Adventures

Citizen science is not the perfect answer to all data collection needs in a watershed. Sometimes there is a need for information from locations that are accessible only by the most adventurous people. Adventurers and Scientists for Conservation is a liaison organization dedicated to improving the accessibility of scientific knowledge by building partnerships between outdoor enthusiasts and scientists. With their help, non-profit organization Rivers for Change connected with scientists seeking data from California rivers.

A program by Rivers for Change, "12 Rivers in 2012," assessed a dozen key rivers in California from source to sea, giving scientists a rare opportunity to collect data from reaches of rivers that only skilled kayakers can access. The campaign also helped shed light on watersheds in their entirety, and build community connections.

In steep isolated canyons of the upper reaches of these rivers, expert kayakers were able to collect algae samples for scientist Mike Deas, who is developing an algae bank that can provide important information about climate change. In the San Francisco bay area, kayakers escorted and assisted botanists in a successful search for rare native plants in areas not accessible by land.

Time constraints, equipment size and the level of scientific expertise in a group of adventurers are the greatest considerations when pairing research with expeditions. When the right match is found between scientists and adventurers, the results can be as thrilling as discovering a new species, or paddling a Class 5 rapid.

Interview

China's Green Hunan trains citizen scientists to fight river pollution

Green Hunan, founded in 2007, is the only civil society organization focusing on basin-wide environmental issues in Hunan Province's Xiang River watershed. **Katy Yan** asked them about their citizen-science projects to protect water resources in the watershed.



A Green Hunan volunteer collects water samples.

WRR: Describe your citizen science efforts. How does it work? How many volunteers does it take?

GH: Our current "citizen science" projects include the volunteer Observation and Action Network of Xiang River Watershed, the Vote for the Top Ten Environmental Events in Hunan Province, and a Pollution Information Transparency Index.

For the Observation and Action Network, we established 63 on-site monitoring stations on six upper tributaries of the Xiang River and two heavy polluted areas in the watershed for long-term monitoring. There have been more than 60 frequent volunteers (also called Stewards of the Xiang Rivers) involved in the Network, who are from 23 local cities and counties by the river. Their professional backgrounds include industrial workers, farmers, students, professors and public officials. These volunteers conduct basic tests of water quality on a regular basis at the monitoring stations, track pollutants, push for solutions to the pollution problems and record any environmental changes in the watershed.

Recently, one of our volunteers discovered that a local company had been secretly discharging pollution into the river during the night. As part of his investigation, he went to the discharge outlet late every night, making records, taking pictures, and sampling the pH of the polluted river. When the pollution was confirmed, he immediately reported it to the government and circulated the information on Weibo (China's version of Twitter), where it was immediately re-tweeted 4,000 times. The outcry from the public and local media directly led to enforcement actions by the environmental protection bureau, which shut down the polluting factory, followed by an unprecedented public apology from the company chairman.

It has been one and a half years since the beginning of our Observation and Action Network. We have accumulated 100 monitoring logs recorded by volunteers and more than 5,000 monitoring

pictures. Our project not only encourages local governmental authorities to stop polluting activities, but also offers an abundance of data on the ecological and environmental changes in the Xiang River watershed.

Including the Stewards of the Xiang River, there have been more than 100 regular volunteers now working for Green Hunan on various projects. We expect more volunteers to join us, helping us carry out our work while pursuing their own ideals of "citizen science" at the same time.

WRR: What do you do with the results?

GH: First, the collected data is categorized and put on file in a database for follow-up research and investigation. This kind of data collection has long-term value.

Next, the data is analyzed and edited into the final research reports for publication. Copies of the reports are sent to relevant governmental authorities and companies. An example is our "Report of the Pollution Information Transparency Index of the 14 Cities and Autonomous Prefectures in Hunan Province."

In addition, water quality monitoring data is also sent directly to the environmental protection bureau as evidence of pollution events. This has prompted enforcement actions to stop the polluting activity.

WRR: What successes have you had with your citizen science programs?

GH: Although there is still a long way to go to reach real success, below are some of our achievements:

- We managed to establish a non-governmental volunteer network for water quality monitoring in the Xiang River watershed based on "citizen science." Before that, the public was just a set of scattered individuals who may have had good ideas but lacked the means to act. Our network unified these individuals by providing a platform where they can learn basic but practical research methods. The network not only effectively limited environmental disasters in the Xiang River watershed, but also created a model for NGOs in other regions on how to control water pollution in a watershed. This builds the wider network, one comprised of ordinary citizens who can now prevent pollution on a larger scale.
- Thanks to this monitoring and action network, we have been able to research the condition of the entire Xiang River Basin. After travelling for more than 8,000 kilometers, we produced the "Report of the Current Situation of the Ecological Environment in the Xiang River Watershed," which details the situation from the perspective of the citizen scientists, which differs from the perspectives of members from government and academia.
- Some of our projects have been reported on in both mainstream and new media platforms, which has enhanced public awareness of the pollution problems in the Xiang River watershed and widely advertised our volunteer activities. We believe there will be more "citizen scientists" joining us as a result of this.

Continued opposite

initiatives have emerged in several countries based on a methodology designed by Thai communities over the past decade.

But even after overcoming the challenges of conducting this research, communities face the challenge of convincing governments to take their findings into account. In mainland Southeast Asia, the public does not have a strong history of participating in major government decisions. Corruption is pervasive in development projects. In countries such as Laos, local people risk retaliation against themselves and their families for being critical of government decisions. Despite these challenges, efforts are underway in Cambodia, Laos, Thailand, and Vietnam to promote and expand the use of citizen science.

The Thai Baan Movement

Pai Deetes, International Rivers' Thailand campaigns coordinator, previously led a Thai organization called Living River Siam, which has worked over the past decade to promote the use of citizen science (commonly called Thai Baan or "villager" research). She explains, "We believe that every single community living in the river basin knows best about natural resources and how to manage these resources in a sustainable way. Most of the time we see that the studies done by experts or academics depend only on scientific information. They ignore local knowledge and they ignore local use of the natural resources."

Communities in Thailand first began to conduct their own research on rivers in the early 2000s in response to the controversial Pak Mun Dam. The dam was built in 1994 by the Thai government and World Bank on the Mun River, the largest tributary of the Mekong River. Community opposition to the project grew as the dam builders ignored concerns that the dam would devastate fisheries that people along the river depended upon. After the dam was built, fish catch decreased 60-80% even though the project developers included a "fish ladder" technology intended to allow fish to pass through the dam. More than 20,000 people suffered significant reductions in fish catch as a direct result of the dam.

The dam's impacts gave rise to a strong people's movement in Thailand, which became known as the Assembly of the Poor. In 1999, some 5,000 villagers began a long-term occupation of the dam site, demanding that it be decommissioned. In June 2001,



Thai Baan researchers working on Pak Mun. Photo: Living River Siam

the Thai government agreed to open the dam's gates to restore natural flows, so that studies could be conducted on impacts to fisheries and communities. A university conducted the studies for the Thai government. To ensure that people's concerns were heard, the Southeast Asia Rivers Network (now called Living River Siam) developed a research method for communities to conduct their own scientific studies. In what became known as Thai Baan research, Pak Mun villagers systematically documented how the dam had affected their lives and the fisheries they depended on.

The Pak Mun villagers completed their research and recommended that the government decommission the dam. The university study recommended keeping the dam gates open for five years. Nevertheless, the Thai government rejected the recommendations and decided to open the dam's gates for just four months each year – an improvement, but not a solution to the problems the dam caused. Dramatic declines in fisheries have continued.

Nevertheless, the network of Thai communities and NGOs emerged strong and unified after the experience. The Assembly of the Poor continued to support people who were affected by development projects. And interest in Thai Baan research grew.

In 2001, China agreed with Laos and Thailand to blast several rapids along the Mekong River to make it easier for large ships to travel past. China led the environmental impact assessment, which concluded that the blasting of the rapids would not cause significant harm. Soon after, blasting of rapids began. In Chiang Khong district, Thailand, the governments planned to blast away a 10-kilometer-long system of rapids, rocks, and sandbars called Khon Pi Luang that was an important fishing ground for local villagers.

Thai villagers living in Chiang Khong responded with a combination of political pressure and Thai Baan research. From 2003-2004, 146 village researchers studied the Khon Pi Luang rapids and held focus group discussions to learn how people depended on the area. Altogether, they documented that the rapids were an important ecosystem that supported 201 plant species and 96 fish species, including the endangered Mekong Giant Catfish. They also found that 2001 blasting of rapids on the Burma-Lao border had cut the local fish catch in half. The villagers submitted their findings to the Thai government and national human rights commission. Through a combination of Thai Baan research and political pressure, villagers convinced the Thai government to halt the blasting and preserve the Khon Pi Luang rapids.

The Chiang Khong villagers' research was published in a book and has continued to serve as an important source of scientific data about the Mekong. Thailand's human rights commission and several senators continue to build the legitimacy of Thai Baan research by organizing public forums when development projects are proposed. Journalists have also spread awareness of the research. Thai Baan research has expanded to other countries in the region, including Cambodia and Vietnam, where people have found their own local names for this type of research.

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Interview continued from page 7

WRR: What other kinds of citizen science programs do you know about with other Chinese groups?

GH: In recent years, many NGOs in China have initiated public science programs, including the China Pollution Map and Database developed by the Institute of Public and Environmental Affairs in Beijing, which promotes green industrial chains, and the Chongqing Liangjiang Voluntary Service Center's program to prevent and control water pollution. Many of these NGOs are our partners as well as models for our work. ●

Why Our Rivers Need a Citizen Science Movement

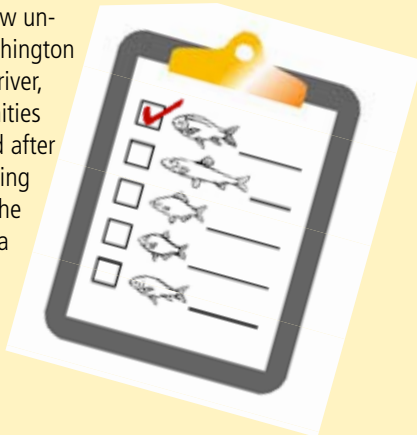
Decisions about managing our rivers are often based on incomplete information – creating a picture whose gaping holes that are likely to remain unfilled by the time construction of a dam or diversion begins. When there is no provision for professional scientists to fill these gaps in our knowledge, citizen science – scientific research conducted by amateurs – can step in to help uncover critical information about a river’s health, and make use of their findings for river protection.

TOO MUCH WORK, TOO FEW SCIENTISTS

Volunteers in the US state of Oregon are helping scientists at the Dept. of Fish and Wildlife survey 146 miles of streams. They are locating and counting salmon and native trout species and helping restore habitat.

Hundreds of volunteers with The Nature Conservancy annually survey how much desert land is made wet by the San Pedro River; they cover more than 250 miles. The information is used by federal land managers, academic researchers, and private landowners in the US and Mexico.

The US’s biggest dam removal, now underway on the Elwha River in Washington state, will restore 113 km of wild river, and is creating a host of opportunities to study the ecosystem before and after removal. Citizen scientists are joining professional scientists to archive the current mix of species in the Elwha before the dams are removed. The work will provide evidence to evaluate the success or failure of dam removal on species’ rehabilitation.

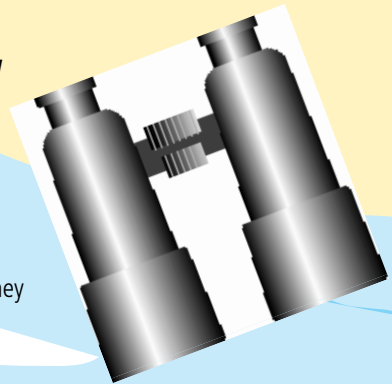


WHAT WE DON'T KNOW CAN HURT US

Large dams can destroy riverine ecosystems, yet dam projects rarely include funding for adequate “baseline” surveys to show what is at stake, or money for post-construction research to document changes to the river.

Citizen science can be used to document basic information about a river system, as well as changes over time to its flow, sediment load, species and water quality.

China’s proposed South-North Water Transfer Project would have massive impacts on many key waterways, yet there are huge gaps in knowledge. Scientist Yang Yong recruited volunteers for a four-year assessment of 10,000km of China’s western rivers. The information they gathered is being shared with citizens’ groups and government agencies to inform land and water use decisions.



CITIZEN SCIENCE IN ACTION: A STEP-BY-STEP CASE STUDY *Fishing*

IDENTIFY THE QUESTIONS YOU WANT TO ANSWER

In 1994, Thailand built Pak Mun Dam on the largest tributary of the Mekong, destroying local fisheries and harming river-based communities. Information on local fisheries was scant.

In 2001, the Thai government relented to international pressure and ordered the dam’s floodgates opened for a one-year study of its impacts to fisheries and communities.



FORM A RESEARCH TEAM

South East Asia Rivers Network (SEARIN) and Assembly of the Poor teamed up to monitor the changes caused by the dam. Their innovative citizens’ science research method, called Thai Bahn (Thai Villager) research, relied on local fishers to gather information.

DEVELOP A PLAN OF ACTION

Methods, areas of study, and research team members were all decided by the local villagers. SEARIN helped write up their findings and increase international awareness.



BECAUSE OUR RIVERS ARE IN PERIL



Just **1 in 10** rivers now reach the sea



8/10 people depend on river resources

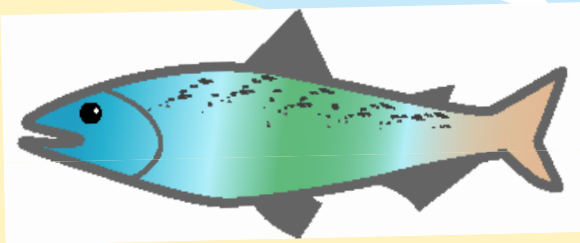


2/3 of Earth's major rivers are dammed

UNCOVERING RIVER MYSTERIES

Citizen scientists can fill in gaps in crucial baseline knowledge about a river's species or general health. Without detailed information about existing populations, we don't even know what we might lose.

The Mekong River in Southeast Asia supports several species of giant fish. Very little is known about them. More information is needed on where they spawn, what natural cues drive them to spawn, population estimates, and maps of their life-cycle territory. Dams on the mainstem would threaten 4 of the world's 10 largest fish.



BECAUSE THEY'RE OUR F

Volunteers for the Mystic River Watershed Association in the Eastern US take water samples at 15 locations along the river to monitor water quality. Advocacy based on their results has helped improve the river's cleanliness.

"We help get residents involved in their natural environment through hands-on science," said watershed scientist Katrina Sukola. "After all, the river belongs to everyone."



For a toolkit on how to create a citizen science program see:

<http://www.birds.cornell.edu/citscitoolkit/toolkit>

Villagers Document Mekong River's Natural Wealth

DOCUMENT YOUR FINDINGS

The natural flows of the one-year trial period allowed people to resume traditional ways of life and eased resource conflicts among river communities. Local fish species not seen for eight years came back; researchers found a total of 156 fish species had returned to the Mun River.



ANALYZE YOUR DATA

SEARIN helped create a report on the team's findings, in two languages. The report is considered one of the most thorough documentations of Mekong fisheries produced for that area.

SHARE YOUR FINDINGS, AND USE THEM FOR ACTION

Thanks to this citizen science effort, the villagers succeeded in getting the Thai government to open the dam gates for four months each year to allow for fish migration, although subsequent governments have unfortunately reneged on this agreement. But the project has inspired many other citizen science projects to protect rivers in the region.



India's Dammed Rivers Suffer Fisheries Collapse

Fishing Groups Take Steps to Fight Back

By Parineeta Dandekar

It may surprise many that India is second in the world in freshwater fish production. More than 75% of fisherfolk in India depend on freshwater fisheries for their livelihoods. Though there is no systematic assessment of livelihood dependence on rivers, nearly 11 million Indians depend on rivers for their livelihoods and nutrition.

Unfortunately, riverine fisheries are one of India's most neglected areas. Rivers have too often been looked at as providers of water or as dumping grounds for wastewater. The many invaluable services that are unique to rivers – fisheries, cultural and religious values, recreation, riparian farming, climate regulation, groundwater recharge and farmland replenishment, to name a few – have been ignored.

Dams in India have led to fisheries collapses in almost all of its major rivers, severely affecting biodiversity and livelihoods. Fisherfolk, one of the poorest segments of Indian society, have been deeply impacted. There is no compensation or rehabilitation mechanism for them, nor strong organized protest.



Marginalized estuarine fisherfolk cross the Vashishti River in the Western Ghats (Maharashtra, India). Photo: SANDRP

Though blessed with one of the richest riverine fish gene pools in the world, with nearly 1,000 fish species and a network of hundreds of rivers, floodplains, oxbows and estuaries, the contribution of riverine and capture fisheries is declining sharply and many have collapsed, despite having a great potential to grow. The past three National Five Year Plans have recognized the problem, but there has been no government action. The current riverine fishery is below subsistence level, with an average yield of 0.3 tonnes per km – about 15% of their actual potential.

According to a 2010 report by the Central Inland Fisheries Research Institute (CIFRI), "Severe and drastic changes in the entire hydrological cycle of the river by dams and water abstractions has affected recruitment of most species ... Larger dams are major cause of degradation of aquatic environment and disruption of livelihood communities dependent upon the fishery along the rivers. In India, natural flow of all major rivers have been regulated for fulfilling water demand of agriculture and the power sector, without giving any attention to the fisheries sector. As a result, rivers

have lost their character and fisheries have suffered huge losses." This and many other critical reports are not easily accessible to the public, neither are there any efforts by the public institutes to disseminate the information.

Mighty Ganga at risk

Fisheries in the Ganga, a lifeline for millions of subsistence fisherfolk in five states, are on a steep decline due to large-scale water diversions through barrages (water diversion structures) and canals. Farraka Barrage, for example, is the main cause of the decimation of the once-thriving Hilsa fisheries along the river. After Farraka closed in 1975, the yield of Hilsa dropped from a high of 91 kg/km to near zero in 2006 in Allahabad. Only the very rich can now afford to buy the fish.

The average yield of major carps in river Ganga has declined by 90% during the past four decades. The biologically and economically desirable fish species have started giving way to the low value species. Exotics have increased sharply as they prefer lower and more stagnant water levels which cannot be tolerated by the carps.

The importance of water levels for fisheries is illustrated by the fact that fisheries improve considerably after Allahabad, where a number of tributaries meet Ganga, bringing freshwater and sediments with them.

Narmada fisheries decline

Hilsa fisheries in the western Narmada River system declined by two-thirds between 1993 and 2005. Carp fisheries collapsed after Tawa Dam and irrigation projects reduced the river's flow. Monthly catches of Mahseer, an endangered species, have now vanished. Fisheries in the Krishna estuary have collapsed due to absence of eflow releases from upstream dams. The estuary is now hypersaline, unable to support estuarine fish.

According to researchers from Assam, carp landings in the Brahmaputra have declined by 30% after embankments cut the river's longitudinal connectivity and destroyed breeding and nursing grounds of carps. In fact, according to CIFRI, dams have been the single most influential factor responsible for fisheries collapse in Indian rivers, a fact corroborated by numerous researchers, communities and nongovernmental groups. Unfortunately, these studies are not available in public domain, nor is there any serious effort to adopt mitigation measures. We do not have an accurate estimate of number of freshwater fishermen in India and their current status. The State fisheries departments are busy giving "No Objection Certificates" to cascade of dams that will be built without fish ladders, passes or eflows regimes. The ancient Fisheries Law of 1897 is entirely inadequate to address any of the current issues.

Taking Action

There are some bright lights in this grim situation. Since 2009, tribal communities in over 32 villages in Central India have come together to work on a People's Biodiversity Register, under the Biodiversity Act of India. The People's Biodiversity Register for the Kathani River, for example, revealed that this small river had 64 distinct fish species; the local tribal fishermen (Dhiwars) had distinct names for all of these species. The process was docu-

Continued opposite

mented in 2009 by Prof. Madhav Gadgil and Dr. Niles Heda, fisheries scientist from Vidarbha. Following declining fish populations in Kathani, the communities, equipped with their own documentation and studies, voluntarily banned herbal fish poisons, and took an ecosystem approach to fish conservation by banning riparian tree felling, planting trees and conserving fish in riverine stretches or sanctuaries. Fish stocks are gradually improving in the river.

In the Vidarbha region of Central India, which has become infamous for its farmer suicides, fisherfolk are getting organized, forming self-help groups and fisheries cooperatives. In reality, “uneducated” tribal fishermen possess in-depth knowledge about fish species, breeding needs, habitats and ecology. With the help of organizations like Bhandara Abhyas Mandal, the groups have started documenting the diversity of fish and aquatic plants. Indigenous fish species found in traditional fish-rearing tanks are being documented. With the help of this knowledge, fish species are being propagated in derelict tanks by creating habitats using indigenous vegetation. Fish yields have increased dramatically following this approach.

In the words of an anguished fisher woman in Maharashtra, “The dam reduced us from being the king of the river, to a slave of this dam.”

The Indian government is exceedingly weak on protecting riverine fisheries. One of the most urgent first steps is to include the impacts of dams on fisheries in Environmental Impact Assessments and Management Plans for dams. We also need to adopt a strong law and supporting policies to protect fisheries and local livelihoods; put pressure on dam owners and operators to compensate affected fisherfolk; adopt a national law mandating restorative eflows through existing dams, and undertake serious research on fish passes and ladders for Indian conditions and species.

We also need honest and holistic cost benefit analysis of dams. Underperforming dams and barrages in biodiversity-rich regions need to be decommissioned. Finally, we need more protected and free flowing rivers to appreciate the range of services a healthy river can provide. ●

The author is with South Asia Dams, Rivers and People (SANDRP) in India. A longer version of this article originally appeared in SANDRP's magazine (Aug-Sept 2012). Download it at <http://bit.ly/RRPZhV>

US Citizen Science *continued from page 5*



Columbia Riverkeeper's Water Quality Director, Lorri Epstein teaches a student how to use a YSI meter, which measures dissolved oxygen. Photo: Columbia Riverkeeper

waters. What started off partly as a community building project has been embraced by the scientific community, with information being widely used by other researchers. That sort of recognition has only reinforced to the volunteers that they are doing meaningful work.

The results have shown huge variability from reach to reach and from year to year in water levels. Only one reach has shown a significant trend, which is an increase in water level attributed to

conservation easements halting irrigation on surrounding lands. People have accepted the results at face value even though there is no absolute answer. What makes the project successful is that both sides of the argument will use the same data set to support their positions.

Take-home lessons

The examples above have common threads, but they are specialized to fit the particular needs of each river. People saw a need to understand more about their rivers; they identified what their major concerns were, and decided what type of information could be collected with easily executed protocols. Here are a few key points in developing citizen science programs:

- Partnering with other community groups and government agencies makes a program more robust, credible and opens opportunities for funding.
- Consistency in leadership is a key component for a sustainable program. Leadership changes need to include a thorough transfer of knowledge to new leaders.
- A qualified scientific advisor is needed to help set up programs and be involved in the periodic review of the resulting data.
- Volunteers often step forward, but can and should be recruited from all parts of the community.
- Most programs require long periods to show any trends.
- Definitive results are not likely, but trends will give you an increased likelihood of answering questions.

In today's economy, funding for science is only going to get tighter. The citizen science approach makes sense financially and it adds a level of meaningfulness to a project. Connecting people with places, natural processes and the challenges we face is the only way we are going to find sustainable solutions. ●

Haven Livingston is a freelance writer and biologist with a background in water resources management. Contact her at wavehaven@yahoo.com

News Briefs

By Kate Ross



At least 200 marine-energy devices are in development.

Marine Energy Surging

While marine energy is still in its very early stages, excitement is building as promising new technologies are finally leaving the laboratory and moving in oceans around the world.

The US has been conducting extensive testing of wave and tidal power devices in open waters, while various universities are working to develop viable marine technologies. Approximately 50 tidal projects are in various stages of development throughout the US.

A new study shows the UK has 153 gigawatts of potential marine energy, using three types of technology. A number of projects are in development, and the industry is poised for expansion.

Another study notes that wave power alone could meet Australia's electricity needs five times over. More practically, given the early state of the industry, the nation is hoping to tap its seas for 10% electricity by 2050.

There are at least 200 different wave energy convertor devices in various stages of development around the world, tapping four distinct sources of marine energy. The most commonly proposed source of power is wave energy, the up-and-down movement of the surface of the water at frequencies of a few cycles per minute. There's also tidal energy, the energy from ocean currents, and finally the energy from temperature differential within the ocean, which is not yet significant enough to making generating power economical.

In the US, the state of Oregon is riding a wave of new developments, with the launch of a federally backed test site and the first public wave energy testing system in Newport. Oregon is poised to launch the nation's first commercially licensed grid-connected wave energy device. The computer equipped buoy will launch in spring 2013.

California also has many potential sites for wave energy, with more than 1,200km of coastline. The projected potential of wave energy is sufficient to meet at least 20% of in-state electricity consumption.

New research from the UK shows the Atlantic Ocean off the coast of Cornwall and the west coast of Scotland also has great potential to generate electricity from the waves that crash around the British Isles. The Carbon Trust reports that rows of wave farms up to 1,000km long facing the Atlantic could generate around 11% of the UK's current power generation.

West Africa Flooding Leads to Dam Safety Concerns

Months of heavy rainfall led to severe flooding across parts of Nigeria and Cameroon, killing at least 363 people and displacing a quarter of the Nigerian population, Nigeria's National Emergency Management Agency reports. Heavy rains destroyed homes and farmland, killing livestock and destroying crops. The floods in Cameroon, which are being called the worst in 60 years, also endangered the Lagdo Dam on the Benue River.

Heavy seasonal rains typically cause flooding across Nigeria, as drainage can be poor and people live in floodplains. However, heavier rainfall this year caused officials in Nigeria and Cameroon to open strained (and, some say, poorly maintained) dams, including the Lagdo Dam in Cameroon and possibly Kainji Dam in Nigeria.

The disaster prompted calls for new procedures to ensure the safe operation of dams. Dr. Akintola Omigbodun, an expert on flood management, argues that the current floods and those that happen annually along the River Benue and River Niger require better systems of dam operation and safety procedures. He is calling for a closer monitoring of water levels behind dams, not just by dam owners and operators, but also by nearby communities. He argues that the allowable water levels of dams in Cameroon and Nigeria need to be lowered to avoid the annual flooding that occurs. For the Lagdo Dam, Omigbodun proposes that the Cameroonian authorities lower the operating water level by 8m.

Nnimmo Bassey, head of Friends of the Earth International, called the floods "manmade" due to poor dam maintenance and operation. "There is the primary need for government to recognize climate change as an urgent justice and security issue," said Bassey. "What we are witnessing now is a foretaste of what would happen when unusual rains and other weather events kick in more forcefully."

Solar Power to Light Tamil Nadu's Future

The Indian state of Tamil Nadu aims to become a regional solar energy hub, generating



A one-megawatt solar plant goes online in Tamil Nadu. Photo: The Hindu

3,000MW of solar power by 2015. Under the State's 2012 Solar Energy Policy, Tamil Nadu will develop solar energy parks, make it compulsory for all new government buildings to have rooftop solar panels and encourage large businesses to use solar power. Colleges will be obligated to get at least 6% of their power from solar (currently many use diesel generators for at least some of their electricity). Local colleges intend to use the drive as an educational opportunity, enabling students to learn about solar energy. The Chennai-based Sri Venkateswara College of Engineering, for example, installed a solar street lighting project that was designed by students of electrical engineering, according to the *Times of India*.

The policy will also use incentives to promote household solar systems, making it the first state in India to tap in to the domestic segment with rooftop solar. Tamil Nadu is said to have roughly 300 days of clear sunny days a year, making it an ideal location to develop solar power projects.

The state is a leading manufacturing hub, and fossil-fuel energy shortages have become a problem. In addition to its plans to install solar into its grid, the state aspires to become a major manufacturer of solar systems. Analysts say it could be a challenge to find financing for the manufacturing side.

The renewable energy plan is not the state's first: Tamil Nadu has also begun to tap its wind energy, and now gets nearly 13% of its power from wind farms. The state accounts for 40% of India's installed wind power.

River Clean-up Sees Return of Salmon

After an absence of more than 70 years, salmon have returned the waters of Still Creek, a small tributary that runs from Burnaby into Vancouver,

Canada. On a cold Sunday in early November, about a dozen chum salmon were spotted breaching and spawning in the creek. Mark Angelo, chair emeritus of the Rivers Institute at the British Columbia Institute of Technology, reports that years of pollution from industrial waste, runoff and raw sewage turned Still Creek into a dead zone for salmon. In recent years, however, local groups put in extensive work to transform the creek. "A lot of groups and many different partners have been working hard to turn this around. Slowly but surely this stream has come back to life,

and it is so exciting to see," said Angelo. With tougher environmental standards now in place for neighboring industries and improved infrastructure to stop sewage flow into the creek, what used to be the most polluted waterway in the Lower Mainland is now on the rebound.

Protesting Dams in Quebec

In October, a renegade group of Uashat-Maliotenam Innu erected blockades on a supply road to a major northern Quebec hy-

dro dam. The communities say they have been "systematically excluded from talks related to Quebec's Northern Plan to develop natural resources." Four people were arrested after the second blockade of the only highway northeast of Quebec City, but the group remains defiant in their opposition to resource extraction occurring on their land. Quebec wants to exploit mining, forest and energy resources in an area about twice the size of France. The protesters allowed trucks carrying food and other essential items to cross the barricade.

Inspiring Advances in Solar and Wind Technology

Creative advances in wind and solar technology continue to create more options for cost-effective, clean and efficient renewable energy solutions. Here are two recent innovations:

- Wind energy technology is blowing in the right direction thanks to a new invention by the Tunisian group Saphon Energy. The group invented a bladeless wind turbine that mimics the function of a sail. Instead of rotating blades, the turbine collects the kinetic energy of the wind. The resulting mechanical energy moves pistons that generate hydraulic pressure that can be stored or converted into electricity. The Saphonian, named after a wind deity that was worshipped by the ancient Carthaginians, is more efficient and less expensive than its bladed counter-parts. While current technologies only capture 30% of the wind's kinetic energy, the Saphonian – which eliminates aerodynamic and mechanical losses associated with conventional turbines – is more like 80% efficient, according to its inventor, Anis Aouini. The bladeless turbine is not a threat to birds and wildlife, and is much quieter. In Tunisia alone, the Saphonian could potentially produce up to 20% of the country's domestic energy.
- In California, scientists at Lawrence Berkeley National Laboratory have figured out a way to make solar panels generate electricity in the dark. A new high-efficiency solar cell utilizes nearly the entire solar spectrum.



The new Saphonian wind turbine functions without blades. Photo: Saphon Energy

Solar cells are made from semiconductors whose ability to respond to light (and produce electricity) is determined by their "band gaps." Different colors have different energy levels, and no single semiconductor has a band gap that can respond to sunlight's full range, from low-energy infrared through visible light to high-energy ultraviolet. Although some full-spectrum solar cells have been made, none have yet been suitable for manufacture at a consumer price. The new designs demonstrate a solar cell that not only responds to almost the entire solar spectrum, but that is also practical to produce.

Dam-Dependent Zambezi Basin Unprepared for Climate Change

New report documents dangers of “business-as-usual” approach

By Lori Pottinger

How much water will our rivers carry as global temperatures rise? How much more destructive will annual floods become? Climate change is throwing a wrench into the science of predicting river flows, but the design of large hydro dams has yet to catch up.

African river basins are expected to be especially hard-hit by climate change, with worse droughts and more extreme floods. Water stress is expected to affect an estimated 60 to 120 million people in Southern Africa alone over the next 50 years.

An in-depth study, *A Risky Climate for Southern African Hydro* by Dr. Richard Beilfuss, warns that new and proposed dams on Southern Africa’s largest river are not prepared to withstand the hydrological shocks of a changing climate. The result could be uneconomic dams that under-perform in the face of more extreme drought, and more dangerous dams that have not been designed to handle increasingly large floods.

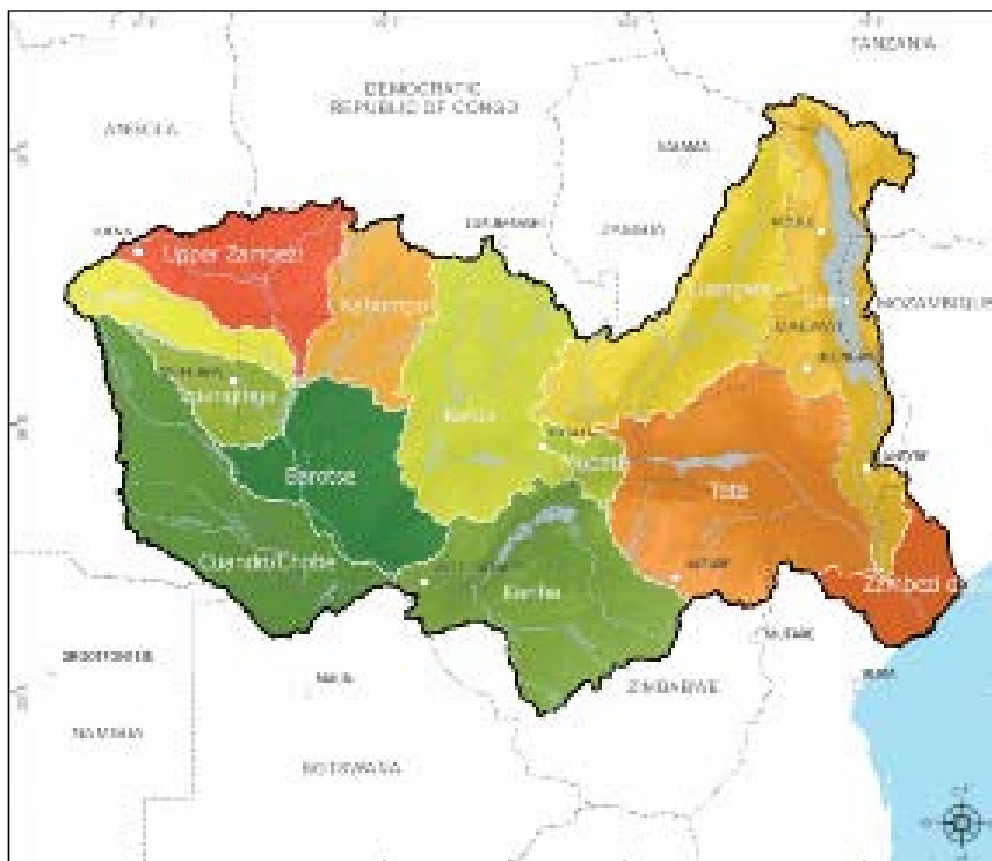
Dr. Beilfuss, a hydrologist with 20 years’ experience on the Zambezi, evaluated the hydrological risks to hydropower dams in the basin. Overall, he says, the river will experience worse droughts and more extreme floods.

Currently, 13,000 megawatts of new large-dam hydro is proposed for the Zambezi and its tributaries. The report finds that existing and proposed hydropower dams are not being properly evaluated for the risks from natural hydrological variability (which is extremely high in the Zambezi), much less the risks posed by climate change.

The report’s key findings describe a region moving toward the edge of a hydrological precipice.

Over the next century, rainfall is expected to decrease by 10-15% over the basin. There will be a significant reduction in the amount of water flowing through the river system, affecting all eight riparian countries. The water that feeds the river is expected to decrease by 26-40% in another four decades, the study notes. Because large reservoirs evaporate more water than rivers, big dams could worsen local water shortages (and reduce water available for hydropower).

The occurrence of more frequent extreme floods threatens the stability and safe operation of large dams. If dams are “under-designed” for larger floods, the result could be serious safety risks to millions of people living in the basin.



The Zambezi’s 13 subbasins and eight riparian countries. Map: CSIR-Africa

Beilfuss notes that the flood-management rules in place for Kariba and Cahora Bassa dams (the two biggest on the Zambezi) are based on the now inadequate historical hydrological records, and as a result may not have enough reservoir storage capacity for predicted large flood events. “The financial and social impact of a major dam failure in the Zambezi River Basin would be nothing short of catastrophic,” he says.

Proposed dams at risk

Two of the most advanced dam projects have not been evaluated for hydrological risks.

“The design and operation of the Batoka Gorge and Mphanda Nkuwa dams now under consideration for the Zambezi are based on historical hydrological records and have not been evaluated for the risks associated with reduced annual flows and more extreme flood and drought cycles,” writes Beilfuss. Under future climate scenarios, these dams are unlikely to deliver the expected services over their lifetimes.

At this writing, backers of the Mphanda Nkuwa project were working on getting a commitment from South African utility Eskom to purchase power from the project, which would boost their efforts to get financing for the US\$2 billion project. Zimbabwe and Zambia recently

Continued opposite

signed an agreement to jointly construct the \$4 billion Batoka Gorge Dam. With such high price tags, these projects could dominate these nations' energy investment for years to come, making their economic risks from climate change that much more critical.

Irreplaceable ecological services

Existing hydropower dams on the Zambezi have caused profound harm to livelihoods and biodiversity. Beilfuss' report describes how the value of ecological goods and services provided by the river, which are key to helping societies survive and adapt to climate change, are not being incorporated into planning for large dams in the basin.

Ecosystem services threatened by hydropower development in the Zambezi River system have been valued at between \$930 million and \$1.6 billion. "The lifecycle of prawns, for example, depends on a wet-season flood pulse and dry season low flows; the lost economic value of prawn fisheries in Mozambique due to dam-induced changes in Zambezi annual runoff patterns is valued at \$10-20 million per annum," the report states. Dam-induced hydrological changes cause an annual loss of 30,000-50,000 tonnes of fish per year in the Zambezi Delta alone.

Recommendations

Beilfuss recommends a number of steps to help African nations weather the coming storm. First and foremost, he calls for incorporating climate change scenarios into dam design, to avoid the hazards of over- or under-designed infrastructure.

Africa faces numerous risks from climate change, including serious water stress. Successful adaptation to this changing hydrology will require radical new ways of thinking about water resources. "While more water storage will be needed, decentralized solutions that preserve river-based ecosystem services are better suited to

the needs of the rural majority, who face the greatest adaptation challenges," Beilfuss writes.

The report recommends more diversified investments in energy supply projects to "avoid putting all eggs into one basket" in a time of increasing hydrological uncertainty – an especially critical step for Africa's most hydropower-dependent nations. Many African countries have a huge untapped potential for solar, wind, geothermal, and other renewable energy technologies that are well-suited for both urban and rural energy development. Beilfuss also suggests that countries in the region improve existing hydropower capacity rather than invest in risky new infrastructure – a practice that is almost always much lower-impact than building new dams.

He makes a strong case for big-picture energy planning, noting: "Planners need to carefully consider dams in the context of how climate change will shape water supply, and how future river flows must meet competing demands for power, conservation, and water for domestic use, agriculture, industry, and other services. A strategy aimed at empowering people to adapt to climate change must be central to these planning efforts."

He also calls for a full accounting of the values of ecosystem services supported by river flows, and changing dam design and operation to allow more natural flows to help restore ecosystem services on dammed rivers.

The situation on the Zambezi is hardly unique. On nearly every continent, in many of the world's major watersheds, large dams are at risk of becoming white elephants due to drought, and weapons of mass destruction during extreme floods. Africa especially cannot afford to take a head-in-the-sand approach to the climate risks of large dams. ●

Learn more: <http://www.internationalrivers.org/node/7673>

Bringing Citizen Science to the Mekong Dams

As plans to build the 11 Lower Mekong dams have advanced, NGOs and communities have been planning their response. Thai Baan research is already underway in several areas of the river that would be affected if the dams go forward.

In Thailand, several NGOs have worked to facilitate the research. Living River Siam has been active in organizing exchange trips between community leaders across the river basin. The Network of Thai People in Eight Mekong Provinces has worked to mobilize Thai communities living along the river to build awareness about the impacts of the Xayaburi Dam. In the past year, TERRA has also facilitated participatory community research on the impacts of the Xayaburi Dam on Thai communities. Despite requests from neighboring countries, the government of Laos and Thai dam builder Ch. Karnchang have not studied the transboundary impacts of the project. Village researchers identified 25,676 Thai citizens in 58 villages whose livelihoods would be harmed by the dam.

In Cambodia and Vietnam, it is difficult for people to speak openly against sensitive development projects. However, both governments have taken a strong public position in favor of further impact studies before more Mekong dams are built. Many view Thai Baan research as a safer and potentially less politically sensitive way to empower communities. Political space has opened, at least temporarily, for communities to provide some input into the process. In Cambodia, Thai Baan style research (called *Sala Phum* or "village school") has been underway for more than seven years on the Mekong. Research is now beginning in Vietnam as well.

In Laos, communities face a particularly difficult situation. Villagers do not have access to information about proposed projects and do not have a culture of questioning the government's decisions. Because the Lao government proposes to build nine of the 11 Mekong dams on its stretch of the river, the issue is particularly sensitive. When International Rivers visited the Xayaburi Dam site last June, we interviewed people living in 15 of the villages that would be affected if the dam goes forward. Many indicated that they could not question what the government decides, and hope that they receive enough compensation. Others described how they risked retaliation by local and national government officials if they became too vocal against the project. Yet the government has no plans to compensate villagers for lost fisheries, and plans to crowd several villages into areas where land is scarce. Despite such difficult conditions, a few experiments in Thai Baan style research are underway.

Science is often assumed to represent the neutral voice of reason. In the Mekong region, governments are more comfortable speaking about science than they are about political topics such as human rights. But even science can be politicized. A poorly written environmental impact assessment can legitimize harmful projects. A well-documented recommendation to open a dam's gates can be ignored. By collecting local knowledge in a systematic and credible way, local communities have a tool to provide input into the development process. As renowned Thai activist Niwat Roygaew said, "If we know who we are, we will have the strength to get our voices heard." ●

Time to start planning for March 14!



Every River Has Its Stories. Share Yours on March 14!

By Kate Ross

Every river has its people and every river has its story. Often we know these stories in our hearts and may talk about them amongst ourselves. But when we share our stories more widely, across oceans and continents, they join us (and our rivers) together. By sharing our stories, and weaving them together, we can paint a powerful image of the importance of the world's rivers.

In 2013, as part of the International Day of Action for Rivers, you can help make a river of stories with us. International Rivers invites you to share your personal story of your river. How are you connected to your river? Why is your river important and inspiring? What is critical for the world to know about your river? We would like to hear your stories through writing, poetry, video, audio clips, or even drawings. Through March 14 and beyond, we will bring these stories together, harnessing the power of our collective voice, to demonstrate and narrate the global importance of our world's rivers.

The river of stories will likely be just one part of the day's activities. For the past 15 years, thousands of people around the world have lifted their voices to celebrate March 14, the International Day of Action for Rivers. Actions range from kayaking, festivals and religious gatherings, to marches, press conferences and river clean-ups. March 14 is a day to celebrate victories such as dam removal and river restoration. It is a day for many of us to take to the streets, demonstrate and demand improvements in the policies and practices of decision makers. This is a time to educate one another about the threats facing our rivers, and learn about better water and energy solutions.



Day of Action 2012: A ritual was held on the Teesta River in India.

Above all, the International Day of Action Against Dams and For Rivers, Water and Life is a day to unite – by acting and speaking together, we demonstrate that our issues are not merely local, but global in scope. In 2013 help us to tell our collective story!

Learn more and join us at www.internationalrivers.org/dayofaction, or email us at dayofaction@internationalrivers.org.