

# **Integrated Management to Enhance Fishery Resources in the Mekong River**

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## **Abstract**

Fishing resources of the Mekong River are crucial to the existence and livelihood of local communities and families. Heavy reliance is placed on fishing as a primary source of household food and income. Large-scale, development projects such as the construction of electricity producing dams aimed solely at regional economic growth have resulted in far-reaching ecological changes throughout the Mekong Region. These changes have had a profound impact at the local level. A combination of community-based management and co-management by local agencies has proven to be ineffective in doing so. A more encompassing, collaborative effort involving international, national, provincial, and community sectors is required. Only through vertical and horizontal cooperation by countries along the Mekong in the joint pursuit of sustainable fishery resource management can a balance between large-scale economic growth and local resource preservation be achieved.

**Key Words:** Fishery resource management; The Mekong River; Community based Management; Co-management

## Introduction

The growth of large development projects, for example, building dams for generating electricity has great impact on natural resources. The natural resources are generally identified as common resources, which refer to “resources can be used by many users at once, and use by each one reduces the benefits available to the others” ([www.encyclo.co.uk](http://www.encyclo.co.uk)). Common resources comprise two key features; exclusion and subtractability. Exclusion refers to resources that are difficult to exclude persons from access for exploitation; it is difficult to control the access of potential users because the territory of the resources is very large. Subtractability refers to resources that compete in acquisition or consumption. The more consumption or the more harvesting one has, the lesser resources the others can access (Berkes 2006; Ostrom 2002). Common resources, for example, forests, fish and water resources are over exploited. This is because there are a large number of consumers and there are no genuine resource owners. Also, users of the resources in the community have no motivation to look after common resources because they cannot exclude users from outside of the community for selfish resource exploitation, resulting in the sharp decline of the natural resources and eventual natural resource deterioration. This phenomenon is called the Tragedy of the Commons (Hardin 1968).

With this concept, policymakers believe that natural resources should be managed and controlled by centralized governmental regulation to avoid selfish resource exploitation and natural resource degradation (Berkes 2007). The government plays a major role to force people to follow regulation and punish persons who violate or break the rules. However, management carried out by the government also has problems because of the lack of government funding and personnel to manage the natural resources (Jeppesen et al. 2006). In the case of the shortage of personnel, many offenders may escape arrest. This can increase the number of offenders, leading to the decline of natural resources and ending up with the Tragedy of the Commons.

With natural resource management by centralized governmental regulation, the degradation of resources or the Tragedy of the Commons remains unsolvable. Ostrom (2002) has proposed natural resource

management through community-based management in which local people partake in resource management by themselves. This concept believes that local people possess the knowledge of their own community resources very well, and understand the ways of their community resource exploitation best. It also is based on the use of social capital (Ostrom 2002) and human relations (Pretty 2003). Thus, community participation in resource management would be more appropriate, leading to the sustainable utilization of natural resources in the community (Murphree 2002).

Ostrom's concept differs from natural resource management by centralized governmental regulation using the regulation and economic incentives in management that may cause behavioral changes, but not attitudinal change in people (Gardner & Stern 1996). Eventually, people return to old behavior because of an absence of the social norm (Pretty 2003) which is not unsustainable management.

Although resource management by resource users is possible, Ostrom emphasizes that community-based management also has restrictions and conditions. Community-based management is not a panacea to be used in every situation (Ostrom et al. 2007). Common resources that are appropriate for community-based management should be immigratory, retainable and predictive of the quantity and timeline of production. Also, the community should possess the knowledge of resource management and conservation. In addition, Ostrom also believes that in the case of a small community, the collaboration of the government to take care of the resource will enable more effective and sustainable management. She pointed out that natural resource management should be integrated with various management approaches, both in the government sector and among natural resource users (Ostrom 2010). This is known as co-management or collaborative management. This type of management refers to "the sharing of power and responsibility between the government and local resource users" (Berkes et al. 1991, p.12) or "the sharing of authority, responsibility, and benefits between government and local communities in the management of natural resources" ([www.dictionary.babylon.com](http://www.dictionary.babylon.com)). To pursue resource management, this management consists of two or more social actors that varies from area

to area (Borrini-Feyerabend et al. 2000). However some co-management programs are strongly dominated by government, with little real decision-making powers given to resource users. Baird and Fasherty (2005), therefore, purposed hybrid management for fishery resources so that resource users could still share power and responsibility with the government and they had considerable management decision-making powers. This is known as community-based fisheries co-management in which local ecological knowledge of fishermen such as fish conservation zones or no-take fish sanctuaries was applied in this management. In the past, common resource management which was studied on a small scale or at the local level remained skeptical if lessons at the global level should be applied. These managements include global resources, climate change and watershed management running through several countries, for example, the Mekong River.

The Mekong River is the twelfth longest river in the world. It is about 4,800 kilometers long running through the south of China, Myanmar, Laos, Thailand, Cambodia and Vietnam (Mekong River Commission 2010). The biological diversity of fish is the second richest in the world after that of the Amazon River (Ziv et al. 2012). It is the habitation of a minimum of 1,500 freshwater species (Mekong River Commission 2004). Also, the populations along the Mekong River have relied on fishery resources for earning a living, consumption and trading. Inland fishery productivity from the Mekong River generates 2.2 to 3.9 billion baht in revenues yearly (Hortle 2007) and is greatly useful to people's livelihood as the fish are the main source of protein and bring food security to more than 60 million people in the Mekong River Basin (Pearse-Smith 2012). However, over the past 15 years, there has been evidence of great developments of the infrastructure, as well as dams and reef blasting for Mekong River navigation.

Building large dams blocking the Mekong River: China has built many big dams to generate electricity and to control the water level for Mekong River navigation. The Chinese government aims to build 14 dams on the Mekong River; some have been completed, some are under construction, and some projects have been delayed. For example, Manwan Dam was completed in 1996, Dachaoshan Dam was completed in 2003,

Xiaowan Dam was completed in 2012, while construction was started on Jinghong Dam in 2005 (Santasombat et al. 2009). In addition, over 100 dams are planned for construction in the lower Mekong River, located in the territory of Thailand, Laos, Cambodia, and Vietnam. In the next 10 years, eleven large dams will be built: seven in Laos, two in Cambodia, and two across Thailand and Laos (International Centre for Environmental Management 2010).

Besides electricity generation, dams are an important mechanism to control the water level allowing shipping throughout the year. Dams will reduce enormous amounts of water during flooding but also draining water during the drought season. Consequently, the period of navigation on the Mekong River is extended from only four months to 8-10 months (Santasombat et al. 2009). Building large dams can cause social, economic and environmental impacts (Dugan et al. 2010), specifically the influence of water level changes which confuse the migratory behaviour of fish such as laying eggs and seeking food. The dam will block spawning migration routs (Dugan 2008) and trap the downstream drift of fish eggs and larval stages. Thus creating dams upstream, in the middle and at the bottom of the Mekong River will block the longest migration of fish along the Mekong River (Poulsen et al. 2002).

Reserving water for power generation and navigation lowers the Mekong water level with the result that fish cannot migrate into wetlands for spawning and finding food. In the event that water overflowing to wetland areas stays only for a short time, baby fish still too small to migrate to the main river will not survive. They have a high risk of becoming prey of the big fish (Santasombat et al. 2009). This destruction of fish productivity and a variety of fish species in the Mekong River (International Centre for Environmental Management 2010) thereby affects the the well-being of the people living in this region. Fishermen report that following the completion of the Chinese dam construction on the Lan Chang River (Mekong River), tidal water changed abnormally; not naturally, causing the fish population and freshwater seaweed to be reduced sharply (Santasombat et al. 2009), reporting a 50-100% decline in fish caught and the disappearance of fish

species (Orr et al. 2012).

Rock and reef blasting projects for navigation on the Mekong River: in addition to building dams to control the water level allowing shipping in the Mekong River throughout the year, rocks and reefs that block shipping needed to be removed (Santasombat et al. 2009). The rock and reef blasting started from the Sue Mao Port in China to Luang Prabang in Laos, a total of 886 km long. This blasting is an agreement between four countries, namely China, Thailand, Laos, and Myanmar. In the initial phase (2002-2004) the reefs were destroyed for a total length of 331 km surrounding the China - Myanmar - Laos border. The project, however, was terminated before blasting the 'Khon Phi Long reef' in Thailand because of opposition from the local community. Not only were the ecosystems destroyed but there was a decline in fish populations, with the habitat of the fish and food sources along the rocks and reefs also being affected. In addition, dredging destroys the natural embankment that can slow down the speed of the water current. Without sandbars, the water flow in the Mekong River becomes stronger and faster. This results in embankment erosion and changes the ordinary watercourse which may lead to future disputes concerning border issues, especially between Thailand and Laos (Santasombat et al. 2009).

Such developments have substantial effects on the ecosystem, for example, destroying spawning grounds and nursery grounds leading to a decrease of fishery resources. This means that the community livelihoods relying on the Mekong River for fishery resources will inevitably be affected, especially villagers of the Pak Ing Tai, where fisheries are mainly part of community livelihood. Pak Ing Tai village is located in Sri Don Chai sub-district, Chiang Khong district, Chiangrai, Thailand. There are 40 households in the village. Most of them earn their living as farmers by contract farming with outside entrepreneurs. Every household has relied on fishing in the Mekong River for a long time. However, people cannot catch fish throughout the year; namely, fishing increases during the high season (May-July), and declines in the low season (January-March). In the past, fish were a main protein source of villagers in daily consumption. Later in the period of tourism promotion, fish became the economic capital for trade and tourism

promotion that generated enormous income for the villagers.

From the above, we see that fishery plays important roles in the Pak Ing Tai community. People have engaged in fishing from the time of the settlement of their village until the present. However, reliance on fish to earn a living has become more of a struggle. This is because of the decrease in fish populations due to many large-scale development projects which are considered as a problem due to poor international watershed management. Thus, Pak Ing Tai village was selected as a study area to understand the way to locally solve these problems. Through qualitative research, this study had a major objective to investigate the types of fishery resource management in Pak Ing Tai village which is under the influence of emerging developments. This also led to minor studies on implementation of that fishery resource management and the results of that implementation. The findings concerning fishery resource management lead to the discussion, as well as recommendations about appropriate management of fishery resources in the watershed which flows through many countries and in which growth and development is similar to those of the Mekong River.

### **Research Methodology**

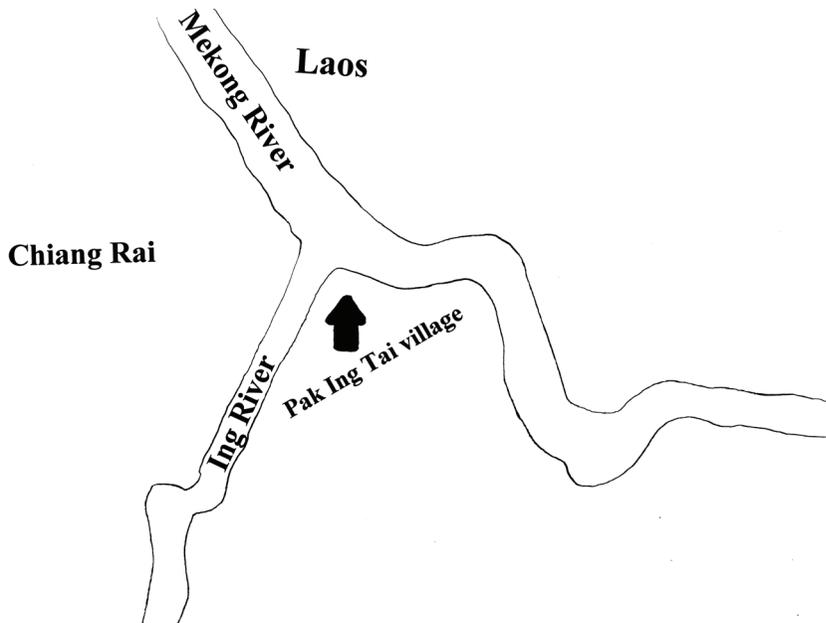
The informants in this study consisted of two groups: 1) 12 Pak Ing Tai villagers, aged 25 years old or higher and earning a living as fisherman. These villagers were randomly selected by the simple random sampling method; 12 family heads were randomly selected from all 46 households, and 2) five local authorities and officials from non-governmental organizations (NGO), randomly selected by snowball sampling. These local authorities and officials from NGO were involved with villagers' fishery resource management and were able to provide detailed information on fisheries management in the local area. They had to have been involved in fishery resource management for over five years. The number of informants seemed likely to be sufficient to achieve theoretical saturation (the point in data collection when new data no longer brings additional insights to the research questions) (Mack et al. 2005) and it was reasonable with the resources and time constraints of the research plan. Those two groups were expected to

acknowledge the problems and provide experiences of management and its implications. The data collection method included an unconstructed in-depth interview which produced deeper information and provided reasons for the answers (Adams and Cox 2008). Questions for in-depth interviews covered many areas, for example, the implementation of community-based fisheries management in each period of time, the results of that implementation and the organizations providing assistance to solve fisheries' problems. Moreover, a time line was also employed to collect data and to examine the changes arising in the area at different times from the past to the present. Data obtained from the interviews were analysed using content analysis.

## **Results**

Pak Ing Tai village locates at the junction that the Ing River flows into the Mekong River as shown in Figure 1. Normally, the fish species migrate from the Mekong River to the Ing River for spawning and breeding. For this reason, the junction area becomes a large fishery source of the Mekong River in northern Thailand. If, then, any changes occur along the Mekong River, the Ing River will be affected subsequently. From the past to the present, Pak Ing Tai village has adapted to the changing situations and external influences such as the promotion of tourism, dam building and reef blasting in the Mekong River which affected the amount of fish in both the Mekong River and the Ing River. Thereby the local villagers' fisheries had been affected accordingly, leading to changes in the model of fishery resource management at different times from the past to the present. From in-depth interviews, all data can be illustrated the model of fishery resource management in three phases.

Phase 1 started from the year 1924 until 1987. Fishery resource management had not been established. This is because at that time the local villagers typically earned a living on rice-growing. The villagers also grew tobacco plants and distributed them to the tobacco curing factory located in the village and owned by an outside entrepreneur.



**Figure 1** Location of Pak Ing Tai village

But fishery resources are primarily for household consumption purposes only. Most fishing tools were hand-made, for example, fishhooks and fishnets. This resulted in fishery resources remaining naturally prosperous neither threatened nor damaged. Without any large-scale development projects in the Mekong River Basin during this period, fish in the Mekong River Basin and the Ing River were maintained in abundance. This could be a simple reason that there was still no establishment of resources management.

Phase 2 started from the year 1987 until 1997 and was considered community-based fishery management. This period has been influenced by tourism promotion emerging along the Mekong River, and Chiang Khong district. Tourism attracted tourists to visit its district through traditional fishing as a point of sale and by creating popularity of fish consumption simultaneously.

In doing so, the image of Chiang Khong was promoted through the concept of eating Mekong fish is good for health. Consequently, the need for fish increased and the price of Mekong fish rose. Hence, Pak Ing Tai

villagers turned to catching fish to accommodate the growing demand of the market. It was regarded the golden age of the fish at Pak Ing Tai village (Santasombat et al. 2009). Most households helped each other to catch fish both for consumption and to deliver to the restaurants in the town of Chiang Khong and neighboring provinces.

Since the number of people catching fish has been growing, the villagers rearranged fishing and set rules and practices within the fisheries groups for equality in fishing, for example, the rule of fishing priority. Also, not more than three fishing boats per fishing round were allowed. This enabled a fisherman with an opportunity to go fishing 3-4 times a day. In addition, the fishing area must be kept clean to avoid underwater wood scraps that may cause damage to fishnets. This is how resource management has been managed in the community.

During this period, fishing was an occupation that made considerable income for the family. However, income generated from fishing was not steady throughout the year; namely, income increased during the high season (May-July), and declined in the low season (January-March). Therefore, most people had to grow tobacco plants to earn extra money.

Phase 3 started from the year 1997 to the present and is considered co-management fishery management. This period has been influenced by large-scale development projects emerging along the Mekong River Basin, for instance, building dams on the Mekong River in China and reef blasting for commercial navigation. The dam building caused deviation of the water level and also blocked the upstream migration of numerous fish species. The reef blasting destroyed spawning grounds and nursery grounds. All this resulted in reduced numbers of the fish, while in turn the number of fishermen was growing. Besides, the villagers had more expenses and these increased every day. The villagers had to overexploit the natural fishing resources and work prolonged hours fishing with an expectation to gain increased number of fish for family survival. With this economic difficulty, most villagers decided to earn a living by agriculture or selling their labour in the big cities. Many fishermen tried to increase their income by growing cash crops such as beans and maize for outside entrepreneurs. Outside entrepreneurs provide

the villagers with seeds and fertilizer for cultivation, and buy the produce from the villagers. It is not necessary for the villagers to research the market to selling the crops. They just invest their labours in cultivation.

Because the reduced number of fish led to a decreased income, people had to look for ways to solve this problem through cooperation among many parties to continuously conserve and sustain the plentiful number of fishery populations. This consists of 1) the cooperation with an NGO to establish fish sanctuary with a length of 200 meters surrounding the estuary of the Ing River. This aims to protect the spawning ground and nursery ground of the fish. In addition, destructive fishing practices like blast fishing are prohibited; and 2) the cooperation with local governmental agencies on breeding local fish such as Greater Black Shark (*Morulus chrysophekadion*), Walking Catfish (*Clarias batrachus*), and Java Barb (*Barbodes gonionotus*) releasing them into the Mekong River to increase the amount of fishery in the watershed. From interviews among local people, it was found that the number of fish in the sanctuary increased after pursuing such an implementation; however, it did not increase enough to generate a greater income than the fishermen had ever realized before. The conclusion of fishery resource management in Pak Ing Tai village is shown in Table 1.

## **Conclusion and Discussion**

The study showed that the Pak Ing Tai Village community has employed fishery resource management in two aspects: community-based management and co-management. Community-based management was employed during 1987-1997. The villagers received a great amount of income from fishery resources to support their families. Community-based management at that time was characterized by the allocation of resources among community members who used resources equally without focusing on sustainable resource conservation. This was for many reasons; 1) villagers lacked of awareness of the problems, which caused a reduction in the amount of fishery resource base because there were vast amounts of fish at that time, and 2) the lack of knowledge in sustainable fishery resource management, as well as a lack of support or instruction provided by the state sector.

Co-management was employed during 1997 to the present. Local people faced problems of the decline of fisheries resources as a result of large-scale developments. This reflected that the community-based management approach did not work in the early stage, showing that community-based management is sensitive to external factors and not powerful enough to deal with large-scale issues. Community-based management is not powerful enough to deal with fishery resources in the area because fishery resource management has been carried out in multiple levels and has involved many countries (Berkes 2006). Hence, the community searched for another solution to solve the decline in fishery resources with the cooperation of multi-agency partnerships, called co-management. It carried this out by defining the sanctuary zone and also by breeding local fish and releasing them into the Mekong River to increase the amount of fish in the watershed. This management has been under the assistance of an NGO and local authorities. Nonetheless, the number of fish has not significantly increased and the villagers have still not earned as much income from fishing as in past years. The implementation was similar to community-based fisheries co-management in Laos which employed fish conservation zones as local ecological knowledge of fishermen in this management, aiming to integrate social and cultural concepts with biological science concepts to increase considerably the potential for improving management (Baird and Mark 2005). It can be argued that local ecological knowledge of fishermen is not powerful enough to cope with a decrease of fish population in large watershed areas like the Mekong River. Fishery management in the Mekong River is very complex as the management has been carried out at multiple levels and has involved many countries (Berkes 2006). From the study, it shows that fisheries' management from the past to the present could not solve the problem of declining resources. This is because there is no linkage to resource management both vertically and horizontally.

Vertical: agencies involving Mekong River resource management consist of multiple levels as shown in Figure 2. Mekong River resource management at each level varies from the international to provincial level. Mekong River resource management in the international and national levels

**Table 1** Fishery resource management in Pak Ing Tai village, Chiangrai

Type of fishery resource management	Influence on the area	Implementation	Result of implementation
<b>None established fishery resource management (1924-1987)</b>	None	Fishery resources were primarily for household consumption.	Fishery resources remained plentiful.
<b>Community-based management (1987-1997)</b>	Tourism promotion and popularity of Mekong consumption	The villagers set out the rules and practices within the fisheries group for equality in fishing.	Fishing creates a considerable income for the family.
<b>Co-management (1997-present)</b>	Large-scale development projects (building dams and reef blasting)	Cooperation among many local agencies to conserve and sustain the plentiful number of fish populations by establishing a fish sanctuary and breeding local fish releasing them into the Mekong River.	The number of the fish in the sanctuary increased after pursuing such implementation; however, it did not increase enough to generate an income greater than the fishermen had ever realized before.

focuses mainly on mega economic growth induced by the large-scale development projects along the watershed; dam construction to produce electricity and reef blasting for commercial navigation. Dams have influenced the change in the water level, thereby affecting the behavior of fish migration in spawning and seeking food. Also reef blasting caused the destruction of spawning grounds, nursery grounds and food sources, resulting in the decline of fish in the Mekong River. At the provincial level, the management focuses on the promotion of tourism for local economic development. Tourism promotion including the encouragement of consuming Mekong fish for good health results in an increase in Mekong fish consumption which expands to restaurants and food stores in Chiangrai and other provinces. This phenomenon has caused a decline of fish in the Mekong River as well. At the community level, the management focuses on the continuous abundance of fish for fishing because the abundance of fish affects the food security of families and increased household income. Thus, when the amount of fish in the Mekong River declines as a result of various external influences, people become aware of resource conservation for sustainable fishing.



**Figure 2** Levels of political and social organization

The focus on resources in the Mekong River at each level causes different resource exploitation and different management of natural resources of the Mekong River at varying levels; internationally, nationally, provincially and in local communities. Natural resources in the Mekong River including water and fishery which local people have used continuously and for a long time, and proclaimed as public property are now taken over and exploit by

many states, claiming that it is for development of power generation and cargo navigation for the economic growth of the majority of the country.

This shows that states are mainly concerned with economic growth rather than local well-being. While states or superior authorities exploit the economic benefits from these natural resources selfishly and cause degradation of those resources, local communities which have depended on natural resources in the Mekong River for a long time are facing a decline of the fish population, leading to many problems such as poverty and food insecurity.

Despite the fact that one local community put a lot of effort into fish conservation or building cooperation with other local organizations on fish conservation, it was unable to recover the abundance of fishery resources because of the many large-scale development projects allowed by states and still appearing in the Mekong River. This points out that there are differences in thinking between the international and local level relevant to the resource availability and sustainability.

Horizontal: because the Mekong River runs through many countries: China, Myanmar, Laos, Thailand, Cambodia and Vietnam, resource management from upstream to downstream concerns those countries. The management of migratory resources such as fish in the joint area of many countries cannot be managed by any single country, but management requires cooperation among the countries by the river. This is because the life cycle of fish circulates in the areas of many countries or more than one national jurisdiction (Berkes 2006). Suppose a country uses the shared resources with selfishness, which leads to an adverse impact on the resources of the neighboring countries, for example, building dams in China in the upstream area blocks fish migration for spawning (Dugan 2008) and movement of fish larva. This includes many dams constructed above the watershed and individual tributaries which limit the amount of fish throughout the Mekong River (Poulsen et al. 2002). Thus, it is essential for migratory resource management to get the cooperation of many nations for cooperative conservation of fishery resources in the Mekong River.

In conclusion, for fishery resource management in joint areas of the international development projects, neither community-based management nor co-management at local levels is powerful enough to manage these kinds of resources. To achieve sustainable resource management in the Mekong River, fishery resource management both vertically and horizontally should be employed.

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