

## **CHAPTER 2**

# **INLAND CAPTURE FISHERIES AND ITS STATUS**

Fisheries activities in inland waters vary considerably and are adequately related to the specific fishing areas, aquatic species targeted, fishing gear used, and social culture of some places. The inland fisheries sub-sector however, is facing various challenges that should be addressed to be able to implement the appropriate management measures.



Fishing is traditionally an important occupation for many rural people living near inland water bodies, generating significant incomes and providing hereditary employment opportunities to the rural peoples. In utilizing the fishery resources, fishers use many different types of gear and commonly used to catch different fish species as shown in **Figure 2.1**, and the growing trend in the number of fishers entering the fisheries is unlikely to correspond to increases in fishery resource productivity, exacerbated by environmental degradation which has also become a major public concern in inland water bodies. The degradation happened in each country is in different stage. Exemplification in the Siak River, Indonesia, the river gets the waste from the industry such as palm oil processing, pulp and paper processing, rubber processing, docking, transportation and household. **Figure 2.2** shows the color of waters surrounding the rubber processing in Siak River.

The addition of the number of fishers entering the fishing area is likely to be not followed with the increases of fishery resource productivity. Nowadays, inland capture fisheries receive relatively little attention from the governments and scientists, and the problems could even be more complicated than those in marine fisheries. For instance, there is no appropriate landing freshwater fish places compared to those for marine fish. The fishers have landed their fish to the waters body side to sell directly the fish to buyers, who prior to give some money to the fishers in case of the bad season or no fishing season. The main concerns in the inland fisheries sub-sector could be urgently addressed if the responsibility of managing the fisheries is handed over to relevant communities, although fisheries management has always been assumed to be a government responsibility (Gordon 1954).

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Stow Net in Myanmar



Kind of bamboo traps in Malaysia



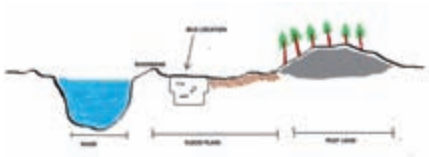
Stationary Trawl (Dai) Fishery in  
Cambodia



Lee Trap Fishery in Lao PDR



Trap in Viet Nam



Beje Trap in Indonesia

**Figure 2.1** Commonly fishing gears in AMS

## 2.1 Portrait of Inland Waters and Its Capture Fisheries

People can fish in inland water bodies whole year round but the amount of fish caught varies from one season to another. Freshwater fishes and other aquatic resources found the inland waters could be categorized as the economically-important fishes, artisanal fishes, threatened fish, or food fish. The life span of each fish is different and determined by the characteristics of the ecosystem and habitats. Exploitation of the fishery resources is also practiced in various ways based on the types of ecosystems. Some pictures showed in **Figure 2.3, 2.4, 2.5, and 2.6.**



**Figure 2.2** The waste of rubber processing flows to Siak River

In 2019, Asian Species Action Partnership (ASAP) stated there are 48 freshwater fish in Southeast Asia that are considered to be just one step away from extinction in the wild. A large portion of these are endemic and restricted-range species, such as: Bagangan (*Barbodes clemensi*, *Mandibularca resinus*), *Betta Persephone*, *Betta spilotogena*, Giant Carp, Giant Pangasius, Irrawaddy River Shark, *Hampala lopezi*, Krabi Mouth Brooding Betta, Mekong Giant Catfish, Mekong Giant Salmon Carp, Poso Bungu (*Weberogobius amadi*) *Schistura leukensis*,

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*Schistura nasifilis*, Sentani Rainbowfish, Siamense Bala-shark, Siamese Tiger Perch (<https://www.speciesonthebrink.org/news/freshwater-fish-the-importance-of-updating-conservation-status/>).

The range of life for each fish is different and determined by the ecosystem and habitat characteristics. The exploitation of fish is operated in various ways related to the types of ecosystem. The components of inland fisheries are types of inland waters, fish diversity, types of fisher, types of fishing gear, role of gender, and postharvest.



*Channa striata*  
Snakehead



*Anabas testudineus*  
Climbing perch



*Clarias batrachus*  
Philippine catfish



*Trichogaster pectoralis*  
Snakeskin gourami

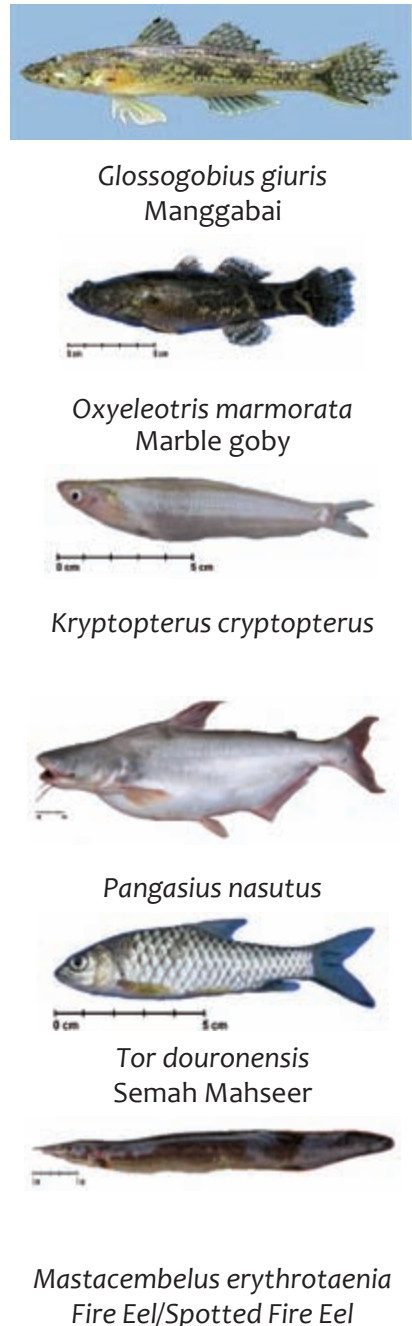


*Anguilla bicolor*  
Indonesian shortfin eel



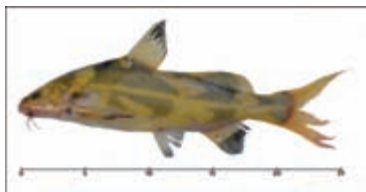
*Chitala lopis*  
Giant featherback

**Figure 2.3** The important economically fish



**Figure 2.4** The important economically fish as well

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*Bagroides melanopterus*  
Harlequin lacer



*Balantiochilus melanopterus*  
Tricolor Sharkminnow



*Epalzeorhynchus kalopterus*  
Flying fox



*Kryptopterus minor*  
Ghost catfish



*Mastacembelus erythrotaenia*  
Fire Eel/Spotted Fire Eel



*Barbodes schwanofeldi*  
Tinfoil barb



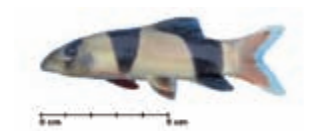
*Leptobarbus hoeveni*  
Hoven's carp



*Kryptopterus limpok*  
Long barbel sheatfish



*Scleropages formosus*  
Asian bonytongue



*Chromobotia macracanthus*  
Clown loach

**Figure 2.5** The ornamental fish





*Chitala lopis*  
Giant featherback



*Scleropages formosus*  
Asian bonytongue



*Glossolepis incisus*  
Rainbow fish



*Telmatherina celebensis*  
Celebes rainbow



*Glossogobius giuris*  
Tank goby



*Giuris margaritacea*  
Snakehead gudgeon



*Neolissochilus sumatranus*

**Figure 2.6** The threaten fish

## Characteristic of Major Inland Waters

The main types of inland waters serve for fishery activities are as follows.

### *Rivers*

River is the natural flowing of water, usually freshwater in an open linear system, which could be divided into three parts: upstream, midstream, and downstream (**Figure 2.7**). In the upstream of the river, food webs are produced by the organic matter that progressively comes from degradation processes resulting from human activities, and also those of the invertebrates and micro-organisms along the course of the river channel (Vannote *et al.* 1980). The degree of deforestation and agriculture practices in the vicinity of a river, impacts significantly on the food chain in the river's midstream. At the downstream of rivers, the nutrient dynamics comprise the materials deposited from the upstream and midstream of rivers.

In terms of total area of the rivers in Southeast Asia, Pongsri *et al.* (2015) reported that Indonesia's rivers taken altogether have the widest area which total to about 1,899,750 km<sup>2</sup>, followed by Myanmar (737,800 km<sup>2</sup>), Thailand (511,311 km<sup>2</sup>), Malaysia (312,840 km<sup>2</sup>), Lao PDR (123,348 km<sup>2</sup>), and the Philippines (108,923 km<sup>2</sup>). The total river area of Cambodia is the smallest at 1,483 km<sup>2</sup>.



(a)



(b)



(c)

**Figure 2.7** (a) Downstream, (b) midstream, and (c) upstream

### *Floodplains*

A floodplain primarily comprises extensive shallow swampy areas, often associated with an interface of a river as part of a riparian zone, and seasonally varies in terms of area depending on the rainfall, discharge from inflowing streams, and groundwater. Floodplains are usually very productive and support fish populations that have already highly adapted to the demanding environmental conditions of the habitats. One of the most threatened of environments of inland waters is a floodplain since the level of water fluctuates very much and is even used as rice fields in the dry season. Although not a permanent area, floodplains account for over half of total wetland areas in Southeast Asia and support high levels of fisheries production, with the population of fish that usually increases during the wet season (Nguyen Khoa *et al.* 2005; Hurtle *et al.* 2008). During the water flooded the swamp

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area, some fish migrate for feeding and starting to spawn by putting and keeping the eggs among the branches of plants. The fish usually migrate to the swamp area are the blackfish group such as snakeheads, climbing perch, kissing gourami, and catfish.

In Southeast Asia, Indonesia has the biggest area of floodplains totaling to about 33,281,155 ha, followed by Thailand (12,851,984 ha), Myanmar (6,000,000 ha), Malaysia (2,979,918 ha), Cambodia (727,382.10 ha), and Lao PDR (156,000 ha).

The unique of Tonle Sap Great Lake in Cambodia is the system expands and contracts seasonally in response to rainfall and the flow of the Mekong, thereby acting as a storage which regulates flooding (**Figure 2.8**). When the level of the Mekong rises, water runs north-west ‘up’ the Tonle Sap towards the lake, which may increase from its dry-season (Dec-June) depth of 1-2 m up to about 10 m at the peak of the flood. The lake’s area expands from 2,500-3,000 km<sup>2</sup> in the dry season to 10-14,000 km<sup>2</sup> during the flood season, when it covers about 5-8% of the land area of Cambodia (Hortle *et al.* 2004).



**Figure 2.8** Tonle Sap Great Lake in Cambodia during the flooded (a) and dry season (b)

### Lakes

A lake is an area filled with water, surrounded by land, apart from any river or other outlets. Lake water body is stable relative than rivers, since it is a closed system and lie on the ground (**Figure 2.9**). Lakes could be natural or man-made. Natural lakes are generally found in

mountainous areas or along the courses of mature rivers. Man-made lakes have been constructed for agriculture purposes, e.g. irrigation, or for generation of hydroelectric power and domestic water supply, or for recreational purposes. and certainly, play an important role for fishery activities. In fact, lakes are multi-purposes usefull to support human being. This condition may arise often some conflicts of interest. Lakes are classified naturally according to the richness of their nutrients, from the oligotrophic lakes being the lowest in nutrients and the least productive to eutrophic lakes being high in nutrients and highly productive.

The total lake area in Indonesia is the biggest in Southeast Asia with about 1,800,000 ha, followed by Cambodia (334,186.79 ha), Philippines (87,168.40 ha), and Malaysia having the smallest lake area at 109,489 ha.



(a)



(b)



(c)



(d)

**Figure 2.9** Some views of lakes (a) Inle Lake in Myanmar, (b) Ranau Lake in Indonesia, (c) Taal Lake in Philippines, (d) Maninjau Lake in Indonesia with the floating net cages

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### Reservoirs

A reservoir is an artificial lake, also known as man-made reservoir, which can be formed by building a dam across a valley, or by excavating the land or by surrounding a piece of land with dyke sand diverting part of a river to flow into the reservoir. The water that accumulated and kept in the reservoir could then be used for irrigation, hydro-power generation or used as water source for domestic and industrial activities. Reservoirs are also constructed to effectively control unexpected floods. A reservoir is filled by precipitation, rainwater runoff or from a constant flow of a river. Sediments from rivers or surface runoff can significantly reduce the storage volume of a man-made reservoir (FAO 1992). Some reservoirs found in the ASEAN Member States (AMSs) include those in Myanmar with the biggest reservoir area of about 1,800,000 ha, followed by Thailand (645,350.62 ha), Indonesia (500,000 ha), Lao PDR (130,309.78 ha), Philippines (19,000 ha), and Cambodia (11,684.47 ha).

## Characteristics of Fish Diversity and Fishing Gears

### Fish Diversity

Freshwater fish which are restricted to inland waters cannot move quickly between different areas, therefore, inland waters are characterized by high endemism. Researches regarding the fish diversity identification has already been done in SEAFDEC Member Countries.

There are about 103 freshwater fish species in Brunei Darussalam of which 100 are native and 3 species were introduced. There are 23 of endemic fish with 15 belonging to the family Balitoridae.

More than 500 fish species are found in Cambodia freshwaters, but for any particular fishery most of the catch usually comprises 10 species or less such as *Cirrhinus lobatus/alamensis* (small river carp/Riel), *Channa micropeltes* (Giant Snakehead/Chdao), *Cyclocheilichthys anoplos* (Soldier river barb/Chhkok), *Labiobarbus* spp. (River Barbs/Ach nok), *Osteochilus*

spp. (Shark minnows/Kroh), *Circhinus microlepis* (Small scale carp/ Pruoi). *Pangasius* spp. (River catfish/Pis), *Barborrymus gontonotus* (Tear os/Chhpin prak), *Pateubuca typus* (Pelagic river carp/Siak russey) and *Channa striata* (Striped snakehead/Roh).

In Lao PDR, more than 481 fish species have been identified, including 22 exotic species, and more species are being discovered regularly. More than 10 exotic fish species have been introduced into Lao PDR through various sources, mostly not formally recorded, include: *Cyprinus carpio* (common carp or pa nai), *Carassius auratus* (gold fish or pa phek in the north), *Hypophthalmichthys molitrix* (silver carp or pa ked lap), *Ctenopharyngodon idella* (grass carp or pa kin gna), *Hypophthalmichthys nobilis* (bighead carp or pa houa nhai), *Oreochromis nilotica* (Nile tilapia or pa ninh), *Labeo rohita* (rohu), *Cirrhinus mrigala* (mrigal), *Catla catla* (catla) and *Clarias gariepinus* (African catfish or pa douk phanh) (Phonvisay 2013).

Indonesia is endowed with diverse freshwater fish species, which more than 1,300 species inhabit the Sundaland (about 798 species), Wallacea (68 species) and Sahulland (about 58 species) zones of the country, moreover of the total of about 924 species, 275 species (30%) are endemic species. About 19 introduced species recorded include: *Aequidens pulcher* (Blue Acara), *Aequidens latifrons* (Platinum Acara), *Aristichthys nobilis* (Bighead carp), *Betta splendens* (Siamese fighting fish), *Carassius auratus auratus* (Goldfish), *Clarias gariepinus* (North African catfish), *Ctenopharyngodon idella* (Grass carp/Tonggan), *Cyprinus carpio carpio* (Common carp/Ikan mas), *Oreochromis niloticus niloticus* (Nile tilapia/Nila), *Oreochromis mossambicus* (Mozambique tilapia/Jahir), *Poecilia sphenops* (Molly), *Poecilia reticulata* (Guppy), *Poecilia latipinna* (Sailfin molly), *Pterygoplichthys disjunctivus* (Vermiculated sailfin catfish), *Pterygoplichthys pardalis* (Amazon sailfin catfish), *Trichogaster pectoralis* (Snakeshin gourami/Lampor), *Tinca tinca* (Tench), *Xiphophorus maculatus* (Southern platy fish), *Xiphophorus helleri* (Green swordtail/Suwadakar) (<https://fish.mongabay.com/data/Indonesia.htm#hH8Ve2erorul5os3.99>).



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Meanwhile, the freshwater fish of Malaysia listed 641 species, 621 native species, 16 introduced species, 4 endemic species and 16 species still in questionable/misidentification. The endemic species are *Wallago maculatus*, *Phallostethus dunckeri*, *Parsphronemus nagyi*, and *Clarias batu*. While the introduced species are *Barbodes gonionotus* (Java barb/Lalawak), *Betta splendens* (Siamese fighting fish/Belaga), *Carassius auratus auratus* (Goldfish), *Catla catla* (Catla/Pla kra ho), *Cirrhinus chinensis* (Chinese mud/Kap Lumpur), *Cirrhinus cirrhosis* (Mrigal/Mrigal), *Clarias gariepinus* (North African catfish), *Clarias macrocephalus* (Bighead catfish), *Cyprinus carpio carpio* (Common carp/Leeko), *Etropus suratensis* (Green chromide), *Gambusia affinis* (Mosquito fish), *Hypostomus plecostomus* (Suckermouth catfish), *Micropterus salmoides* (Largemouth bass), *Oreochromis niloticus niloticus* (Nile tilapia), *Oreochromis mossambicus* (Mozambique tilapia/Tilapia), *Poecilia reticulata* (Guppy), *Pterygoplichthys pardalis* (Amazon sailfin catfish), *Trichogaster pectoralis* (Snakeskin gourami) (<https://fish.mongabay.com/data/Malaysia.htm>).

A total of 449 fish species have been identified from rivers and lake of Myanmar. Those are consisted of 365 native species and 54 endemic fish, 12 introduced species, and still questionable/ misidentification for remaining. The introduced species are *Aristichthys nobilis* (Bighead carp), *Barbodes gonionotus* (Java barb), *Clarias gariepinus* (African catfish), *Clarias macrocephalus* (Bighead catfish), *Ctenopharyngodon idella* (Grass Carp), *Cyprinus carpio carpio* (Common carp), *Gambusia affinis* (Mosquitofish), *Hypophthalmichthys molitrix* (Silver carp), *Pangasinodon hypophthalmus* (Sutchi catfish), *Osphronemus goramy* (Giant gourami), *Oreochromis niloticus niloticus* (Nile tilapia), *Oreochromis mossambicus* (Mozambique tilapia), *Trichogaster pectoralis* (Snakeskin gourami/ Bubble nest builder) (<https://fish.mongabay.com/data/Myanmar.htm>).

The Philippines noted their freshwater fish resources host about 358 species grouped onto 120 endemics, 59 introduces, and 102 threatened species. Some invasive species of Philippines can be processed to fish meal, dried fish skin, and handicrafts. Some of those fish are utilised as



a source of income and livelihood from local fishery, such as: *Gambusia affinis* (Mosquito fish), *Channa striata* (Snakehead), *Cyprinus carpio* (Common carp), *Oreochromis mossambicus* (Mossambique tilapia), *Oreochromis niloticus* (Nile tilapia), *Carassius* spp. (Crucian carp), *Cristaria plicata* (Freshwater mussel), *Liposarcus disjunctivus* (Janitor fish), *Liposarcus pardalis* (Janitor fish), *Clarias batrachus* (Thai catfish/Walking catfish), *Pomacea canaliculata* (Golden apple snail), *Parachromis managuensis* (Guapote tigre/Jaguar guapote), *Barbodes gonionotus* (Java barb/Tawes), *Pygocentrus nattereri* (Red piranha), *Clarias gariepinus* (African catfish), *Channa micropeltes* (Giant snakehead), *Arapaima gigas* (Arapaima), *Piaractus brachipomus* (Red-bellied pacu) ([http://www.ffc.agnet.org/htmlarea\\_file/activities/20110826121346/paper-729213301.pdf](http://www.ffc.agnet.org/htmlarea_file/activities/20110826121346/paper-729213301.pdf)).

Further, Thailand determined about 836 species of freshwater fish which consist of 17 endemic species, 23 introduced species and 756 native species. The endemic species are: *Badis siamensis*, *Cryptotora thamicola*, *Devario maetaengensis*, *Elloptostoma mystax* (Enigmatic loach), *Epalzeorhynchos bicolor*, *Homaloptera sexmaculata*, *Lobocheilos nigrovittatus*, *Lobocheilos thavili*, *Nemacheilus troglodactylus* (Blind cave loach), *Platyptropius siamensis*, *Propuntius speleops*, *Pterocryptis buccata* (Cave sheatfish), *Schistura jarutanini*, *Schistura oedipus*, *Schistura reidi*, *Schistura spilota*, *Trigonostigma somphongsii*.

The freshwater fish fauna of Singapore consists of 135 species of which 73 were regarded as native species, with 56 being introduced species and six being identification (<https://fish.mongabay.com/data/Singapore.htm>).

Viet Nam has 632 species which consist of 587 native species and 17 introduced species. The introduced species are *Aristichthys nobilis* (Bighead carp), *Aspidoparia morar*, *Carassius auratus auratus* (Goldfish), *Catla catla* (Catla), *Cirrhinus cirrhosis* (Mrigal), *Clarias gariepinus* (North African catfish), *Ctenopharyngodon idella* (Grass Carp), *Cyprinus carpio carpio* (Common carp), *Gambusia affinis* (Mosquito fish), *Hypophthalmichthys molitrix* (Silver carp), *Hypostomus plecostomus* (Suckermouth catfish),

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*Labeo rohita* (Rohu/Cá Trôi Ân Độ, Rôhu), *Micropterus dolomieu* (Smallmouth bass), *Oreochromis niloticus niloticus* (Nile tilapia/Cá Ro phi van), *Oreochromis mossambicus* (Mozambique tilapia/Cá Ro Phi den), *Pangasius pangasius* (Yellowtail catfish/Cá ba sa), *Poecilia latipinna* (Sailfin molly) (<https://fish.mongabay.com/data/VietNam.htm>).

Previous decade, people prefer to eat marine fish, but currently, many people tend to likely eat freshwater fish. It could be seen that it is easy to find the “pecel lele” restaurant in Indonesia. Lele is the *clarias* catfish that grows up from aquaculture with many advantages such as: rapid growth, containing high protein, and cheap price. Besides that, the tilapia issues development is very massive. This way could support the need of human being for fish consumption if conventional fish decreases.

The water condition in the whole stretch of river determines the different types of fishes. Welcomme (1985) stated that the condition towards the mouth of a river could differ from the rest of the parts of the river as saline waters penetrate many kilometers upstream, particularly in lowland rivers. Three groups of fishes inhabit in this transitional zone: (a) freshwater stenohaline species which enter the area during the flood and retreat upstream at low water according to the penetration of saline waters; (b) marine stenohaline species which follow the influx of marine waters into the river for feeding; and (c) euryhaline species which move a little but could adapt to the changing salinities of the water. Several aquatic species migrate between the river system and the sea either for breeding or feeding, and are called anadromous or catadromous species. Anadromous species completes its breeding cycle in freshwater, for example the salmonids, while catadromous species essentially lives in freshwater habitats but breed at sea, for example the anguillid eels (**Figure 2.10**).

Welcomme (1985) also stated that there are three distinct groups of freshwater species that migrate between rivers and floodplains. These are:

- a. The “blackfish” species, whose migrations are between dry and wet season habitat and these species are more normally confined to the swamp. During the dry season, the blackfish stay in the deep pool as their habitat.
- b. The “greyfish” species undertake moderate movements within the river, then spawn in the floodplain. The major migrations disperse in the floodplain as favored breeding places in the dry season.
- c. The “white fish” species undertake an upstream migration during the dry season or early in the wet season. Such migrations are usually linked to both the reproduction and the need to escape the adverse conditions of the downstream river channels and lakes in which water levels where the dissolved oxygen concentrations may become dangerously lowered for sensitive species.

### *Types of Fishing Gears*

Fishing gears used in inland fisheries are traditionally developed from small-scale fishing activities. The most widely used gear is stationary pots, stow net, lift net, gillnet, line, scoop net, bamboo trap, and cast net (**Figure 2.11**).



**Figure 2.10** The anguillid eels

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These gears are quite selective and straightforward to use. The use of fishing gears in inland waters often called “selective fishing gears” has to be permitted by authorities. A selective gear is a fishing gear designed to select target species including the sizes of fish. The selectivity of gears can reduce or exclude the capture of unwanted sizes of fish and incidental catch. It should be noted that multi-species and multi-size fishes inhabit the inland waters so that the application of gear cannot only select the appropriate size of fish to be caught. However, most fishers do not clearly define their target species, but their experience and knowledge of various environmental factors such as seasonal fish migration patterns, spawning seasons, and high-water level, while fishing lead them to get more fish or avoid catching specific species of fish.

In terms of fishing gear operation, there are two basic categories of fishing gears, namely the passive gears and active gears (**Figure 2.12**). Passive gears are stationary gears that are not to be dragged, pulled or towed to capture fish, and include among others, hook and lines, traps, wires, and gill nets among others that could effectively fish by themselves. The catch is recovered by merely removing the gear from the water after a certain period of time. No energy is expended in towing, pulling or dragging the gear out of the water. While active gears have to be moved, dragged, or towed to capture fish, and require engine-propelled boats to operate and thus, usually involve additional investments (Eyo and Akpati 1995).

## Characteristics of Fishers and Trading

### *Type of Fishers*

There are two types of fishers with respect to the fishing gears used. These are the individual fishers (**Figure 2.13**) and grouped fishers (**Figure 2.14**). The individual fishers work individually using simple fishing gears, usually inhabitants native to an area and do not need a license for the fishing activity. Usually, the fishers do fishing by himself, but in some case, they go to fish with their family. The grouped fishers work as a team of 3 to 10 people using more complex fishing gears, and may not necessarily include the inhabitants native to a place only but also the migrant fishers. Usually, they need an appointment before working together. The laters usually occurred in some countries, such as in Indonesia and Lao PDR. The migrate people comes from the intern country for example from village to other villages. In order to fish in a certain water body, the grouped fishers should have obtain permit to to fish, from the local government units. The license could be obtained through auctions conducted by the district government. Individual fishers could still fish in the auctioned area by paying certain a cost as rental, to the winner of the auction.

The levels of fisheries based on the practices adopted in utilizing the inland waters, are classified into two, namely: small-scale fisheries and middle-scale fisheries. Small-scale fisheries are generally meant to provide important source of food, employment, and income, and usually require only small capital investment, use low technology gear and vessels (often non-motorized), and catch fish for subsistence or for sale in local markets only.

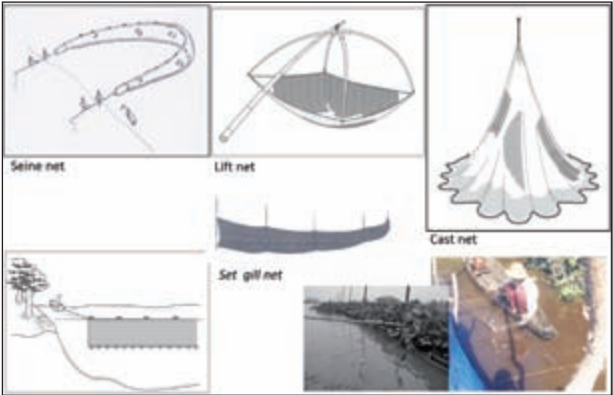
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(a)



(b)



(c)

**Figure 2.11**  
(a) Pot Traps;  
(b) Trap nets; and  
(c) Gill nets





**Figure 2.12** Passive gears (stow net) and active gears (cast net)



**Figure 2.13** Individual fishers

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Although some fishers often work part-time or seasonal, they play a key component in the livelihoods of millions of people, especially in the rural areas. Small-scale fishers are known to inhabit the areas along freshwater lakes, rivers, and reservoirs, and are dependent on fisheries activities daily. Although some fishers might be relatively well-off, majority of these fishers live in rural (often remote) areas, with poor standards of living, and are unable to meet their operating constraints. Middle-scale fisheries could be operated only in the open access area of the inland fishery domains using middle-scale fishing gears. In case of Cambodia, there are group of fishers categorized as middle-scale fishing, their fishing operation is only in the open access area.



**Figure 2.14** The fishers in Group



### *Women's Role in Inland Fisheries*

Women play multi-dimensional roles in the households that are often undefined or undervalued. It is for these reasons that gender issues in fisheries received attention in the global fisheries arena. The gender issues in fisheries across Southeast Asia have been evolving since the late 1980s. Although the Gender in Aquaculture and Fisheries Section (GAFS) of the Asian Fisheries Society (AFS) was officially founded in January 2017, the AFS has been active in promoting the importance of gender dimension in fisheries and aquaculture early on.

In the Southeast Asian region, women and men utilize different spaces and have differential access to resources because of the norms and values attached to certain places. In fisheries, the contributions of women are either overlooked or considered less valuable compared to those of men. Women are often assumed to play more traditional and supporting roles with lesser economic values attached to their activities. Women participate in the households' fishing activities that take place along the waters which are in the vicinity of their house because they want to stay close to their house. When not fishing, the women dominate in activities that support fishing, such as preparing food for their families, especially for their husbands when they go fishing, repairing fishing equipment (**Figure 2.15**), and sorting the landed fish catch of their husbands. Women also participate in the economic activities, usually in the processing and marketing of the fish catch (**Figure 2.16**).

### *Post-Harvest and Fish Trade*

Freshwater fish products from the inland waters constitute a significant part of the rural peoples' diet. Most of the fish catch are consumed immediately although some portions of the catch are sold in local markets. The surplus of the fish catch is preserved in variety of ways according to cultural preference and the prevailing local conditions. Commonly, fishers' families are engaged in fermenting (the primary process), pickling, drying, and smoking of fish (**Figure 2.17**).

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**Figure 2.15** Woman’s roles in repairing the fishing gear and sorting fish



**Figure 2.16** Woman’s roles on fish marketing

In the rural areas, where fresh fishes are not always available, preserved fish products are generally more valuable. In the Southeast Asian region, fermented fish is a significant staple product, particularly during times of the year when fish catch is low, or at the peak of agricultural labor requirements that reduce peoples' time available for fishing.

In processing the fish catch, the women are the main players. In spite of the women's key role in processing and marketing fish, both fresh and preserved fish products, still such economic activities are under-valued in the society.



**Figure 2.17** Traditional fish product

Markets are the central points where sellers and buyers meet. Insufficient support from local governments, especially providing better market facilities in the rural areas, often forces women to restrict their activities in the market. Thus, women would prefer marketing on a limited scale or directly selling their catch to middlemen even if the price is often quite low.

## 2.2 The Challenge to Manage the Inland Fisheries

The challenges in implementing some management approaches to inland fisheries include the multiple uses of inland waters and difficulties in acquiring accurate information on the status of the inland fishery resources. These challenges that impede the promotion of sustainable fisheries management are discussed below:

### Fishing Gears Used

According to Megwalu *et al.* (2018), the majority of the fishing gears used, either passive or active, has damaging effects to the environment. Illegal fishing practices in small-scale fisheries also impede the sustainable development of the inland fisheries, e.g. the use of dynamite and other explosives, and poison to kill the fish; the use of small mesh-size fishing nets and other destructive gears, and irresponsible methods and techniques; as well as the use of traps and weirs. These practices have been the root of certain problems associated with decreasing diversity, as well as the economic, institutional and social nature of inland fisheries. Since the inland waters are open access for small-scale fisheries, economic problems occur when the number of fishers increase and compete for the exploitation of the vulnerable resources. Social concerns take place because of low education and general poverty of the fishers, e.g. limited funds to buy appropriate or legal types of fishing gears. From the government side, there is no legislation governing small-scale fisheries, and the lack of capability and capacity of fisheries administrations to effectively monitor, control, manage, and to advocate the advantages of using legal fishing gears and related activities. The biological consequences of using the unconventional fishing gears include destruction of the natural habitats and ecosystems that sustain the fish populations; capture of juvenile and immature fishes before allowing them to grow to commercial sizes depriving fishers of more economic benefits; and damaged or loss of fish stocks, especially of the most commercially-important and target species.

## Lack of data and information

The catch statistics of inland fisheries are fragmented and discontinuous, and causes alarming condition in small-scale fisheries where large numbers of fishers are involved including occasional fishers, and where catches are unrecorded as these are brought directly to the local markets. Moreover, the catches comprised multi-species of fish that go immediately to various channels without proper recording, while large portions of the catches brought home for household domestic consumption.

In order to achieve the sustainability of the inland fish resources, it needs to understand the importance of catch statistic (especially on inland capture fishes). Statistic data would help the decision makers in taking the fisheries management policy measures.

The data needed initially come from a wide variety of sources. The existing subsistence fisheries may furnish some written or oral records of species available, fishing grounds, seasonal fluctuations and types of gear which are effective. Data collection can be done by hiring enumerators. To monitor the present situation of fish stock through the trend of CPUE, it needs to collect the data not only the catch but important also the fishing effort.

## Environmental Pressure

A human exploitation of fish resources can cause environmental degradation (**Figure 2.2**), such as the influence on the aquatic environment in the form of pollution that has worst effects on aquatic life. Most of the loss of freshwater biodiversity originates to failure in understanding the linkages between development activities and their impact upon freshwater ecosystems. The first pollution of aquatic comes from several sources, such as: agriculture (run-off of fertilizers and pesticides), domestic sewage, and industrial waste. Furthermore, the need for water to fulfil irrigation and domestic purposes will

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continuously reduce water availability for fisheries, especially during dry seasons. Also, an increasing demand for energy, including hydropower would likely lead to further damming of rivers.

The other environment pressure affecting inland waters is the climate change phenomena, which changing a of environment condition variability includes increasing of temperature, strong rainfall, and high river runoff charge.

### **Fish Stocking Activities**

Fish restocking in inland waters is done by releasing billion of hatchery bred species to increase fish population in the next future. The fish the caught by people are important as protein source for people living in rural areas, and also to conserve actually fish resources sustainability (**Figure 2.18**).

Most countries report that they conduct fish release to respond to degraded natural fish populations in some degrees. Fish release is an attempt to fix a problem to control fish exploitation as a result of habitat change or overexploitation of fish, or just to increase the fish stocks in general. The release of fish into the wild will increase stock abundance, and thereby harvest levels would be to increase. Fish restocking activity should be used local fishes, in order to fish be easy to adapt with the aquatic environment. Fish release activity in some countries tends to be as ceremonial to celebrate feast day in the country. Sometimes there is a confused word with introduced fish activity, for which the stocked fish are perceived to affect negatively the wild fish through competition or predation.





**Figure 2.18** Restocking activities in Serau River, Lipis, Pahang, Malaysia

## Inadequate Governance Systems

States should develop and publish policies and regulations for implementing the fisheries management. Procedures for allocation of fisheries management should be consistent with broader social, economic, and environmental objectives. Local communities use traditionally the inland waters for fishing should be received the attention from authority. Policies should take into account the interest of everyone which could be affected in the fishery management should be included in the consultation, participation and decision-making processes. Such systems should ensure that the allocation of management does not hurt the people in term of their livelihoods, by depriving them of their legitimate access to fish resources.