Mekong Fish and Fisheries Basics
The commercially valuable fish species in the Mekong basin are generally divided between ‘black fish’, which inhabit low oxygen, slow moving, shallow waters, and ‘white fish’, which inhabit well oxygenated, fast moving, deeper waters (MRC, 2010a). People living within the Mekong River system generate many other sources of food and income from what are often termed ‘other aquatic animals’ such as freshwater crabs, shrimp, snakes, turtles, and frogs.

Other aquatic animals comprise about 20 percent of the total Mekong catch. When fisheries are discussed, catches are typically divided between the wild capture fishery (i.e. fish and other aquatic animals caught in their natural habitat), and aquaculture (fish reared under controlled conditions).

Wild capture fisheries play the most important role in supporting livelihoods. Wild capture fisheries are largely open access fisheries, which poor rural people can access for food and income.

Broadly, there are three types of fish habitats in the Mekong: i) the river, comprising all the main tributaries, rivers in the major flood zone and the Tonle Sap, which altogether yield about 30 percent of wild catch landings; ii) rainfed wetlands outside the river-floodplain zone, comprising mainly rice paddy in formerly forested areas, seasonally inundated to about 50 cm and yielding about 66 percent of wild catch landings; and iii) large water bodies outside the flood zone, including canals and reservoirs yielding about 4 percent of wild catch landings (MRC, 2010a).

The Mekong Basin has one of the world’s largest and most productive inland fisheries (Baran and Myschowoda, 2009; Baran and Ratner, 2007; ICEM, 2010; Sarkkula et al., 2009). An estimated 2 million tonnes of fish are landed a year, in addition to almost 500,000 tonnes of other aquatic animals (Hortle, 2007). Aquaculture yields about 2 million tonnes of fish a year (MRC, 2010a). Hence, the Lower Mekong Basin yields about 4.5 million tonnes of fish and aquatic products annually. The total economic value of the fishery is between USD 3.9 to USD 7 billion a year (MRC, 2010b). Wild capture fisheries alone have been valued at USD 2 billion a year (Baran and Ratner, 2007). This value increases considerably when the multiplier effect is included, but estimates vary widely.

An estimated 2.56 million tonnes of inland fish and other aquatic animals are consumed in the lower Mekong every year (MRC, 2010a). Aquatic resources make up between 47 percent and 80 percent of animal protein in rural diets for people who live in the Lower Mekong Basin (Baran

“40 million rural people, more than two-thirds of the rural population in the Lower Mekong Basin, are engaged in the wild capture fishery”
The Impacts of Dams on the Fisheries of the Mekong, May 2012

SOK 1: The Impacts of Dams on the Fisheries of the Mekong, May 2012 - - (Baran et al., 2009). Eliminate 10 to 60 percent of fish species in their vicinity (Agostinho et al., 2008). Globally, dams ecosystems and hydrology work. River damming is a process well established that dams affect the ways in which river entirely on fishing for their live. Around the Tonle Sap (Baran and Ratner, 2007; Baran and Myschowoda, 2009; Friend and Blake, 2009; World Bank, 2004). They provide a principal form of income for a large number of people and act as a safety net and coping strategy in times of poor agricultural harvests or other difficulties (Baran and Ratner, 2007; Baran and Myschowoda, 2009; Friend and Blake, 2009; World Bank, 2004). In Lao PDR alone, 71 percent of rural households (2.9 million people) rely on fisheries for either subsistence or additional cash income. Around the Tonle Sap Lake in Cambodia, more than 1.2 million people live in fishing communities and depend almost entirely on fishing for their livelihoods (MRC, 2010).

Dams affect fisheries in several significant ways:

- Acting as barriers to fish migrations. Fish migrations are highly complex events and an inherent part of fish breeding cycles. The presence of dams in the Amazon Basin, for example, has halted the long distance migrations of several species of catfish, reducing downstream catches by up to 70 percent (Bergkamp et al., 2010).
- Interrupting natural flood cycles to which fish have adapted over thousands of years.
- Hardening of the riverbed. Dams typically release water in bursts, which removes smaller sediments like silt, sand, and gravel, as well as aquatic plants and animal debris from vegetation. As a result, the bedrock below the dam becomes exposed and loses its value as a habitat for fish.

How will dams affect the migration of fish in the Mekong?

Any development that directly impedes fish migration in the middle and lower reaches of the river will have significant impacts on fish production (Stone, 2011). Dams act as physical barriers, blocking fish migration and disconnecting spawning and feeding habitats (Baird, 2009a, 2009b; Baran and Myschowoda, 2009; Kirby and Mannaudin, 2009; Sarkkula et al., 2009; World Bank, 2004). These barriers will impact fish productivity on the arrival of many species (Baird, 2009a; World Bank, 2004). Given the fact that most long-distance fish migrations include a reach of the Mekong mainstream, dams on the mainstream are expected to have more of an impact on fisheries than dams on tributaries (Dugan, 2008). Dams located higher in the basin will have less of an impact on fisheries, as most fish production comes from the middle and lower reaches of the basin and relatively few species migrate the full distance from lower to upper basin (Baran and Myschowoda, 2009; Ferguson et al., 2011). It should be noted, however, that “The lower Mekong is likely to have proportionally fewer vulnerable species compared to the upper Mekong because the diverse floodplain habitat characteristic of the lower Mekong supports species of fish that do not undertake extensive migrations to upstream habitats.” (Halls and Kshatriya, 2009: 73). Run-of-the-river dams are often thought to have less of an impact on fisheries than reservoir dams. This, however, depends on how the dam is designed and operated. Moreover, all run-of-the-river dams act as a barrier to migration (Baran and Myschowoda, 2009).

Not all fish species will be threatened by mainstream dams. Species that undertake significant migration as part of their life cycle are most likely to be impacted (Halls and Kshatriya 2009). Estimates for the number of migratory fish species in the Mekong vary. Approximately 87 percent of species whose migration status is known (about 160 species) are migratory (Baran, 2006; Baran and Ratner, 2007; Baran and Myschowoda 2009).

Long-distance migratory fish represent at least one third of the fish biomass harvested in the Lower Mekong Basin, including a large percentage of important commercial species (ICEM, 2010; World Bank, 2004). It is estimated that migratory species comprise more than 37 percent of the overall yield in the basin (Ferguson et al., 2011). Fifty-eight species in the ecological zone upstream of Vientiane are highly vulnerable to mainstream dam development and further 26 species are at medium risk of impact as a result of their migratory behavior (ICEM, 2010).

“"It is probable that dams will negatively affect biodiversity by creating barriers to fish migration and increasing habitat loss, thereby affecting fish breeding and life cycles”

Will dams affect the Mekong’s flood pulse? Will dams affect the Mekong’s flood pulse? Will dams affect the Mekong’s flood pulse? Will dams affect the Mekong’s flood pulse?

Will dams affect the Mekong’s flood pulse? It is well established that dams will alter the Mekong’s seasonal variation in water levels, known as the ‘flood pulse’. The presence of dams may result in an increase in dry season discharges (Friend and Blake, 2009) and reduce the severity of the flood pulse, hence reducing flooding (Stone, 2011). But dams may also benefit fisheries as they open up new areas for fish to feed. Many Mekong fish species rely on hydrological triggers to start them on their migrations. If dry season flows are increased, this may prevent fish that are sensitive to these triggers from migrating, thereby reducing fisheries in the region (Baird 2011; Baran and Myschowoda, 2009; Baran and Ratner, 2007; Friend and Blake, 2009; Halls and Kshatriya, 2009; Hogan et al., 2004, 236; Jutagate et al., 2003; Valbo-Jorgensen et al., 2009). Even run-of-the-river projects can potentially alter flow patterns, depending on how they are constructed (Baran and Ratner, 2007). The estimates for the number of species that could potentially be impacted by altered flood pulses vary widely (Baran and Ratner, 2007). Flow modifications will have other impacts, including diminished feeding and refuge opportunities, as well as unfavorable conditions for fish.
The stabilization of the Tonle Sap as a result of alterations to the natural flood pulse will disrupt the ecosystem, where current fisheries production is correlated to the magnitude of the flood (Kirby and Mainuddin, 2009; Stone, 2011).

**Conclusion:** Dams will reduce the magnitude of the Mekong’s flood pulse, although by how much is not well established. It is probable that this will have knock-on impacts on fish migrations and breeding cycles, thereby reducing fisheries productivity.

### Will dams affect the Mekong’s fish habitats?

It is well established that deep pools are important fish habitats throughout the basin, serving as dry season/low water refuges (i.e. where fish can hide from predators) (Bush, 2003; Baird, 2009b). Deep-water pools in the Sesan watershed will be obstructed, and therefore inaccessible to floodplain migratory fish (Baran, 2010).

**Conclusion:** It is probable that dams will have a significant negative impact on fish habitats, reducing fish reproduction and interrupting fish life cycles, thereby reducing fish landings. More research is, however, required to determine the extent of habitat loss, and the likely impact of this on fish landings.

### Will dams affect ecosystem benefits in the Mekong?

The degradation of Mekong fisheries has the potential to impact the ecosystem integrity and functioning of the entire basin (Halls and Kshatriya, 2009; Kirby and Mainuddin, 2009a). At risk will be the economic, nutritional and social benefits of ecosystem services (Dugan et al., 2010). If all planned dams are built in the basin, the worst-case scenario loss of ecosystem services is valued at USD 274 billion (Stone, 2011).

**Conclusion:** Dam developments on the Mekong will significantly affect the fisheries production of the system, whether those dams are built on the mainstream or its tributaries.

### Can wild capture fisheries losses as a result of dam development be mitigated?

In 2008, acquaculture production was estimated to be about 2 million tonnes, equivalent to 78 percent of wild fisheries consumption (MRC, 2010a). Aquaculture in the Mekong Delta is heavily dependent on aquaculture. It should be noted that in the Mekong before any level of certainty on their effectiveness can be determined (Dugan, 2008: 14). There is no evidence from the region, or, globally, that these mitigation measures prevent the negative impacts of hydropower on fisheries completely. They can, however, reduce them.

**Conclusion:** While technical, managerial and ecological applications can help to mitigate fisheries losses to a limited extent, they cannot restore them to levels associated with an undammed river.

### Can intensified aquaculture production compensate for potential future fisheries losses, in addition to increased regional demand for fish?

**Conclusion:** Whether or not aquaculture can replace lost production from wild capture fisheries as a result of dams is uncertain. Scenario studies suggest that it can, under best case scenarios. Under mid-case assumptions there will also be excess yield, except when all mainstream dams are built. In the worst case scenarios, there would be a significant basin-wide deficit after 2015 of 436,000 tonnes per year. Most of this deficit would accrue in Cambodia, Thailand and the Vietnamese highlands would also suffer a deficit, and in Lao PDR there would be a small deficit in the worst case (MRC, 2010a). The Mekong delta would be in excess under any scenario due to its large aquaculture production capacity.

**Experience from elsewhere around the world provides evidence of significant negative impacts on fisheries as a result of barriers to fish migration**

It should be noted that production is not the same as consumption. As has been well demonstrated elsewhere, the availability of large amounts of food does not necessarily equate with consumption if it is not distributed to those who need it, and the latter cannot afford to buy it (Sen, 1981). This is an important distinction between wild capture fisheries and aquaculture – aquaculture production must be paid for by those who consume it; this is not necessarily the case for wild capture fisheries.
“Whether or not aquaculture can replace lost production from wild capture fisheries as a result of dams is uncertain”

Conclusion: Intensified, large-scale aquaculture can probably compensate for wild capture fish production deficits, but this is not certain. This option comes at a price, however. Rural people cannot harvest aquaculture fisheries ‘for free’. In addition, the ecological impacts of large-scale aquaculture intensification need to be factored into any cost-benefit analysis of such a strategy.

Do dam reservoirs represent new opportunities for fisheries development?

Currently, reservoir fisheries account for approximately 10 percent of Mekong fishery production (Baran et al., 2007). Reservoirs will not be able to support the same levels of fish diversity as the present riversine system (ICEM, 2010; Robson, 1996). Only nine Mekong fish species are known to breed in reservoirs (Baran, 2006). In the past, reservoir stocking has not been able to compensate for the level of capture fisheries losses (Friend and Blake, 2009). It is likely that the economic costs associated with lost fisheries production as a result of dam development will outweigh the expected economic benefits of these structures (Baran and Myschowoda, 2009; Baran and Ratner, 2007; Friend and Blake, 2009).

Conclusion: Initial studies on the trade-offs between the environmental and social impacts of dams development with their economic gains, suggest that the economic benefits of dams are unlikely to outweigh the environmental and social costs of dams development (Kirby and Mainuddin, 2009).

Conclusion: Fisheries production from dam reservoirs cannot compensate for losses in capture fisheries arising from dam development.

Are the benefits resulting from hydropower production large enough to offset the costs associated with the impacts on fisheries?

A 2006 World Bank and Asian Development Bank joint study found that the Mekong Basin’s capacity for flexibility and tolerance indicated sustainable and integrated development could lead to widespread benefits. It recommended that policies related to water management be founded on economic, environmental and social trade-offs (Friend and Blake, 2009). It is likely that the economic costs associated with lost fisheries production as a result of dam development will outweigh the expected economic benefits of these structures (Baran and Myschowoda, 2009; Baran and Ratner, 2007; Friend and Blake, 2009).

References


What is the State of Knowledge (SOK) Series?

The SOK series sets out to evaluate the state of knowledge on subjects related to the impact, management and development of hydropower on the Mekong, including its tributaries. Publications in the series are issued by the CGIAR Challenge Program on Water and Food – Mekong Programme. The series papers draw on both regional and international experience. Papers seek to gauge what is known about a specific subject and where there are gaps in our knowledge and understanding. All SOK papers are reviewed by experts in the field. Each section in a SOK papers ends with a conclusion about the state of knowledge on that topic. This may reflect high levels of certainty, intermediate levels, or low certainty.

The SOK series is issued on CD-ROM and in print. The versions that appear on CD-ROM also include the source material on which conclusions are based.


This SOK has been reviewed by Eric Baran (WorldFish Centre), Kent Hortle (fisheries consultant), Yumiko Kura (WorldFish Centre), Chris Barlow (ACIAR) and Robert Arthur (MRAG Ltd). Reviewers cannot be held responsible for the contents of any SOK paper, which remains with the CPWF and associated partners identified in the document.

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The Challenge Program on Water and Food was launched in 2002 as a reform initiative of the CGIAR, the Consultative Group on International Agricultural Research. CPWF aims to increase the resilience of social and ecological systems through better water management for food production (crops, fisheries and livestock). CPWF does this through an innovative research and development approach that brings together a broad range of scientists, development specialists, policy makers and communities to address the challenges of food security, poverty and water scarcity. CPWF is currently working in six river basins globally: Andes, Ganges, Limpopo, Mekong, Nile and Volta. More information can be found at www.waterandfood.org.

In the Mekong, the CPWF works to to reduce poverty and foster development by optimizing the use of water in reservoirs. If it is successful, reservoirs in the Mekong will be: (a) managed in ways that are fairer and more equitable to all water users; (b) managed and coordinated across cascades to optimize benefits for all; (c) planned and managed to account for environmental and social needs; (d) used for multiple purposes besides hydropower alone; (e) better governed and the benefits better shared. More information can be found at www.mekong.waterandfood.org.

The CPWF is part of the CGIAR Research Program on Water, Land and Ecosystems. This new research program combines the resources of 14 CGIAR centers and range of international, regional and national partners to provide an integrated approach to natural resource management (NRM) research, and to the delivery of its outputs. The program focuses on the three critical issues of water scarcity, land degradation and ecosystem services, as well as sustainable natural resource management. It will also make substantial contributions to improved food security, poverty alleviation and, to a minor extent, health and nutrition. More information can be found at www.iwmi.cgiar.org/CRP5.

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