

Fishing gears around Lam Se Bai, a tributary of the middle Mekong river basin

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Abstract: This study demonstrated fisheries and fishing gears around Lam Se Bai which is one of the secondary tributaries of the middle Mekong river basin. Fisheries in the Lam Se Bai basin were exclusively small-scale and were considered as a kind of community-based routine activities for local inhabitants. The fishing activities were dependent on seasonal patterns of flooding and recession of water level, and a lot of unique fishing gears have been developed through generations of their fishing experience and knowledge on fish behaviors and habitats. In a series of our field surveys, a total of 62 kinds of fishing gears and the related tools were recognized in and around the Lam Se Bai basin. They were classified into four categories; 16 net fishing gears, 29 trap fishing gears, 3 hook fishing gears, 8 other miscellaneous fishing gears and 6 related tools. Some fishing gears were in common with everywhere else in Thailand and others were indigenous fishing gears developed predominantly in the Lam Se Bai basin; for example, stake net trap, branch weir trap, bamboo screen trap, basket traps and cylinder traps. Indigenous fishing gears were traditionally made of materials available locally and easily obtainable, and some of them were designed for a particular hydrological environment and/or target species. Structures and fishing methods of every fishing gears and the related tools observed in and around the Lam Se Bai basin were described with pictures.

Key words: Fishing gear, indigenous fisheries, fishery resources, inland fisheries, Mekong river.

Introduction

The Mekong is the world's 10th longest river which flows over 4,900 km² through six countries; China, Myanmar, Laos, Thailand, Cambodia and Vietnam. Local inhabitants living along the basin are exclusively associated with the huge water system of the Mekong river and the numerous tributaries. For the local inhabitants, a variety of hydrological systems of rivers, tributaries, channels, canals, swamps, ponds, reservoirs, floodplains and paddy fields are important not only for the site of their daily living but also the ground to obtain natural resources for supporting their livelihood (MRC 2001, 2007).

The Mekong river basin is considered to support the richest inland fishery resources in the world and the estimated annual production of capture fisheries is 2.1 million tons of which estimated price is 2.1-3.8 billion US\$ (Dugan *et al.*, 2010), in which 0.9 million tons and 0.7 billion US\$ are recorded in Thailand (MRC 2007). Fish and other aquatic organisms are main source of animal protein for the local inhabitants of the Mekong river basin, particularly those who live in rural areas, and about 50-80 % of protein are considered to obtain from fishery resources (MRC 2001, Dugan *et al.*, 2010). In addition to the direct contribution of fisheries for their livelihoods, there are many additional economic benefits from engaging in fish processing and marketing.

For various fishing activities, a lot of unique fishing gears have been developed through generations of fishing experience and knowledge of fish behaviors and habitats in the Mekong river basin. Southeast Asian Fisheries Development Center summarized approximately 150 kinds of coastal and offshore fishing gears in Thailand and classified them into 12 major categories (SEAFDEC 2004), but there was little description about freshwater fishing gears. Mekong River Commission reported about fisheries of the middle Mekong river, particularly in Thailand (MRC 2007). Although they mentioned more than 150 types of fishing gears were recognized throughout the river basin, only 22 kinds of fishing gears were presented (MRC 2007). Ubon Ratchathani Regional Forest Office presented pictures of about 10 fishing gears found in the tributary of the middle Mekong river (URRFO 2007). Thai Baan Research Network summarized fisheries and fishing

gears in Songkhram river which is one of the branch of the middle Mekong river (Friend, 2005). Iwata (2002) and Iwata *et al.* (2003) summarized fishing gears found in Laos of the middle Mekong river. Punswarn (2005) and Tapkorn (2010) demonstrated various freshwater fishing gears predominantly observed in the central parts of Thailand.

Despite a lot of unique and indigenous fishing gears were found in the tributaries and the floodplains in the Mekong river basin, the knowledge has been still limited thus causing difficulties for the management and conservation of fishery resources in recent years. We demonstrated in this study that fisheries and fishing gears around the Lam Se Bai basin which is one of the tributaries of the middle Mekong river.

Materials and Methods

In the northeastern Thailand, there is an extensive hydrological network consists of a lot of rivers and reservoirs of the Mekong river basin, in which the Lam Se Bai is one of the tributaries (Fig. 1). The stream of the Lam Se Bai starts from the northern hilly terrain of Yasothon and Roi Et provinces, in which the main headstream is originated from hillsides of Phu Pha Nam Yoi (16°19'56.7"N, 104°19'13.7"E, 421 m above SWL), Phu Choko Hin Kong (16°22'07.3"N, 104°22'42.2"E, 445 m above SWL) and Phu Tham Yang Diao (16°21'46.0"N, 104°24'21.0"E, 411 m above SWL). The stream flows toward southward and connects to the Mun river near Ban Kut Chum village (15°14'26.0"N, 104°46'48.0"E 110 m above SWL), Ubon Ratchathani province. The straight-line distance from the origin to the intersection is about 130 km and the main stream is assumed to be about 270 km. The Mun river is one of the main tributaries of the middle Mekong river basin, and therefore, the Lam Se Bai is one of the secondary tributaries of the Mekong river.

The Lam Se Bai is conveniently divided into three parts: upper, middle and lower streams. The upper Lam Se Bai is the area from the origin to around the Kut Peng reservoir, the middle one is from there to the Pa Ao dam and the lower one is from there to the intersection to the Mun river. In the middle part, the river flows on the border between Yasothon and Amnat Charoen provinces at

altitudes between 110 and 120 meters above mean seawater level. Extensive riparian swamps, floodplains, paddy fields, dry lands, orchard gardens, community forests and small villages are distributed in this areas (Sano *et al.*, 2011). The middle Lam Se Bai diverges into a lot of small branches and streams, and make a hydrological network, including reservoirs, ponds and swamps. For these branches and streams, a lot of names are given; for example Lam Se Noi, Lam Pla Daek, Lam Phong, Huai Sam Kha, Huai Khamen, and so on.

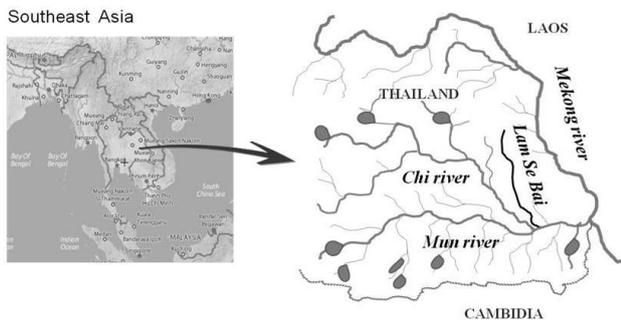


Figure 1. Map of southeast Asia and northeastern Thailand. Lam Se Bai is one of the secondary tributaries of the middle Mekong river basin.

The hydrological conditions in the middle Lam Se Bai basin were characterized by seasonal patterns of flooding and recession, in which the rivers flooded frequently during the rainy season between June and October (Fujioka *et al.*, 2011). The water level at the Lam Se Bai dam fluctuated more than 9 m from about 113 m to 122 m above mean seawater level (Fujioka *et al.*, 2010). When water level of upper dam (Lam Se Bai Dam) exceeded 118 m above mean seawater level, dam gates opened to avoid water flood in the upper areas.

For about three years from 2009 to 2011, we investigated fishing activities and environmental conditions mainly in the middle Lam Se Bai (Fujioka *et al.*, 2010, 2011, 2012). We selected this areas because various traditional fishing activities have been still carried out even now. During our field surveys, we found a lot of indigenous fishing gears throughout the Lam Se Bai basin from the headstream to the lowest end where it connects to the Mun river. In this report, we demonstrated fishing gears observed in and around the Lam Se Bai. Almost all the pictures shown in this report were taken within the Lam Se Bai basin, but some pictures taken at the adjacent areas; for example, Chi river and Mun river, were also used to explain clearly the characteristic of fishing gears.

Results and Discussion

In the Mekong river basin, commercial fisheries were developed and most of fisheries products were traded as fresh fish in local market or as processed products to brokers (MRC 2001, 2007). However fisheries in the Lam Se Bai basin were exclusively small-scale and fishermen preferred compact and simple fishing gears because most aquatic habitats were too small to introduce large fishing gears. Trawl, surrounding net, seine net, big bag net and other large fishing gears were hardly found in this area. Fisheries in the Lam Se Bai basin were not commercial but were considered as a kind of community-based routine activities for local inhabitants.

The behavior of fishes depended largely on complex interacting relationships among annual floods, recession and natural flow patterns, in addition to the extent and quality of flooded forest and the variety of swamp ecosystems. A lot of fish species living in the trunk of the mainstream migrated to the tributaries during the rainy season for feeding, breeding and nursing (Paulsen *et al.*, 2002). Among 850 fish species recorded from the Mekong river basin, 135 of which migrated within the river on certain stages of their life cycle (Dugan *et al.*, 2010). In the Songkhram river basin which was the longest tributary of the middle Mekong basin, 58 species out of 124 fish species migrated for feeding and spawning from the Mekong mainstream into tributaries from May to July (Friend, 2005). Thus, the seasonal flooding was largely concerned with fishing activities by local inhabitants in the Lam Se Bai basin.

Fishery resources provided fundamental ecological services for local inhabitants living along the Lam Se Bai basin. Local inhabitants have adapted their livelihoods over the years to utilize the fishery resources based on a deep understanding of fish migration patterns, feeding and spawning, flood patterns and fish habitats. A lot of fishing gears have been developed through generations of their fishing experience and knowledge. Thereby the efficient use of the indigenous fishing gears depended on understanding of fish behaviors, habitat and seasonal environmental conditions, and as the results local inhabitants can utilize sustainably fishery resources. They sometimes made an agreement by themselves to conserve fishery resources to keep them in sanctuary.

In the present study, a total of 62 kinds of fishing gears and the related tools were recognized in and around the Lam Se Bai basin. They were classified into four categories; 16 net fishing gears, 29 trap fishing gears, 3 hook fishing gears, 8 other miscellaneous fishing gears and 6 related tools. Some fishing gears; for example, gill net, cast net and scoop net, were in common with everywhere else in Thailand (SEAFDEC 2006) and other countries (FAJ, 1996, Kaneda, 2005), and others were indigenous fishing gears predominantly developed in the Lam Se Bai basin; for example stake net trap, branch weir trap, bamboo screen trap, basket traps and cylinder traps.

Indigenous fishing gears were traditionally made of materials available locally and easily obtainable, such as bamboo, branch, wood, rattan, ivy and stone, and some of them were designed for a particular hydrological environment and/or target species. Nowadays, some industrial materials such as nylon net, polyethylene net and rope, polyvinyl chloride (PVC), fiber reinforced plastic (FRP), polystyrene and plastic were used because of their advantage of low cost, easy operability and good permanence. Although fishing has evolved with the development of fishing gear and fishing operations, many fisheries experts believed that the increasing use of modern fishing gears is one of the major threats confronting the Mekong's fishery resources (MRC 2007). Structures and fishing methods of every fishing gears and the related tools observed in and around the Lam Se Bai basin were described as follows. Pictures of every fishing

gears were also exhibited in colored plates at the end of at the end of description of each fishing gear.

Gill net (Mhong, Khai): Gill net is one of the most popular fishing gear for small scale fisheries along the Lam Se Bai as well as other river basin. A net wall, with its lower end weighted by sinker and the upper end raised by floats, is transversely set toward the path of migrating fishes at certain depths from the upper to the lower layers. Fishes are tangled up in the net. The net is sometimes fixed with woody or bamboo poles to prevent it drifting. The mesh is rhombi formed made by monofilament nylon strings and usually one layer. The size of one lot is about 20-50 m long and 0.5-1.7 m high with the mesh size ranges from 10 to 30 mm, but the bigger net exceeds 4 m high with the mesh size 125 mm. Because of simplicity in its structure, principle, operation and low investment cost, fishermen prefer the gill net for routine fishing activities. Fishermen set gill net at evening and harvest in the next morning, but they can use it all the day round and all the year round. Gill net is sold in the market and the fishing tackle store. "Mhong" is the northeastern dialect and "khai" is the standard Thai language.



Gill net

Drift gill net (Mhong lai, Khai loy): During the rainy season, fishermen sometimes make gill net drifting in the river stream without fixing in certain place. A net wall is set across the water current and be allowed to drift according to the current direction. The upper lobe is floating on the water surface and the lower part does not touch to the bottom. Polystyrol float, plastic float or polyethylene terephthalate (PET) bottle are used for floating the net. The mesh size varies 30-50 mm depending on target fishes. Fishermen usually operate the drift gill net on the small boat with or without engine. Drift gill net is found in the middle and the lower Lam Se Bai. "Mhong lai" is the northeastern dialect, in which "lai" means the net follow the water current. "Khai loy" is the standard Thai language, in which "loy" means floating on the water.



Drift gill net

Handy surrounding net (Dang): The word "dang" is sometimes used for comparatively large gill net, but at the same time "dang" means a kind of surrounding net. The

net is made by twisted cotton yarn, with its lower end weighted by metal chain and the upper end raised by floats. The mesh size ranges from 15 to 30 mm. In the shallow waters of rivers, reservoirs and ponds, fishermen surround some water areas, sometimes those around the bush shelter trap (No. 44), by means of handy surrounding net. Handy surrounding net is found throughout the Lam Se Bai basin. "Dang" is the northeastern dialect.



Handy surrounding net

Seine net (Uwan tub taling): A large scale fishing operated collaboratively by several fishermen by means of long nets and fishing boat. The net is made of twisted cotton yarn or nylon fiber, with its lower end weighted by sinker and the upper end raised by floats and the size is approximately 200 m long and 14-20 m high. One side of the net is set on the beach and another side is brought by fishing boat to surround water areas. Seine net is operated in the dry season when water depth and water current are reduced. We found seine net several years ago near the junction of the Chi river and the Mun river, but it is presently prohibited by the fisheries law in the river basin. Seine net is frequently operated in coastal waters (SEAFDEC, 2004, Kaneda, 2005). "Uwan" is the standard Thai language.



Seine net

Handy seine net (Pason, Payaeng, Uwan): Handy seine net consists of two bamboo poles and a shallow bag net between them. The net is made by twisted polyethylene fibers or cotton yarn, with its lower end weighted by metal chain. The mesh size ranges from 3 to 10 mm. Two fishermen handle the poles of each side and walk forward slowly to collect small fishes and other aquatic organisms. Handy seine net is operated in the shallow waters of rivers, reservoirs and ponds of the Lam Se Bai basin. Both "pason" and "payen" are the northeastern dialect and "Uwan" is the standard Thai language.



Handy seine net

Portable lift net, Four-armed scoop net (Sadung lek, Yor, Yor deun): Square shaped small liftnet which made of twisted polyethylene fibers and bamboo framework. Every corners of the net connect individually to curved

arms and are suspended by a long bamboo rod. Fishermen manipulate it by themselves to lift and down in the shallow waters of riverside, ponds and reservoirs. Rice bran and fermented fish meat are sometimes set in the center of the net to attract fishes, but the bait is unnecessary when it is used on the fishway. After sinking it slowly into the water, they wait several minutes, and finally draw up from the water to scoop small fishes. Water depth is less than about 0.5-2.5 m. It can collect every kinds of small fishes inhabiting the surface layers, such as river sprat (*Clupeichthys aesarnensis*), river abramine (*Paralabuca* spp.), rasbora (*Rasbora* spp.) and other small cyprinids. In the Lam Se Bai basin, portable liftnet larger than 2 m in diameter is prohibited by the fisheries law during the breeding season from 16th May to 15th September every year. Portable liftnet is found around Kut Peng reservoir and Pa Ao dam of the middle to the lower Lam Se Bai. "Sadung" is the northeastern dialect, while "yor" and "yor deun" are the standard Thai language, in which "deun" means walking. In some cases, "sadung" represents relatively smaller fishing gear than "yor".



Portable lift net, Four-armed scoop net

Lift net (Sadung yai, Yor prajam tee): Liftnet is a large boat-mounted fishing gear which is manipulated on the bamboo raft anchored near the riverside. The net is connected to the top of about 12-17 m long bamboo beam and operated mechanically by means of the rope and the lifting winch equipped on the raft. About 3-5 m square shaped net is suspended with four bamboo arms. The mesh size is 20-50 mm depending on the target fishes. Bamboo fence is sometimes used in order to guide fishes onto the liftnet. Fishermen put rice bran and fermented fish meat in the center of the net to attract fishes and submerge it near the bottom layer. After waiting certain times, they lift up the net over the water surface. Target is various small fishes inhabiting the middle to the surface layers, such as sheatfish (*Kryptopterus* and *Micronema*) and cyprinids (*Cyclocheilichthys* and *Barbonymus*). Large liftnet is hardly found in the Lam Se Bai basin, but it is frequently observed in the middle Chi river. "Yor prajam tee" means a permanent fishing equipment.



Lift net

Mobile pushnet, Boat dip net (Chorn sanan): Mobile pushnet is an indigenous boat-mounted fishing gear operated widely in the Mekong river basin. It consists of two main components that are a net and a triangle bamboo frame of more than 10 m long. The net is made by twined fiber with the mesh size is about 30-40 mm, and the mouth of it is linked to open widely by means of the bamboo frame. The bamboo frame is fixed to the head of boat and

manipulated mechanically to lift and down by means of the rope and the lifting winch. Mobile pushnet can be operated only on the flat sandy or muddy substratum. Every kind of fishes are collected from nearly bottom layer to the surface layer during the engine-driven boat is pushing the net forward. Two fishermen ride on one engine boat, one for controlling the boat and the another operate the mobile pushnet at the head of the boat. Mobile pushnet is frequently operated around the Yasothon dam of the Chi river. "Chorn" is the standard Thai language.



Mobile pushnet, Boat dip net

Handy pushnet, Dip net (Chorn, Chorn ka keam): The structure and the usage are similar to the mobile pushnet, but handy pushnet is smaller and manipulated by only human power. The bamboo poles are about 2-4 m long and they can be collapsible. In the river and stream, local inhabitants manipulate it with or without boat throughout the year. Nothing bait is used when it is used on the fishway. Handy pushnet is observed at the lower Lam Se Bai basin. "Chorn" is the standard Thai language.



Handy pushnet, Dip net

Cast net (Hae): Cast net is the most popular portable fishing gears in the Lam Se Bai as well as other shallow waters in the Mekong river basin. Because of the simple structure and the low investment cost, fishermen prefer cast net for their routine small scale fisheries. Although the operation is required skill, it can be carried out by a single fisherman, with or without boat.



Cast net

The body is shaped as a bag and made by monofilament nylon string or twisted cotton yarn. The net size ranges 2-3 m long and 5-10 m in the circumference and the mesh size is about 20-30 mm. The top of the net has a line so that casting and hauling can be more easily. Metal weights (or chain) are connected to every 0.2-0.4 m intervals of the bottom margin to sink the net rapidly. Local inhabitants operate cast net during daytime throughout the year in every shallow waters of rivers, ponds, reservoirs and channels. "Hae" is the standard Thai language.

Drop net (Toan, Toan lee): A simple fishing method to collect small fishes and shrimps which are overflowed from weir of rivers and channels. Polyethylene net is set below the weir by means of woody and bamboo frameworks. Fishermen set continuously the drop net and sometimes collect fishes and shrimps from it by scoop net (No. 54). Drop net is found at Kut Hae and Kut Peng villages along the upper to the middle Lam Se Bai. "Toan" and "lee" are the northeastern dialect.



Drop net

Shrimp net (Sai khung): A specialized fishing gear to collect freshwater shrimps, predominantly *Macrobrachium lanchesteri*, in the river banks, reservoirs and floodplains during the rainy season. The net is approximately 0.5-0.6 m high and 1-1.4 m wide per one segment and is vertically stood by means of woody or bamboo poles. Shrimps are collected in the blind alley of the nets. Shrimp net is frequently operated throughout the Lam Se Bai basin.



Shrimp net

Small bag net (Tong pla): A simple fishing method to collect small fishes coming out from irrigation channels and paddy fields. Polyethylene bag net is set on the outlet of the drain. It is found at Kut Ching Mi village of the upper Lam Se Bai. "Tong pla" is the northeastern dialect.



Small bag net

Bag net

Bag net (Pong pang): Approximately 20-50 m long bag net which is made of twisted cotton yarn or polyethylene fibers is installed to block the river stream with the entry facing upstream. Both side of net are connected to trees or poles. About 50-70 mm large mesh is used near the entrance to reduce water resistance, and the mesh size is gradually decreased toward backward and it becomes finally about 15 mm at the bottom end. The production is very large (ca. 20-30 kg/day), but it is possible to operate only several days in the peak of the rainy season. Bag net was formerly operated in the middle Lam Se Bai, but it is presently prohibited by the fisheries law. "Pong parn" is the standard Thai language.

Stake net trap (Pong pang, Jip yai): Stake net trap "Pong pang" is an unique indigenous fishing gear observed around Na Kae village of the middle Lam Se Bai. The structure of stake net trap consists of two main components that are wooden pole fence and a big bag net. The fences block the river stream and so that the pathway of migrating fishes to guide them into the bag net. The

poles stands 5-9 m high above the riverbed. About 20-30 m long bag net is installed between pole fences in the center of the river with the entry facing upstream and every kinds of fishes going to downstream are collected by the net. Several fishermen operate collaboratively the stake net trap in the rainy season. The production is usually 10-30 kg/day and the maximum one is about 100 kg/day which can be sold about US\$ 1,700 (53,000 bahts) in the market, but the suitable water conditions (water level and current speed) are restricted only a few weeks every year. Stake net trap is prohibited in the beginning of rainy season from May to August to conserve the fishery resources because a lot of migrating fishes come upstream for mating and breeding in this season (Paulsen *et al.*, 2002). Smaller mesh size than 30 mm is also prohibited by agreement among local inhabitants. A total of 25 stake net trap is presently installed along the middle Lam Se Bai. More detailed knowledge is described in Fujioka *et al.* (2011). "Pong pang" is the standard Thai language to express big bag net and "jip" is the northeastern dialect.



Stake net trap

Branch stake net trap (Jip): Smaller branch stake trap is called as "jip". Branch or bamboo fence arranged on the shallow floodplains with facing upstream to guide fishes into the central parts in which trap net is installed. The net is made of twisted cotton yarn or polyethylene fibers. Branch stake net trap is observed only in the peak of the rainy season at the shallow floodplains near the Lam Se Bai dam.



Branch stake net trap

Branch weir trap (Luan loub): Branch weir trap "luan loub" is an unique indigenous fishing gear observed within swamp forests of riparian floodplains in the middle Lam Se Bai. The structure consists of two main components, branch fence and fish traps. The branch fence (called as "luan") is made by dried branches of "hualing" tree (*Hymenocardia wallichii*) and is arranged vertically toward the river stream. The branch of this tree is suitable to make the fence because (1) it can be obtain easily in the swamp forest, (2) the form is stable for a long time and (3) the leaves do not fall even when the branch is dried. The height of the fence is about 1.4-1.8 m and it block the pathway of migrating fishes to guide them into the trap. Cylindrical shaped fish traps (called as "loub") is installed on the triangular opening near of the bottom of the branch

fence with the entry facing downstream. The trap is about 1.3-1.6 m long and 0.4-0.5 m in diameter and is made by rattan and covered by splitted bamboo, but cotton yarn or twisted polyethylene fibers are presently also used. A fist-sized stone is put on the trap with strings to prevent it drifting. The trap does not contain any bait and is continuously kept to collect any kinds of fishes inhabiting near the bottom layer. Every fisherman has 1-9 branch fences "luan", and a total of more than 200 "luan" may be arranged around Na Kae village of the middle Lam Se Bai. When collecting fishes, they dive into the water and bring the trap onto their boat. More detailed knowledge is described in Fujioka *et al.* (2011). "Luan loub" is the standard Thai language.



Branch weir trap

Bamboo screen trap (Jip lek, Jip noi, Fuak, Pok): The structure is same as the branch weir trap, but the size is smaller and the fence is made by bamboo screen. Fish trap is made of small bag net or bamboo trap with the entry is facing whether upstream or downstream. The trap is installed at shallow waters of small channels, rivers and floodplains and is popular throughout the Lam Se Bai basin. "Jip" is the northeastern dialect, whereas "fuak" and "pok" are the standard Thai language.



Bamboo screen trap

Marginal trap (Loub duk pla): Marginal trap is structurally similar to the former two traps, but in this gear, the fish traps are set inside of the fence. The fence is about 15 m long and 1.5 m high and is made by bamboo poles and cotton net of about 30 mm mesh size. Several cylindrical shaped fish traps are installed with the entry facing along the inner margin of the fence. Marginal trap is observed at the reservoir near Si Than village of the middle Lam Se Bai.

20. Door trap (Jun, Jun duk pla): Door trap "jun" is an indigenous fishing gear with the specific device to catch rather big fishes of catfish (*Pangasius*, *Hemibagrus*, *Bagarius*) and cyprinid carps (*Hampara*, *Barbodes*). The structure consists of two main components that are branch stake fence and gate trap.



Marginal trap

The gate trap is made by wood or bamboo and covered by net or splitted bamboo. When fish enter the trap, it touch the fine string which is vertically stretched in the center, and then the door will be suddenly shut because the supported pole is disengaged, so the fish can not escape from the trap. The size of a big trap is 2.4 m long x 2.0 m high x 0.8 m width, in which the entrance area is 0.8 x 0.4 m. Door trap is found in the floodplains around Na Kae village in the middle Lam Se Bai. "Jan" is the standard Thai language.



Door trap

Weir trap, Fishpound (Lee): Weir trap or fishpound "lee" is a kind of gate trap observed around paddy fields and irrigation canals. The trap is made by woody and bamboo fence which is arranged vertically toward the water stream to interrupt the fishway. A bag net or bamboo shelf is installed on the water exit between the fences. When water is flooded from the paddy fields in the rainy season, farmers collect every kinds of fishes, shrimps and other aquatic organisms by means of their own weir traps. Although big weir traps have been observed about 20-30 years ago in the Lam Se Bai basin, they are hardly found in the recent time. Big weir trap is found in Laos (Iwata, 2002, Iwata *et al.*, 2003), and typical huge weir traps can be observed around the Khon water fall of the Mekong main stream. "Lee" is the northeastern dialect.



Weir trap, Fishpound

Shrimp trap (Loub khung, Duk khung): Shrimp trap is a specialized compact fishing gear to collect small shrimps, predominantly *Macrobrachium lanchesteri*, in the river banks. The shape is cylindrical fan or rectangular box with the size is about 1.0-1.4 m long. The frame is made of splitted bamboo or steel which is covered by twisted polyethylene net. The trap is stand by means of bamboo pole with the slit-like entry facing whether upstream or downstream. Net fences are installed to guide the shrimp into the trap. Nothing bait is used under the running waters, but rice bran and fish meat are provided under the stagnant waters. Fishermen set shrimp traps in the evening and collect 2-3 times midnight mainly in the rainy season. Shrimp trap is frequently operated around the Yasothon dam of the Chi river.



Shrimp trap

Funnel basket trap (Sai): Funnel basket trap "sai" is one of the most popular indigenous fishing gear in the Mekong river basin. Long and cylindrical shaped fish trap is weaved by splitted bamboo and rattan with the size of 0.8-2.0 m long and 0.1-0.5 m diameter. The trap has two entrances; one is the narrow end and the another is the side of the trap. The entrance is funnel shaped and become bottle necked to prevent the escape of fishes after enter the trap. The trap is horizontally set in the shallow waters of rivers, streams, channels, ponds, floodplains and paddy fields to catch benthic fishes during rainy season. Rice bran and fish meat are sometimes put inside as bait, but they are unnecessary when the trap set on the fishway. The size, the form and the structure varies according to the target species; tube like trap (Sai tor), globe like trap (Sai loy), frog trap (Sai kob), and so on. Funnel basket trap is sold at the fishing tackle store in which the market price is about 6-19 US\$ (200-600 bahts). Small funnel basket trap is used for interior decoration. "Sai" is the standard Thai language.



Funnel basket trap

Upright basket trap (middle layer type) (Tum, Tum pasew): Upright basket trap is a unique indigenous fishing gear frequently observed throughout the Mekong river basin. The trap is cylinder or bottle shaped and weaved by splitted bamboo and rattan. The fish entrance is opened at the bottom of the trap, and inside of the opening, there is pointed bamboo funnel which prevent the fishes escaping from the trap. The size varies from 1.2 to 1.8 m long and from 0.3 to 0.5 m in diameter. The trap is connect to a long pole and vertically set in the middle layer of shallow waters of rivers, streams, channels, ponds, reservoirs and swamps. Main target of this trap is silver rasbora (*Rasbora argyrotaracha*) and other small cyprinid carps inhabiting the middle layer. Natural organic matters such as rice bran, fish meat, molluscs, crabs, insects and sometimes dried buffalo dung are put inside as fish bait. In the rainy season, the trap is set midnight and collect in the morning, but sometimes keep for a few days. There are a lot of types according to the size, shape and the target fishes. The basket trap was traditionally weaved by local inhabitants themselves but recently sold in the market. "Tum" is the standard Thai language.



Upright basket trap (middle layer type)

Upright basket trap (bottom layer type) (Tum bong, Tum pla kod): Different from the former one (No. 24), this is a basket trap to collect fishes inhabiting the bottom layer. The shape is cylinder or bottle like and it is weaved by splitted bamboo and rattan. The fish entrance is opened at the lower side of the trap. The size varies from 1.0 to 1.5 m long and from 0.3 to 0.5 m in diameter. The trap is vertically set on the bottom of the shallow waters of rivers, streams, channels, ponds, reservoirs and swamps. Main target of this trap is river catfishes (*Hemibagrus* spp., *Bagarius* spp.), walking catfish (*Clarias* spp.) and spiny eel (*Mastacembelus armatus*).



Upright basket trap (bottom layer type)



Small basket trap (hanging type)

Small basket trap (hanging type) (Tum klom, Tum pla soi): Because of the compact structure and the low investment cost, small basket trap is very popular fishing gear for small scale fisheries in the Lam Se Bai basin. The trap is barrel shaped and weaved by splitted bamboo and rattan. The triangle or rectangle fish entrance is opened at the lower side of the trap. Inside of the opening, there is pointed bamboo funnel which prevent the escape of the fishes after enter the trap. Rice bran, fish meat, and other organic matters are put inside as fish bait. The size is from 0.3 to 0.5 m long and from 0.2 to 0.5 m in diameter. The trap is vertically hung in the middle layer of shallow waters of rivers, streams, channels, ponds, reservoirs and riparian swamps. Main target fishes are river sprat (*Clupeichthys aesarnensis*) and other cyprinid carps.

Small basket trap (bottom type) (Tum larn): This is the bottom layer type of the small basket trap. The trap is approximately 0.4-0.6 m high, bottle, barrel or bell shaped

and weaved by splitted bamboo or twisted polyethylene fiber. The trap is installed on the shallow waters of 0.2-1 m deep with rice bran and termite as fish bait. Main target fishes are *Mystus* spp. and *Heterobagrus* spp., but it can collect every kinds of fishes inhabiting the bottom layer.



Frog basket trap



Small basket trap (bottom type)

Grass bush trap (Sue noan gin): Cylindrical fish trap weaved by splitted bamboo, rattan and ivy with the size of 0.8 m long and 0.2 m in diameter. Glasses and branches are set inside of the trap and it is laid down on the substratum from 0.5-2.0 m deep without any bait. The trap provide habitats for botia (*Botia* spp.) and sand goby (*Oxyeleotris marmorata*). Glass bush trap is observed near the junction of the lower Lam Se Bai and the Mun river. The Thai name "sue noan gin" is originated from the meaning that "tiger can eat without any effort (sleep)".



Grass bush trap (Sue noan gin)

Eel basket trap (Eju): Compact basket trap specialized to catch swamp eel (*Monopterus albus*) at the paddy fields, channels and swamps. The trap is weaved by splitted bamboo and rattan with the size of 0.3-0.8 m in height and 0.2-0.4 m in bottom diameter. Fish meat, smashed apple snail and crab are packed in cylindrical bait container (named as "kapor") and set it inside of the trap. The upside of the trap is kept over the water surface and covered by coconut shell or straw. Eel basket trap is sometimes observed along the Lam Se Bai basin. "Eju" is the standard Thai language.



Eel basket trap

Frog basket trap (Tum kob): A pot shaped small basket trap to collect frogs (*Rana* spp.) at the paddy fields and swamps. The trap is weaved by splitted bamboo and the rounding entrance is opened near the lower side. Rice bran, fish meat, and other organic matters are put inside as bait. The size is 0.3-0.4 m in height and 0.2-0.3 m in diameter. Frog basket trap is frequently observed along the Lam Se

Bai basin. Frog basket trap is traditionally weaved by local inhabitants themselves but is recently sold in the market.



Upright shrimp trap (Tum khung): A compact and portable fishing gear to collect small shrimp (*Macrobrachium lanchesteri*) in swamps and riverside. The height is about 0.3-0.4 m and the frame is made by splitted bamboo covered with twisted polyethylene net. There are several entrances which are made from the tap of polyethylene terephthalate (PET) bottle. Rice bran is used as bait. Upright shrimp trap is sold about 1.4-1.9 US\$ (45-60 bahts) in the market.



Upright shrimp trap

Pot trap (Thong): Pot shaped large fish trap observed in the Mekong river basin. The material and structure are similar to those of the upright basket trap ("tum"), but the size is extremely larger (1.5-7.0 m in height and 0.6-1.2 m in diameter). The trap connects to wooden pole and stands vertically on the middle to the lower layers of the river to catch cat fishes, barbs and other benthic fishes. Rice bran, fish, chicken, molluscs, crabs and insects are used as bait. Although this trap is operated in large tributaries such as Mun river (MRC 2007) and Songkhram river (Friend, 2005), we have never found it in the Lam Se Bai basin yet.



Pot trap

Horizontal cylinder trap (Loub, Loub noan): Horizontal (or laying) cylinder trap is one of the most popular fishing gear operated along the Lam Se Bai basin. The shapes are various, but mostly cylindrical and are weaved by locally available materials such as splitted bamboo, rattan and ivy. The size varies 0.5-2.5 m long and 0.3-0.8 m in diameter depending on the target fishes and the environments. One or two entrances are opened on the bottom or side of the trap. Inside of the opening, it has pointed bamboo funnel which prevent to escape the fishes after enter the trap. The trap is laid on the substratum of river, reservoirs, ponds, swamps, paddy fields and floodplains. Fishermen select the installation site based on their knowledge about topography, water current and fish behavior. Fish bait is sometimes put in the trap, but it is unnecessary when the trap is used on the fishway. The trap is traditionally

weaved by local inhabitants themselves but recently sold in the market.



Horizontal cylinder trap

Vertical cylinder trap (Loub yuen, Loub tang): Vertical (or standing) cylinder trap is a variation of bamboo trap. The shape is cylindrical or beer barrel like and the size varies 0.3-1.0 m long and 0.2-0.5 m in diameter. It is made by rattan and splitted bamboo which is covered with twisted cotton yarn or polyethylene fiber. In the shallow waters of rivers, channels, reservoirs, ponds, swamps and floodplains, fishermen set the trap with or without bait at certain depths according to the target fishes and environments. The main target is cyprinid carps and barb (Paralabuca, Barbodes, etc.), catfishes (Mystus, Hemibagrus, etc.), walking catfish (Clarius) and snakehead (Channa). This trap is observed in Kut Chiang Mi and Na Kae villages of the upper and the middle Lam Se Bai.



Vertical cylinder trap

Flexibility trap (Loub yued, Eroa): Flexibility trap is a variation of net trap. The frame is made by steel or stainless and covered by twisted polyethylene net, so that foldable and easy to carry to fisheries ground. When spread it, the size is about 2-7 m long and 0.5 m high with four to ten segments. The fish entrances are alternately opened near the bottom of each segment. Every kinds of fishes can be collected without any bait. Flexibility trap is sold about 22-26 US\$ (700-800 bahts) in the market and it introduced around 2005 in Na Kae village of the middle Lam Se Bai. "Eroa" is the northeastern dialect.



Flexibility trap

Lying trap (Suang, Son): Lying trap is a simple indigenous fishing gear to collect snakehead (Channa spp.), walking catfish (Clarius spp.) and other small fishes around paddy fields. It is laid down on the waterway between embankment of paddy fields and canals. The size is 1.2 m long and 0.15 in diameter. The trap is weaved by splitted bamboo. Local inhabitants traditionally use lying trap, but it is currently hardly found in the Lam Se Bai basin. "Suang" is the northeastern dialect and "son" is the standard Thai language.



Lying trap

Snake head trap (Chud): This is an indigenous fishing trap to catch snakehead around paddy fields. The trap is placed on the small waterway beside of embankment and tie it up with the sticks. Once enter the trap, the fish can not go out because it is as same size as the trap. Local inhabitants have weaved the trap by means of ivy of climber plant, *Toxocarpus spirei* (Family Asclepiadaceae) until 20-30 years ago, but it is currently hardly found in the Lam Se Bai basin. They prefer another fishing gear because fish dies shortly in the trap. "Chut" is northeastern dialect to express the climber plant.



Snakehead trap

Eel trap (Lun): A specialized fishing gear to catch swamp eel (*Monopterus albus*) in muddy waterways. The trap is made by cylindrical bamboo which consists of 4-5 segments and about 0.8-1.2 m long. Small holes are drilled for fish breath. Nowadays, it is made by polyvinyl chloride (PVC) pipe. Earth worm, smashed or fermented snail, crab and fish meat are put into the base of the trap to attract swamp eels. The trap is horizontally or diagonally put in the shallow waterways, usually not deeper than knee level. Eel trap is observed at the lower Lam Se Bai and the Chi river. "Lun" is the standard Thai language.



Eel trap

Botia trap (Bang): The structure is similar to eel trap, but this trap is specialized to catch cobitid fishes, *Botia* spp. The trap is made by cylindrical bamboo which consists of 4-5 segments and about 1.2 m long and 80 mm in diameter. The trap is laid down on the shallow waters about 0.1-0.3 m deep. Bait is unnecessary because the trap provide only fish habitat. We found this trap at Nong Kin Phen village where is located near the junction of the Lam Se Bai and the Mun river.



Botia trap

Box trap (Jun pla chon, Jun pla kor): A small woody box trap to catch snakehead fish (*Channa striata*) and walking catfish (*Clarius* spp.) utilizing the fish behavior to hide in narrow gap. The box size is about 45 x 30 x 20 cm. The trap is laid on the mud of extremely shallow water without any bait. Fishes come into the box for mating and breeding. Although snakehead fish is commonly cultured in Thailand, capture fishing is still performed in the northeastern Thailand. Box trap is found in Kut Chang Mi village of the upper Lam Se Bai.



Box trap

Catfish trap (Loub pla duk): A small box trap to catch walking catfish (*Clarius* spp.) and other fishes inhabiting the shallow waters of rivers, channels, reservoirs, ponds and paddy fields. The box size is about 0.3-0.5 m and the frame is made by metallic wire covered with fine wire mesh or twisted polyethylene fiber. The fish entrance is opened vertically or horizontally on both sides. Catfish trap is found in the upper and the middle Lam Se Bai.



Catfish trap

Fish trap (Loub pla, Loub duk pla): Semi-cylindrical shaped trap to catch fishes, crabs and other aquatic organisms around river sides. The size is about 0.8-1.0 m long 0.5 m in height and the frame is made of rattan and covered with twisted fiber net. Chopped fishes are placed in the trap to attract fishes. The pathway is sometimes dug to guide fishes and crabs toward the entrance of the trap. This trap is commonly used in the coastal areas throughout

the Thailand, but it is rarely seen in the Lam Se Bai basin.



Fish trap

Frog trap (Ngaeb, Duk kob): A bag shaped small fishing trap to catch frogs (*Rana* spp.) in the paddy fields and swamps. The trap is weaved by only splitted bamboo and about 20-30 cm in size with the oval shaped entrance. Insect, fermented fish and crabs are usually used to attract frog at midnight. Frog trap is frequently observed throughout the Lam Se Bai basin. "Ngaeb" is the northeastern dialect and "duk kob" is the general term for it.



Frog trap

Bush shelter trap, Bush pile trap (Yoa, Klum): Bush shelter trap or bush pile trap is an indigenous fishing method in riparian swamps and is categorized as a kind of fish attractant device. A bundle of tree branches are combined each other to make bush basket and submerged it in the shallow water. Wooden poles stand to connect the basket to prevent it drifting. The basket provides the preferred habitats and breeding sites for fishes inhabiting in the bottom layer; for example, snakehead (*Channa striata*), sheatfish (*Micronema* spp.), catfishes and small cyprinid carps. Every a few days, fishermen collect these fishes by mean of gill net (No. 1) or handy surrounding net (No. 3) by surrounding the bush basket. This fishing is collaboratively operated by several fishermen. Bush shelter trap fishing is found in Na Kae village of the middle Lam Se Bai. "Yoa" is the northeastern dialect and "klum" is the central or the standard Thai language.



Bush shelter trap, Bush pile trap

Bush shelter, Branch shelter (Klum, Ban pla): Local inhabitants preserve fishes in the reservoirs and irrigation canals beside of their own paddy fields. They put a bundle of tree branches and bamboo piles in the waters to provide shelter and habitat for fishes. Branches are also useful as a landmark to protect their fishes from disturbance by other villagers. Whenever they collect fishes, they remove branches from the waters, and then they catch fishes by means of net. Although the structure is same as the former one (bush shelter trap), bush shelter is a kind of fish aquaculture activities. Bush shelter is widely observed throughout the Lam Se Bai basin, but this method is

prohibited at the public waters. Both "klum" and "ban pla" are the standard Thai language. This method is also found in the paddy fields and ponds in Laos and other Asian countries (Akimichi *et al.*, 2008).



Bush shelter, Branch shelter

Hook and line (Bed): Hook and line are popular fishing gears observed in everywhere in Thailand. In general, it consists of a main line, sometimes a few branch lines, with hook(s) and sinker. Monofilament nylon or cotton yarn are used for lines. The rod is made from natural materials such as bamboo and rattan, but glass fiber rod is presently used. Big hook of about 30 mm is used to catch the big catfish (*Pangasius larnaudi*, *P. sutchi* and *P. siamensis*), knifefish (*Notopterus notopterus*, *Chitala ornata*), sheatfish (*Wallago attu*) and so on. Crab, shell, worm, fruit (for *Pangasius*), chicken, rice bran and some other edible materials are attached to hook as fish bait. During the rainy season, big catfish, *Pangasius larnaudi*, comes to eat the fruit of "waa tree (*Syzygium*)" in the floodplain of Na Kae village. "Bed" is the standard Thai language.



Hook and line

Pitch hook (Bed tong, Bed pak): Several bamboo rods are set on muddy embankment of the shallow waters of reservoirs, ponds, channels and paddy fields, to catch mystus (*Hemibagrus*), walking catfish (*Clarius*), snakehead (*Channa*), and other small fishes.



Pitch hook

Pitch hook is consists of bamboo rod, string and hook. The rod is about 80 cm in length. Worm, crushed snail, grasshopper, frog, crab and small fish are used as fish bait. The hooks are usually kept overnight and collect them in the next morning. Pitch hook is frequently observed in the Na Kae village as well as other Lam Se Bai basin and is sold about 0.1 US\$ (3 bahts) per pole in the market. "Bed tong" is the standard Thai language and "bed pak" is the northeastern dialect.

Long line (Bed rao): Fishermen sometimes make a long line to hanging a series of branch lines with hooks and suspended it in the rivers, reservoirs and floodplains. A series of hooks are set at about 1-2 m intervals. Crab, shell, worm, fruit, chicken and some other edible materials are used as bait. Long line is sometimes observed in the

middle and the lower Lam Se Bai basin. "Bed rao" is the standard Thai language.



Long line

Plunge basket, Cover pot (Sum): Plunge basket or cover pot is a simple fishing gear to catch fishes in quite shallow water mainly at night. The shape is like a conical basket and is made of splitted bamboo with the surroundings forked toward the bottom. The size of the basket is about 40-50 cm in height, 40 cm in bottom diameter and 10-15 cm in upper diameter. Termites, Ants or other organic matters are placed on the water as fish bait. Fisherman holds the top of the gear to wait without moving for a while. When fish come to snap the bait, fisherman plunged vertically the basket. The market price of plunge basket is 5.4-9.6 US\$ (170-300 bahts). In Myanmar, the larger plunge basket "Inlay basket" is operated with fishing boat (SEAFDEC 2006). "Sum" is the standard Thai language.



Plunge basket, Cover pot

50. Fish scaring boat (Rua phee loak, Long pla): Fish scaring boat is a very unique indigenous fishing gear. Large rectangular white board of about 3 m x 0.7 m is installed beside of small fishing boat by means of steel frames and fish net of about 3 m x 0.8 m is installed on another side of the same boat. In the nighttime of new moon, fishermen move slowly the boat without engine in the rivers and swamps. When fishes come up against the white board they surprise and spontaneously jump up from the water into the boat. Main target fishes are sheatfishes (*Kryptopterus limpok* and *K. kryptopterus*) and mud carp (*Henicorhynchus siamensis*). This fishing appeared to be operated until 15-20 years ago around the tributaries of the Mekong river basin, but it is currently difficult to find it. We found only one boat on February 2012 at the coast of Tha Khon Mai Yung village where is located near the junction of the Chi river and the Mun river. More detailed explanation of this fishing is presented by Punswarn (2005) and Tapkorn (2010). "Rua phee loak" is the standard Thai language which means "ghost scaring boat". "Long pla" is the northeastern dialect.



Fish scaring boat

Spear (Chamouk): Spear is a simple fishing gear consisting of long shaft, usually of wood or bamboo, with

a pointed head, the tip of which is divided into several to nine. Fisherman use it at nighttime to capture snakehead (*Channa* spp.), catfish (*Clarius* spp.) and frogs (*Rana* spp.). When he light up on the water, fishes come to the surface, so that he spear the fishes. Spear is observed throughout the Lam Se Bai basin, but nowadays it becomes not popular because fishes decrease and the operation is not efficient.



Spear

Harpoon (Chamouk deaw, Chanak, Som sud pla): A harpoon is a long spear-like fishing gear to catch comparatively large fishes. It is also consisting of a shaft, usually of wood or bamboo, with one pointed steel tip. The shaft is longer than the spear and the total length is about 5-6 m.



Harpoon



Scoop net

Scoop net (Sawing, Takpra): Scoop net "sawing" is a simple fishing tool to scoop small fishes, crabs, shrimps and other aquatic animals in shallow ponds, reservoirs, rivers, swamps and paddy fields. The size is 0.2-0.5 m in diameter and mesh size varies from 3-10 mm according to the purpose. The frame is made by rattan, steel or plastic, and the net is made of nylon, polyethylene fiber and twisted cotton yarn. It is sold 1-3 US\$ (30-100 bahts) in the market and the fishing tackle store. "Sawing" is the standard Thai language and "takpra" is the northeastern dialect.

Long pole scoop net (Sawoak): "Sawoak" is a kind of scoop net with a long shaft. It is also a supplemental fishing tool to collect and carry fishes and other aquatic organisms. "Sawoak" is the standard Thai language.



Long pole scoop net

Scoop basket (Chanang, Takpra): Scoop basket "chanang" is an indigenous fishing tool to collect small fishes and other aquatic organisms in shallow waters. The frame is made by rattan and the basket is made of splitted bamboo or twisted polyethylene fibers. Local inhabitants have used it about 20-30 years age, but it is currently hardly found in the Lam Se Bai basin. "Chanang" is the standard Thai language and "takpra" is the northeastern dialect.



Scoop basket

Water scoop (Phoang, Kaso): Water scoop "Phoang" or "Kaso" is an indigenous tool to scoop water in paddy fields and canals, but it is also used for collecting small aquatic organisms. It is made of bamboo pole and splitted bamboo. Local inhabitants have used it about 20-30 years age, but it is currently not used in the Lam Se Bai basin. "Phoang" is the standard Thai language and "kaso" is the northeastern dialect.



Water scoop

Other collecting tools: For local inhabitants, handy collecting is a basic fishing activity to collect shell, crab, worm and freshwater algae. They sometimes use shovel and scoop for digging the soil.



Container

Container (Khong): Fishermen keep and carry fishes into bamboo container, "khong". There are a lot of kinds of containers according to the shape and the purpose. They are made of locally available materials, splitted bamboo, ivy, rattan, and twined fiber net and string, but nowadays, plastic and polystyrol containers are also used. "Khong" is the standard Thai language.



Container

Basket (Takra, Kata, Kung pla): Basket type container is used for routine works of local inhabitants. It is made of coconut shell, splitted bamboo and rattan. Water container ("khong tak nam") is made of coconut shell and be available to carry living fishes with water. Nowadays, plastic bucket becomes more popular. "Takra" and "Kung pla" are the standard Thai language and "kata" is the northeastern dialect.



Basket

Fish bag (Sai pla, Kung pla): Fish bag is a supplemental tool to keep and carry the fishes. Local inhabitants prefer polyethylene net bag because it is cheap and stout.



Fish bag

Fish cage, Crawl, Fish preserve (Sai pla, Kung pla): Fishermen use fish cage or crawl to keep fishes for a short period. The cage is made of metal or bamboo frame, which is covered by polyethylene net. Polystyrol float, plastic float or polyethylene terephthalate (PET) bottle are used for floating the cage.



Fish cage, Crawl, Fish preserve

Aquaculture cage (Krachung, Kung pla, Leang pla): Fish aquaculture are very popular around the Lam Se Bai basin, in which cage aquaculture systems are found in the rivers, ponds and reservoirs. Tilapia (*Oreochromis niloticus*), tapian (improved strain of tilapia), catfish (*Pangasianodon hypophthalmus*) and some other

freshwater fishes are cultured into the cage mainly in the rainy season.



Aquaculture cage

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