

An Introduction to the Mekong Fisheries of Thailand



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Foreword

Thailand is blessed with an abundance of marine and freshwater resources. In 2002 it ranked in the top-ten fishing nations of the world. Thailand is also recognised for the advances it has made in developing its aquaculture sector.

Capture fisheries and aquaculture in the Thai portion of the Lower Mekong Basin are a major component of these aquatic resources. It has been estimated from fish consumption studies that the average annual yield of inland fish is around 795,000 tonnes. At a conservative first sale price, of about US\$1/kg, the freshwater fisheries of the Mekong in Thailand are worth about US\$700 million per year. Marketing and value-adding would increase the value and importance of the fishery.

However, the fisheries are more than just an important element in the economy of the country; they are the chief source of livelihoods and incomes for many of the inhabitants of Thailand's northeastern and northern provinces. Fish and other aquatic animals are also a major component in the diet of the people of the basin, particularly those who live in rural areas, providing them with their main source of animal protein.

Despite their importance, the aquatic resources of the Lower Mekong Basin have not been well documented and there are few books that provide the lay reader with a general description of the fish, fisheries, and fishing communities of the region. Therefore, the MRC, through its Fisheries Programme, has committed to publish a series of reports, each of which deals with the freshwater fisheries of one of the MRC's four member countries. These reports will be available in both English and the appropriate riparian language; a report has already been published on the fisheries of Cambodia.

This report is the second published in the series. It provides a wealth of information about fishery resources, fisheries management, fish produce and fish marketing in the Thai portion of the basin. However, above this, the report gives an insight into the central role of fish and fisheries in the identity, culture, and lives of the people of northern and northeastern Thailand.

I am confident that this report will be of great value to all those people who are interested in the Mekong River Basin, its inhabitants and its aquatic resources, whether they are from government agencies, academic institutions, NGOs or members of the general public.



Dr Olivier Cogels, Chief Executive Officer, MRCS



His Majesty King Bhumipol gives Nile tilapia fingerlings to the Director General, Department of Fisheries (Mr Preeda Karnasuta) for breeding and distribution. The fish, which were cultured in the Jitlada Palace for a year, were a gift from Prince Akihito of Japan.

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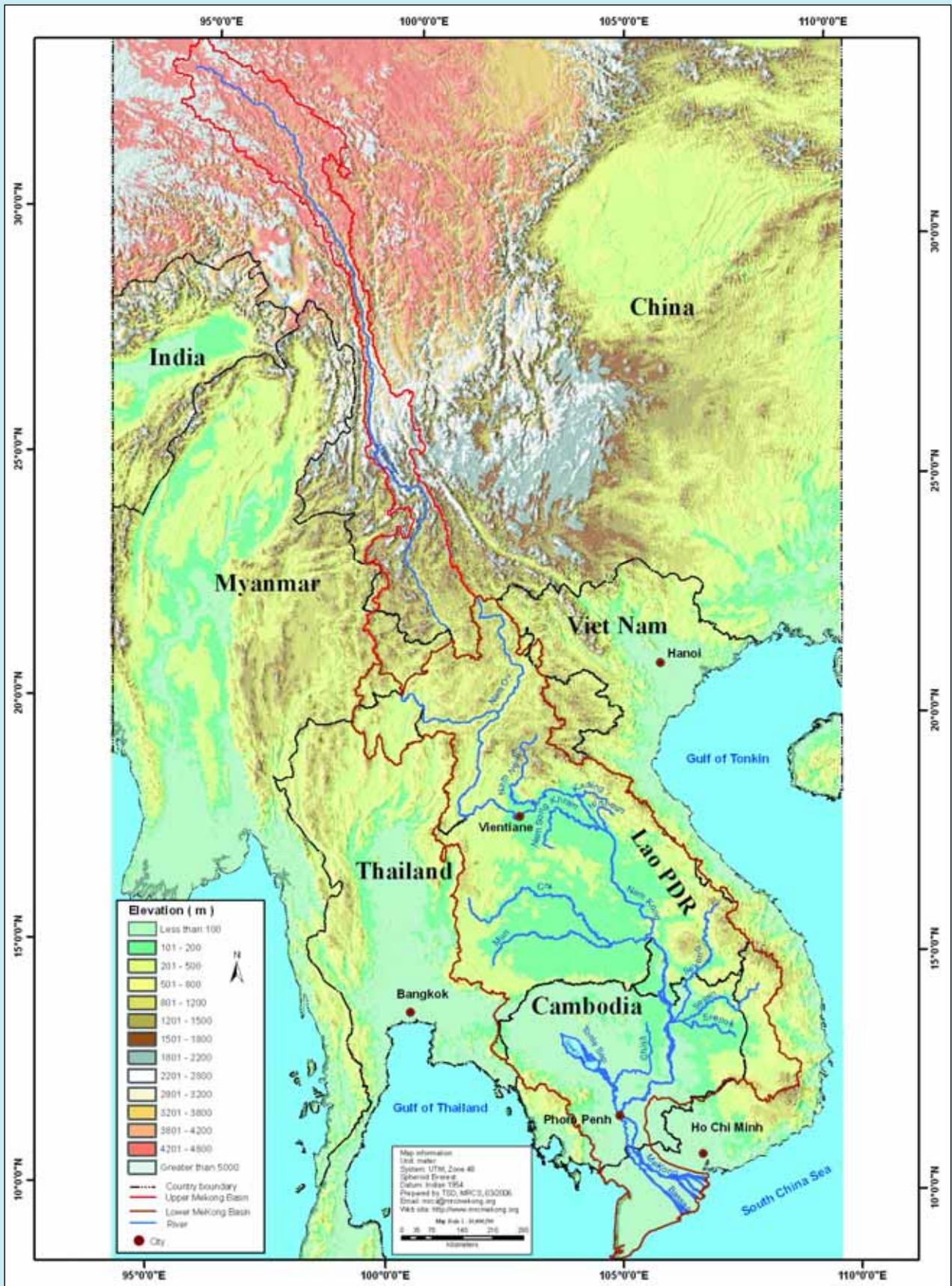
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Map1 Geography of the Mekong River Basin

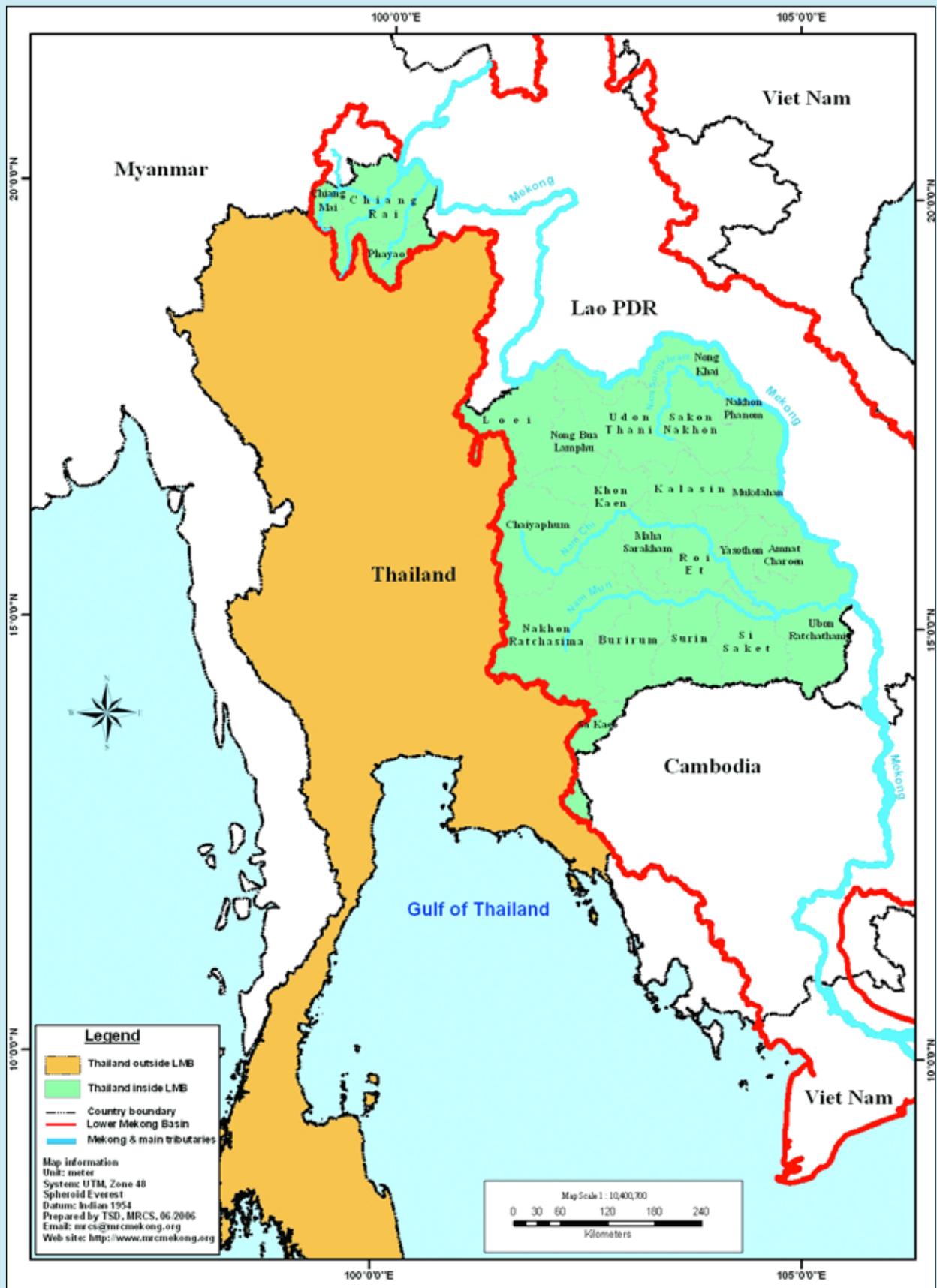
Summary

Aquatic animals, particularly fish, play a major role in the life and livelihoods of the people of the Mekong Basin in Thailand, especially those living in rural areas for whom fish is a staple of their diet and the chief source of animal protein. Rural people fish in a variety of freshwater bodies including rivers, ditches, canals, swamps, wetlands, and even paddy fields. Annual consumption of fish and fish products in this region amounts to 30-35 kg/capita, equating to an estimated total consumption of inland fish of 795,000 tonnes.

The capture fisheries of northeast Thailand are under pressure from a number of factors. Commercial fisheries with their efficient gears indiscriminately harvest all kinds of fish of any size. Spawning and feeding grounds have been altered by various development projects such as industrial development, urban expansion, the construction of roads and highways, expanded agriculture, as well as government's management and administration. Legal measures, such as the Fishery Act of 1947 and its various directives, have proven insufficient and somewhat ineffective because a large segment of the population is heedless of fish conservation. The lack of regard for conservation is manifest in continued illegal fishing, such as the use of prohibited gears and methods, and fishing in conservation zones or during moratoria. However, administrative devolution, that enables a greater role for local people and stakeholders in resource management, may help improve the situation.

The aquaculture sector has expanded and diversified in the last couple of decades. Fish rearing is now a widespread and common practice. Fishes are grown in earthen ponds, paddy fields, cages in rivers and by both public and private sectors. Infrastructure, essential to aquaculture and hatcheries for producing seed has been built throughout the region. Many exotic species, including Nile tilapia, common carp, Chinese carp, and African catfish have become popular for aquaculture as they grow quickly and are easy to manage. Research into the aquaculture of indigenous species as substitutes for exotic species is therefore essential for the preservation of the Mekong fisheries and the natural ecosystems of the river and its tributaries.

The majority of fish and fish products come from local capture fisheries and from aquaculture, although some small amounts are imported. Fishery products, either from capture fisheries or aquaculture, are traded, as with any other merchandise, from wholesalers to retailers and consumers. The produce comes in various forms including fish on ice, frozen fish, fermented fish, cured fish, and dried and salted fish. Recently, newer types of produce, such as fish balls, fish-cakes, sausages (smoked or frozen), have become popular.



Map 2 Map of Thailand showing the portion of the country and the provinces that lie within the Lower Mekong Basin

Introduction

Thailand is blessed with an abundance of marine and freshwater resources. To the east, the coastline of the Gulf of Thailand extends some 1,870 kilometres from the eastern province of Trat to Narathiwat province in the south. To the west, the Andaman seaboard stretches 740 kilometres from the province of Ranong in the north to Satun province in the south. A considerable proportion of the population living along both coasts makes a living from inshore and offshore fishing. In 2002, Thailand ranked in the top-ten fishing nations of the world. According to the Department of Fisheries (DoF, 2002), in that year alone, Thai marine fishers landed 2.64 million tonnes of fish, of which 1.86 million tonnes were caught in the Gulf of Thailand and 0.78 million tonnes in the Andaman Sea.

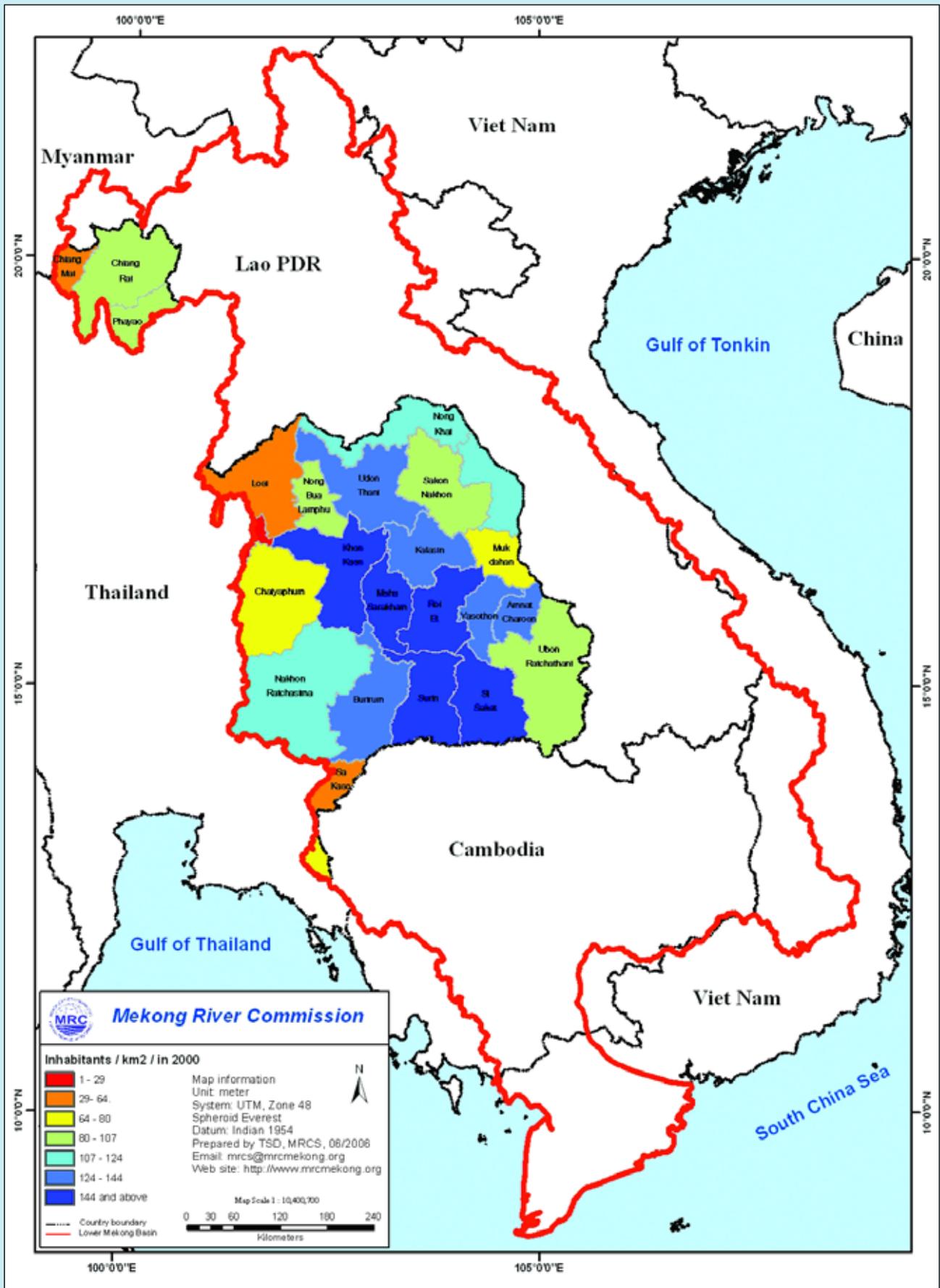
Thailand's progress in developing aquaculture systems is also noteworthy. The country's coastal aquaculture industry produces a variety of aquatic animals. During the period from 1992 to 2000, when Thailand was the world's leading shrimp exporter, its shrimp farms covered an area of between 64,000 and 72,000 ha and produced 150,000-200,000 tonnes of marine shrimp a year. As much as 80% of these shrimps were exported to markets as far afield as the USA, Europe, and Japan.

Thailand's inland fishery resources are equally as important; not only in terms of exports, but also as a vital source of food for remote rural communities. Freshwater bodies, including rivers, canals, swamps and reservoirs, contribute to an aggregated inland water area of 566,400 ha (Office of Agriculture and Economics, 1992). For irrigation purposes, the Royal Irrigation Department has classified these water bodies into 25 river basins; these have a combined annual water flow of 213,423 million m³ and extend over a total area of 51,136,100 ha.

Thirty seven percent of the land area of Thailand (18,793,200 ha) lies within the Lower Mekong Basin. On average, the drainage from this part of basin contributes 2,560 cumecs (cubic metres a second) to the flow of the Mekong.

Thailand's northeast region lies within the seasonally arid and difficult terrain of the Khorat Plateau. These difficult environmental conditions have prompted successive governments to undertake a variety of development projects aimed at increasing the availability of water for human consumption, hydroelectric power generation, and irrigation. These projects have had both negative and positive impacts on the fishery resources of the northeast Thailand.

This report introduces the geography and demography of the portion of the Mekong Basin that lies within the borders of the Kingdom of Thailand and describes the importance of fisheries, to the people who live in the basin, particularly to the many rural people who rely on fish as a staple part of their diet. It addresses the issues of fishery resources, fishing grounds, fishery management, aquaculture, fish products and marketing, as well as the importance of fish and fisheries to the culture and way of life of the inhabitants of the basin.



Map 3 The population density of the Thai provinces in the Mekong River Basin

Geography and demography

With a total length of 4,800 km, the Mekong is the world's 12th longest river. The river also ranks 8th in the world in terms of mean annual flow. The catchment of the Mekong covers an area of 79,500,000 ha, the discharge averages 475 km³ per year (MRC, 1997). The Mekong passes through six countries; China, Myanmar, the Lao PDR, Thailand, Cambodia and Viet Nam (Map 1). Some 18% of the water that flows from the Lower Mekong Basin into the South China Sea comes from Thailand. The major sub-basins are the Kok River Basin (789,500 ha); the Chi River Basin (4,913,300 ha); the Mun River Basin (7,057,400 ha); the Ang Sakon Nakhon Basin (5,751,300 ha), and a small portion of the Tonle Sap Basin, which is located on the eastern fringes of Chanthaburi and Sakaeo provinces (Map 2).

Despite extensive dam-building, much of northeast Thailand is inundated annually, either from rainfall or floodwaters, creating vast areas of seasonal wetlands, especially rice-fields, which are the basis of much fishery production. Although fish and OAAs may be caught in swamps and running waters, much of their biomass is actually built up during the time they spend feeding in the productive flooded areas.

The Mekong Basin in Thailand contains a variety of water bodies including floodplains, tributaries, canals, swamps, and reservoirs. According to the Office of Environmental Policy and Planning (OEPP), the 8,667 rivers, rivulets, and canals; 6,751 swamps and reservoirs; 463 wetlands and lowlands; and 161 other types of water body cover a combined area of 236,000 ha (OEPP, 1999).

Most of the Mekong Basin in northeast Thailand lies in a geological province known as the Khorat Plateau. The sedimentary succession in this province comprises a thick sequence of sandstones and mudstones with occasional beds of rock salt; these beds can reach a thickness of over 100 metres. This subsurface geology contributes to some key factors that characterise the soils in the region. The dominance of sand limits the capacity of the soil to retain water. This together with strongly seasonal rainfall pattern means that droughts are common despite the region's plentiful overall annual rainfall.

Some 23 million Thai people (36% of the country's population) live within the boundaries of the Mekong Basin, an average population density of 1.3 people/ha (www.dopa.go.th). Nakhon Ratchasima (population 2.5 million) is the most populous province, while four other provinces have populations in excess of 1.5 million (Ubon Ratchathani, Khon Kaen, Buriram, and Udon Thani). The population of five provinces is in the range of 1.0 to 1.5 million. The population of seven provinces is in the range of 0.5-1.0 million, while the population of the remaining four provinces is under 0.5 million (Map 3).



River



Swamp



Reservoir

Maharakham province has the highest population density, with 1.8 people/ha. The provinces of Surin, Srisaket, and Khon Kaen follow with the densities of 1.7, 1.6, and 1.6 people/ha. The least populous province is Mukdahan where there are 0.8 people for every hectare of land. Because of the scarcity of water, most people in the northeast tend to settle close to water bodies or near to roads and highways which provide access to markets.

Box 1. Water bodies that are important to fisheries

The widely scattered network of tributaries and floodplains found in the Mekong Basin provide a variety of fishing grounds. These include:

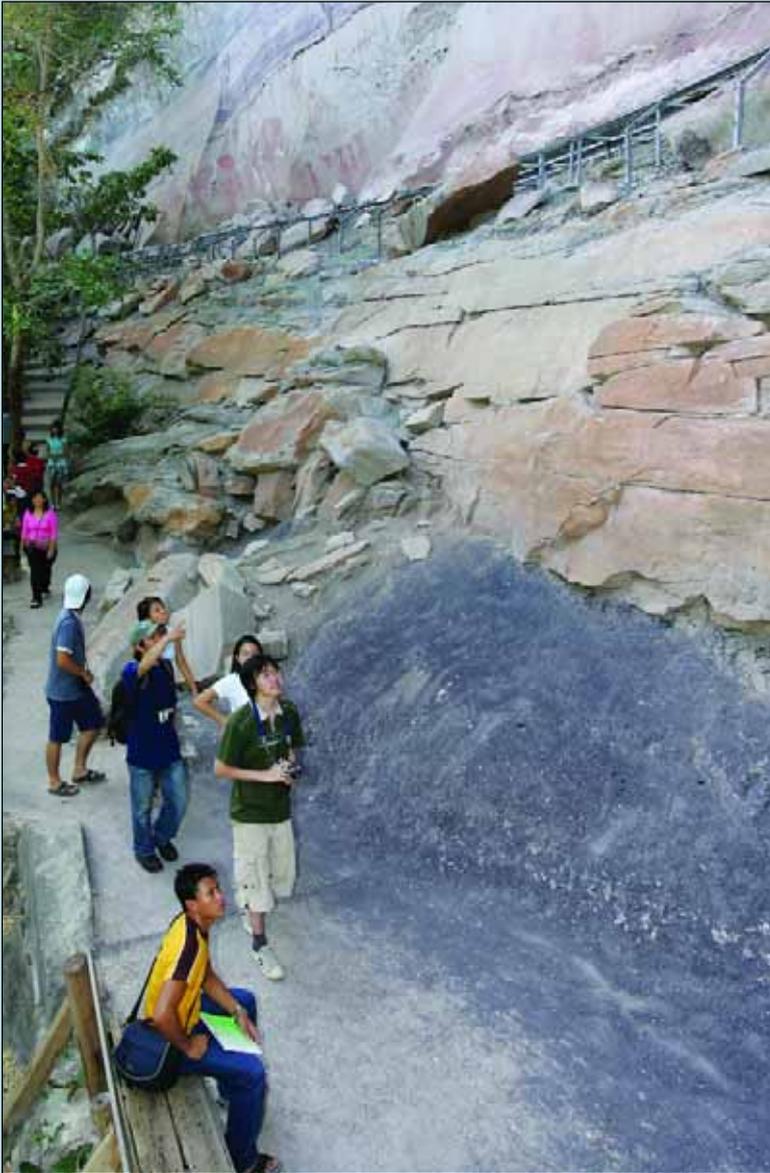
- Rivers; Chi, Mun, and Songkhram;
- Swamps; Nong Harn in Sakon Nakhon province, Kwan Payao in Payao province;
- Large reservoirs; Ubolratana in Khon Kaen province, Lam Pao in Kalasin province, Sirindhorn in Ubon Ratchathani province, Oon in Sakon Nakhon province, Chulabhorn in Chaiyaphum province, and Lam Phra Pleung and Lam Takong in Nakhon Ratchasima province.
- Seasonally flooded wetlands, especially rice-fields.

Box 2. Fish consumption

According to a recent study of fish consumption in the Lower Mekong Basin (Hortle, in press), people living in northeast Thailand on average eat 24.9 kg of inland fish and 4.9 kg of other aquatic animals each year. In addition, they also consume 6 kg of marine produce (Prapertchob, 1989). Most of the inland fish is eaten fresh, with the remainder (between 4 and 22 kg) consumed as preserved produce in the form of fermented fish, fish paste, fish sauce, smoked fish or salted dried fish.

Fish consumption varies across the region, often depending on the proximity of villages and households to water bodies. It also varies according to the season and in some cases according to whether or not dams are impounding or releasing water. For example, a survey of fishing families living in the vicinity of the Pak Mun Dam showed that monthly consumption was 9.3 kg when the dam's sluice gates were closed and 12.9 kg when they were open (DoF, 2004).

Despite these variations, the consumption figures show that overall the people of northeast Thailand (along with those of the other LMB countries) are prodigious consumers of fish and that fish generally provide the principal source of animal protein in their diet.



The 340 km² Pha Taem National Park covers the parts of Khong Chiam, Sri Muang Mai and Pho Sai districts that are adjacent to the Lao PDR. Here the Mekong River demarcates the international boundary.

The connected cave system of Pha Kham, Pha Tam, Pha Jek and Pha Moie has over 300 prehistoric paintings that date to around 3,000-4,000 years ago.

These paintings, which are mainly in red, depict giant catfish, elephants, humans (both women and men), fish bones, fish traps, palms, as well as geometric figures such as triangles and rectangles.



Fisheries development

Rice and fish have formed the staple diet of the people of this region since time immemorial. Three to four thousand-year-old paintings on the sandstone cliffs of Pha Taem in Khong Chiam district in Ubon Ratchathani province depict people and fishes along with other animals including cattle, water buffalo, elephants and turtles.

Fishing is commonly practiced in most rural communities, particularly those located near water bodies. Traditionally, fishing skills are handed down from parents to children, generation after generation. Much of this local wisdom and expertise survives today.

Formerly, fishing was exclusively for subsistence, as a means to provide food for fishers and the members of their families. Any excess catch was turned into processed products such as dried or fermented fish, to be eaten during the dry season, when catches are lower. In addition, fish and fish products were sometimes used as commodities to barter for other goods.

However, recently the demand for fisheries products has increased in line with population growth. As a result, the number of people fishing both for subsistence and for employment has increased. This, together with the introduction of more efficient fishing gears, caused the size of the catch to dwindle as wild fish stocks became threatened by over-fishing. As a result, while some segments of the rural population are committed to fishing as an occupation, others have moved to towns and cities to find work in factories or in other labour-intensive industrial sectors. Nonetheless, fishing remains an important occupation around permanent water bodies such as rivers, reservoirs, swamps and bogs, and fish continue to be the favourite food of many Thai people, as well as providing a vital source of animal protein for many of the basin's inhabitants.

Nong Harn, Kwan Payao, Ubolratana Reservoir, Sirindhorn Reservoir, Chulabhorn Reservoir, Lum Takong Reservoir, Lumpao Reservoir, Nam Oon Reservoir, and flood plains, including those in the Songkhram River Basin, are well known as the primary fishing grounds in the northeast.

As wild stocks decline, aquaculture is becoming increasingly important, both as an occupation and as a food source. The rural Thai have a long tradition in fish farming, which these days is increasingly advanced, partly through the key role the Department of Fisheries plays in its development. Freshwater Fisheries Research Centres/Stations and provincial fisheries offices located throughout the basin have continued their research and extension on a large number of species. Fish farming in ponds, paddy fields, and fish farmers' cooperatives, community cage cultures, and participation of private entrepreneurs are now common place.

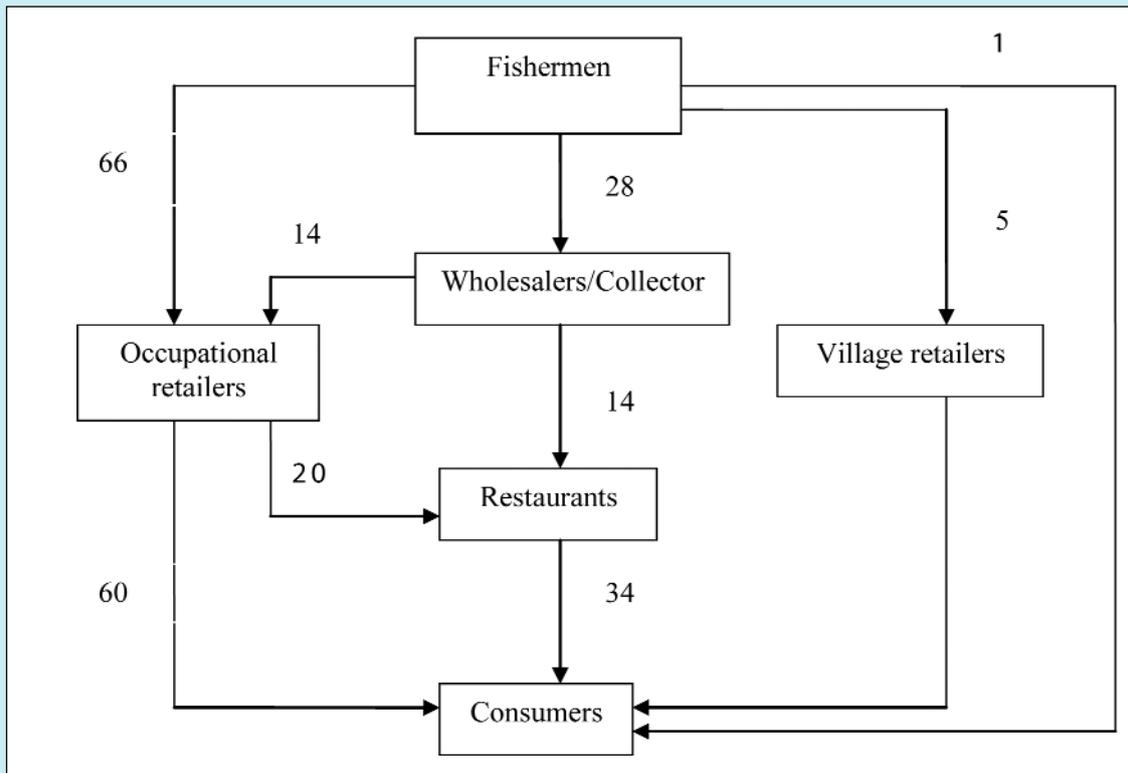


Figure 1 Diagram showing transactions in fish trade in the vicinity of the Lower Mun River (DoF, 2004). Figures are percentages by weight.



Fish production, marketing and utilisation

Production parameters

Calculating the fish production of the fisheries in a complex river-system such as the Mekong is difficult for a number of reasons. While monitoring catches is the most direct method, it proves inaccurate because it is very difficult to estimate the amount of fish caught by the many thousands of small-scale subsistence fishers who are found throughout the basin. Likewise, monitoring trade and marketing is also inaccurate because it misses the large portion of the catch that is not traded but is eaten by the fishers and their families or bartered locally. Multiplying per capita consumption by population numbers provides perhaps the best method because consumption and population are both well documented statistics.

The MRC has recently finalised (Hortle, in press) a synthesis of 20 consumption studies from across the whole LMB. Using a variety of factors to convert the weights of fresh inland fish and preserved produce to 'fresh whole animal equivalents' (FWAEs), the study estimates the annual production of capture fisheries, including other aquatic animals, in the whole basin exceeds 2.6 million tonnes. The catch from Thai Mekong fisheries, at 0.9 million tonnes, represents well over one-third of the basin's total production. Of this catch 0.7 million tonnes is inland fish and 0.2 million tonnes is other aquatic animals.

Fish production in the Mekong Basin in Thailand comprises not only capture fisheries, but also the products from the rapidly expanding aquaculture sector. Furthermore, it is quite likely that the DoF estimate for Thailand's 2002 aquaculture production in the Mekong Basin, of 61,855 tonnes, is a gross underestimation. A similar view was also expressed by Coates (2002) who argues that official figures of fish production provided by the four LMB countries could be underestimated by 2.6 to 21 times.

Fish marketing in the Mekong region continues to be conducted according to local Thai customs and traditions. Sharing of the catch with families and relatives, and with nearby villages, is a normal practice. In a cash economy, a surplus quantity of fish may be sold or bartered for other goods and merchandise. Once the concept of the market place is understood by villagers, it rapidly becomes a venue for transactions of all types.

A study conducted by DoF in 2004 of the lower Pak Mun area reveals that 56% of the catch was sold fresh, and the remaining 44% was sold as processed products. Some 66% of the catch was firstly traded as fresh fish in the local community and then later transported to an established market in a nearby town. Brokers who buy fish merchandise from one or several villages account for another 28% of the fish catch by weight, 5% comprised small fishes that were sold in local retail markets, and the remaining 1% was sold directly to the consumers (Figure 1). Restaurants did not appear to have a specific means for acquiring their fish; they either bought from fish retailers, the usual fishmongers, or directly from the fish market.

The price fishers receive for their merchandise is normally fixed by wholesalers using the referenced market standards. Consumers normally buy small fish at a price 10-15 baht/kg above the wholesale price and 20-25 baht/kg higher for the larger or more popular species. Wild fish is normally priced higher by the retailers than fish of the same species reared in aquaculture.

Processed fish products



Smoked fish



Sun-dried fish



Fermented fish



Kem Bug Nut



Smoked fish sausages

Utilisation

Because it is readily available at an affordable price, fish has long been the favoured source of animal protein for the people of the Lower Mekong Basin. Both fresh and processed fish are used in a variety of dishes. As with other food produce, fish consumption is expressed in terms of weight per capita. Consumption at the national level is determined by averaging the fish consumption for each person.

Fishing communities along the Thai reaches of the Mekong River process fish in a number of ways depending on the type of fish and their freshness. Some popular methods date back hundreds of years. These products have a longer shelf-life despite the simplicity of the processing method.

As a result of improved transportation and better storage facilities, more live aquatic products are now available on the market; some, such as giant freshwater prawns, Nile tilapia, and catfish, are kept alive in aerated aquaria. In addition, other products, including freshwater eels, frogs and various shellfishes can be kept fresh on ice, even if they cannot be sold alive. The increasing number of refrigerators owned by many householders allows them to keep their purchases fresh in their own homes.

Lower quality and smaller fish, which are often caught in large numbers, fetch low prices at the market. However, processing provides a way to keep the product for later sale when demand is higher. Small fish, which are no longer fresh, are good raw material for fermented products. Because they keep longer, these fermented products are particularly popular in northeast Thailand.

Low-value fish which are caught in large quantities, such as barb or featherback, are usually preserved by smoking. This process is also used to preserve some high-value fishes including snakehead, silver barb and sheatfish. Because 3-4 kg of fresh fish is needed to make a kilogram of smoked product, smoked produce fetches a higher unit price.

Various kinds of small fishes, e.g. clupeids, and some barb (such as silver barb) are simply scaled, spread, salted and sun-dried. Larger sized fishes, e.g. striped snakehead and giant snakehead may be dried just for one day. Other smaller fishes, such as horse-faced loach, are simply salted and dried whole. Most consumers believe that whole fish is a good source of calcium.

Medium-sized fish, such as the silver barb and the Nile tilapia, are often processed as fermented products. Small fish, shrimp and their roe, are also processed this way, although the product is known by a different name.

High quality fermented fish, known as *Kem Bug Nut* of Ubon Ratchathani province, requires good quality fish, such as striped catfish.

The market for smoked fish sausages is increasing as some small-fish processors (who have a daily capacity of about 250 kg) in Kalasin province are introducing new products using African catfish and a hybrid of African catfish and walking catfish.

Box 3. Fish production

Fish production can also be calculated based on the known yield of particular types of habitats and the area of these habitats within the basin. Welcomme (1985) estimates that globally nearly three-quarters of the production of large river systems can be determined from the area of their floodplains. This is believed to be true for the LMB. However, the yield from floodplains varies across the basin depending on the duration of flooding during the wet season. As a result the productivity of the floodplains in Thailand is probably lower than for example the Great Lake of Cambodia where the plains are inundated for longer periods.

In northeast Thailand, rice-fields comprise 95% of the land classified as 'wetlands'. The other significant wetland habitats are lakes and ponds (natural or manmade) and swamps (including back-swamps, grasslands and marshes).

Swamps are known for their high fish productivity. In 2004, annual fish production at Kwan Payao (comprising common carp, Nile tilapia, transverse-bar barb, Jullien's mud carp, common silver barb, snakehead, and walking catfish) was 400 tonnes (Faculty of Fisheries, 2004); while Nong Harn in Sakon Nakhon province yielded 140 kg/ha (DoF, 1973).

Fish species composition varies between water bodies, but the major species of Cyprinidae, including *Cirrhinus jullieni*, *Barbodes gonionotus*, *Puntioplites proctozysron*, *Micronema* sp., *Channa striata*, *Hemibagrus nemurus*, *Oxyeleotris marmorata* and *Clupeichthys aesarnensis* are common to most. Many reservoirs show a great variation in the annual production of *Cirrhinus jullieni* and *Clupeichthys aesarnensis*. The production of these two species can reach more than 1,000 tonnes in Ubolratana reservoir in some years (Nughua *et al.*, 1982).

Besides the various fish species, other aquatic animals such as frogs, small shrimps, crabs, tadpoles, clams, and snails also make an important contribution to the catch.

Food fish and food animals in the Mekong Basin

Of the great variety of fishes sold in markets, the large majority is made up of wild species caught in rivers, swamps, reservoirs, and paddy fields. Some marine fishes are transported to the northeast from the Central Plain, as both fresh and processed produce.



Various kinds of large fish on display at a market stall



A large catch from a reservoir fishery



Sheatfish



Swamp eels



Lanchester's freshwater prawn



Freshwater herrings



Tadpoles



Freshwater clams



Paddy field crabs



Giant freshwater prawn from a reservoir



Frogs



Marine fishes and shellfish imported from the coast via the Central Plain



Crickets



Silkworm pupae



Grasshoppers



Status of fisheries

Biological health

The Mekong River and its tributaries are well known for the rich biodiversity they support. The MRC's database of the Mekong includes over 924 species belonging to a diverse range of families (MRC, 2004). However, the biodiversity and species composition varies from one sub-basin to another. In 1967 the DoF, recorded 101 species of freshwater fishes in the Pamong area, including three new species. In the Mun River, Jutagate *et al.* (2003) found 184 species of fishes belonging to 44 families; and in the contiguous Chi River Basin, Leelabhat (1977) identified 110 species belonging to 22 families. Thongpun *et al.* (2004) found 115 species belonging to 22 families of freshwater fishes in samples from the Songkram River, another river that is renowned for its rich biodiversity.

According to Bhopitak and Sinchaipanich (1995), several Mekong River fishes that are known to migrate up the Mun River to spawn and feed, have never been found in any other of the Mekong tributaries in Thailand (e.g. *Chitala blanci*, *Probarbus labeamajor*, *Probarbus labeaminor*, *Datnioides* spp., *Hemisilurus mekongensis*, *Pangasius krempfi*, *Cyclocheilichthys furcatus*, *Discherodontus ashmeadi*). In terms of size, the Mekong Basin harbours both the world's largest catfish *Pangasianodon gigas*, and the world's third smallest fish *Boraras micros*.

As well as these fishes, Kottelat and Whitten (1996) also found the freshwater jellyfish *Moerisia* (Family Moerisiidae) at various locations, including the stretch of the Mekong in Loei province.

The countless reservoirs and swamps that lie within the Thai portion of Mekong Basin also support diverse fish faunas of both indigenous and introduced exotic species. In some older reservoirs, species of fish that thrive in fast moving river water have died out, as they were unable to cope with the still waters of the reservoir. In general, fishes belonging to the Cyprinidae family dominate the catches taken from reservoirs. The next most abundant fish families are the Clupeidae, Anabantidae, Siluridae, Channidae, and Notopteridae. The Nile tilapia is the most common exotic fish (Bernacsek, 1997).

Fish habitats

Each species of fish has a preferred habitat. Fishes of the Mekong River Basin may be classified into three categories according to these habitats:



Large river fishes live and breed in major rivers, although some species migrate to floodplains to spawn. These fishes are by and large members of the Family Cyprinidae, such as the small-scale mud carp (*Cirrhinus auratus*), banded shark (*Hampala macrolepidota*), red-tail tinfoil barb (*Puntius altus*), golden shark (*Leptobarbus hoevenii*), Pla Prom (*Osteochilus melanopleura*), black shark (*Morulius chrysophekadion*), and members of Pangasid, Silurid, and Notopterid families.

Swamps are characterised by low levels of dissolved oxygen and acidic or brackish water, which favour carnivorous fishes of the Channidae family (such as the snakehead and the giant snakehead) and fish species that feed on detritus. Some fish living in these environments can travel significant distances overland as they possess special respiratory organs and can breathe air. These include the walking catfish (*Clarias batrachus*), catfish (*Mystus nemurus*), climbing perch (*Anabas testudineus*), and three-spot gourami (*Trichopterus trichopterus*).



The floodplain dwellers are largely small, fast growing, and prolific breeders that complete their life-cycle during the short time when floodplains are inundated. They include members of Family Cyprinidae, e.g. Pla Kled Ti (*Thynnichthys thynnoides*), Pla Za (*Dangila siamensis*), Jullien's mud carp (*Cirrhinus jullieni*) (Interim Mekong Committee, 1992).

Fishing gears

The fishing gears used in Thailand are similar to those employed elsewhere in the Lower Mekong Basin. Currently there are over 150 types of fishing gear in use. While each is designed for a particular river environment or fish species, they can be classified according to mode of action.

Many traditional gears have been developed through generations of fishing experience and knowledge of fish behaviours, their habitats, and fishing seasons. The gears come in various sizes and shapes. Solitary fishers often use small, simple gears made from locally available materials. Nowadays, larger fishing gears are often made from synthetic fiber and are designed to catch selected species and sizes of fish. These modern fishing gears are very efficient. Operated by a large crew, some use mechanised gears. They can be either stationary or mobile and operated from motorised craft or simple rowing boats. Nevertheless, most aquatic habitats cannot be fished efficiently with large gears so most of the catch is still made by the small-scale family fisheries.

Box 4. Evolution of fishing gears

Fishing has evolved with the development of fishing gears and fishing operations. Traditional fishing gears are usually small and designed using local knowledge about a particular fish species. These kinds of fishing gear are made of materials available locally, such as bamboo and vines. The efficient use of such gear depends on the fisher's understanding of fish's behaviour. As a result, fishing using this gear is in harmony with the ecology of the river and presents little threat to wild fish stocks.

The invention of new types of fishing gear that use synthetic materials, such as nylon net and nylon rope, has had a considerable impact on fishery development and on the status of fishery resources. Fishing gears made of these materials are durable, highly portable, and capable of catching any size of fish that match their mesh sizes. The low cost of these modern fishing gears has led to a rapid increase in the number of fishers and fishing effort, which in turn has had a detrimental impact on fish stocks of most fishing grounds. Many fisheries experts now believe that the increasing use of modern fishing gear is one of the major threats confronting the Mekong's fisheries resource.

Fishing gears used in the Mekong River Basin

A number of fishing gears are made from nylon yarn, which gives them a thread-like flexibility, durability, appropriate specific gravity, and translucence while in water. Fishing gears made from nylon are used to catch a great variety of fishes, they are not species-specific, and they can catch large amounts of fish.



Small liftnet (*Sadung lek, Yor*)



Large boat-mounted liftnet (*Sadung yai*)



Castnet (*Hae*)



Gillnet (*Khai*)



Mobile pushnet (*Chon sanan*)

Seine nets and bag nets block a creek or stream and catch fish in their fine-mesh netting. Fishing with these gears is destructive and is illegal.



Seine net (*Aun Tub Taling*)



Bag net (*Toeng*)

Local materials, especially bamboo, have been used to make a variety of fishing gears. These fishing gears tend to be specific to species and fishing grounds. They usually operate as traps, both with or without bait.



Standing trap (*Chan*)



**Bamboo trap for swamp eels
(*Tum Pla Lai, Tum Ian*)**



Cyprinid trap (*Tum pla kao*)



Frog trap (*Tum kob*)



Spiny eel trap (*Tum pla lod*)



**Catfish standing trap
(*Chan pla khao, Pla kod*)**



**Snakehead standing trap
(*Chan pla chon*)**



**Horizontal trap
(*Lob non*)**



Camouflage trap (*Sai*)



Pot trap (*Tong*)



Weaving a pot trap



Plunging trap (*Sum*)



Bamboo bottom trap (*Tum*)



**Another horizontal trap-for snakehead
(*Lob loh, Lob pla kor*)**



Bamboo bottom trap (*Tum*)



Bamboo scoop
(*Ngab*)



Submerged trap
(*Cha nang, Klum*)



A variety of bamboo fish traps and gears on display at a bamboo-weaver's shop.

A harpoon may possess one or several shafts that are used for a specific species of fish.



Harpoon (*Cha-muak*)

Ko-Anandakul (2004) identified 16 types of fishing gears commonly used in the Songkram River, although four types (grabbing with bare hands, poisoning with chemicals, using pumps/buckets to empty ponds, and scaring fish with chains noise boxes) are not listed here as they are best described as 'fishing processes' rather than gear made for fishing.

1. Scoops, skimmers, dippers, both with or without handles. The materials used are both bamboo and nylon yarn.
2. Hurting tools, e.g. spears including harpoons, gaffs, lances, and pikes. They come with single or multiple shafts for throwing at relatively large-size fish or other animals. This category includes hooks, talons, claws, and rakes.
3. Hooking devices, e.g. longlines, luring hooks, drifting or floating hooks, and multiple hooks.
4. Traps come in a great variety (including luring pits, various bamboo traps) according to the ways they are set (standing, laying, and camouflaging). They are made of wood, bamboo or nylon yarn. They may be used in combination with bamboo fencing to obstruct fish movement. Some traps are used with bait.
5. Gillnets usually come with floats. They may be put together in multiple layers to increase ensnaring. Nets are deployed as stationary or mobile gears, sometimes accompanying fish-scaring devices.
6. Circling nets include drag nets, purse seine, or simply encircling areas of ponds with brushpiles.
7. Manually operated trawl nets are rarely seen in the Mekong fisheries.
8. Push nets often come with pushing devices, two wooden poles held apart by a beam that are installed on a boat. Some smaller push nets can be operated manually in shallow fishing grounds.
9. Lift nets come in various sizes. They are operated along shorelines, either as a one-person gear or a large and mechanised lift net.
10. Superimposing gears, e.g. cast nets and plunge baskets that are mobile.
11. Bag nets are a type of gear made of nylon net set across a river or creek, sometimes in combination with bamboo fencing.
12. Luring gears are designed to attract fish into structures where they will be trapped. Such gears include brush-piles, shrubs, or piles of twigs and branches of trees in which fish will aggregate. Fishing is done by means of lifting the net or surrounding the brush-pile with net.

Box 5. Mekong giant catfish

The Mekong giant catfish (*Pangasianodon gigas*) is now extremely rare and is included in the World Conservation Union's (IUCN) Red List of Threatened Species. In 1983, biologists from the Department of Fisheries of the Ministry of Agriculture and Cooperatives succeeded in propagating this giant fish using broodstock caught from the Mekong River in the Chiang Khong district of Chiang Rai province (Figure 2). The first attempt yielded only 16 fingerlings. Similar attempts have been made annually thereafter; and nearly 590,000 fingerlings were reproduced by artificial propagation of 11 pairs in 1992, and 24 pairs in 1993.

The fingerlings produced from artificial propagation have been used to stock many of Thailand's large water bodies, including the Mekong River. The first successful artificial propagation using captive broodstocks took place in 2001, and now both captive and wild brood stocks are used to breed giant catfish.

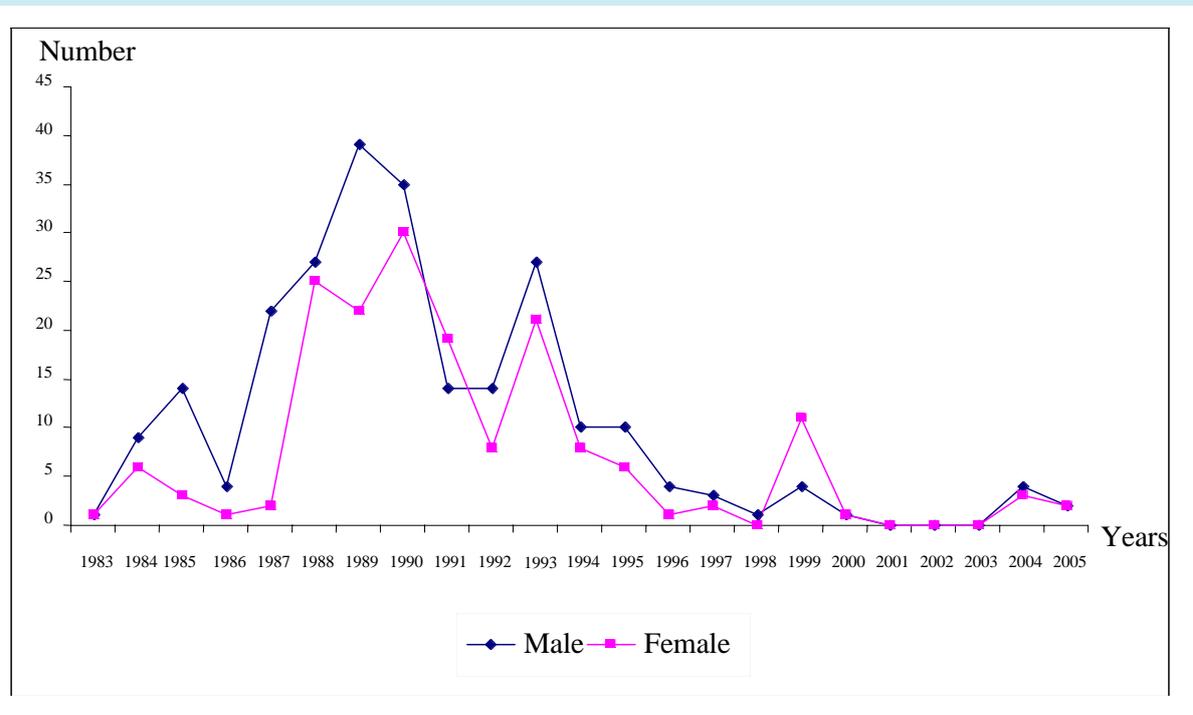


Figure 2 Number of Mekong giant catfish caught from 1983 to 2004

Propagation and stocking of the Mekong giant catfish being carried out by the Department of Fisheries in the Ministry of Agriculture and Cooperatives



Selected Mekong Basin fishes that have been bred successfully by Thai biologists and the date they were first bred



Striped catfish, 1966
(*Pangasianodon hypophthalmus*)



Black shark, 1978
(*Morulius chrysophekadion*)



Giant carp, 1973
(*Catlocarpio siamensis*)



Yellow catfish, 1982
(*Mystus filamentus*)



Jullien's barb, 1975
(*Probarbus jullieni*)



Goonch, 1983
(*Bagarius bagarius*)



Whisker sheatfish, 1977
(*Kryptopterus bleekeri*)



Chao Phraya giant catfish, 1983
(*Pangasius sanitwongsei*)



Mekong giant catfish, 1983
(*Pangasianodon gigas*)



Black sheatfish, 1990
(*Wallago leeri*)



Spotted knife fish, 1995
(*Chitala ornata*)



Common sheatfish, 1997
(*Micronema apogon*)



Giant gourami, 1999
(*Osphronemus gouramy*)

Box 6 Women in fisheries

Women play a major role in Thailand's fisheries, participating in all types of fishing activities. They are active in subsistence fishing, fish processing, and marketing, and even more involved in aquaculture (e.g. in feed preparation, feeding, harvesting, marketing, accounting, acquisition of new skills, and coordinating with the concerned agencies).

In many communities, women have organised themselves into occupational groups to undertake fishery enterprises. They meet to share knowledge, to resolve problems, and to exchange information. A study of women's role in aquaculture conducted by Kyoko *et al.* (2003) concluded that women get more involved than men do in discussions with government officials, representatives from feed-mills, hatcheries and fish merchants. This is because women, who tend to work in or close to their home, have greater opportunity to meet and talk with these various people than men who are out working.

Thailand has participated in the regional network for gender in fisheries since February 2000.



Women are active in all aspects of fisheries: from fishing and aquaculture to processing and marketing.

Fisheries management

Good fisheries management aims to utilise the resource while at the same time maintaining its viability for future generations. Legislation is part of the management process. In Thailand, the Fishery Act of 1947 prohibits destructive fishing practices such as poisoning, electro-fishing, and the use of explosives. It also designates certain fishing grounds as fish sanctuaries; these include Nong Harn in Sakon Nakhon province and Kwan Payao in Payao province.

The Fishery Act makes a provision for fishery research in order that fisheries management measures are based on sound scientific evidence.

The law also defines "no fishing season" or "fishing moratoria" to protect the spawning and feeding grounds of important species of fish. In addition to these legislative measures, the Act also supports many other fisheries management techniques such as periodic stocking, religious sanctuaries, community fishing zones, and the construction of fish habitats.

The Kingdom's Constitution of 1997 contains provisions for administrative devolution, so that people, or groups of people (e.g. Tambon Administrative Organisations-TAOs), can take part in the management of their own natural resources, including fish resources. One or several TAOs may participate in drafting sets of rules to manage their fish resources and fisheries. These include the demarcation of fishing grounds, prohibition some of fishing gears, and introduction of fishing seasons and fishing fees.



Ways of life of the people in the Thai-Mekong Basin

In the simple lifestyles that prevailed some centuries ago, the Thai people of the Mekong Basin lived in close association with nature. Difficulties in travelling meant they stayed near their own homes to do their daily work. Depending on water for sustenance, they largely settled near bodies of water where they were able to irrigate their paddy fields. They occasionally held traditional fairs and festivals to cherish their beliefs. Rice, fish, and salt were the three essential foods on which all lives depended. Therefore, many of these festivals centred on various rice recipes: *Boon Khao Jie* (roasted rice), *Boon Pawate*, and *Boon Khao Sark* (sweetened rice), and so on. However, as Eng-wanich *et al.* (2003) recognised, fish played little or no part in these festivals, even though it is a staple part of the diet of rural people. This changed in 1999 when the people of Sri Songkhram district of Nakhon Phanom province held a festival in recognition of the importance of fish resources in the Songkhram River Basin. The festival has been held annually ever since.

The development of irrigation schemes has transformed people's way of life in many rural regions of the world. This is true for the people of the Thai Mekong Basin in Thailand. Readily available supplies of water have enabled communities within the irrigated areas to grow many kinds of horticultural or field crops. Cash crops like cassava, sugar cane, maize and kenaf are now common. The ready access to water also allows farmers to grow two rice crops each year. Combined rice-fish cultivation provides a way to compensate for dwindling stocks of wild fish.

Increasing industrialisation also impacts traditional life styles; some neighbourhoods have been taken over by industrial plants, farmhands leave their traditional jobs for the factories, emigration becomes a norm, and the demographic structure is distorted.

Economic importance of fisheries

Fisheries are an important factor in the economy of the Thai Mekong Basin, the annual inland fish production of 795,000 tonnes is worth around 23,850 million baht (approximately US\$700 million), a value that no economist can ignore.

Rural communities are also supported by associated industries, such as the manufacture of fishing gears, boat building, engine repair, refrigeration, ice-making, fish processing, manufacture of fish feed, and transportation. These industries probably double the value of the fisheries.

The fishing village near Pak Mun Dam, many of whose inhabitants depend on fishing for their livelihood, provides a good example of the importance of fisheries to the economy of rural communities. According to DoF (2004), the overall profit reaped by these fishers was around 31,216 baht a household per year (US\$ 1,000).



Pond fish culture

Integrated chicken-fish culture



Pond culture

Pond fish culture is practiced in a variety of forms, including mono-cropping, combination stocking or in combination with land animals, such as duck, poultry, swine, or cattle. Most fish from pond culture are used for home consumption, or if there is any surplus, for sale locally. The popular fishes farmed are Nile tilapia, river carp, African-Thai catfish hybrid, river catfishes, rohu, and various Chinese carps. These fishes are characterised by their ease of handling and fast growth. The practice is also simple, involving little more than emptying the pond, drying its bed, applying lime and manure, filling the pond with fresh water, stocking and feeding the fish fingerlings.

The stocking rate depends on the species and their sizes – the African-Thai catfish hybrid is the most densely farmed commercial species. Commercial fish farms normally obtain fish seed from private or government hatcheries, or even from mobile fish fingerling sellers. Simple, readily available feed, such as farm residues, various vegetables, broken rice, and rice bran is popular with small-scale farmers. Commercial farms however, normally opt for pellet feed. Most fish farmers do not treat water quality in ponds by using aeration as in coastal aquaculture, but use water exchange methods instead.

Aquaculture

Aquaculture development in Thailand dates back to the 1950s when the Food and Agriculture Organisation (FAO) of the United Nations provided technical assistance to Thailand. However, progress developing the sector was slow largely because supplies of wild fishes were still abundant. The rapid development of aquaculture in the Mekong Basin seen today benefited from the extension services made available to fish farmers from fisheries institutions located in all provinces, through the efforts of the DoF (Edwards *et al.*, 1983). In 2002, the DoF estimated that 155,656 farmers practised aquaculture and that their operations covered an area of 33,398 ha. Aquaculture production in that year produced 61,855 tonnes (DoF, 2002).

Aquaculture Systems

Fish farming takes place in a variety of water bodies. The majority of Thai fish farmers in the Mekong Basin cultivate their fish in earthen ponds and in cages. Some rear their fish in paddy fields, in ponds in paddy fields, or in ditches in orchards (DoF, 2002). In 2002, aquaculture was most commonly practised in ponds (148,443 farmers, 27,513 ha), followed by paddy fields (6,742 farmers, 5,835 ha) and ditches (127 farmers, 41ha). There are also a number of private hatcheries that meet fish farmers' demand for fish seed from a variety of species and for different sizes of fingerlings.

Species used in aquaculture

The most popular species used by Thai fish farmers in the Mekong Basin tend to be exotic fishes that are prolific, fast growing, hardy, tasty, and of a greater market demand than native species. These include, Nile tilapia, African catfish, common carp, rohu, and various other Chinese carps. Farmers also raise frogs and prawns.

However the possible harmful impacts caused to native species by these alien fishes has long been recognised and this has led to the promotion of greater research on aquaculture of indigenous species. The AIMS project run by the MRC's Fisheries Programme, works to develop aquaculture technologies of indigenous Mekong species, and it is being implemented in all four MRC member countries.



Cage culture

Cage fish farming is normally practised in the riverine environments typical of the Mekong and its tributaries. Most cages are made of nylon yarn fitted in wooden frames. The most common is a 2x4x2 m cage. These are suspended in the river by floats.

The most popular fishes are male Nile tilapia, and red tilapia. Fingerlings 8 cm in size are usually used for stocking because

they can grow to 300-500 g (marketable size) in 3-4 months, making two crops a year possible.

Cage culture, especially of Nile tilapia, has been actively promoted by pellet-feed manufacturers, who provide technical assistance and supply fish seed and feed. The promoters also promise to buy the farmer's produce. Nowadays, many other fishes, such as the American catfish and striped catfish, are being promoted for cage culture.



Paddy fields

Most paddy fields in the region have a pond or pit dug at the lowest end to lure and collect wild or cultivated fish when waters recede. All the fish are removed at the end of the rice harvesting season before the pond dries out.

Popular aquaculture species



Nile tilapia
(*Oreochromis niloticus*)
introduced from Japan in 1965



Common carp
(*Cyprinus carpio*)
introduced from mainland China in 1913



Rohu
(*Labeo rohita*)
introduced from India in 1968



Grass carp (*Ctenopharyngodon idella*)
introduced from mainland China in 1932



African catfish
(*Clarias gariepinus*)
introduced from the Lao PDR in 1974



Bighead
(*Aristichthys nobilis*)
introduced from mainland China in 1913.



Climbing perch
(*Anabas testudineus*)



Silver barb
(*Barbonymus gonionotus*)



Small-scale mud carp
(*Cirrhinus microlepis*)



Red-tailed catfish
(*Hemibagrus wyckiioides*)



Giant gourami
(*Osphronemus gouramy*)



Catfish
(*Pangasius bocourti*)



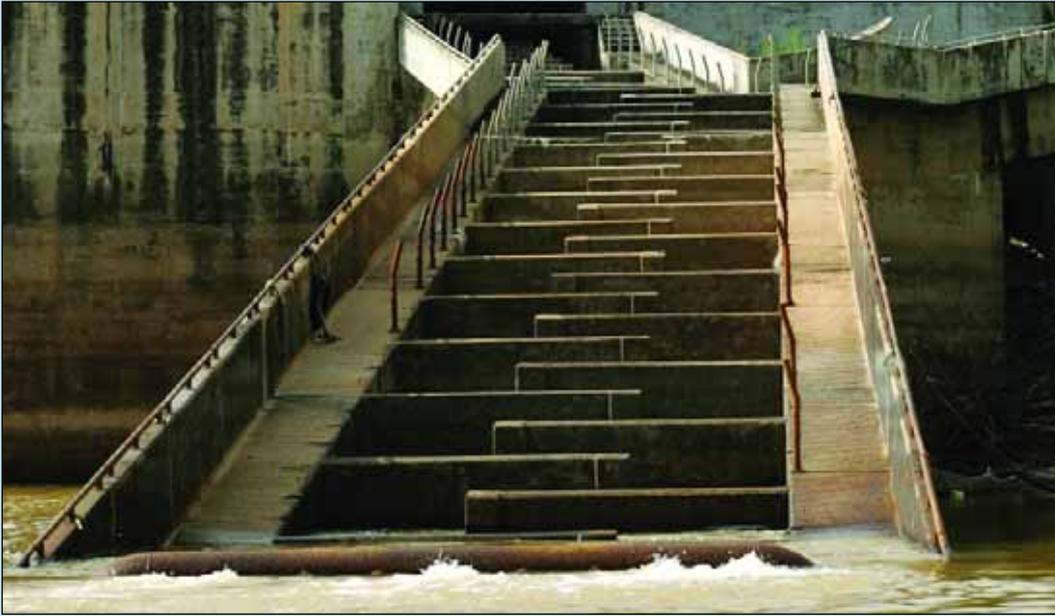
Striped catfish
(*Pangasianodon hypophthalmus*)



Black-ear catfish
(*Pangasius larnaudii*)



Golden shark
(*Leptobarbus hoevenii*)



Fish ladder



Dam



Fragmentation of wetland resulting from road construction



Commercial port

Impediments to fisheries development

While it is unrealistic to expect that the development of the Mekong's many water resources will not harm fisheries, a number of development projects have the potential to seriously harm wild stocks and slow fisheries development. Development activities in the fields of industry, transportation, water management, agriculture and urbanisation can all harm natural fish stocks. The modification of natural spawning and feeding grounds will probably create the most damaging impacts.

Dams, sluice gates, and spillways

Dams modify the natural character of river water and can change the riverine environment from flowing to standing water. Fish faunas that are unable to adapt to the new environment will gradually disappear. Changes to river flows caused by dams can also obstruct the migration pathways of several riverine fish species and disrupt their seasonal migrations to and from dry season refuges and spawning and feeding grounds.

To overcome this, many dams and weirs are equipped with fish ladders to allow fish passage over the structure. Fish ladders at Kwan Payao, Nong Harn, and various other weirs on the Nam Kham and Pak Mun Dam have certainly helped certain fish species. However, others fall easy victims to fishers waiting downstream of the dam or weir.

Dams and weirs contribute to direct and indirect alteration of habitats, both upstream and downstream. Encroachment of farming land in the catchment tends to accelerate the deposition of silt. Residues from fertilisers, herbicides, and insecticides harm the fauna and flora, and if these chemicals accumulate in fish they can cause health problems for humans.

Human activities can have both negative and positive impacts on the natural resources and the environment on which aquatic animals depend. Corrective measures that have been put in place, such as fish ladders or fish passages, while being helpful, have not fully compensated for these negative impacts.

Transportation

Developing transportation systems, such as the construction of new roads and highways, can alter or divert water flows and eventually disturb fish habitats, spawning and feeding grounds. Fish landing sites face pollution from oil spillage from ships and the use of oil in various cleaning operations.

Agriculture

The conversion of floodplains and wetlands for the purpose of agriculture often destroys important fishing grounds. Encroachment has altered the floodplains in the Songkhram River Basin in the province of Nakhon Phanom and throughout northern and northeast Thailand.

Fishing

The use of destructive fishing gears directly affects broodstock, the quantity of recruits, and future fish production. The indiscriminate use of highly efficient fishing gears, such as fine meshed trawls, fences, and other fishing methods, such as poisoning, electro-fishing, and explosives, can greatly reduce the wild population. Over-fishing tends to deplete larger fish, many of which are high-value species, leaving the cheap small forage fishes at the base of food chain, to occupy rivers, lakes and reservoirs.



Examples of destructive fishing gears

Industrial installations

Industrial plants, owing to their dependence on water, are often sited close to permanent bodies of water containing healthy natural fish stocks. Factories that produce paper pulp, sugar, animal feed, alcohol and spirits, canned fruits and vegetables often discharge untreated wastewater. In Khon Kaen province alone, the six large industrial plants located along the Nam Pong River use as much as 1.7 million m³ of water each month, and fish farmers believe the waste water they discharge is the cause of significant fish kills. In 1992, a sugar plant discharged seven tonnes of sugar pulp into the Nam Pong River, and the resulting water pollution killed as many as 81 species of fish in a long stretch of the river (Bernacsek, 1997).

Aquaculture

Aquaculture, including the propagation of ornamental fishes, has direct impacts on stocks of wild fish. Many exotic fish escape from commercial aquaculture operations and these can establish populations in the local environment. Furthermore, exotic species may introduce new pathogens that cause high mortality among the population of indigenous fish. In some cases, the hardier exotic species can replace the native fishes.

Poor management of cage culture, especially too high stock density, may pollute the surrounding water with excess uneaten feed and fish excrement. Polluted water may increase the spread of pathogens among indigenous fish and damage the capture fisheries.

Collecting wild seed for use in fish farming can also harm natural fish stocks. Mass mortality of wild seed is common as many fingerlings die during confinement and transportation. The reduction of new recruits can deplete wild fish population, as has already happened in the case of gobies, river catfish, gourami, and snakehead.

Poorly controlled bulk import and export of exotic species in hatcheries often leads to large numbers of fish escaping and forming colonies in the wild. The black sucker (*Loricariidae*), for example, has colonised a number of local waters.

Stocking

Stocking water bodies without taking account of the genetic implications may also lead to damage to indigenous fish stocks.

DoF has introduced a programme to stock various water bodies with exotic fishes and domesticated indigenous species that have been propagated by various fishery stations. Mass stocking could have negative consequences as indigenous species are prone to pathogens carried by exotic species. Careless management of broodstock of domesticated fish is a problem as these fishes inbreed easily and the resulting low heterozygosity of their progenies could weaken the genetic vigour of the stock in the long-term.

The traditional festivities that involve releasing various kinds of animals can also affect fisheries.

Conclusion

The per capita fish consumption in the Thai portion of Mekong Basin region is estimated at 30-35 kg/year, and the total annual consumption of 795,000 tonnes. Regardless of their origin, whether from the wild, farms or as imports, these fish play a major role in the socio-economic fabric of the region. Livelihoods that involve fishing, fish farming, trading, or other occupations related to fisheries now make important contributions to Thailand's economy.

The Mekong River and its tributaries have been important fishing grounds for Thai fishers for many years; however, the annual catch, particularly of some important economic species, is on a downward trend. Over-fishing has reduced stocks of some species to the point of near extinction. The threats from many man-made alterations to their habitats, such as dams, industrial plants, agriculture and transport and communication facilities, are having direct or indirect impacts on fish, fishing grounds and fisheries.

Although the measures used in fisheries management have been successful, they are not employed widely enough to ensure fish stocks will survive. Development of efficient fishing gears and destructive means of harvesting used in Thailand's inland waters have hindered effective fisheries management. Ignorance of the appropriate methods of resource extraction and the principles of fish conservation have made management even more difficult.

During their long association with fisheries, Thai people in the Mekong Basin have exploited their fish resource profitably and efficiently. All sizes and all species of fishes are eaten fresh or in a variety of processed forms. Fish and fish products have never lost their popularity among the people of this region.

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