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PRACTITIONER BRIEFING SERIES

Transboundary Dams

Transboundary Dams

Dams and Their Changing Legacy

Since 2000 there has been a 200% increase in the construction of large hydropower dam projects around the world, with roughly 2,000 existing dams, and nearly 4,000 additional projects currently being developed or planned into 2030.[i] There are more than 57,000 "large" dams worldwide, and 300 "major" dams at least 150 meters high.[ii] This construction boom comes after a period of relative stagnation in the development of dams and hydropower projects from around 1980 (Increasing financial constraints and environmental concerns led to a stagnation in hydropower capacity in the 1980s and 1990s) but the need for more energy, and from a carbon-neutral source, has increased the demand for these projects in national development strategies.[iii]

The US Energy Information Administration (EIA) and United Nations estimate an increase in global energy demand of over 50% by the year 2040.[iv] While wind and solar are becoming increasingly viable options for renewable energy, the readily available energy of hydropower is still highly appealing to many countries to manage base-load and peak-power demands, particularly in emerging economies.[v] The importance of hydropower has gone full circle; as an excellent alternative when compared to coal-fired power plants, to a sub-optimal solution with many negative externalities.

Dams provide a number of benefits both in terms of power supply and water management, as a traditional "grey" infrastructure method for regulating water supply, increasing water security, mitigating drought, controlling flooding, and managing water temperatures. Over the past century they have also been seen as a mark of human development, conquering nature and transforming a landscape for development, lending them to being marked as projects of national pride and significance.

Recently however, as their long-term environmental impacts have become better understood, or as their initial purpose has been removed or run its course, these structures have fallen out of favor in many respects, and thousands of dams have been decommissioned. Paradoxically, in other places dams are being built in a frenzy to meet the energy demands of rapidly developing economies, from Brazil to the Balkans and South East Asia.

Shared Responsibility:
Examining the costs and benefits of dams that reshape environments across political boundaries

Population growth and economic development are tightly connected to an increasing demand for energy. Since 2000, electric power consumption per capita worldwide has increased from 2,386 kWh to 3,132 kWh in 2014, an increase of 31.3%.[vi] This is expected to continue to grow with economic development, particularly in Africa, and South and South East Asia, taking an increasing share of global manufacturing output and improved livelihoods with economic development. This demand for electricity also creates demand for water, and the added pressures of climate change to meet this demand in a carbon-neutral way.

Practical Summary

- Dams are historical landmarks of humans conquering nature that provide numerous benefits to economic development and aid water security and management.
- The long-term impacts of dams and their method of construction have become more well-known over time, as the negative externalities of projects are better internalized.
- Climate change is producing greater pressure to provide carbon neutral energy sources to growing nations with increasing per capita demands.
- Greater unpredictability in precipitation and weather patterns makes large dam projects even more difficult to develop and determine their viability, particularly long-term.
- Alternatives to large hydropower dam projects and integration with green infrastructure are more resilient alternatives to traditional large grey infrastructure projects.
- In a transboundary context, the benefits of dams are often local, while their negatives occur downstream and across political borders.
- Coordination is critical to share both burdens and benefits and avoid conflict.

The Benefits of Dams

Throughout human history people have harnessed the power of water for industry and development, including the transformation of rivers and landscapes through the use of dams. From powering mills and machinery, later to generating electricity, or for providing a reservoir of drinking water, dams have been a notable symbol of human development and triumph for centuries. Landmarks like the Hoover Dam in the US or the Three Gorges Dam in China are also national symbols as feats of engineering, which have provided many benefits to each nation, particularly in terms of electricity generation.[vii]

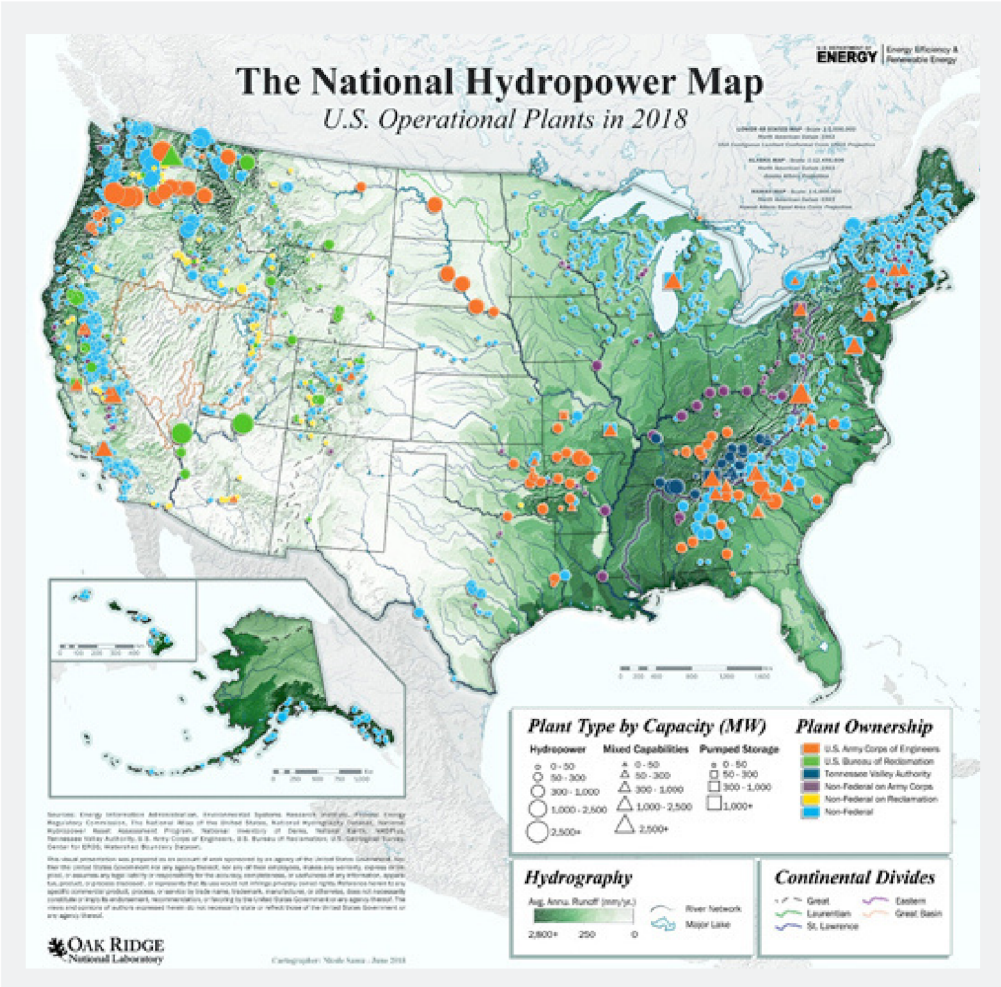
In addition to electricity, dams provide options for flood control that can protect both people and property, and provide valuable water storage to be used for irrigation, or improve navigation. Dams also create areas for recreation which generate numerous economic benefits, creating man-made lakes that create various opportunities for businesses and services.[viii]

In the context of climate change and the need for clean and renewable energy resources that are stable and predictable for base power loads, Hydroelectric power has been seen as a clear alternative to burning coal or fossil fuels.

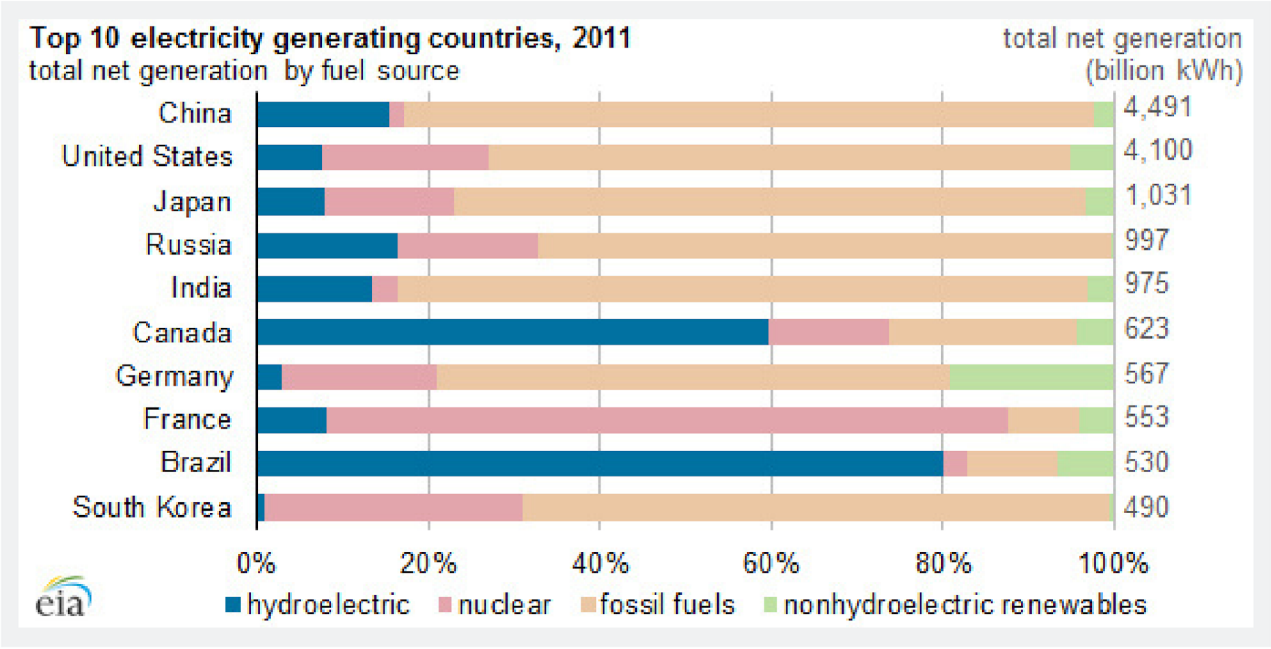
Hydroelectric dams can create large and stable amounts of power without the use of fuel and without producing emissions like carbon dioxide, making them an attractive option for many nations.[ix]

However, not all dams are necessarily large hydropower projects, and only a small percentage are built for electricity generation. Most dams are small, and serve to control river flows for navigation, irrigation and flood control, and are known as mixed capabilities, or pumped storage. Another benefit of a large dam project is the development of a large water reservoir as a measure of water security during drought periods, or as a means of mitigation to control floods.

In the United States, only 3% of dams are actually used to generate power, but generate 7% of the nation's electricity, and more than half of its renewable energy.[xi] For the Three Gorges Dam in China, unpredictability and flooding are the primary concerns, and the dam serves to help tame the Yangtze river and improve navigation, while generating massive amounts of power without using fossil fuels. For the Hoover Dam in the US, Lake Mead is a primary drinking water source fed by the Colorado river, and serves as a bulwark against drought.



Source: US Department of Energy



Source: *US Energy Information Administration*

The Difference Between Weirs, Barrages, and Dams

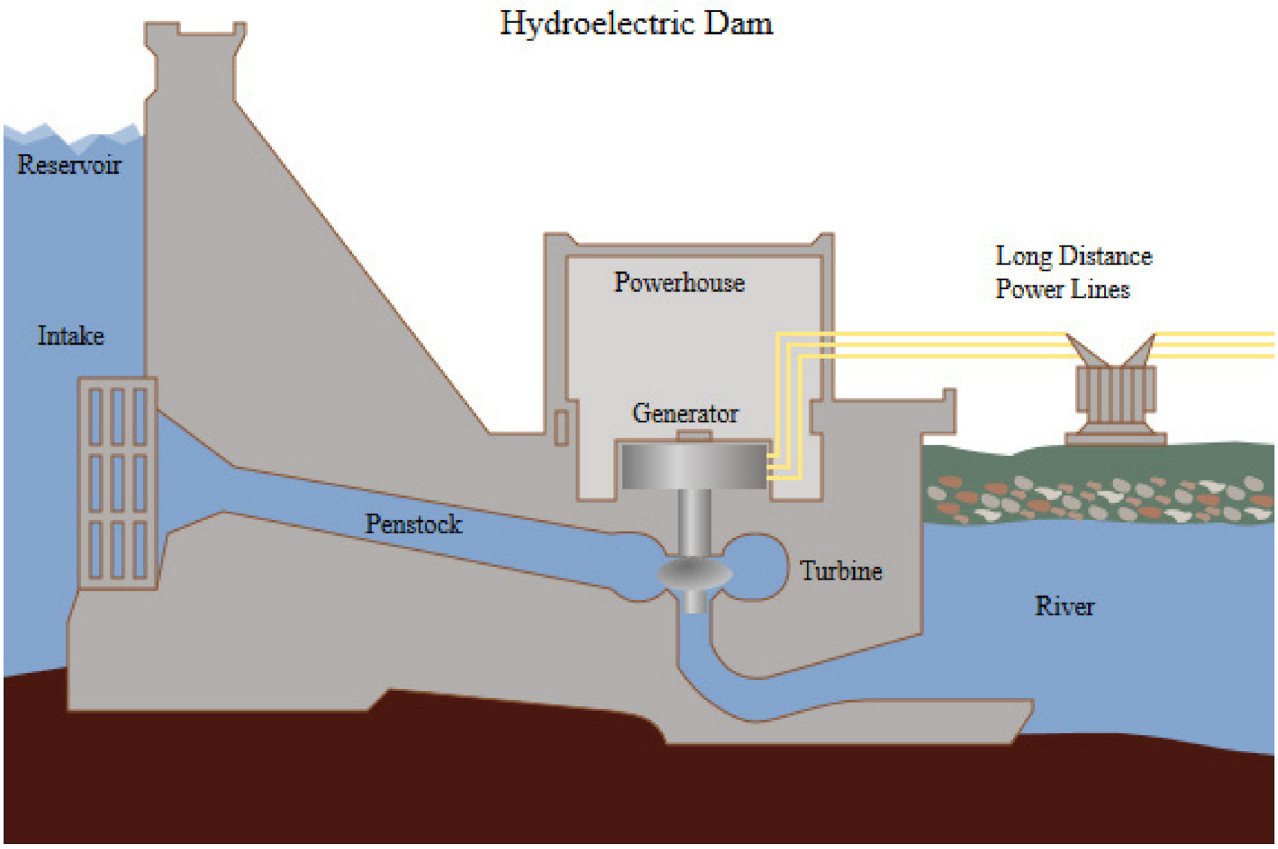
There are many ways to control the flow of a river, depending on the intended goal. In general terms a dam is an impervious barrier constructed across a river that creates a reservoir upstream. Overflow is typically managed via a spillway route, and hydropower can be created via a penstock to a turbine. While a weir can be used to raise the water level of a river on the upstream side, by creating a barrier that raises the water level without blocking the river, as water flows over the top.

In a dam, a weir can exist as the overflow mechanism at the crest of the dam, and a number of small weirs can be used in the overall design of a large hydroelectric dam to improve the overall project design, and help manage fish stocks. Finally, a barrage is an adjustable weir with the addition of gates over the top, allowing for more control over water heights depending on the need via the use of gates.

Many variations of the above design exist, with different methods for controlling excess water, managing sediment, or even using only partial river diversions to generate electricity without creating a reservoir. Today, engineers are re-thinking these types of projects in order to mitigate some of the negative externalities and environmental impacts from large dam projects.

Changes in technology are helping to facilitate this, and a growing awareness of overall ecosystem impacts and water basin management are illuminating the potential downsides of these projects. This has also led to a large increase in the decommissioning of dams, both due to age, being obsolete, and also environmental impacts such as the destruction of fisheries.

Illustration of a typical hydroelectric dam design
Source: WikiCommons



The Cost of Dams — Negative Externalities

While the national or global benefits of dams and hydropower are often clear, often ignored are the particularly local harms, or negative externalities, caused by such projects.[xii] Dams can do environmental harm to waterways in a variety of ways, which may ultimately cost more than their benefits depending on the project and its location. The greatest impact or transformation is through the blockage of a river's flow and creating a reservoir that floods a pre-specified region. This impacts the speed and flow of the river, affecting fish migration as well as the passage of sedimentation that fertile lands rely on downstream. Even smaller structures used for controlling a river for the purposes of navigation can cause damage to wildlife that depend on and navigate by a river's running currents.[xiii]

In areas such as the Pacific North West the construction of dams has caused considerable damage to its famous salmon run, which sustains not only salmon populations, but a variety of other wildlife in the region, from bears to wolves to birds, in a balanced ecosystem. Many of the dams being removed are over one hundred years old, installed for various purposes from running mills to trapping fish for hatcheries, which no longer serve a purpose or are considered as structural hazards.

As more knowledge is gained about the long-term impacts of dams on fish migration and the flow of sediments, many structures are being reconsidered. [xiv]

According to the non-profit American Rivers, over one thousand dams across the US have been removed to date, with several of these projects occurring in Washington state. As mentioned, the decision to remove dams is typically down to a cost/benefit analysis to consider how much power a dam generates versus how much harm it does to its local environment, or that downstream. The blockage of sediment can also lead to increased oxygen consumption in the reservoir, leading to algae blooms as well as dead-zones downstream. In many cases the decision is simple, as the dam produces little to no electricity, or is a remnant of a prior era that required the blockage of the river.[xv]

In recent decades a more complete picture of the environmental impact of dams has become clearer as a basin-wide approach of water management and analysis has been undertaken. Dams were typically seen as being a green or low-carbon energy source when equipped for hydropower, particularly on a large scale. However, when compared to other renewable energy alternatives, this may not be the case once all factors and negative externalities are considered, from their construction to their long-term impact and operation.

Three Gorges Dam, China
Source: AP/ Der Spiegel

Beyond the large financial costs and the complexity of engineering, dams require a large amount of physical resources to be completed, particularly cement and concrete, which are among the largest sources of greenhouse gases (GHG). Large hydropower dam projects require very large volumes of concrete. Concrete is the most widely used man-made material in existence, second only to water as the most consumed resource. While cement, the primary ingredient of concrete, is the source of roughly 8% of global CO2 emissions on its own, which would make it the 3rd largest country in terms of annual GHG emissions.[xvi]

The Three Gorges Dam project in China required 28 million cubic meters of concrete, or, enough to circle the earth with a 1-meter wide solid pipe of concrete. At roughly 410 kilograms per cubic meter, that's 11.5 billion kg of carbon dioxide, or 11.5 Megatons (Mt). This makes the green aspects of hydropower projects limited to their power production once installed, while the GHG of its construction is often not factored when making such comparisons to alternatives.

Furthermore, the creation of large reservoirs behind a dam often occur in areas with dense vegetation, the creation of which destroys a natural carbon sink, while releasing other GHG via the destruction of this vegetation. In terms of climate finance, these are critical factors when considering the true cost of these projects relative to their output and their lifespans, in terms of their carbon footprint, their environmental externalities, and what they will displace. Even when dams are functioning as designed and built, this can mean large-scale displacement of communities, with often insufficient compensation for inhabitants' losses. [xvii]

Over reliance on hydropower can also be particularly damaging to poorer countries, where most of the new dam capacity is currently being built. When struck with a drought, overly hydro-dependent countries can suffer blackouts and energy rationing that is crippling to economic activity and development, due to the lack of water available to power their turbines consistently. As such, greater energy and water security can be obtained through a more diversified portfolio of power sources, while lowering environmental impacts from hydropower.[xviii]

Srekor village in Cambodia was submerged when the reservoir for the Lower Sesan 2 Dam began filling up in late 2017.
Credit: Sergey Ponomarev /The New York Times

Dam Failures

Recent high-profile dam failures in Laos bring up another concern of dam construction, particularly with large-scale hydroelectric projects. In the rush to develop and harness the hydropower capacity of Southeast Asia, some projects have failed with a devastating effect on the environment, wiping out entire villages of people. In the long-term, such failures could become more common, and nations that are relying on such infrastructure development for their national strategies may not be well equipped to mitigate the impact of dam failures. This is particularly concerning in a rain-heavy environment subject to greater erosion.

In 2018, a fatal hydropower dam collapse in Laos wiped out numerous villages and killed an estimated 71 people, displacing over 7,000 according to estimates. The collapse of a 'saddle dam' of the Xe Pian-Xe Namnoy hydropower project in Southern Laos caused the flooding.

The failure has been blamed on substandard construction, including improper concrete pouring, and the substitution of soil instead of cement. The dam was being constructed by an international consortium, including a local Laos company, a South Korean engineering firm, a Thai electricity holding, and financing from Thai banks — implying the blame may lay more with the regulatory environment as opposed to a lack of any particular project expertise.

Roughly 90% of the electricity to be generated by the project was intended for sale to Thailand, which would serve as an important revenue source for Laos. The project is one of 352 hydropower dams planned or currently under construction throughout Laos, as part of its Battery of Asia development strategy. Thailand is now rethinking some of these power purchase agreements, and reportedly construction on this same dam is continuing again today.[xix]

Flooding in Laos in the wake of a dam collapse in 2018
Source: The New York Times

Dams in Mining

Another context is dams used in mining to store waste product materials, which includes sand, rock, and chemicals, known as tailings. The failure of these structures over time, or due to natural disasters such as a flood or earthquake, can have devastating consequences for neighboring water resources, or anything caught in its path. These failures can have long lasting impacts that damage lakes and rivers. A waste dam failure in Brazil is still among Brazil's worst even environmental disasters, affecting the environment, fishing industries, and tourism.[xx]

This has led to a renewed call for action to secure the storage of mining waste, as serious failures have increased, although overall dam failures have decreased, with a total of 40 incidents in the last decade. UNEP has called for efforts to establish best practices and stronger international regulations on the construction and monitoring of tailings dams.[xxi]

Overall better knowledge about the number of tailings dams and their condition is critical, as the number of structures is estimated to be at least three thousand five hundred, yet there are more than thirty thousand mines, making the actual number of tailings dams likely to be far higher.[xxii]

Achieving the Sustainable Development Goals will mean that the demand for minerals and metals will continue to rise, and environmental impacts along with them, making their safe and cleanest possible extraction all the more important. Tailings dams remain the most common method for storing mining waste material but little is known about the volumes of waste they contain, or how many of them are at risk of failure.

"Messages to remember: [xxiii]

- A resurgence in the construction of large dams is expected by 2030; their usefulness is undeniable for electricity production and energy storage, flood and drought regulation, and irrigation.
- However, they constitute physical barriers that modify in particular the hydrological regime, the physio-chemical characteristics, and the solid load of the watercourses concerned.
- Solutions exist to restore the transit of sediments from time to time.
- Sediment management in these artificial reservoirs can be difficult since during their deposition, due to their long residence time, they can accumulate organic and inorganic pollutants."

Source: Encyclopedia of the Environment

Transboundary Impact of Dams

Dams pose particular challenges in relation to transboundary water relations and cooperation, as their benefits are typically localized, while their costs are felt downstream and across political borders. This makes the transboundary dynamics of large dam projects particularly relevant as national decisions have international impacts. However, the coordination of benefits and costs between all effected parties can create many avenues for shared benefits and outcomes that deepen interconnections and make conflict less likely, while improving the health of watercourses.

Emerging examples of this today are the Mekong River in South East Asia [xxiv], and the Nile in the Horn of Africa.[xxv] There has been tremendous tension on these rivers as the construction of dam projects has increased, with many uncoordinated projects, or even just one very large project.[xxvi]
The national benefits of one project can mean devastating impacts downstream as rivers run dry and fish stocks are depleted. This requires carefully considered agreements on the development, operation, and maintenance of dams, with a sharing of both benefits and burdens.

According to the Stockholm International Water Institute (SIWI) around two-thirds of transboundary rivers do not have a cooperative management framework to address areas of conflict or means of cooperation. With over 50% of global freshwater crossing political borders, and nearly 90% in Africa, this creates a challenging environment for understanding the impacts of dams on transboundary watercourses.[xxvii]

In order to move from conflict to coordination, mechanisms are needed to jointly identify issues and develop negotiated solutions that help to share both costs and benefits. This includes sharing data and experiences, sharing financial burdens, and cooperating to ensure both benefits and costs are distributed in an equitable manner. On the Mekong, this starts with China, who is not a member of the Mekong River Commission, preferring to work in bilateral relationships with its smaller neighbors. On the Nile, it is Ethiopia and Sudan who share the river's origins, while Egypt depends on its flows for survival.

In the context of dam construction, this requires a consultative mechanism to determine environmental impacts and potential benefits before project construction. By taking a wider approach, the potential for benefits and avenues of cooperation increase. Agreements on power sharing, integrated electricity grids, established minimums for "environmental flow", and strategic placement of central and distributed infrastructure can help to alleviate the negative externalities of dams, while better sharing their benefits.

On the Mekong, this is particularly relevant for Laos and Vietnam. Laos is looking towards hydropower for revenue and economic development, but its assumed customer of Thailand is rethinking its prior agreements. Vietnam will be the most impacted by dams upstream of the Mekong Delta, and is looking to add more fossil fuel sources to keep up with rising power demands of its evolving population. While Vietnam’s energy use has doubled, per capita emissions have tripled in the last two decades, going from an energy exporter to importer, with a need of energy imports set to reach 60%.[xxviii]

While Laos would be eager to meet this power gap and develop in the process, doing so with unmitigated hydropower projects will destroy Vietnam's breadbasket in the Delta. The balance between meeting power demands in a sustainable way, while preserving watercourses can only be achieved through transboundary cooperation.

Alternatives to Dams — New Technology, Green Infrastructure & Nature Based Solutions

In November 2000, the World Commission on Dams released its final report 'Dams and Development - A New Framework for Decision-Making' to address the social, economic, and environmental impacts of hydropower projects across the globe. Now, twenty years later, many of these points are still not being fully considered. In addition, twenty years on the impact of climate change is leading to changes in precipitation patterns that could impact the viability of many large dam projects.[xxix]

Alternative solutions exist for the many uses of dams, from flood control to controlling water temperatures. Green solutions that are natural carbon sinks can be cost-effective and resilient solutions for meeting adaptation challenges. Integrating this 'green infrastructure' with the typical 'grey infrastructure' solutions used in urban and rural communities is a key challenge for the next generation of infrastructure development.[xxx]

By placing adaptability and sustainable thinking at the center of infrastructure design processes from the beginning, nature-based solutions used in tandem with traditional hard infrastructure can make for climate resilient projects that provide greater protections from shifting lands and conditions. The World Bank estimates that developing countries need to invest 4.5% of their GDP in infrastructure projects to meet the SDGs. Pursuing a Green Infrastructure approach that seeks to blend traditional grey with green infrastructure can help to achieve these goals.[xxxi]

Design Solutions

For the problems of sedimentation traps, solutions can be considered that will help to mitigate these issues and minimize their impact downstream.[xxxii] First among these are the location of the project itself, taking into account all hydro-morphological characteristics of the river, erosion rates and potential, and the feedbacks of the natural environment once the dam is in operation long-term. Bypass systems can also be used, and more focus can be given to improving turbine design that can accept more fine sediments in their operation, allowing for transfer downstream.[xxxiii]

The design of a dam and its ability to operate in various ways depending on conditions and the potential environmental impacts are critical to making more efficient and environmentally sound hydropower projects. However, such designs can greatly increase the cost of construction and operation, which can invert the economic prospects of some projects and make them nonviable. A mix of other solutions may then be more viable and efficient to meet development goals.[xxxiv]

Companies like GE Renewable Energy are working on solutions that take a more micro and distributed approach to generating electricity from flowing water, without the level of disruption caused by large hydropower dam projects.[xxxv] For developing countries this is particularly of interest as all the power generation in the world doesn't matter if rural communities aren't connected to the grid. Distributed systems have the benefit of being more cost effective, while generating power closer to where it is needed, with less infrastructure required to reach the people that need it most.

Solutions like "water-to-wire" can be built-to-purpose and modular, allowing for electricity to be generated while sediments can move downstream, and fish can travel in their normal migration patterns, preserving stocks. The obvious trade-off is the lack of water retention via reservoirs, and smaller scale power production. However, bigger is not always necessarily better. When combined with wind power and solar panels, a more diverse portfolio of energy sources provides for greater energy security by distributing risk, while green infrastructure can help store and regulate water flows.

The best combination of green versus grey infrastructure, or large-scale centralized projects vs small-scale decentralized projects, will depend on the context of each nation and region for the best use of natural resources with the lowest environmental impact. In addition to project size, scaling up cooperation to include more stakeholders over larger water basin areas can help to share costs, increase benefits, and minimize the risk of conflict caused by uncoordinated development.

CASE STUDY

GERD — Ethiopia v Egypt & Sudan

The Grand Ethiopian Renaissance Dam (GERD) is a marquee $4.5 billion USD project of great ambition for Ethiopia, which its lofty name conveys. The project is seen as a critical development milestone to provide clean and sustainable power to its people that will aid progress and be a catalyst for Ethiopian Renaissance. The plant will not only provide power for Ethiopia's growing economy, but also allow for the sale and export of clean electricity to its neighbors.

It is understandable then why they may appear intransigent in the face of demands and pressure from riparian Nile nations downstream — particularly Egypt. For the Egyptian government, the dam represents a threat to its livelihood and the loss of control of a river that makes up its lifeblood. The government of Egypt has even threatened to blow up the dam with an airstrike if it goes into operation and disrupts the vital water supply of the delta downstream. Recent negotiation outcomes hope that won't be necessary.

At the core of the issue is a lack of trust and means of cooperation between the upstream and downstream nations to assure the available flow of water is not disrupted. Estimates of the environmental impact from filling the dam show that a slow filling of the dam can minimize the downstream impacts, and thus save valuable farmlands of Egyptians. However, this is asking Ethiopia to delay the benefits of the project, increasing its costs, and lowering the project's rate of return on investment.

One side wants to fill the dam and become operational straight away, while the other wants to delay as much as possible. The dam is nearing completion and could begin to fill the summer of 2020, already several years behind schedule. In February 2020 the outlines of a final agreement appeared to be in reach to cover filling period, drought alleviation, and long-term operation.[xxxvi]

"To Ethiopians, the dam is a cherished symbol of their ambitions — a megaproject with the potential to light up millions of homes, earn billions from electricity sales to neighboring countries and confirm Ethiopia's place as a rising African power. After years of bumpy progress, including corruption scandals and the mysterious death of its chief engineer, the first two turbines are being installed. Officials say the dam will start filling in July. That prospect induces dread in Egypt, where the dam is seen as the most fundamental of threats."[xxxvii]

Credit: D.Walsh & S. Sengupta/The New York Times

The View From Ethiopia

With one of the fastest growing economies in Africa, Ethiopia is looking upwards and forward to its future, eager to make a statement. It has a chance to declare its arrival, and become the largest power exporter on the continent. The Nile and the Grand Ethiopian Renaissance Dam (GERD) is central to this strategy. At a cost of $4.5 billion USD, the project will be the largest dam and hydropower project in Africa.

With a rapidly growing economy and increasing incomes of its people, power demands are rising rapidly, and a lack of power could stifle this economic growth. With the GERD, Ethiopia plans to satisfy its own power needs to aid economic growth, while generating national income through the sale of excess electricity to its neighbors, further aiding its development, and aiming to reduce poverty.[xxxviii]

The project has been in the works for nearly a decade today, and while setbacks in delays and increased project costs have been challenges throughout its development, the nation is eager to finish the project and start generating benefits. Most notably, the project's manager was found dead, and the main contractor was fired over corruption accusations. For Ethiopia, the project is about building a landmark to its development and independence, with references made to the Hoover Dam of the United States in the 1935, and are ready to begin filling this summer in July 2020.

In addition, Ethiopians view that they are only doing what Egypt did for itself in the 1970s in constructing the Aswan High Dam on the Nile river inside of Egypt, helping to control seasonal flows and transforming Egypt's agriculture. Why shouldn't Ethiopia be entitled to benefit from the Blue Nile river, which originates in their lands? From downstream, Egypt sees 85% of the Nile's waters being fed from the Blue Nile, making cooperation and communication between Egypt and Ethiopia critical.

The View From Egypt

Roughly 95% of Egyptians live along the Nile river and in the Nile Delta. It is one of the most densely populated regions on earth and one of the most dependent on a single water source. Nearly two-thirds of Egypt's food comes from the delta. The Nile is truly a lifeblood to the nation and its over one hundred million people.

This number is also set to grow to one hundred and thirty million by 2030, increasing the demands of on river, which has been further damaged by pollution.

The problem of population growth has been coming for some time. In 2000 the UN estimated the population would reach 96 million by 2026, and the nation reached this milestone a decade earlier. At current fertility rates, a Brookings report estimates a population of 128 million in the next decade. Currently, Egypt's population is expanding by 1 million people every six months, which the UN believes will create water shortages by 2025.[xxxix]

This will continue to stress the Nile in several ways; in terms of the demand for freshwater, the demand for food and water for agriculture, and the increase of pollution and wastewater that will further damage resources without effective management. Add to this increased drought and unpredictability from climate change, and the sense of impending doom becomes very clear.

Due to these pressures, desalination will become an increasingly important option for Egypt, but while many projects are planned, little capacity has been completed to date to increase water supply, and there are concerns about high energy demands with limited current capacity.[xl] Insufficient efforts have been made to prepare for a drier future by discouraging the production of crops with high water demand, such as rice or bananas. The problem of pollution has remained ever present as well. Further upstream, Ethiopia will have excess energy to sell and export, which could create avenues for cooperation and exchanges with the correct infrastructure and mechanisms in place. Providing energy for desalination to address water shortages.

Further complicating matters is climate change, and this is also a reason for greater cooperation and integration. Ethiopian representatives argue that global studies estimate that rainfall will increase in the Upper Nile Basin over the next century, and the GERD will help to safely store these annual increases in rainfall, where they can be more efficiently managed and released without the risk of evaporation, as it would in Egypt.[xli]

From Conflict to Cooperation

The project began in Ethiopia in 2011, while Egypt was in the midst of turmoil and the Arab Spring. By 2013, under President Mohammed Morsi, Egypt was threatening to eliminate this threat to its livelihood through various means, including bombings. Under current President Fatah el-Sisi, Egypt has pursued a blend of diplomacy and strong posturing regarding the project to achieve its desired assurances. Mr. Abiy Ahmed, the Prime Minister of Ethiopia, has promised the project will not affect Egypt's water supply, while also remaining firm that no amount of force will prevent the project, making references to mobilizing millions of Ethiopians for war, if necessary.[xlii]

In March 2015, a declaration of principles was signed in which Egypt no longer opposed construction of the dam, but instead focused on technical issues that needed to be addressed, and no significant harm to downstream nations.[xliii] These include the reservoir capacity, the fill-rate of the reservoir, and the fair allotment of the water of the Nile between Egypt, Sudan, and Ethiopia, including how this is calculated. Egypt has sought a 15-year filling period, as anything less will destroy farmland on the Nile delta. Ethiopia has sought a 4-year fill period.

By November 2017, talks between Ethiopia and Egypt broke down. Over time the dam has continued to be completed, and Sudan has joined the discussion mostly siding with Ethiopia, while raising concerns of how water allocations are being calculated between the parties. More recently, in early 2020, the United States and the World Bank brokered talks between the parties that have made some progress, with a final agreement set to be made by the end of February [xliv].

According to Egyptian researchers, a 3-year fill period will mean the destruction of 50% of farmland in that time. While a 6-year period would result in a 17% loss of farmland. The optimal fill rate of the dam must be determined by both parties, but time is running out. A trilateral committee to conduct an environmental impact assessment has also not come to an agreement on their projections of its impact, with Ethiopia being optimistic, Egypt being pessimistic, and Sudan concerned about the calculated contributions.

President Trump of the U.S. has pushed for a deal to be made by the end of February 2020, and agreements appear to have been made in principle, but not officially.[xlv] An agreement on the fill rate of the dam, at any rate, will be critical to the management of downstream flows and the High Aswan Dam to help alleviate any problems for Egypt.[xlvi] The recent preliminary agreements have mentioned a fill rate of thirty-seven bcm and agreements on responses to drought, established filling stages, a consultation process, and emergency situations.[xlvii]

However, even after the agreement is made, the main sticking points remain in implementation; how quickly does filling the dam affect downstream flows, and how effective is the response in the event of droughts, or prolonged droughts, and other issues downstream? How effective will the mechanism for notification and adjustment be to ensure all parties get what they need from the river, and/or from the GERD? Other transboundary agreements have been made, but they only function as well as they are implemented and communicated. Warning systems between Tijuana, Mexico and San Diego, California serve as a cautionary reminder.

The only way for the parties to avoid conflict, adapt to climate change, and plan for an unpredictable future with more population and more energy demands, is through cooperation and negotiated solutions that share burdens and resources. This agreement is critical as a means of setting precedence for future Nile projects and has implications for Ethiopia's future relations on transboundary water issues between Sudan, South Sudan, as well as Kenya, Somalia, or Uganda.[xlviii]

CASE STUDY

Damming the Mekong — Downstream from China

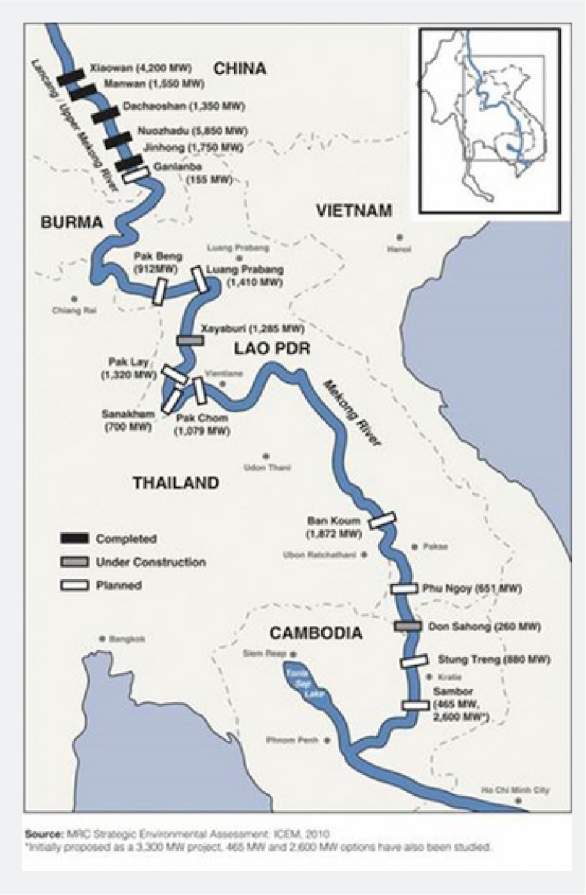
As discussed, shared resources can be either a source of conflict or cooperation, a means of dependency or shared interests. Positive or negative outcomes are largely determined by the power dynamics and asymmetries of the parties involved. It is therefore critical to have every member at the same table.

The Mekong is considered the world's most productive river, as it winds along borders and passes through six different countries, providing water, food, and navigation for the region. The most powerful and largest of these countries is China, which is also where the river begins from glacial melt and runoff. China has built numerous dams on the river over recent decades that have already greatly impacted the flow of the river and decreased fish stocks, but it is a much smaller and poorer nation that is causing the most concern today.

On the mighty Mekong river, Laos' abundance of opportunities for hydropower creates an opportunity for economic development, to become the 'battery of Asia'. It is also an avenue for cooperation through the development of a transboundary integrated electrical grid to efficiently distribute electricity across the region, while increasing the share of renewables. However, with current hydropower dam development by China further upstream, and now up to 70 more developments planned by Laos, there is increasing potential for conflict with Cambodia and Vietnam if rivers run dry, depleting nutrients and destroying fish stocks.[xlix]

The differences driving these dynamics are critical to understanding how to move from conflict to cooperation on transboundary resource issues. By first understanding the balance of needs between each stakeholder, it is possible to find shared solutions and mechanisms for cooperation that avoid conflict and move beyond a zero-sum framework.

First, we must look at the issue of dams and their impact on the environment. In terms of reducing greenhouse gas emissions, hydropower dams have been touted as an excellent way to generate large amounts of power in a clean way, without the burning of fossil fuels.



Source: Mekong River Commission Strategic Environmental Assessment, 2010

For a nation like China, large scale hydropower projects should be welcomed by other nations as an alternative to coal-fired power plants. However, as discussed, dams are not without their own environmental impacts on their surrounding areas, and can have tremendous impacts downstream.

Further development on the Lower Mekong River will exacerbate these impacts even further. The Xayaburi dam is among the first to start operating in October 2019, after taking seven years to complete, and the impacts are already being felt by river communities. The water level dropped considerably, changing its color as the light shined through the shallow waters, the river flow slowed, and algae blooms sprouted. This has meant low fish yields and flows that could devastate farms and fisheries, effecting tens of millions of people. With over 240 million people in the region that could be affected directly or indirectly, the benefits of these projects are under heavy scrutiny.[l]

"The Mekong's ecosystem is adaptable and resilient but the worry is that the river's massive resource base won't be able to overcome all these dams and extreme weather."

Brian Eyler, Stimson Center
Source: H. Beech, The New York Times [li]

The establishment of dams at the headwaters of the Mekong in China over the past half century have lowered fish stocks, and also reduced the size of fish according to locals. The new Xayaburi dam has also affected farms by moving waters away from riverbeds as flows drop, requiring pumps to feed fields. Then a sudden discharge from the dam upstream floods the river and destroys the crops. This is currently happening in Thailand, which financed and helped build the Xayaburi dam, but the dam is operating in Laos. The lack of coordination between dam operators, local authorities, and the Mekong River Commission, has left villagers in the dark.

"But the commission — which counts the governments of Laos, Thailand, Vietnam and Cambodia as its members — can only disseminate news if someone informs it. One rights group in Nong Khai was told that the Thai department of irrigation is the body in charge of notifying villagers about the dam's flow, but government officials denied that. The Thai electrical authority, which is buying Xayaburi's power, and the dam operator, which is backed by Thai investment, have pointed fingers at each other. Neither answered questions about the dam's operations." [lii]

The demand for power in South East Asia and riparian nations of the Mekong river is pushing a drive for hydropower. However, there are other ways for Thailand, Vietnam, Laos and Cambodia to achieve their goals for renewable energy and meet their overall growing power demands. As the costs of solar and wind power have plummeted in the last decade, and with much less negative externalities, it would be more efficient and beneficial to have a greater mix of these renewables in place of large hydropower projects on the Mekong and its tributaries.[liii]

From the early 2000s, the Mekong River Commission (MRC) touted the economic benefits of building dams for its four member countries, with an estimated $30 billion in benefits. Now, under new assessments, those same projects are estimated to cause a loss of $7 billion if they are implemented. If all planned projects move ahead, 97% of the sediment that fed the Mekong Delta, the most fertile area on earth, would be blocked. Salt-water intrusion could quickly turn one of the most fertile regions on earth infertile. [liv]

From its inception the Xayaburi dam project in Laos has been met with reservations and concerns from riparian countries and international observers of a lack of international standards and coordination. It is a test of the MRC's 1995 agreement between the countries, which called for a process of consultations, but retained the right of each nation to build dams with or without agreement by neighboring countries. [lv]

"Laos says it is satisfying the requirement to consult with other countries — but only consult. "This is not an international issue," said Mr. Daovong of the Department of Electricity. "It's more an internal affair."

Source: T. Fuller, P. Amatatham, The New York Times [lvi]

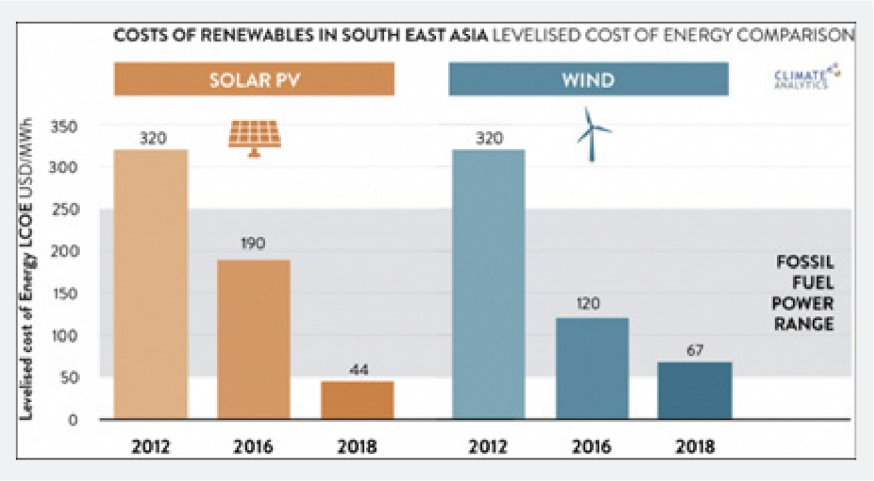
Technical issues including the transport of silt, which may block turbines and decrease the project's efficiency by 60% in 30 years, and the passage of fish species, were not alleviated to the satisfaction of neighboring nations. Although the MRC Chief Executive Hans Guttman stated Laos had proposed several changes to flush sediment and improve fish ladders, nearly a decade later the consequences are becoming clearer.[lvii]

The recent collapse of dams has also brought the viability of these projects to the forefront as well. The collapse of a dam under construction by a consortium of companies from Laos, Thailand, and South Korea, displaced thousands of people, swept away hundreds of people and dozens of villages, and killed several. [lviii]

One potential factor in the collapse is the excessive rainfall in the region of three-times the normal amount, which led to erosion. Climate change will continue to create unpredictable circumstances for these projects, making them potentially less profitable and far more dangerous. Once dams are built, they can be difficult to remove, and the governments responsible for them may be ill-suited to deal with the fallout.

Another threat to the Mekong's livelihood is sand mining, which is also in demand due to construction booms and urban development much further away. In Cambodia, downstream of China, Laos, and Thailand, the demand for sand is compounding the impacts of upstream dams in China and Laos, accelerating sediment loss that affects both Cambodia and Vietnam. The World Wildlife Fund estimates a 77% loss of total sediment transport since 1994.[lix]

The sand dredging is happening up and down the Mekong river, in Laos, Cambodia, and Vietnam, and the demand for sand is fed by construction booms that are mostly benefiting Chinese and Thai companies.[lx] As such, there is not one nation or group to blame for the destruction of the Mekong, it is happening all along the river. However, without new efforts and thoughtful coordination between all parties and sectors, all will be to blame.



Source: Climate analytics, January 2020

Endnotes

[i] https://www.researchgate.net/publication/271996520

[ii] https://www.internationalrivers.org/questions-and-answers-about-large-dams

[iii] https://www.hydropower.org/blog/blog-hydropower-growth-and-development-through-the-decades

[iv] https://www.eia.gov/outlooks/ieo/pdf/ieo2019.pdf

[v] https://www.eia.gov/todayinenergy/detail.php?id=17051

[vi] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC

[vii] https://www.scmp.com/native/news/asia/topics/sustainable-hydropower-asia/article/3045977/why-global-switch-renewable

[viii] https://www.fema.gov/benefits-dams

[ix] https://chineseclimatepolicy.energypolicy.columbia.edu/en/hydropower https://thediplomat.com/2015/07/the-hidden-costs-of-chinas-shift-to-hydropower/

[xi] https://www.eia.gov/energyexplained/hydropower/where-hydropower-is-generated.php

[xii] https://www.sciencedirect.com/science/article/pii/S0140988316300950

[xiii] https://www.internationalrivers.org/environmental-impacts-of-dams

[xiv] https://www.nwcouncil.org/reports/columbia-river-history/damsimpacts

https://www-1.thenewstribune.com/latest-news/article217458060.html#

[xv] https://www.scientificamerican.com/article/how-do-dams-hurt-rivers/

[xvi] https://www.bbc.com/news/science-environment-46455844

[xvii] https://www.reuters.com/article/us-china-environment-yangtze-feature/on-chinas-yangtze-river-giant-dams-legacy-blocks-revival-idUSKBN1XO0LD

[xviii] https://www.internationalrivers.org/economic-impacts-of-dams

[xix] https://www.internationalrivers.org/resources/press-release-backers-of-collapsed-laos-dam-must-be-held-accountable-17325

https://www.internationalrivers.org/sites/default/files/attached files/reckless_endangerment_final_for_web.pdf

[xx] https://www.npr.org/sections/goatsandsoda/2017/12/02/565681233/u-n-body-alarmed-over-mining-waste-disasters

[xxi] https://www.unenvironment.org/news-and-stories/story/new-report-urges-global-action-mining-pollution

[xxii] http://www.industriall-union.org/why-you-need-to-know-about-tailings-dams

[xxiii] https://www.encyclopedie-environnement.org/en/water/how-reconcile-dams-sediment-transport/

[xxiv] https://www.nytimes.com/2019/10/12/world/asia/mekong-river-dams-china.html

[xxv] https://www.nytimes.com/2014/10/12/world/dam-rising-in-ethiopia-stirs-hope-and-tension.html

[xxvi] https://www.nytimes.com/2020/02/15/world/asia/mekong-river-dams-thailand.html

https://www.nytimes.com/interactive/2020/02/09/world/africa/nile-river-dam.html

[xxvii] https://www.siwi.org/priority-area/transboundary-water-management/

[xxviii] https://climateanalytics.org/publications/2019/decarbonising-south-and-south-east-asia/

[xxix] https://www.internationalrivers.org/resources/dams-and-development-a-new-framework-for-decision-making-3939

[xxx] https://www.worldbank.org/en/news/feature/2019/03/21/green-and-gray

[xxxi] https://www.worldbank.org/en/news/infographic/2019/03/21/green-gray

[xxxii] https://www.downtoearth.org.in/news/water/there-are-alternatives-to-dams-but-we-are-not-taking-about-them-experts-59297

[xxxiii] https://www.encyclopedie-environnement.org/en/water/how-reconcile-dams-sediment-transport/#3_What_to_do_with_the_sedimentary_material_accumulated_over_time

Endnotes

[xxxiv] https://www.encyclopedie-environnement.org/en/zoom/some-examples-of-sediment-management/
[xxxv] https://www.ge.com/renewableenergy/hydro-power/micro-hydropower-kinetics-solutions
https://emrgy.com/
[xxxvi] https://www.middleeastmonitor.com/20200215-egypt-ethiopia-sudan-reach-final-deal-on-filling-renaissance-dam/
[xxxvii] https://www.nytimes.com/interactive/2020/02/09/world/africa/nile-river-dam.html
[xxxviii] https://energypedia.info/wiki/Ethiopia_Energy_Situation
https://www.iea.org/articles/ethiopia-energy-outlook
[xxxix] https://www.brookings.edu/blog/future-development/2018/05/22/egypts-population-boom-then-bust/
[xl] https://www.desalination.biz/news/related_stories.asp?id=8917
http://www.sis.gov.eg/Story/141631/A-presidential-decree-approves-loan-to-establish-4-desalination-plants-in-South-Sinai
[xli] https://www.dartmouth.edu/pressreleases/more_rain_yet_less_water_expected_for_up_to_250_million_people_along_the_nile.html
[xlii] https://thelede.blogs.nytimes.com/2013/06/06/with-cameras-rolling-egyptian-politicians-threaten-ethiopia-over-dam/
[xliii] https://www.aa.com.tr/en/africa/african-nations-ink-dam-deal-in-washington/1720872
[xliv] https://www.reuters.com/article/us-egypt-ethiopia/egypt-ethiopia-sudan-say-final-agreement-on-blue-nile-dam-ready-by-next-month-idUSKBN1ZU2YU
https://www.aljazeera.com/news/2020/02/ethiopia-egypt-sudan-sign-dam-agreement-february-200201082946941.html
[xlv] https://www.aa.com.tr/en/africa/african-nations-ink-dam-deal-in-washington/1720872
[xlvi] https://www.water.ox.ac.uk/filling-the-grand-ethiopian-renaissance-dam-seeking-middle-ground-on-the-nile/
[xlvii] https://www.theeastafrican.co.ke/news/africa/Ethiopia-says-no-deal-yet-on-Nile-talks/4552902-5456930-14fjtkm/index.html
[xlviii] https://foreignpolicy.com/2020/01/16/egypt-ethiopia-gerd-talks-renaissance-dam-accord/
[xlix] https://www.nytimes.com/2011/04/18/world/asia/18mekong.html
[l] https://www.nytimes.com/2020/02/15/world/asia/mekong-river-dams-thailand.html
[li]Ibid
[lii]Ibid
[liii] https://climateanalytics.org/latest/south-and-south-east-asia-can-power-ahead-with-renewables-report/
[liv] https://www.nytimes.com/2019/10/12/world/asia/mekong-river-dams-china.html
[lv]https://www.nytimes.com/2011/04/18/world/asia/18mekong.html
[lvi]https://www.nytimes.com/2012/11/07/world/asia/laos-presses-ahead-with-mekong-dam-project.html
[lvii] ibid
[lviii] https://www.nytimes.com/2018/07/24/world/asia/laos-dam-collapse-hundreds-missing.html
[lix] https://www.npr.org/2020/02/17/806729347/sand-mining-in-cambodia-and-dams-upstream-threaten-mekong-river
[lx] https://www.mekongeye.com/2016/08/04/grain-drain-laos-sand-mining-damaging-the-mekong/

Sources for Further Learning

Reports

Dams and Development: A New Framework for Decision-Making - World Commission on Dams, November 2000

Decarbonizing South and South East Asia - Climate Analytics, May 2019

Integrating Green and Grey - World Bank Group, World Resources Institute, March 2019

Water Infrastructure Resilience: Examples of Dams, Wastewater Treatment Plants, and Water Supply and Sanitation Systems – World Bank, 2019

Capacity Building for Cooperation on Dam Safety in Central Asia – UNECE

Advancing Dam Safety in Central Asia: The Contribution of the UNECE Water Convention – Bo Libert, Iulia Trombitcaia

Organisations

International Rivers

Mekong River Commission

UN Environment

UN Water

Books

Last Days of the Mighty Mekong, Brian Eyler, February 2019

The UNECE Water Convention on the Protection and Use of Transboundary Watercourses and International Lakes: Its Contribution to International Water Cooperation, Chapter 27 - Advancing Dam Safety in Central Asia: The Contribution of the UNECE Water Convention, Bo Libert and Iulia Trombitcaia

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