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A REVIEW OF THE INLAND FISHERIES OF THE PEOPLE'S REPUBLIC OF CHINA AND THE STRENGTHENING OF CAPACITY IN THE COLLECTION AND ANALYSIS OF INLAND FISHERIES STATISTICS

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Contents

Abbreviations

BCE	Before Common Era
CAFS	Chinese Academy of Fisheries Science
CE	Common Era
CPC	Communist Party of China
FAO	Food and Agriculture Organization of the United Nations
FAO RAP	Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific
FFRC	Freshwater Fisheries Research Center of Chinese Academy of Fishery Sciences
IBI	index of biotic integrity
MARA	Ministry of Agriculture and Rural Affairs (former Ministry of Agriculture)
MoA	Ministry of Agriculture (Now the Ministry of Agriculture and Rural Affairs)
NBS	National Bureau of Statistics
NGO	non-governmental organization
TAR	Tibet Autonomous Region
UNEP	United Nations Environment Programme

Executive summary

China has extremely diverse topography and a high degree of water diversity, with various rivers, lakes, reservoirs and other natural water resources. Although China's freshwater water resources are relatively rich, ranking sixth in the world, its large population results in a low per capita availability (at only 2 300 m^3). This is less than one-quarter of the world average and China is considered a water deficient country. China's surface water area of rivers, lakes and reservoirs is 20.6 million ha (not including 9.9 million ha in pits and ditches), comprising 8.8 million ha of rivers, 8.5 million ha of lakes and 3.4 million ha of reservoirs. There are 1 133 species of fish in China's inland waters, belonging to 19 orders, 54 families and 286 genera, including more than 1 000 freshwater fish species, more than 20 migratory fish species and more than 100 estuarine fish species. These waters and aquatic living resources not only sustain wild natural fishery production, but also support fish production based on stock enhancement and aquaculture.

Capture fishery production in inland waters of China is relatively heterogeneous, with wild capture fisheries common in natural waterbodies but with relatively low productivity. Most inland wild capture fishery production is concentrated in the major rivers and lakes, whereas most reservoir fisheries are dominated by enhanced fisheries. The productivity of wild capture fisheries in open waters is far lower than that of aquaculture, although aquaculture productivity is rather variable across the country and systems.

With increasing economic development, the role of inland capture fisheries in the social economy has also changed. Even though aquaculture production has massively increased and provides the bulk of freshwater fish supply, high-quality aquatic products from natural waters are still highly sought after by consumers, and inland capture fishing remains the primary freshwater fishery activity in some areas.

Although there are currently no accurate statistics for total freshwater fisheries catches in various waterbodies, there are more accurate statistics for some individual species that are caught in freshwaters. In 2020, the national freshwater fishing output was 1.46 million tonnes, which was a decrease of 20.84 percent over the previous year. Freshwater fish capture accounted for most of that production reaching 1.11 million tonnes. Since 2005, the output value of freshwater capture fishing and aquatic products in China has exceeded CNY 20 billion, reaching a peak of CNY 46.577 billion in 2018.

This review conducted some pilot field surveys, to explore the accuracy or weaknesses in the inland capture fishery statistics. Five waterbodies that are top producers for inland fisheries in China were selected (Baiyangdian Lake, Nansi Lake, Fuxian Lake, Huaihe River and Qiantang River). Their selection was based on factors such as high inland fisheries production, wide geographical distribution and the possibility of fishing under the closed season system, when inland fisheries continue to be practised. Based on the average yield of the sample vessels in each sampled waterbody between 2021 and 2022, the total inland fisheries yield of each waterbody was estimated compared with the inland fishery yield reporting data for each waterbody. The results revealed that the yield extrapolated from the data reported by the sample vessels was slightly lower than the reported value, but the overall difference was not significant.

With one exception (Fuxian Lake, where the sales method of the catch was standardized for vendors to buy on site), fishers used both direct sales and sales to vendors. There was a clear

difference in the sales proceeds of the catches in different surveyed waters. This difference arose not only from the differences in catch volume but also because of the different unit prices of the same species in different locations, and the prices of different species.

China's freshwater products have maintained a continuous growth, with gradual increase during the early years of the New China (1950–1960) when freshwater aquaculture production was negligible. Since the 1990s, there has been a gradual increase in aquaculture and a gradual decrease in inland capture fishery production since 2010. From 2016 onwards, with the issuance of various fishing ban policies and the strengthening of enforcement actions, especially the implementation of the "10-year fishing ban" on the Yangtze River and the fishing ban on major lakes, inland capture fisheries production dropped sharply. With the gradual expansion of closed areas and the gradual extension of closed periods, the output value of freshwater aquatic products in China has declined. It is expected that this production and value will decline further, with the increased awareness of the need for ecological protection in large waterbodies, the implementation of the fishing ban policy and the strengthening of law enforcement.

China's freshwater capture fishery has a long and rich cultural and spiritual history. The traditional production methods, special customs and habits, and wise production concepts offered ways to move towards transformation and upgrading of the inland capture fishery sector. The exploitation of cultural resources offers a basis for the sustainable development of inland capture fisheries and new associated industries with higher economic premiums than they currently provide through basic food provision. As China's freshwater capture fishery evolves, new models and new modes of fishery are rapidly emerging such as recreational fishing and so-called "green fishery".

A combination of factors is affecting China's freshwater ecosystems, resulting in a decline of natural fishery resources. The development of an ecologically conscious society with strengthened resource protection, enhanced environmental information and a conservation-oriented, ecological and sustainable approach has become the theme of the current era in China's development strategy.

China has established a comprehensive water resources management system, which is the basic system of the country's institutional arrangements on water resources management including the division of management powers. Numerous laws and regulations have been introduced as part of the introduction and implementation of sustainable water resources management. This is intended to promote the integration of livelihoods into water conservation projects and accelerate the development of a resource-saving and environmentally friendly society. A considerable number of aquatic ecological restoration projects have also been launched with restoration of rivers and lakes becoming one of the most important projects for resource protection.

However, problems remain with respect to China's water resources management with a mismatch in some localities between economic development and water resources allocation, resulting in economic development failure to align with water environmental carrying capacity. There has been severe depletion of aquatic biological resources over the last decade, especially rare and endangered aquatic fauna in the Yangtze River which has attracted significant attention. The historic promotion of aquaculture farming in large waterbodies has made outstanding contributions to China's freshwater fish production, but also created issues in terms of water pollution.

Domestic urban river regulation concepts and measures remain relatively immature, particularly the ecological restoration of urban rivers which is still in a preliminary technical

exploration stage. Restoration and improvement efforts are essentially limited to water quality and habitat improvement and there is still a lack of an integrated approach to link this with traditional water conservation. There are very few fishways in the country. Statistics on 3 641 national surface water assessment sections in 2021 showed that 85 percent of them had excellent water quality. The principal pollution indicators measured were chemical oxygen demand, the permanganate index and total phosphorus content.

China has strengthened the planning and construction of fisheries standards system since 2004. With more than 350 new national standards and industry standards formulated and released, with a focus on aquatic product quality and safety standards, the number of existing fisheries national standards and industry standards now stands at 804. The fisheries standards system has taken shape, with national standards and industry standards as the basis, with linked local standards and enterprise standards. The standards system covers various fields such as fisheries resources, environmental stewardship, breeding, processing, fishing vessels, fishing technology, fishing gear, engineering as well as provision of technical guarantees for regulating fisheries production, management and trade activities.

The legal basis for China's fisheries statistics system is mainly the Statistics Law, the Fisheries Law and the Regulations on Fisheries Statistics. At present, a combination of comprehensive statistical surveys and sample surveys is mainly used to obtain basic fisheries data.

The current development of the inland fishery sector is now demonstrating an increased need for better statistics (both capture fisheries and aquaculture). However, the foundation of fisheries statistics is still relatively weak and the management system and its implementation need to be further improved. Inland capture fishery production data are summarized at each level of the administrative hierarchy, starting from the grassroots organization where the fishing village or fishing vessel is located and proceeding through a bottom-up cascade of reporting. In recent years, to improve the reliability of statistical data, the national fisheries management authorities have organized the construction of a national fishing dynamics information collection network. This is supported by stratified sampling techniques and based on independent survey information sources, with sampling surveys as a basis for assessing the status of the fisheries industry. In freshwater capture fisheries, although the operating fishing vessels have low horsepower, the number of operating vessels is huge, and the statistical indicators and data volume are very complex.

Since the early 1950s, the State Council and the state fishery authorities have promulgated a number of fishery regulations and related circulars and instructions. The promulgation of the Fisheries Law of the People's Republic of China in 1986 marked the creation of China's fisheries management system and the beginning of the era of comprehensive management. China has now formulated and promulgated nearly 1 000 national and local fisheries laws, regulations and rules, covering all aspects of fisheries production and fishing. Local regulations on fisheries, developed under decentralized authorities, are an important basis for each locality to implement national laws and administrative regulations on fisheries, and are an important source of fisheries regulations in China.

There are also transboundary cooperation agreements for the conservation of endangered aquatic organisms and the conservation and utilization of fishery resources. Various non-governmental organizations (NGOs) have been established in different regions of China since 2004 to strengthen water resources management and aquatic life conservation and advance scientific and technological innovations. This will ultimately contribute to the conservation of water resources in China.

Since the founding of New China, the policy of China's fisheries industry has been to promote rapid development of aquaculture and capture fishery simultaneously. Propagation, stocking enhancement and protection of aquatic resources have been used to encourage consolidated management and joint development of reservoir fish farming and integrated fishery management. There have been initiatives to adjust and optimize the structure of the fisheries industry according to the objective laws of fisheries development and market demands. They also address the need for the zoning and reasonable layout of aquaculture production, together with the delineation of prohibited and restricted areas and breeding sites.

More recently an important change in China's management policies for capture fisheries has seen a move from the simple pursuit of yield growth to sustainable development. Over time this has also seen a shift in focus from development of capture fisheries in marine and freshwaters to a focus on aquaculture, complemented by capture fisheries. From the perspective of inland fisheries, the development of enhanced fisheries in China has mainly taken the form of enhancement of waters through stocking.

China's fishing ban policy began in 1980 with the piloting of the fishing moratorium implemented in the Yellow Sea and East China Sea regions. This has evolved from pilot exploration, comprehensive intensification to modern governance, and is characterized by an evolutionary path from offshore to inland river basins, from short-term to long-term fishing bans, and from local to basin-wide fishing bans. Since the implementation of the fishing moratorium system in 1995, nearly 30 years have passed. The implementation of the fishing moratorium system has great significance and has strongly promoted the protection and scientific management of fishery resources.

Importantly, there has also been a shift in the focus of fisheries management from controlling the volume of biological resources, towards safeguarding the rights and interests of fishers, with more emphasis on the overall enhancement of ecological, economic and social benefits. Traditional fishing methods are gradually being withdrawn from large water areas, and the development of ecologically enhanced fisheries for the purpose of resources conservation, in collective and other situations, may be the direction for developing ecological fisheries in large water areas in China.

The long-term development of capture fisheries management will focus on innovation or introduction of more advanced fisheries management concepts, reasonable arrangements for the open and closed seasons and the establishment of more effective inland capture fisheries management. Most reservoirs and lakes are now more inclined to develop ecological proliferation fishery since the onset of the new era. The coordinated development of fishery utilization and ecological protection through artificial proliferation and scientific fisheries rotation is one of the main directions of the development of large surface fisheries.

Recreational fishery is another field of fishery development in China. Overall, the development prospects of recreational fishery are very good. Tourism-oriented recreational fishery, recreational fisheries and collection industry are the leading subdivided industries, all of which are mainly conducted in freshwater waterbodies. In recent years, the state and local governments have attached great importance to recreational fishery and have issued a series of policies to promote the healthy development of recreational fishery. The recent, rapid development of recreational fisheries has made it an important factor influencing the integrated development of the fisheries industry and high-quality green development. Recreational fisheries has played an important role in promoting the implementation of the rural revitalization strategy, driving employment and income of farmers and fishers, and meeting the aspirations of urban and rural residents for better quality of life.

1. Introduction

1.1 INTRODUCTION

Capture fisheries and aquaculture are essential components of China's national economy and make an important contribution to China's food security, rural development and the incomes of farmers and fishers.

A well-developed fishery is conducive to supporting rural industry, sustaining natural resource and biodiversity welfare as well as improving people's diets and their health. It also provides national fiscal revenue including foreign exchange earned from exports, taxes and fees. Moreover, it contributes to the development of value chains, expansion of employment opportunities and the promotion of industries related to aquatic nutrition.

China has a long history of inland capture fishery that started in the Neolithic Period and inland capture fisheries are now found throughout the country. In some cases, fish are the principal source of animal protein and provide essential micronutrients in local diets. The nutritional profile of wild fish may be better than cultured fish and importantly, wild captured inland fish may be more accessible and affordable to poor rural households than fish from aquaculture or marine capture fisheries.

Inland capture fisheries worldwide are facing tremendous pressure from various drivers, including population growth, construction of water projects (*inter alia* waterways, harbours, reservoirs and dykes), excessive discharge of pollutants and landscape transformations. Overfishing caused by improper management of fishery resources, the expansion of fishing areas and the increase of fishing intensity has also contributed to impacts on fishery resources, resulting in a decline of productivity and loss of biodiversity.

Although inland fishery resources are renewable, they are finite and the aquatic ecosystem can only sustain catches that are commensurate with its productivity. Declining environmental integrity and overfishing will result in the system losing its regeneration capacity and consequently lack of sustainability.

The total surface area of inland water in China is 270 500 km^2; rivers accounting for about 46 percent. The main fishing waters include Poyang Lake, Dongting Lake, Hongze Lake and Taihu Lake.

China has collected statistics on inland fishery output since 1950 and has produced the *China fishery statistics yearbook* since 1981. The total landings from inland fisheries in China more than doubled from about 0.3 million tonnes in 1950 to 0.7 million tonnes in 1960. Due to overfishing, water pollution and water area exploitation for aquaculture, the output decreased sharply to 0.31 million tonnes in 1978. Since the evolution of the Reform and Opening-up programme, China experienced rapid and continuous growth in inland fisheries during the 1980s and produced more than 0.3 million tonnes in 1985, mainly due to economic reforms that allowed the microeconomic departments to operate independently, thus improving economic efficiency and promoting the rapid development of inland fisheries.

From the late 1980s until the early 1990s, the growth rate decelerated but with industrialization of the sector and improvement of fishing technologies, inland fisheries production reached new peaks, with over 1 million tonnes in 1993 and 2 million tonnes in 1998. Combined inland fishery and inland aquaculture production stabilized at 2.1 million tonnes to 2.5 million tonnes during the 20-year period between 1998 and 2017.

Since 2015, the government has attached great importance to the protection and restoration of aquatic biological resources and their habitats. It has implemented a series of fishing ban policies and ecological restoration measures that have resulted in a rapid decrease in inland fisheries output, falling to below 1.5 million tonnes in 2020.

As inland capture fishery has great significance for food security, nutrition and livelihoods, as well as biodiversity and aquatic ecosystem functioning, it is necessary to better understand the inland fishery resources of China and strengthen the collection and collation of inland fishery data at the provincial level.

Most inland capture activities are small scale and spatially dispersed; some are not reported to the government. In addition, other aspects, such as recreational fishing, have not been estimated, so it is difficult to obtain accurate inland capture production information. These weaknesses and inaccuracies in inland capture production data make it difficult to assess the true state of inland fishery resources.

Inland capture fishery statistics also do not clearly distinguish between landings of wild fish and fish from enhanced or culture-based fisheries. Assessments by the Food and Agriculture Organization of the United Nations (FAO) of China's fishery data in 1976, 2002 and 2008 respectively, found that China's reported inland fishery production did not disaggregate the reservoir output of enhanced fisheries from wild capture fisheries. It is therefore possible that this enhanced part of the output is also included in the inland capture output, resulting in unclear statistics on the contribution of inland wild fish capture and the considerably greater amount derived from enhanced or culture-based fisheries.

Another challenge has resulted from the large-scale implementation of China's fishing ban system in recent years, which has resulted in increased difficulty in compiling reliable statistics on inland fisheries. There is now an urgent need for an improved, science-based approach to the collection of inland capture fishery statistics, to improve understanding of the current situation in terms of inland fisheries and to develop a strategy for their sustainable development and management. These are essential for developing appropriate fishery management measures to make inland fisheries commensurate with ecosystem protection, conservation and sustainable use.

1.2 SIGNIFICANCE OF THIS OVERVIEW

1.2.1 Assessment of the current situation regarding inland capture fisheries in China

The collection and analysis of inland fishery production data in China are jointly conducted by the National Bureau of Statistics (NBS) and the Ministry of Agriculture and Rural Affairs (formerly the Ministry of Agriculture, MoA). This is done via the collection of comprehensive statistics, supplemented by sampling, participatory surveys and other survey methods. Obtaining accurate, comprehensive and standardized inland fishery production data can provide an important basis for fishery management and lay a foundation for the protection and rational utilization of inland fishery resources in China.

1.2.2 Preparation of inland fishery development plans

Studying inland capture fisheries production provides a basis for assessing the status of inland fishery resources and value chains, as well as the components of inland fishery production. This contributes to understanding interactions among fishery activities, the aquatic environment, fishery resources and the fishery economy as well as the preparation of appropriate inland fishery development plans. Ultimately, adjustments to the structure of the sector and optimization are enabled to achieve the sustainable development of inland fisheries.

1.2.3 Formulation of inland fishery conservation and management policies

Surveying inland fisheries production is an important basis for obtaining accurate inland fishery data, formulating and implementing effective fishery management policies as well as protecting aquatic organisms and other biodiversity. Facing the depletion of natural fishery resources, the fishery management departments have issued a series of measures to curb this trend and restore fishery resources. However, fishery management policies, based on inaccurate fishery production data, have not achieved their anticipated purpose.

The success of both the current fishing moratorium/ban system and the upcoming quota system for fisheries is strongly dependent on accurate fisheries production data. Effective decision-making on the declaration of prohibited fishing areas, length of closed fishing seasons and implementation of quota systems, is closely linked to the accuracy of capture fishery production data.

1.2.4 Promotion and awareness of inland fisheries

Conducting fisheries yield surveys is also important to make rational use of fishery resources and to improve social awareness of natural fishery resources protection. In addition, systematic inland fishery production surveys can support information related to fishery economic activities in China, improve national awareness about the need for rational utilization and protection of fishery resources, and contribute to better understanding of inland fisheries in the country.

1.3 EXPLANATION OF TERMS USED IN THIS REVIEW

Annual output statistics: The annual output of aquatic products is calculated according to the calendar year, i.e. from 1 January to 31 December. The annual output of aquatic products that has been produced in aquaculture ponds or caught in natural waters and has been returned to the port for unloading is included.

Aquaculture: The farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants with some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms that are harvested by an individual or corporate body that has owned them throughout their rearing period contribute to aquaculture (FAO, 1997).

Aquatic products: The final outputs from fishery and aquaculture production activities with the following characteristics: (1) They are the **result of fishery and aquaculture production activities**. They include all marine and freshwater fish, shrimp and crab, shellfish, seaweed and other fishery and aquaculture products except freshwater aquatic plants. Products created by other industries such as construction industries cannot be counted in the output of aquatic products. (2) They are the **final result** of fishery and aquaculture production activities. Intermediate elements in fishery and aquaculture production, such as fish fry, transferred pond fish and products used as bait cannot be counted in the output of aquatic products. (3) They are the **effective result** of fishery and aquaculture production activities. Aquatic products that have rotted and deteriorated before returning to port for unloading and cannot be eaten or processed into other products are not counted in the output of aquatic products.

Culture-based fisheries: A fishery in which the use of aquaculture facilities is involved in the production of at least part of the life cycle of a conventionally fished resource. Aquaculture is usually the initial hatchery phase that produces larvae or juveniles for release

into natural or modified habitats (FAO Term Portal, 2022). In China, culture-based fisheries are regularly and/or systematically stocked waterbodies that are owned by a cooperative, the state or a private company or fishing association. The fish are caught using fishing techniques (not pond harvesting as in aquaculture) and this catch is recorded as aquaculture production.

Division principle of aquaculture yield and capture fishery yield: The aquaculture yield is the aquatic products that have been artificially cultured and raised, and the fisheries yield is the aquatic products that grow naturally before capture:

a) The capture fishery yield of aquatic products growing naturally in natural waters (non-recruiting species), or stocked as hatchery seed, but with a minimum returned yield of less than 30 percent, are included in the freshwater capture fishery yield.
b) The output of aquatic products harvested or captured from freshwater aquaculture waters, where fish are artificially stocked and artificially raised and managed is calculated as freshwater aquaculture output; otherwise it is freshwater capture output.
c) Aquatic products from rice field aquaculture (where fish are stocked in rice fields) are also calculated as freshwater aquaculture output.
d) The output of aquatic products caught in mariculture waters where cultured or wild fish are artificially stocked and artificially raised and managed is calculated as the output of mariculture; otherwise it is the output of marine capture.

Enhanced fishery(ies): Fisheries that are supported by activities aimed at supplementing or sustaining the recruitment of one or more aquatic organisms and raising the total production or the production of selected elements of a fishery beyond a level which is sustainable by natural processes. Enhancement may entail stocking with material originating from aquaculture installations, translocations from the wild and habitat modification (FAO, 2011).

Fish catch: The mass or weight of aquatic organisms with economic value obtained by humans in natural waters in the process of fishery production.

Fish fauna: All fish presently or historically living in a certain geographical area or in a certain river basin.

Fisheries management: The state uses administrative and legal means to adjust the relationship between people and nature in the field of fishery, safeguard national fishery rights and interests and the legitimate interests in the process of fishery production, promote the ecological balance of fishery, continuously develop fishery productivity and provide high-quality aquatic products. Fisheries management organizations must rely on the authorization of fishery laws and regulations to exercise their functions and powers. Therefore, fisheries management is the state using legal procedures to implement the government's administrative supervision and scientific management of fisheries. Legal procedures include fishery legislation, fishery law enforcement and the observation of fishery laws by fishers.

Fishery resources monitoring: Continuously or regularly observing, measuring and analysing the status of fishery resources and environmental elements.

Fishery resources: Also known as aquatic resources. They are the natural sources and foundations of fishery production. They are freshwater and marine biota with development and utilization value in natural waters that are harvested for food, nutrition or economic purposes. According to the water area, they are divided into inland water fishery resources and marine fishery resources. Fish resources predominate.

Capture fisheries yield: Refers to the quantity of fish and other aquatic animals caught in the fisheries. It may be registered in kilogrammes, tonnes, load, boxes and other units of measurement. For large, rare and valuable aquatic animals, it is sometimes registered in number of heads, tails and other units of measurement.

Freshwater capture fisheries: The capture of wild fishery resources/aquatic resources from inland waters (rivers, lakes, reservoirs and ponds).

Freshwater capture products: These include freshwater fish, crustaceans (shrimp, crab), shellfish, algae and other groups.

Household food fisheries: Banned in some locations (e.g. the Yangtze Basin). elsewhere they are limited to single rod or reel capture. Similar to a recreational fishery, but the catch is brought home for consumption.

Inland capture fisheries: The removal of fish and other aquatic organisms from natural or enhanced inland fisheries, but excluding aquaculture. The extraction of living aquatic organisms from natural or artificial inland waters, but excluding those from aquaculture facilities (FAO, 2011).

Output measurement standard: Except for jellyfish and various seaweeds, aquatic products are measured according to the actual weight (live weight).

Recreational fishery: Any fishery for which the primary motive is leisure rather than profit, the provision of food or the conduct of scientific research and which does not involve the sale, barter, or trade of part or all of the catch (FAO Term Portal, 2022).

In China, this is similar to household food fishing but may involve registration with a fishing association. According to national fisher associations, 100 million people engage in some sort of fishing activity (note that this includes coastal fisheries and fishing in stocked ponds). Not all waterbodies are closely managed and do not require fishers to be registered, thus the total number of people who engage in recreational and subsistence fisheries is likely to be even higher.

Statistics: In aquatic product output statistics, aquaculture output is counted according to the location of water areas, fisheries output is counted according to the landing site and the output of pelagic fisheries is counted according to the measures for the administration of pelagic fisheries.

Stock enhancement: Activities aimed at supplementing or sustaining the recruitment of one or more aquatic species and raising the total production or the production of selected elements of a fishery beyond a level, which is sustainable through existing natural processes. In this sense stock enhancement includes enhancement measures, which may take the form of: introduction of new species; stocking natural and artificial waterbodies, including with material originating from aquaculture installations; fertilization; environmental engineering, including habitat improvements and modification of waterbodies; altering species composition, including elimination of undesirable species or constituting an artificial fauna of selected species; genetic modification and introduction of non-native species or genotypes (FAO Term Portal, 2022).

In China, this refers to placing or transferring eggs, juveniles or adults of aquatic organisms targeted by fisheries that are produced by artificial methods, directly into natural waters such as oceans, beaches, rivers, lakes and reservoirs. The purpose is to restore or increase

the populations of these species and improve and optimize the community structure of the waters. Broadly speaking, it also includes measures to improve the ecological environment of the water area, use of enhancement structures (for egg/larval attachment, artificial reefs, etc.) in the specific water area. It includes the indirect measures to increase wild population resources through protection of broodstock or breeding areas. It should be noted that the waters where seedlings are released or cultured and released in rivers, lakes and reservoirs are not included in the aquaculture surface area. Waters where the catch of artificially proliferated aquatic products is less than 30 percent of the total production are not included in reports of aquaculture production and surface area. The catch is reported as freshwater capture fishery yield.

Subsistence fishing: Households that engage in the occupation full time for household food needs – mainly undertaken by ethnic minorities and no longer a common livelihood.

Waterbody productivity: Also known as biological productivity of waterbody, it refers to the capacity of a unit waterbody to produce organisms in a unit time. It is the performance of a waterbody to ensure the reproduction rate of aquatic organisms. It is the comprehensive performance of the waterbody to meet the living requirements of economically valuable organisms. Its size is usually determined by the interaction of physical and chemical factors, biological factors and human factors.

2. General characteristics of China's inland waters

2.1 COMPOSITION OF INLAND WATERS

China has some of the largest inland surface water resources in the world. Overall, the inland water area is about 27 million ha, including about 12 million ha of rivers, 8 million ha of lakes and more than 80 000 reservoirs. These water areas are not only used for capture fishery production, but also for stock enhancement and aquaculture.

The exorheic river basins are largely distributed in the southeast of the country, with a total area of 612 million ha, accounting for 63.8 percent of the land area. The endorheic basins have a total area of 348 million ha, accounting for 36.2 percent, however their runoff is considerably lower, accounting for only 4.5 percent of surface water flows.

Lakes account for about 30 percent of the total inland water area in China and are largely concentrated in the eastern plain, northeast plain, Yunnan Guizhou Plateau, Mongolia Xinjiang Plateau and Qinghai Tibetan Plateau. The country's reservoirs are most densely distributed in the south of the Qinling Mountains and the middle and lower reaches of the Yangtze River. Due to the warm climate and good water quality conditions, they are often suitable for the development of aquaculture.

The development of fishery production in inland waters is relatively uneven. Capture fisheries in natural waters are more common, but the output is far lower than that of aquaculture. Most inland capture fishery production is concentrated in major rivers and lakes, and most reservoirs are dominated by stock enhancement fisheries. Although the output of artificial pond aquaculture is high, the per unit yield of aquaculture in different types of waterbodies is highly variable.

2.1.1 Distribution of water resources

The total volume of surface water resources in China is relatively high, ranking sixth in the world. However, due to China's large population, annual water availability per capita is only 2 300 m^3, which is less than one-quarter of the world's average.

China's water resources are unevenly distributed (Table 2.1). The Huaihe River Basin and its northern region account for 63 percent of the country's land area, but the water resources only account for 19 percent of the country's total. The Yangtze River Basin and its southern region account for 81 percent of the country's water resources, while the cultivated land area in this region accounts for only 36.5 percent of the country. As a result, the southern region has less cultivated land but more water, and the northern region has more cultivated land but lacks water.

The ten water basin systems of China can be divided into three distinct regions: southern, northern and northwestern:

- **The southern region,** including the four basins (the Yangtze River, the Pearl River, the coastal areas of East and South China, and the southwest rivers), is characterized by more people, less land and relatively rich water resources.

- **The northern region**, including the five basins (Songhuajiang River, Liaohe River, the Yellow River, Huaihe River and Haihe River to the north of the Yangtze River), is an area with a large population, extensive land and a serious shortage of water resources.
- **The northwestern region**, except for the Ertix River, consists of inland river basins, with a land area of 3.37 million km^2, and accounts for about 35 percent of the country. This region is a vast area with few people, an arid climate and a fragile ecological environment. Although water availability per capita in this area is adequate and the cultivated land resources are rich as well, the development and utilization of water and soil resources are seriously restricted by the ecological environment.

TABLE 2.1. Total water resources of provinces and cities in China

Provincial level administrative region	Precipitation /mm	Surface water resources (10^8 m^3)	Groundwater resources (10^8 m^3)	Non-renewable quantity of groundwater and surface water resources (10^8 m^3)	Total water resources (10^8 m^3)
China (total)	**692**	**28 311**	**8 196**	**1 328**	**29 638**
Beijing	924	32	48	30	61
Tianjin	984	31	11	9	40
Hebei	790	228	220	149	377
Shanxi	733	156	114	52	208
Inner Mongolia	344	789	239	154	943
Liaoning	933	460	151	52	512
Jilin	710	380	166	79	459
Heilongjiang	648	1 021	347	176	1 196
Shanghai	1 475	46	11	8	54
Jiangsu	1 190	443	135	58	501
Zhejiang	1 993	1 323	262	21	1 345
Anhui	1 292	798	212	85	883
Fujian	1 477	757	239	1	759
Jiangxi	1 587	1 401	332	19	1 420
Shandong	980	382	238	144	525
Henan	1 128	557	257	132	689
Hubei	1 269	1 170	326	18	1 189
Hunan	1 490	1 784	437	7	1 791
Guangdong	1 421	1 211	301	10	1 221
Guangxi	1 383	1 541	349	1	1 541
Hainan	1 881	335	93	7	342
Chongqing	1 404	751	129	0	751
Sichuan	1 005	2 923	626	1	2 925
Guizhou	1 227	1 091	264	0	1 091
Yunnan	1 124	1 616	563	0	1 616
China, TAR*	579	4 409	994	0	4 409
Shanxi	955	811	200	42	853
Gansu	289	268	120	11	279
Qinghai	356	824	363	18	842
Ningxia	274	8	16	2	9
Xinjiang	162	768	434	41	809

Note: * China, Tibet Autonomous Region.
Source: Ministry of Water Resources of the People's Republic of China. *China Water Resources Bulletin* 2021. China Water & Power Press.

2.1.2 River systems

China has many large rivers (Table 2.2). The total length of all rivers in China is 430 000 km. There are more than 50 000 rivers with basin areas ranging between 100 km² and 1 580 km². There are 79 large rivers with a catchment area of more than 10 000 km² and more than 20 rivers with a length of more than 1 000 km. The Yangtze River and Yellow River systems are the longest in China.

Since antiquity, rivers have played important roles in inland fisheries and fish production in China. The Northern Jiangsu Plain, belonging to the Yangtze River Delta, is densely covered with rivers and is the area in China with the most developed freshwater fishery, followed by the Pearl River Delta, the Heilongjiang River system and Ertis River in Xinjiang autonomous territory. The major rivers in China include the Songhua River, Liaohe River, Haihe River, Yellow River, Huaihe River, Yangtze River and Pearl River.

TABLE 2.2. Major river basin areas

Type	Basin name	Area (km²)	Proportion (%)
Exorheic regions	Heilongjiang River and Suifen River	934 802	9.83
	Liaohe River, Yalu River and nearby coastal rivers	314 146	3.30
	Hailuan River	320 041	3.37
	Yellow River	752 773	7.92
	Huaihe River and the coastal rivers of Shandong	330 009	3.47
	Yangtze River	1 782 715	18.75
	Zhejiang, Fujian rivers	243 528	2.57
	Pearl River and nearby coastal rivers	578 974	6.09
	Yuanjiang River and Lancang River	240 389	2.53
	Nujiang River and rivers in western Yunnan	157 392	1.66
	Yarlung Zangbo River and rivers in southern China, TAR	387 550	4.08
	Rivers in western China, TAR*	58 783	0.62
	Ertis River	48 779	0.51
Endorheic regions	Inner Mongolia inland rivers	311 378	3.28
	Hexi inland rivers	469 843	4.94
	Jungar inland rivers	323 621	3.4
	Central Asia inland rivers	77 757	0.82
	Tarim inland rivers	1 079 643	11.36
	Qinghai inland rivers	321 161	3.38
	Qiangtang inland rivers	730 077	7.68
	Closed flow areas of the Songhua River, Yellow River and rivers in southern China, TAR	42 271	0.44

Note: *China, Tibet Autonomous Region.
Source: Ministry of Water Resources of the People's Republic of China. *Second water resources evaluation.* Conducted from 2002 to 2005.

2.1.3 Lakes

Lakes account for about 30 percent of the total area of inland waters in China (Table 2.3). China's lakes are mainly distributed in the middle and lower reaches of the Yangtze River Plain and the Qinghai Tibetan Plateau.

TABLE 2.3. Statistical data on lakes in China

Size (km²)	Number	Total area km²
>1 000	14	34 618
500–1 000	17	11 231
100–500	108	22 415
10–100	517	16 992
10	656	85 257
1–10	2 086	5 763
1.0	2 759	91 020

Source: Authors' elaborations.

There are numerous freshwater lakes in the east, such as Poyang Lake, Dongting Lake, Hongze Lake, Taihu Lake and Chaohu Lake, accounting for about 45 percent of the total area of lakes. There are also saltwater lakes in the west, such as Qinghai Lake (Table 2.4).

Very large lakes include Qinghai Lake, Poyang Lake, Dongting Lak and Taihu Lake, and large lakes include *inter alia* Chaohu Lake, Gaoyou Lake, Eling Lake and Yamdrok Lake. These lakes account for only 1.1 percent of the total number of lakes, while their area accounts for 50.5 percent of the total area of lakes in China.

TABLE 2.4. Main lakes in China

Lake	Main location	River basin	Area/km²	Storage/ $10^8 m^3$	Lake type
Qinghai Lake	Qinghai	Qaidam	4 200	742	Saline
Poyang Lake	Jiangxi	Yangtze River Basin	3 960	259	Freshwater
Dongting Lake	Hunan	Yangtze River Basin	2 740	178	Freshwater
Taihu Lake	Jiangsu	Yangtze River Basin	2 338	44	Freshwater
Huhun Lake	Inner Mongolia	Inner Mongolia	2 000	111	Saline
Namtso Lake	China, TAR	Northern TAR Basin	1 961	768	Saline
Hongze Lake	Jiangsu	Huaihe River Basin	1 851	24	Freshwater
Siling Co Lake	China, TAR	Northern TAR Basin	1 628	492	Saline
Nansi Lake	Shandong	Huaihe River Basin	1 225	19	Freshwater
Zhari Namco Lake	China, TAR	Northern TAR Basin	996	60	Saline
Bosten Lake	Xinjiang	Gansu–Xinjiang region	960	77	Saline
Dangra Yun Co Lake	China, TAR	Northern TAR Basin	835	209	Saline
Chaohu Lake	Anhui	Yangtze River Basin	753	18	Freshwater
Buluntuohai Lake	Xinjiang	Gansu–Xinjiang region	730	5	Saline
Gaoyou Lake	Jiangsu	Huaihe River Basin	650	9	Freshwater
Yamdrok Tso Lake	China, TAR	Northern TAR Basin	638	146	Saline
Eling Lake	Qinghai	Yellow River Basin	610	108	Freshwater
Hala Lake	Qinghai	Qaidam	538	161	Saline
Ayakekumu Lake	Xinjiang	Northern TAR Basin	570	55	Saline
Gyaring Lake	Qinghai	Yellow River Basin	526	47	Freshwater
Aibi Lake	Xinjiang	Gansu–Xinjiang region	522	9	Saline

TABLE 2.4. (*continued*)

Lake	Main location	River basin	Area/km^2	Storage/ 10^8m^3	Lake type
Ngangla Ringco Lake	China, TAR	Northern TAR Basin	513	102	Saline
Taro Co Lake	China, TAR	Northern TAR Basin	487	97	Saline
Gyaring Co Lake	China, TAR	Northern TAR Basin	476	71	Freshwater
Sayram Lake	Xinjiang	Gansu–Xinjiang region	454	210	Saline
Songhua Lake	Jilin	Heilong River Basin	425	108	Freshwater
Bangongco Lake	China, TAR	Northern TAR Basin	412	74	Eastern end Freshwater and western end brackishwater
Manasarovar Lake	China, TAR	Southern TAR Basin	412	202	Freshwater
Honghu Lake	Hubei	Yangtze River Basin	402	8	Freshwater
Acike Lake	Xinjiang	Southern TAR Basin	345	34	Saline
Dianchi Lake	Yunnan	Yangtze River Basin	298	12	Freshwater
Rakshastal Lake	China, TAR	Southern TAR Basin	268	40	Freshwater
Liangzi Lake	Hubei	Yangtze River Basin	256	7	Freshwater
Erhai Lake	Yunnan	Southwest Region	253	26	Freshwater
Longgan Lake	Anhui	Yangtze River Basin	243	4	Freshwater
Luoma Lake	Jiangsu	Huaihe River Basin	235	3	Freshwater
Dalinuoer Lake	Inner Mongolia	Inner Mongolia	210	22	Saline
Fuxian Lake	Yunnan	Pearl River Basin	211	19	Freshwater
Pohu Lake	Anhui	Yangtze River Basin	209	3	Freshwater
Shijiu Lake	Jiangsu	Yangtze River Basin	208	4	Freshwater
Yucliangpao Lake	Jilin	Heilong River Basin	206	5	Freshwater
Daihai Lake	Inner Mongolia	Inner Mongolia	140	13	Saline
Botegang Lake	Xinjiang	Gansu–Xinjiang region	160	13	Freshwater
Jingpo Lake	Heilongjiang	Heilong River Basin	95	16	Freshwater

Source: Ministry of Water Resources of the People's Republic of China. 2017. *China water statistics yearbook*. China Water & Power Press.

2.1.4 Reservoirs

Reservoirs are artificial lakes formed by the damming of rivers or streams, with the primary functions of flood control, power generation, irrigation and shipping. Reservoir construction is a significant anthropogenic activity that affects inland waterbodies worldwide. They are ubiquitous, especially in areas with few natural lakes. China accounts for 46 percent of the global total of reservoirs with a height of more than 15 m.

By 2020, China had built more than 98 566 reservoirs of various types, with a total capacity of 930.6 billion m^3 (Table 2.5). There are 774 large reservoirs with a total storage capacity of 741.0 billion m^3, 4 098 medium reservoirs at 117.9 billion m^3 and 93 239 small reservoirs at 70.2 billion m^3. The largest reservoirs are listed in Table 2.6. The Three Gorges reservoir project is the world's largest.

TABLE 2.5. Inventory of water control structures built in China up to 2020

Type	Number
Reservoirs	98 566 reservoirs of various types with a total storage capacity of 930.6 billion m^3. There are: • 774 large reservoirs with a total storage capacity of 741.0 billion m^3, (79.6% of total storage capacity). • 4 098 medium reservoirs with a total capacity of 117.9 m^3, (12.7% of total storage capacity). • 93 239 small reservoirs with a total capacity of 70.2 billion m^3
Irrigation	7 713 irrigation areas of more than 6.67 km^2, with a total cultivated land irrigation area of 336 380 km^2. There are: • 282 irrigation areas between 200 km^2 and 333 km^2, with a total cultivated land irrigation area of 54 780 km^2. • 172 large-scale irrigation areas exceeding 333 km^2, with a total cultivated land irrigation area of 12 344 km^2.
River embankments	• 328 100 km of irrigation channels above level 5. • 239 600 km of embankments are up to standard. • Dyke compliance rate is 73.03%.
Water control structures	• 103 474 sluice gates with a flow rate of 5 m^3/s and above. • There are: 8 249 flood diversion gates, 18 345 discharge gates, 5 109 tide retaining gates, 13 829 diversion gates and 57 942 control gates.

Source: Ministry of Water Resources of the People's Republic of China. *2020 Statistic Bulletin on China Water Activities.* China Water & Power Press.

TABLE 2.6. Basic information on reservoirs in China

Reservoir	Province	River basin	Storage ($10^8 m^3$)
Three Gorges	Hubei	Yangtze River	393
Longtan	Guangxi	Pearl River	272.7
Longyangxia	Qinghai	Yellow River	247
Xin'anjiang	Zhejiang	Qiantang River	220
Danjiangkou	Hubei	Yangtze River	209.7
Daqikong	Guizhou	Yangtze River	190
Shuifeng	Liaoning	Yalu River	146.7
Xinfengjiang	Guangdong	Pearl River	139.8
Xiaolangdi	Henan	Yellow River	126.5
Fengman	Jilin	Songhua River	107.8
Tianshengqiao	Guangxi	Pearl River	106.8
Sanmenxia	Henan	Yellow River	103.1
Dongjiang	Hunan	Yangtze River	81.1
Zhelin	Jiangxi	Yangtze River	79.2
Baishan	Jilin	Songhua River	65.1
Liujiaxia	Gansu	Yellow River	61.2
Ertan	Sichuan	Yangtze River	57.9
Minyun	Beijing	Haihe River	43.8
Guanting	Hebei	Haihe River	41.6
Dongping Lake	Shandong	Yellow River	40
Lianhua	Heilongjiang	Songhua River	39.2
Yunfeng	Jilin	Yalu River	39.1
Geheyan	Hubei	Yangtze River	37.7
Datengxia	Guangxi	Pearl River	37.1
Zhexi	Hunan	Yangtze River	35.7
Huanren	Liaoning	Yalu River	34.6
Yantan	Guangxi	Pearl River	33.5
Songtao	Hainan	Nandu River	33.4
Xijin	Guangxi	Pearl River	30

TABLE 2.6. (*continued*)

Reservoir	Province	River basin	Storage ($10^8 m^3$)
Wuqiangxi	Hunan	Yangtze River	29.9
Panjiakou	Hebei	Luanhe River	29.3
Xierhe	Yunnan	Xi'er River	27.7
Chencun	Anhui	Yangtze River	27.2
Xianghongdian	Anhui	Huaihe River	26.3
Shuikou	Fujian	Minjiang River	26
Ankang	Shanxi	Yangtze River	25.8
Hongshan	Inner Mongolia	Liao River	25.6
Baozhusi	Sichuan	Yangtze River	25.5
Hualiangting	Anhui	Yangtze River	24
Meishan	Anhui	Huaihe River	23.4
Wujiangdu	Guizhou	Yangtze River	23
Wan' an	Jiangxi	Yangtze River	22.2
Mianhuatan	Fujian	Ting River	22.1
Dahuofang	Liaoning	Liao River	21.9
Guanyinge	Liaoning	Liao River	21.7
Hunanzhen	Zhejiang	Ou river	20.6
Zhanghe	Hubei	Yangtze River	20.3
Fengshuba	Guangdong	Pearl River	19.4
Erlongshan	Jilin	Liao River	17.6
Jingpohu	Heilongjiang	Songhua River	16.3
Nanwan	Henan	Huaihe River	16.3
Fushui	Hubei	Yangtze River	16.2
Gezhouba	Hubei	Yangtze River	15.8
Gangnan	Hebei	Haihe River	15.7
Yuqiao	Tianjin	Haihe River	15.6
Fengtan	Hunan	Yangtze River	15.4
Wangkuai	Hebei	Haihe River	13.89
Xiashan	Shandong	Weihe River	13.77
Chaersen	Inner Mongolia	Tao' er River	13.65
Luhun	Henan	Yellow River	13.2
Bailianhe	Hubei	Yangtze River	12.5
Nanshui	Guangdong	Pearl River	12.43
Yahekou	Henan	Yangtze River	12.25
Huangbizhuang	Hebei	Haihe River	12.1
Dahua	Guangxi	Pearl River	12.1
Guxian	Henan	Yellow River	12
Huanglongtan	Hubei	Yangtze River	11.6
Chengbihe	Guangxi	Pearl River	11.54
Hedi	Guangdong	Jiuzhou River	11.51
Gaozhou	Guangdong	Jianjiang River	11.5
Yuecheng	Hebei	Haihe River	10.9
Xidayang	Hebei	Haihe River	10.7

Source: FFRC using data from the Ministry of Water Resources of the People's Republic of China for this review.

2.1.5 Overview of inland waterways

Except for the artificial canal between Beijing and Hangzhou, the main natural inland waterways of China, such as the Yangtze, the Pearl, the Huai and the Heilongjiang (Amur) rivers generally flow west to east. This alignment also generally reflects the distribution

pattern of China's natural resources and economy that is densely concentrated in southern provinces and regions.

There are 12 provinces and regions with a channel length of more than 2 000 km (Table 2.7). Except for Heilongjiang Province, 11 provinces and regions are located along the Yangtze River and to its south; the total channel length of these 11 provinces and regions is 95 200 km, accounting for 87.1 percent of the total channel length of the country. Jiangsu Province has the longest river length, at more than 24 000 km, accounting for 22 percent of the total river length in China, followed by Guangdong, Zhejiang and Hunan provinces, each of which has more than 10 000 km of rivers.

In terms of channel density, there are 15 provinces and regions with an average channel length of more than 10 km per 1 000 km^2. Except for Shandong and Heilongjiang provinces, they are all distributed along the Yangtze River and to the south. The density of Shanghai is the largest (412 km/1 000 km^2), followed by Jiangsu (240 km/1 000 km^2) and Zhejiang (106 km/1 000 km^2).

The navigable channels for ships of more than 100 tonnes are mainly distributed in the five major water systems – the Yangtze River, the Pearl River, the Heilongjiang River, the Huai River and the Beijing–Hangzhou Canal (hereafter referred to as the "three rivers and two rivers" water system) amounting to nearly 30 000 km, accounting for more than 80 percent of such channels in China. The Yangtze River system accounts for the largest proportion, followed by the Pearl River system and the Beijing–Hangzhou Canal.

TABLE 2.7. The distribution of China's main inland waterways

Waterway length (km)			
Size	**Number of provinces**	**Total**	**Percentage of the country**
>2 000 km	12	100 695 km	92.13%
Channel density			
Size	**Number of provinces**	**Largest**	
>10 km/km^2	15	Shanghai (412 km/km^2)	
Waterway systems navigable to ships of more than 100 tonnes			
Main distribution		**Total**	**Percentage of the country**
Yangtze River, Pearl River, Heilongjiang River, Huaihe River, Beijing–Hangzhou Canal		30 000 km	>80%

Source: National Bureau of Statistics of China. 1989. *China statistical yearbook*. China Statistics Press.

The Yangtze River is the third largest river in the world and the most developed river in inland navigation terms. It is known as China's golden waterway. There are more than 3 600 navigable tributaries and its trunk and tributaries have a total navigable length of more than 70 000 km (including the Beijing–Hangzhou Canal and Huaihe River). At present, most of the inland river freight volume in China is concentrated in the Yangtze River system.

The Pearl River is one of the four major rivers in China. The river basin encompasses six provinces and some regions of Viet Nam. The total navigable length is more than 14 000 km, with Xijiang River as the main channel.

2.1.6 Overview of the fish passage and fish-friendly waterway crossings project

Fish passage projects involve the establishment of infrastructure that enables fish to bypass river gates and reservoirs and reach their spawning or breeding areas.

Fish migration facilities can be divided into upstream and downriver fish migration facilities. The methods used include fishways, fish locks, fish elevators and fish collecting boats. After a river channel is cut off by a gated reservoir, the natural riverine migration channel of fish is blocked. The construction of fish passage facilities is a measure to protect and sustain river fish resources.

Compared with earlier initiatives in Europe, the United States of America and other countries, Chinese fishway research started relatively late in the 1960s. China's research and development of fishways can be divided into three periods: the initial development period (1960s to 1970s), a stagnation period (1980s to 1990s) and the secondary development period (after 2000).

The initial development period began when the Qililong hydropower station on the Fuchunjiang River was constructed. The fishway concept was mentioned for the first time and scientific experiments and environmental impact assessments of the water system were carried out.

The stagnation of fishway development was mainly due to the debate on the fishway-related measures of the Gezhouba Water Control Project. Methods for building breeding and release stations were adopted to address the protection of rare species such as Chinese sturgeon. However, research data showed that most other fish were found downstream of the three ship locks at Gezhouba, indicating that other fish were still unable to migrate and breed effectively and that breeding and stocking were only alleviating the upstream problem of protecting populations of the rare Chinese sturgeon, but did not solve the other upstream problem of ordinary fish, let alone maintaining the circulation of rivers and the protection of the aquatic ecosystem.

With a deeper understanding of environmental protection, reservoir and hydropower projects are now required to add fishways during new construction, or as part of restoration and reconstruction initiatives for ecological restoration, biodiversity maintenance and mitigation of impacts on fish. Some examples are the Shangzhuang sluiceway in Beijing, the Changzhou water control project in Guangxi and the Cao'e River tidal barrier in Zhejiang.

There are incomplete statistics for 24 national water conservancy and hydropower projects completed since 2000. After technical assessment of the environmental impact of fish passage construction, it was concluded that there were 12 fish passes:

- 7 vertical slot fishways
- 3 natural channel fishways,
- 1 guide wall fish passage
- 1 cross partition fish passage

The vertical slot, natural channel can be used with a wider range of reservoir heights. The reservoir height for a vertical slot fishway is between 6.0 m and 39.7 m, the reservoir height for a natural channel fishway is 6.0 m to 28.7 m. The reservoir height for a guide wall fishway is 32 m.

2.2 OVERVIEW OF FISH RESOURCES

China has a very large area for freshwater fisheries, covering about 200 000 km^2, of which about 50 000 km^2 are natural habitats. Most parts of China are located in temperate or subtropical zones, with a mild climate and abundant rainfall, which both promote fish growth.

2.2.1 Fish biodiversity

Chinese freshwater fish fauna comprise 1 323 species, with most belonging to Cypriniformes and Cyprinidae (Xing *et al.,* 2016), of these, there are 877 species which are endemic to China.

Xiong Ying *et al.* (2015) list 1 133 species of fish in China's inland waters, belonging to 19 orders, 54 families and 286 genera, including more than 1 000 freshwater fish species, more than 20 migratory fish species and more than 100 estuarine fish species. Among the native species, Cypriniformes are dominant, with 838 species, accounting for 74.0 percent of the total. The next order is Siluriformes with 113 species, accounting for 9.97 percent of the total. There are 88 species of Perciformes, accounting for 7.77 percent of the total. In addition, there are 32 species of Salmoniformes, 9 species of Scorpaeniformes, 8 species of Acipenseriformes, 7 species of Anguilliformes and Mugiliformes, 5 species of Cyprinodontiformes, and 3 species of Petromyzontiformes, Clupeiformes and Pleuronectiformes. There are two species each in the order Gadiformes, the order Gasterosteiformes and the order Synbranchiformes, and 1 species each in the order Myliobatiformes and the order Osteoglossiformes.

There are a total of 161 endemic species out of 199 threatened species, with most classified as "endangered" (85 species) or "vulnerable" (70 species) (Xing *et al.,* 2016).

There are at least 439 non-native, freshwater fish species which have been introduced into China, belonging to 22 orders, 67 families, and 256 genera (Xiong *et al.,* 2015). The four most dominant orders are Perciformes (38.5 percent), Characiformes (14.8 percent), Siluriformes (13.9 percent) and Cypriniformes (11.2 percent). The origins of these non-native freshwater fish species are South America (35.5 percent), followed by Asia (23.0 percent) and Africa (21.4 percent).

2.2.2 Aquatic realms

Li Sizhong (1981) divided China's freshwater fish distribution into 5 zones and 21 subzones according to China's natural environment, biological sources and anthropogenic effects. These are:

Southeast region: This area includes mainland China (Guangdong, Guangxi, Yunnan, Guizhou, Fujian, Hainan) and Taiwan Province of China. These areas mainly have warm water fish with a wide variety of species. Representative fish include *Cirrhinus molitorella*, *Botia almorhae*, *Beaufortia levertti* and *Clarias fuscus*.

Northern region: This area mainly produces cold water fish, and is rich in *Acipenser sinensis*, *Mugil cephalus* and other species, such as *Plecoglossus altivelis* and *Lethenteron camtschaticum.*

Northwest Plateau: This region includes, *inter alia*, Xinjiang, northern China, TAR, Inner Mongolia, Qinghai, Gansu, and Shanxi. The natural waterbodies are rich in *Schizothorax sinensis*, *Diptychus maculatus Steindachner*, *Gymnocypris przewalskii* and other species.

Nulan District: This area includes southern China, TAR, Sichuan and Western Yunnan. It has a special geography; hence there are mixed fish groups from the southeast and northwest like *Balitoropsis zollingeri*, *Misgurnus anguillicaudatus* and *Lateolabrax japonicus.*

River plain area: This area includes the middle and lower reaches of the Yangtze River, the lower reaches of the Yellow River and the lower reaches of the Liaohe River. The area consists of numerous lakes and rivers and is the main producer of freshwater fish in China. There are many native fishes, including bighead carp, black carp, silver carp, common carp, crucian carp and silurid catfish (*Silurus asotus).*

The Yangtze River Basin: This is the most important production area of freshwater fisheries in China and has the most abundant fish resources, with more than 400 species of fish and more than 350 species of pure freshwater fish. The fish landings from the Yangtze account for up to 60 percent of the total inland capture fisheries production in China. It is rich in dozens of commercially important fish such as black carp, silver carp and bighead carp. However, due to the impact of human activities and environmental changes in recent decades, overall fish resources have decreased significantly and some species have become endangered.

2.2.3 National aquatic resource protection areas

China is rich in aquatic biodiversity with resources that are both are abundant and widely distributed. However, due to overfishing, creation of water-storage and water-management structures and habitat destruction, the aquatic resources in many areas of China have decreased sharply or even been lost. This has seriously affected the economic viability of inland capture fisheries, fish genetics, reproduction and ecological protection.

According to the list of endangered fish species in China's inland waters, a total of 245 endangered species (202 endemic) belong to 10 orders, 28 families and 108 genera, accounting for about 20 percent of the total fish species in inland waters. *The national list of key protected wildlife* published by China in 2021 contains the national protected fish of the first class including *Acipenser sinensis*, *Acipenser dabryanus*, *Tenualosa reevesii* and *Coreius septentrionalis*. More than 60 other species (some listings only cover wild populations) are classified as national protected fish of the second class, including *Anguilla marmorata*, *Myxocyprinus asiaticus*, *Coreius guichenoti* (wild population) and *Trachidermus fasciatus* (wild population).

The establishment of aquatic resource protection areas is an important measure for the protection and rational utilization of aquatic resources and their spawning grounds, feeding grounds, wintering grounds and migration channels. In 2007, the general office of the MoA made it clear that aquatic resources must be protected and managed according to law.

To date, China has established 535 national aquatic resource protection areas to conserve more than 300 aquatic species. The protected areas encompass more than 150 000 km^2 and are mainly for the protection of fish resources, especially freshwater fish. Nearly 1 000 seed conservation banks have been established and 2 028 species have been preserved (including more than 120 aquaculture species) as well as cell, gamete and gene resources of important species. A technical system for collection, sorting and preservation of aquatic resources has been established and fish germplasm conservation technologies have been studied and developed. The whole genome sequence map and high-precision genetic linkage map of more than 30 aquatic organisms has been completed.

2.3 STATUS OF AQUATIC ENVIRONMENTS IN INLAND WATERS

2.3.1 Water quality conditions

Status of surface waters: The Bulletin of the State of Eco-Environment in China 2021 provides an assessment of the status of China's 3 641 km^2 of national water surface areas (January to December 2021):

- 84.9 percent of the sections have excellent water quality (Class I to Class III) (surface water environmental quality Standard GB3838-2002), an increase of 1.5 percent compared with 2020.
- The proportion of inferior Class IV sections was 1.2 percent, all of which met the water quality target of 2021.
- The main pollution indicators were chemical oxygen demand, permanganate index and total phosphorus content.

Water quality of 210 lakes and reservoirs: This showed that good quality waterbodies (Class I to Class III) accounted for 72.9 percent of the total, a decrease of 0.9 percentage points from 2020. Poor water quality waterbodies (Class V) accounted for 5.2 percent. The main pollution indicators were total phosphorus content, chemical oxygen demand and the permanganate index.

Nutrient status monitoring of 209 lakes and reservoirs: In this analysis, 9 waterbodies were moderately eutrophic, accounting for 4.3 percent; 48 were mildly eutrophic, accounting for 23.0 percent; while the remaining 135 were in a mesotrophic or oligotrophic state. For example, Taihu Lake Basin was lightly polluted and lightly eutrophic; the main pollution indicator was total phosphorus content. Chaohu Lake was moderately polluted and moderately eutrophic; the main pollution indicator was total phosphorus content. Dianchi Lake was lightly polluted and moderately eutrophic; the main pollution indicators were chemical oxygen demand, total phosphorus content and the permanganate index. The water quality of Danjiangkou Reservoir and Erhai Lake is excellent and moderately eutrophic. Baiyangdian Lake has good water quality and is lightly eutrophic.

Compared with the same period in 2020, the water quality of Baiyangdian Lake had improved, while that of Taihu Lake, Chaohu Lake, Dianchi Lake, Danjiangkou Reservoir and Erhai Lake showed no significant change. The nutrient status of Baiyangdian Lake had improved and that of Chaohu Lake had diminished. The nutrient status of Taihu Lake, Dianchi Lake, Danjiangkou Reservoir and Erhai Lake had no significant change.

Selected rivers subject to national-level monitoring: Eighty-seven percent of the sections of seven major river basins and the Northwest rivers, the Southwest rivers and the rivers of Zhejiang and Fujian was Excellent to Good water quality (Class I to Class III). This was an increase of 2.1 percent on 2020. Among them, the water quality of the Yangtze River Basin, the Northwest rivers, the Southwest rivers, the rivers of Zhejiang and Fujian and the Pearl River Basin was excellent. Yellow River, Liaohe River and Huaihe River basin water quality was good. Songhua River and the Haihe River Basin were lightly polluted. Rivers with poor water quality (Class V) were at 0.9 percent, a decrease of 0.8 percent. The main pollution indicators were chemical oxygen demand, the permanganate index and total phosphorus content (Table 2.8).

TABLE 2.8. Standard limits of some measures of surface water environmental quality standards

Water quality measure	I	II	III	IV	V
Temperature (℃)	Anthropogenic changes in environmental hydrology should be limited to: a) Maximum weekly average temperature rise ≤1 ℃ b) Maximum weekly average temperature drop ≤ ℃				
pH	6–9				
Dissolved oxygen ≥	7.5 Satn＞90%	6	5	3	2
Potassium permanganate index ≤	2	4	6	10	15
Ammonia nitrogen ≤	0.15	0.5	1.0	1.5	2.0
Total phosphorus content ≤	0.02 L/R: 0.01	0.1 L/R:0.025	0.2 L/R:0.05	0.3 L/R:0.1	0.4 L/R:0.2
Total nitrogen content ≤	0.2	0.5	1.0	1.5	2.0

Note: Satn. = dissolved oxygen saturation; L/R = lakes or reservoirs.
Source: Authors' elaborations.

2.3.2 Productivity analysis of some major waterbodies

Statistics of fish resources in the main stream of the Yellow River indicated that from the 1950s to 1960s, the Yellow River was rich in fish resources and had high yields, which decreased sharply in the 1970s and became even lower in the 1980s. Compared with the 1950s, fishery production decreased by about 80 percent to 85 percent. There are few quantitative studies on fish populations in the main stream of the Yellow River. At present, there are still some fishery resources in the upper reaches of the Yellow River, the reach below Xiaolangdi Reservoir has fewer fishery resources and the middle reaches of the Yellow River have the fewest fishery resources, especially the main stream of the middle reaches. The fish resources in the main stream of the Yellow River have been seriously impacted.

The number of fish species in the different sections of the Yangtze River basin and typical catches by fishing boats are listed in Table 2.9.

Dongting Lake is a representative example of lakes in the Yangtze River Basin (between Jingzhou and Honghu), with 130 species identified (Chen *et al.*, 2022) and 71 species of fish were caught in the lake. The catches of sedentary fish such as carp, crucian carp, *Silurus asotus* (Amur catfish) and *Tachysurus* spp. (Bagrid catfish), accounted for 63.7 percent of the total population and these represent the main economic fish in Dongting Lake. It is estimated that the natural fishing output of Dongting Lake is 27 000 tonnes, or 12 000 tonnes in East Dongting Lake, 9 000 tonnes in South Dongting Lake and 6 000 tonnes in West Dongting Lake.

In Poyang Lake (downstream of Huangshi), 78 species of fish were collected, and the fish catches were dominated by carp, crucian carp, catfish, yellow catfish, the "four major fishes", accounting for 85.4 percent of the total population. These species are the main economic fishes in Poyang Lake. On this basis, it is estimated that the natural fishing output of Poyang Lake is 29 000 tonnes.

TABLE 2.9. Fish species caught and the catch in different sections of the Yangtze River

The Yangtze River	Number of fish species	Main fish species	Average daily production per vessel (kg)
Downstream section of the Jinsha River	71	*Coreius guichenoti*, *Pseudobagrus vachelli*, *Garra pingi pingi*, *Silurus asotus* and common carp	3.0
The river section above the Three Gorges Reservoir area	112	*Pseudobagrus vachelli*, *Lates calcarifer*, *Rhinogobio cylindricus*, *Saurogobio dabryi* and crucian carp	2.9
Three Gorges Reservoir area	62	Silver carp, common carp, crucian carp, *Pseudobagrus vachelli* and *Culter alburnus*	12.3
Jingzhou River section	50	*Coreius heterodon*, bream, *Siniperca chuatsi*, grass carp and *Squaliobarbus curriculus*	9.3
Honghu River section	28	*Coreius heterodon*, *Silurus asotus*, *Tachysurus dumerili*, common carp and grass carp	20.3
Huangshi River section	53	*Coreius heterodon*, common carp, silver carp, bighead carp and black carp	21.0
Downstream section of the Yangtze River	83	Silver carp, bighead carp, common carp, crucian carp, bream and grass carp	–
Estuary section	142	*Lateolabrax japonicus*, *Acanthogobius ommaturus*, *Odontamblyopus lacepedii*, *Cirrhinus molitorella* and *Coilia nasus*	–

Source: FFRC using data from the *China water statistics yearbook*.

2.3.3 Biotic integrity assessment of waterbodies

Biological integrity assessment mainly addresses the study of the whole ecosystem and the assessment of river health, by establishing a reliable Index of Biotic Integrity (IBI). The IBI refers to a series of changes in the structural function and habitat of organisms when a river is disturbed by human activities or natural disasters. It evaluates the health of an ecosystem by using biological parameters sensitive to environmental changes. This index evaluation method mainly reflects the health status of the ecosystem in terms of composition, structure and function of biological groups, and the most sensitive biological parameters to environmental disturbances are selected and constructed to quantitatively describe the relationship between biological characteristics and abiotic factors.

At the end of the twentieth century, China began to realize that activities such as flood control and water resources development had caused major changes in the hydrological conditions and topographic and geomorphological features of rivers, and the ecosystem functions of rivers had been seriously degraded. Since then, China has begun to absorb and adopt more advanced ideas and concepts of ecological protection and restoration for river management and gradually shifted its focus and policies towards this.

Compared with developed countries, domestic urban river regulation concepts and measures are relatively old-fashioned in China; in particular the ecological restoration of urban rivers is still at the initial and technical exploration stage. Efforts are basically limited to water quality improvement and landscape construction. The organic combination of traditional water conservation, habitat restoration, landscape development and so forth needs considerable attention.

Studies on river water quality in China are still mainly based on chemical methods, and there are few reports on river biology monitoring. Only the Yangtze River, the Huoxi River in Sichuan and the West Campsite River in Zhejiang have biological integrity assessments. With the implementation of sustainable development strategies, a healthy river ecosystem will become the main goal of river management. Therefore, it is necessary to carry out relevant research rapidly, establish a set of river ecosystem health theories and evaluation systems applicable to China, evaluate the health of major rivers, and conduct a quantitative assessment for ecological restoration. These activities would provide basic data to inform decision-making for low-carbon ecological river and watershed management, to ultimately achieve sustainable socioeconomic and environmental development.

2.3.4 Analysis of the causes of resource decline

At present, a combination of factors is affecting China's freshwater ecosystems, resulting in a decline of natural fishery resources. These factors are: (1) water resource development projects are blocking the passage of migratory fish in some areas, and the flow of water into static water is changing the shape of the waterbody, reducing the self-purification capacity of the river ecosystem; (2) some river sections are in a serious state of pollution year round or in some seasons; (3) overfishing is one of the main reasons for the decline of fishery resources in the twenty-first century; (4) the introduction of non-native species that are usually well adapted to their new environments, so they keep reproducing and form self-sustaining populations, affecting the germplasm resources of the original indigenous fish; (5) the impact of climate change, such as the drying up of the main stream of the Yellow River, has led to the reduction of some estuarine and anadromous fishes, and the shrinkage of the distribution range of some fishes that are sensitive to environmental changes; (6) the influence of other anthropogenic factors, such as heavy fishing and arbitrary release, has seriously damaged the ecological balance, thus changing the population structure and the composition of the fishery system.

2.4 THE STATUS OF INLAND WATER RESOURCES PROTECTION

2.4.1 Water resources protection laws and regulations

With continuous and rapid economic and social development, the human demand for water resources is expanding and the pressure posed by human activities on aquatic ecosystems is increasing in China. In order to implement sustainable water resources management, promote the integration of livelihoods into water conservation projects and accelerate the construction of a resource-saving and environmentally friendly society, China has introduced numerous laws and regulations, including the Water Law of People's Republic of China (1988), the Water Pollution Prevention and Control Law (1984), the Environmental Protection Law (1989), the Implementation Measures of the Water Abstraction Permit System (1993) and the Interim Regulations on the Prevention and Control of Water Pollution in the Huaihe River Basin (1995).

Overall, China has established a comprehensive water resources management system, which is the basic mechanism of the country's institutional arrangements on water resources management, including the division of management powers. It is an institutional guarantee for the rational development, utilization, conservation and protection of water resources, prevention and control of water disasters, and the sustainable use of water resources.

2.4.2 Water environmental protection measures

To achieve the construction of an ecologically conscious society with strengthened resource protection and upgraded environmental information, taking a conservation-oriented, ecological and sustainable path has become the theme of the current era in China's development strategy. Looking back at the history of China's fishery industry development, three kinds of net closure in aquaculture farming in large waterbodies has made an outstanding contribution to China's fishery production but also generated water pollution problems. As China pursues the development of an ecologically conscious society, a considerable number of aquatic ecological restoration projects have been launched.

Ecological restoration refers to the comprehensive restoration of a polluted environment that is guided by ecological principles, based on biological restoration, combined with various physical, chemical and engineering measures, through an optimal combination to achieve the best effect with the lowest cost. Since 2002, China has initiated the first batch of pilot ecological restoration projects for soil and water conservation, and ecological restoration has developed rapidly since then.

So far ecological restoration of rivers and lakes has become one of the most important projects for resource protection. China is also using the policy of establishing an ecological red line – i.e. the bottom line of ecological and environmental security – to establish the most stringent ecological protection system and put forward higher regulatory requirements for ecological function protection, environmental quality security and natural resource utilization. The aim is to promote a balance between population, resources and the environment and the unification of economic, social and ecological benefits.

In January 2014, the Ministry of Environmental Protection issued the Technical Guide for the Delineation of the National Ecological Protection Red Line – Ecological Function Baseline (Trial), which became China's first programmatic technical guidance document for the delineation of the ecological protection red line. One year later, China issued the Technical Guide for the Delineation of the Ecological Protection Red Line and the Notice on the Pilot Work of Ecological Protection Red Line Control to explore pilot activities. In August 2019, the Notice on the Issuance of Technical Regulations for Ecological Protection Red Line Survey and Demarcation was issued, and it required the country to fully complete the ecological red line survey and demarcation work by the end of 2020, which marked the start of a new era for ecological protection in China.

2.4.3 Non-governmental organizations for water resources protection

Water resources are an important strategic resource for China's economic development and provide the basic conditions for human survival and development. At present, there are still some problems with respect to China's water resources management. The economic development layout of some localities does not match the water resources allocation pattern, and the economic development mode does not coordinate with the water environment's carrying capacity.

Moreover, China's severe depletion of aquatic biological resources in the last decade, especially the rapid depletion of rare and endangered aquatic animals in the Yangtze River, has attracted much attention. Since 2004, a variety of NGOs, including waterbody conservation alliances, aquatic life conservation alliances and water environmental protection organizations, have been established in different regions of China (Table 2.10). These organizations aim to strengthen water resources management and aquatic life conservation and advance scientific and technological innovations, to ultimately contribute to the conservation of water resources in China and globally.

TABLE 2.10. Resource conservation organizations

Name	Est.	Main purpose
Clearwater Alliance	2004	Committed to improving the management of China's water sector, protecting water resources, reducing pollution, improving water quality, ensuring national health, promoting business and public participation, positively influencing public policy and interacting with the government.
Water Resources Association	2005	The aim is to raise public awareness of water culture, water conservation laws and regulations, and new concepts of water management, so that the concept of "love and conservation of water" can take root in people's hearts and minds, thus achieving "harmony between people and water".
Aquatic Wildlife Protection Branch of Wildlife Conservation China	2007	Aims to save rare and endangered species, protect biodiversity, raise awareness of environmental protection among all people and create a better future for humanity to live in harmony with nature through extensive publicity and the organization and mobilization of society in general.
National Strategic Alliance for Technology Innovation in the Rare Fish Industry of the Yangtze River	2014	Focuses on the needs of the healthy and sustainable development of China's Yangtze River rare fish industry and taking the Yangtze River rare fish species population as the main unit, it focuses on research and demonstration of common and key technologies for the industry, and strives to enhance the core competitiveness of China's rare fish industry.
Groundwater Pollution Prevention, Control and Remediation Industry Alliance	2016	Aims to enhance capacity for national groundwater system management and scientific decision-making.
Chinese Sturgeon Conservation and Rescue Alliance	2016	Focuses on the "whole life history" conservation of the Chinese sturgeon.
Yangtze Finless Porpoise Rescue Alliance	2017	Aims to promote the establishment of five new natural relocation reserves for the Yangtze finless porpoise and establish a population exchange mechanism to protect the species.
Yellow River Aquatic Life Conservation and Ecological Restoration Science and Technology Innovation Alliance	2020	Striving to address the major scientific issues and common critical technical problems faced in the protection of aquatic life and ecological restoration of the Yellow River Basin. It seeks to create a new pattern of harmonious coexistence between humans and nature in the Yellow River Basin.

Source: Authors' elaborations.

2.4.4 Management and utilization history of major waterbodies

China's protection of water resources is gradually increasing and the utilization of wild fishery resources in China's major inland waterbodies is subject to tightening regulations or even prohibition in some places. Taihu Lake, for example, is one of the five major freshwater lakes in China, with more than 2 133 km^2 of water surface and rich fishery resources. Since establishment in 1946, the Taihu Lake Fisheries Production Management Committee of Jiangsu Province and its Fishery Supervision and Administration Station have always

adhered to the principle of "Taking from fishery and using it for fisher", following the path of combining economic self-reliance and protection of fishery resources. As a result, the fishery of Taihu Lake gradually underwent rapid development, with fishery production increasing year by year and the income of people living along the lake constantly increasing. However, since 1984, Taihu Lake has been closed to fishing for half a year, this has reduced the operational costs of fishing production and also improved the quality and yield of fish, improving economic benefits and has been strongly supported by the local fishers.

Since 1989, the lake has been closed for half a month in addition to the half-year closure.

Taihu Lake Basin has become one of the most economically and socially developed areas in China. However, rapid industrialization and urbanization have also caused the eutrophication of Taihu Lake that has reached serious levels. In 2007, the large-scale bloom of cyanobacteria in Taihu Lake led to a drinking water crisis, which made people realize the importance of protecting the water environment. Since then, the Taihu Lake Fisheries Management Office has been committed to the protection of water quality in Taihu Lake through various measures, such as large-scale proliferation and release of silver carp and bighead carp, regulation of small-sized fish and proliferation of benthic organisms. Since 2007, 266.67 km^2 of three national aquatic resource reserves have been designated in Taihu Lake.

On 1 October 2020, the Department of Agriculture and Rural Affairs of Jiangsu Province withdrew fishing rights from Taihu Lake fishery producers, revoked fishing permits and cancelled relevant certificates in compliance with a ten-year fishing ban along the Yangtze River that prohibits productive exploitation of natural fishery resources. In 2020, the fishers of Taihu Lake fully retired from fishing owing to the local government policy mentioned below, which is of great significance for the protection of fishery resources of Taihu Lake.

3. Overview of inland fisheries in China

3.1 HISTORY OF INLAND FISHERIES DEVELOPMENT

3.1.1 Historical timeline of inland capture fisheries in China

China is one of the most geographically and climatically diverse countries in the world with significant parts of the country spanning both the temperate zone and subtropical latitudes of Asia as well as the arid ones. The country has rich aquatic resources covering an area of up to 270 000 km^2. These are both natural and human-induced, including rivers, streams, lakes, ponds, reservoirs and other diverse and vast inland waters, all of which provide favourable conditions for aquatic species and the development of inland capture fisheries. Since antiquity, fishing has been an important income earner, and it has gradually developed and flourished as a standalone activity or in close association with the developing agricultural systems of the country, especially rice cultivation (Li Shihao and Qu Ruoju, 2018).

During its long history China's inland fishing industry evolved as Chinese civilization developed (Table 3.1). Fishing technology has developed over time and the level of production has increased constantly (Shi Dingjun, 1999).

With increasing economic development and a shift from agricultural to urban and industrial societies, the role of fishing in the social economy has also changed. Water-related and fisheries-related policies have changed to reflect shifting societal priorities and the competition for aquatic resources. Even though aquaculture production has increased massively and provides most of the freshwater fish supply, high-quality aquatic products from natural waters are still much sought after by consumers, and inland capture fisheries remains the primary freshwater fishing activity in some areas (Lu Binggen, 2019).

TABLE 3.1. Key events at different stages along the historical timescale

Stages	Historical timescale	Key events
Neolithic society – the dawn of inland fisheries	Before 2100 BCE	Inland fisheries in China can be dated back to at least 18 000 years ago. A variety of fishing gears were already being used, including fish darts, fishing nets, fish hooks, fish traps, bows, arrows and harpoons for fishing, and fishing vessels.
Ancient civilizations – mainly small-scale and artisanal production driven by wind and human activity	Xia Dynasty (~2070 to 1600 BCE)	Fishing gear included well-made bone fish darts, bone fish hooks and net pendants.
	Shang Dynasty (~1600 to 1045 BCE)	Fishing areas were mainly located in the middle and lower reaches of the Yellow River. Species caught in inland waters included *Mylopharyngodon piceus*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Squaliobarbus curriculus*, *Tachysurus fulvidraco*, *Mugil cephalus*. The earliest metal fish hooks in China were unearthed in 1952 at the site of the early Shang Palace in Erlitou, Yanshi, Henan Province.
	Zhou Dynasty (1046 to 771 BCE)	Fishing tools and methods became more diversified. For example, one fishing method called chi (罶) was created, which placed branches and logs in the water; fish were lured to inhabit the space, where they were subsequently caught. This method is still in use today and is called a brushpark. A fishing ban was in place. Spring, autumn and winter were the fishing seasons; during summer, fishing was prohibited to allow fish breeding. Fishing gear and fishing methods were regulated. Small-mesh nets and fishing with poison were prohibited.
	Chunqiu period (770 to 476 BCE)	Fish hooks began to be made of iron, which increased fishing capacity significantly. A variety of species were caught in inland waters. *Shi jing* (*The book of poetry*) recorded more than 10 species (such as bream, snakehead, common carp, shark sheatfish), and the section of the *Erya* dictionary *Erya shi yu*, recorded more than 20 species.
	Han Dynasty (~202 BCE to 220 CE)	Liaodong, Chu, Ba, Shu and Guanghan were important fishing production areas, as recorded in *Han shu di li zhi* (*Book of Han: Geographical records*). There was a large supply of commercial fish in the market, and fishing technology advanced with the development of early fishing machinery (e.g. using an axle to lift and release a fishing net).
	The Three Kingdoms period, Wei, Jin and Sui dynasties (220 to 618 CE)	Fishery production in the Yellow River Basin declined dramatically due to frequent wars in the region. The fishing industry in the Yangtze River Basin made great progress. A fishing method called *ming yu* (using a certain sound to lure fish) emerged, and there was a gradual recognition of natural sciences, such as greater understanding of the migration laws of fish.
	Tang Dynasty (618 to 907 CE)	The main fisheries production was concentrated in the Yangtze River, the Pearl River and their tributaries. Records of fishing with domesticated birds and animals (e.g. cormorants, otters). Comprehensive descriptions and categorization of the fishing gear and fishing methods used in the lower reaches of the Yangtze River were recorded in a famous poem – *Yu ju shi* (*The poem of fishing gear*) – written by the poet Lu Guimeng (died in 881).
	Song Dynasty (960 to 1279)	The production scale of freshwater fishing was further expanded. According to *Lan zhen zi* (written by Ma Yongqing who died in 1136), hundreds of fishing boats came to Poyang Lake in winters when the water level fell, using bamboo stirring and drumming methods to drive fish into the nets. Empty hook longline fishing emerged in the middle reaches of the Yangtze River, and there were records of winter fishing under the ice in Northeast China.
	Ming Dynasty (1368 to 1644)	The inland fishing industry was very prosperous partially owing to the sea fishing ban. Fish production was very active in the middle and lower reaches of the Yangtze River, and the fishing tax from this region contributed about 70% of the total annual national fishing tax in the late Ming Dynasty.
	Qing Dynasty (1616 to 1912)	The production scale of fishing continued to expand. There were large fishing boats with up to six masts operating on Taihu Lake. Many special economic fish began to be developed and utilized, such as trout, *Coregonus* sp., *Hucho taimen* and so forth in Wusuli River, and *Anabarilius grahami* in Fuxian Lake.

TABLE 3.1. (*continued*)

Stages	Historical timescale	Key events
Modern China – attempts to modernize inland fishery production and governance	1840 to 1949	Inland fishing vessels were still dominated by traditional wooden rowing boats and wind-driven vessels, despite the existence of a few motorized fishing vessels imported from abroad. There were attempts to modernize the fishing industry in China, including the establishment of fishing companies and government agencies in charge of fishery affairs.
New China – rapid development and shifting priorities from increasing production to making ecological restitution	1949 to 1978 (centrally planned economy)	With centralized leadership and unified planning, the fishing volume increased steadily, but the overall growth rate was slow (see Figure 3.4).
	1978 to 2012 (economic reform and liberalization)	The inland fisheries catch increased sharply (see Figure 3-4), benefiting from strong policy and legislation support. In 1986, China passed the Fisheries Law, which marked the formation of China's fisheries management system, and since then many fishery-related laws, regulations and rules have been developed and enacted.
	2012 to present (shifting priorities to ecological sustainability)	The rapid expansion of inland fishery production was putting increasing pressure on the environment, which raised considerable concerns. In 2012, the 18th National Congress of the Communist Party of China (CPC) attached high priority to making ecological restitution (also translated as "ecological civilization" in China's official documents), which led to the accelerated promotion of integrating environmental protection with economic sectors, including inland fisheries. In January 2020, China implemented a fishing ban in 332 conservation areas in the Yangtze River Basin. In January 2021, the ban was expanded to cover natural waterways along the Yangtze River and will last for ten years.

Source: Authors' elaborations.

Neolithic society – the dawn of inland fisheries

Archaeological analysis of 18 000-year-old artefacts uncovered in a mountaintop cave in Zhoukoudian, near Beijing reveals that people made their living gathering plants, hunting wild animals and also by harvesting fish and shellfish in the nearby ponds. A piece of orbital grass carp bone (about 80 cm long) painted red with a small hole drilled in it, found inside the cave site, indicates that fishing was an important part of daily life.

During the Neolithic period, hunter-gathering, embryonic farming methods and animal husbandry were practised, but fishing occupied an important position in meeting people's nutritional needs. In some areas, where natural conditions were favourable for fish production, this developed into specialized fish production with the development of new fishing tools. Archaeological findings reveal that a variety of fishing gear was already available and used during the Neolithic period including:

1. **Fish darts:** These appeared 7 500 years ago and early forms were made of long animal bones with several barbs on each side. The fish dart then developed into various forms, such as tying the dart head directly to the dart shaft or tying one end of a line to the collar of the dart head, and the other end to the dart shaft to become a fish dart with a line.

2. **Fishing nets:** These have been used since the Banpo period[1] 6 000 years ago and their historical use is still under investigation (as they are not hard like bone, archaeological records on their first use are not clear). Square and conical fishing nets are painted on the pottery unearthed in Banpo and many stone and ceramic net pendants have been unearthed at various Neolithic sites around the country, indicating that fishing nets were widely used in Neolithic society.
3. **Fishing hooks:** These first appeared in the Banpo period. Initially, fish hooks were carved from bone and tooth material. They were barbed and non-barbed.

[1] Banpo is an archaeological site in the Yellow River Valley, just east of Xi'an, China. It contains the remains of several well-organized Neolithic settlements which have been dated to 6 700 to 5 600 years ago.

4. **Fish traps:** These have been dated to 4 600 years ago and were found at Neolithic sites in Qiansanyang (Wuxing, Zhejiang Province). These conical traps had bamboo ribs and were woven from wattle. The opening had an inverted beard funnel. The traps were placed in fish migration channels and fish could enter but not exit.[2]

From ancient society to the start of the industrialized era (2100 BCE to 1840 CE)

Capture fisheries in the ancient era of Chinese society were primarily small-scale manual production driven by wind and human labour. There were innovations in production technology and during this period, capture fisheries developed in two stages.

Xia Dynasty (~2070 BCE to 1600 BCE): During this period China's elite was served by a slave society, with agriculture as the main focus of production and fisheries accounting for a certain proportion. The fishing gear unearthed from the Xia culture site include well-made bone fish darts, bone fish hooks and net traps, which reflect the fishing production technology at that time.

Shang Dynasty (~1600 BCE to 1045 BCE): The fishing areas were mainly concentrated in the middle and lower reaches of the Yellow River. Fishing tools included nets and fishing tackle and fish species caught in the Shang Dynasty included *Mylopharyngodon piceus*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Squaliobarbus curriculus*, *Tachysurus fulvidraco* and *Mugil cephalus*. Bones unearthed in the ruins of the Yin Dynasty have hieroglyphs symbolizing fishing with both hands and fishing with hand-held rods. In 1952, the earliest metal hooks in China were unearthed at the site of the early Shang Palace in Erlitou, Yanshi, Henan Province.

Zhou Dynasty (1046 BCE to 771 BCE): This was an important period for the development of fishing and fishing tools became more diversified. There were many kinds of fishing tools, such as Gū (罛, a large fishing net in ancient times), Jiǔ yù (九罶, a net with a bladder bag to catch small fish), Zhǔ (罟, a small fish net), Zēng (罾, a square fishing net with a wooden stick or bamboo pole as a support), Diào (钓, bamboo fishing apparatus – the mouth is small, the fish can get in but not out), Gǒu (笱, bamboo fishing apparatus – the mouth is small, the fish can get in but not out), Zhào (罩, a kind of bamboo basket for catching fish) and Liǔ (罶, a kind of bamboo basket for catching fish).

The fishing method Shèn (罙) was created, which placed branches and logs in the water; fish were lured to inhabit the space, where they were subsequently caught. This method is still used today and is called a brushpark.

In order to protect fish resources, the Zhou Dynasty also stipulated a fishing ban period. Spring, autumn and winter were the fishing seasons. During summer, fishing was prohibited. At the same time, fishing gear and fishing methods were also regulated. The use of small-mesh nets and fishing with poison was prohibited.

Chunqiu period (770 BCE to 476 BCE): This period saw the transition from bronze to iron tools and fish hooks also began to be made of iron. With the improvement of fishing tools fishing capacity increased correspondingly. Fish recorded in *The book of poetry* (*Shi jing*) include more than ten species, such as bream, snakehead, common carp and sheatfish. The *Er ya shiyu* (the first comprehensive dictionary in China organized by meaning) recorded even more species (over 20 species). At this time, offshore fishing also developed considerably.

[2] This type of conical trap design is still in use today across Asia.

Han Dynasty (~202 BCE to 220 CE): Inland fisheries were more productive during the Han Dynasty. According to the *Han shu geographical records*, Liaodong, Chu, Ba, Shu and Guanghan were all important fishing production areas. There were many commercial fish in the market and fishing technology also made progress with the development of early fishing machinery. This used an axle to lift and release a fishing net.

The Three Kingdoms period, Wei, Jin and Sui dynasties (220 CE to 618 CE): During the 400 years of this period, the Yellow River Basin experienced frequent and brutal wars and fishery production declined dramatically.

During the same period however, the fishing industry in the Yangtze River Basin made great progress. Guo Pu's *Jiang fu* describes the prosperity of the Yangtze River fishing industry, the further development of fishing technology, the emergence of a sound fishing method called *Ming Yu* and the gradual recognition of natural sciences such as a greater understanding of the migration laws of fish.

Tang Dynasty (618 CE to 907 CE): In the Tang Dynasty, the main fishing production was concentrated in the Yangtze River, the Pearl River and their tributaries.

In addition to inheriting the fishing gear and fishing methods of the previous generation, there are also records of the use of many domesticated birds and animals for fishing. From 766 CE to 768 CE, the residents of Fengjie County, Sichuan Province generally kept cormorants for fishing (Su Yongxia, 2010). At the end of the seventh century, otter fishing appeared in Daxian County, Sichuan Province.

By the end of the Tang Dynasty, the poet Lu Guimeng made a comprehensive description of the fishing gear and fishing methods in the lower reaches of the Yangtze River. He wrote a famous fishing gear poem, which summarized the structure and usage of the fishing gear and classified them.

Song Dynasty (960 CE to 1279 CE): In this period the scale of freshwater fishing further expanded. At Jiangxi Poyang Lake in winter when the water level fell, fishers concentrated hundreds of fishing boats, using bamboo stirring and drumming methods to drive fish into the net. In the middle reaches of the Yangtze River, empty hook longline fishing emerged. In Northeast China's Liao River, there are records of winter fishing under the ice.

Ming Dynasty (1368 CE to 1644 CE): Due to the sea ban policy, marine fishing was affected to a certain extent, therefore, the inland fishing industry became very prosperous, especially in the middle and lower reaches of the Yangtze River. In the late Ming Dynasty, such as the Wanli period, in the middle and lower reaches of the Yangtze River, the annual catches amounted to about 70 percent of the total national fishing catch.

Qing Dynasty (1616 CE to 1912 CE): Over this period, the fishing gear used for inland fishing was basically the same and the scale of fishing continued to expand. This period saw large fishing boats with up to six masts operating on Taihu Lake, and many special economic fish began to be developed and utilized, such as trout, *Coregonus* sp. and *Hucho taimen* in Wusuli River, and *Anabarilius grahami* in Fuxian Lake, Yunnan Province. By 1840 China had transitioned to a nascent industrialized society.

Modernizing China (1840 to 1949)

The timescale shows that the ancient fishing industry made great progress over thousands of years. Each period had its own characteristics in an agricultural society that has evolved over thousands of years.

Since entering the modernizing period (1840 to 1949), the mechanization that appeared during the industrial revolution was gradually applied to marine fishery production as well as inland fisheries to some extent. In the late Qing Dynasty, some open-minded intellectuals began to introduce these new technologies and knowledge, so China's fishing industry moved from the traditional manual production method to that based on power; China's motorized fishing industry started in the ocean and gradually developed into inland waters, and the fishing methods changed. However, China's freshwater fishing industry generally did not witness substantial change in terms of modernization or mechanization during this period. On the whole, fishing vessels were still dominated by traditional wooden rowing boats and wind-driven vessels. There were only a few hundred marine and inland motorized fishing vessels (very few inland motorized fishing vessels) owned by private and state-owned enterprises across the country which were imported from abroad. However, fishery science education and the formulation of fishery laws and regulations were mostly moribund as in other countries.

New China period (1949 to the present day)

The founding of New China in 1949 began the modernization period of China's fisheries industry, including several key milestones (the founding of New China, reform, liberalization and the 18th National Congress of the Chinese Communist Party from 8 to 15 November 2012, hereafter referred to as the 18th Party Congress). The period from the founding of New China to reform and liberalization witnessed China's initial exploration of modern fishing methods.

Modernization: During this period, China's freshwater fishing industry gradually changed from the more primitive production methods to more modern production techniques; catch volume steadily increased, but the overall growth rate was slow. Following reform and liberalization up to the 18th Party Congress, China's freshwater fishing industry expanded rapidly and the exploitation of natural waterbodies became increasingly intensive, with a rapid increase in fisheries and aquaculture production. This was accompanied by various environmental and natural resource issues (Ge Xiangan and Liu Shilu, 2009.). After the 18th Party Congress, the development of ecological civilization gained prominence and there were major changes in inland fishery policies (such as fishing ban measures and new fishing methods). Freshwater fishing began to seek transformation and production began to shrink from the pursuit of yield to that of achieving ecological benefits (Zhou Xiaohua and Li Mingshuang, 2009).

Scientific and rational planning: After the founding of the People's Republic of China, the development of fisheries always had stable centralized leadership and unified planning, which led to the qualitative improvement of China's freshwater fishing industry.

In February 1950, the first national fisheries conference was held in Beijing. The meeting determined the policy of underscoring fishery production before development, centralized leadership and decentralized management. This required arrangements for restoring fishery production in accordance with the principle of "giving consideration to public and private interests, benefiting both labour and capital, developing production and rejuvenating the economy".

Recognition of the need to increase production from freshwater capture fisheries and aquaculture: In May 1956, the Ministry of Fisheries of the People's Republic of China was officially established. In 1958, President Mao Zedong declared that "30 percent of China is mountains, 60 percent is rivers and 10 percent is agricultural fields, and there is great potential for fisheries". In the late 1970s, Comrade Deng Xiaoping indicated that there was a policy issue in the development of fisheries – "We should focus on aquaculture and use all kinds of water surfaces, including ponds".

Greater appreciation of the importance of the ecological sustainability of aquatic ecosystems: In 2012, the 18th Party Congress proposed the development of ecological civilization, as well as the implementation of the ten-year ban on fishing in the Yangtze River and the high-quality transformation of fisheries. The freshwater fishing industry began to transform and upgrade, and fisheries output began to shrink, shifting from the pursuit of yield efficiency to the pursuit of ecological efficiency. Relevant policies and regulations were further improved, and more comprehensive fishery resource protection regulations were gradually established.

Keeping pace with the times and upgrading industrial structure: Since the 18th Party Congress, in accordance with General Secretary Xi Jinping's "green water and green mountains is the silver mountain" guiding ideology, the national fisheries industry goal is to implement the new development concepts of innovation, coordination, green and transparent production. This was promulgated to improve quality and efficiency, reduce expenditure and promote green development (Ministry of Agriculture and Rural Affairs, 2019).

Move from increasing production volume towards increasing quality and efficiency: In 2016, Guiding Opinions on Accelerating the Transformation of Fishery Mode and Structure Adjustment were proposed to change the development mode under the umbrella of the new development concept. Key thrusts were to accelerate structural reform of the supply side, shift the focus of fishery development from focusing on quantity to improving quality and efficiency, enhance people's livelihoods and gradually make traditional fisheries more receptive to quality and efficiency, resource conservation and ecological health. The creation of green and environmentally friendly fisheries began a new journey of comprehensive transformation and upgrading of fisheries.

Gradual move towards ecological fisheries: In March 2019, the Ministry of Agriculture and Rural Affairs established a study group for large surface ecological fisheries to launch a new round of statistical investigation, key regional research, scientific and technological innovation research, expert demonstration and other activities. According to statistics, as of 2018, there were about 1 500 large natural waterbodies suitable for fishing with an area of more than 300 ha in China.

The aquaculture area of lakes and reservoirs accounts for about 52 percent of the country's freshwater aquaculture area, but the output only accounts for about 20 percent of the country's freshwater fisheries (aquaculture and capture fishery output). Extensive water aquaculture has an important position in China's fisheries. With the gradual withdrawal of the traditional "three nets" aquaculture, based on the carrying capacity of water areas, integration of ecological fisheries (enhanced fisheries and capture fisheries, with a reduction of aquaculture in open waters) with the development of primary, secondary and tertiary industries has gradually become a new direction for the development of large waterbody fisheries.

Legislation reforms – constantly improve laws and regulations: In January 1986, the Fisheries Law of the People's Republic of China was reviewed and approved. This was the first basic fisheries law to be formulated since the founding of New China, marking China's entry into a historical period of "managing and promoting fisheries according to law".

Subsequent amendments were made in October 2000, August 2004, August 2009 and December 2013 respectively. Since the entry into force of the Fisheries Law, the Detailed Rules for the Implementation of The Fisheries Law, the Regulations on the Administration of Traffic Safety in Fishing Port Waters, the Regulations on the Inspection of Fishing Vessels, the Regulations on the Reproduction and Protection of Aquatic Resources and the Regulations on the Implementation of the Protection of Aquatic Wild Animals and Other Administrative Regulations have been issued in succession, and the scientific and legal degree of fishery law enforcement has been continuously improved. Nearly 1 000 fishery legal instruments have been formed based on the Fishery Law, supplemented by fishery resources management, production management, water ecology management, administrative supervision and management, fishing vessel and fishing port management and other fishery-related laws, regulations and rules.

The law enforcement body has been constantly improved: China adheres to the management and promotion of fisheries in accordance with the law. China has established a series of rights and licences, fishing licences and laws pertaining to the protection of fishery resources. The country has gradually established a strong law enforcement body.

Since the mid-1950s, relevant provincial and municipal fishery administration institutions have been gradually established. On 3 April 1958, the Ministry of Fisheries issued the Ministry of Fisheries of the People's Republic of China on the Adjustment of the Ministry's Institutions Notice, clearly establishing the Department of Fisheries. There are four main divisions, including the Department of Fisheries and Resource Protection Division for management and law enforcement.

After reform and liberalization, China's fishery law enforcement force was strengthened and all administrative regions above the county level set up basic fishery administration agencies. China's fishery administration for law enforcement became more systematic.

The field of fisheries law enforcement has also changed from a single fisheries order and fishing vessel management law, to resource conservation, aquatic wildlife protection, fisheries safety, aquatic health breeding and quality safety and other multidirectional areas (Ministry of Agriculture, 2006).

3.1.2 Cultural aspects of inland fisheries

China's freshwater fishing industry has a long spiritual and cultural history. Currently, China's freshwater fishery industry is developing new fishery models and modes such as recreational fishery and green fishery. These cultural resources will help to empower the sustainable development of the industry.

Cultural history

Use of aquatic genetic resources: Freshwater fishing and aquaculture began more than 3 000 years ago during the Yin Shang period, and after the mid-Tang Dynasty, freshwater aquaculture, especially that of *Mylopharyngodon piceus*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis* and *Cirrhinus molitorella*, relied on fishers in the Yangtze and Pearl River basins to obtain the fry needed for aquaculture. At present, China has 31 genetic breeding centres, 26 aquatic introduction and breeding centres, 429 original aquatic breeding farms and 3 aquatic germplasm testing centres. On 14 July 2022, the Chinese Ministry of Agriculture and Rural Affairs announced 26 new aquatic species, including 9 freshwater species.

Food culture

The freshwater fishery processing industry involves the production, preservation and processing of fresh aquatic products. Historically, limited amounts of fish were caught and catches were preserved using drying and pickling methods, but these traditional methods have now been replaced by modern preservation technology.

China has a vast consumer base for fresh and processed marine and freshwater aquatic products. Fish-based dishes have been on the tables of Chinese people nationwide since time immemorial. Fish is an indispensable part of the Chinese diet.

Recreational fishing

Recreational fishing is a new industry based on existing fishery resources. It meets the leisure needs of the public and benefits fishers economically. Recreational fishing resources are often unique fishing landscapes, special fishing villages and fish towns, fishing harbours and docks that have existed for many years (Ning Bo, 2010).

Cultural appreciation of freshwater fish and inland fisheries in society

Chinese fishers have created a rich culture of festivals and many customs, which have become an important part of the behavioural culture of freshwater fisheries. The festivals show people's gratitude and reverence for nature and demonstrate the joy and desire for a good harvest (Li Yong, 2009; Liu Jinming, 1988). For example, the Dali Lake Winter Fishing Festival and Chagan Lake Ice and Snow Fishing and Hunting Cultural Festival have made great contributions to the dissemination of the fishing and hunting culture by organically combining fisheries production, fishing and hunting with recreational fishing. These fishing culture festivals have important economic, cultural, ecological and other values. In 2006, the Fish Killing Festival of Xianqiao Wangka, Fuquan, Guizhou, was listed on the Guizhou Provincial Intangible Cultural Heritage Protection List. The festival has a strong link to the hunters and gatherers of antiquity. In terms of customs and habits, fishers are different from land-based farmers. They sometimes live on the water for a long time, forming a highly characteristic culture, such as the Fuzhou boat-dwelling folk culture. They are an important component of traditional Chinese fishing culture and customs. For example, the fishers in Zhejiang have unique production and living habits. They are adept at building boats and use cormorants to catch fish; some of them are named after animals in the Chinese zodiac, while others are named after shrimps and small turtles.

Spiritual aspects

The cultural aspects of freshwater fisheries are reflected in many ways such as literary and artistic works, daily tasks and folk customs. The carp has always been popular among Chinese people and is a symbol of hard work, kindness, steadfastness and good fortune (Shi Dingjun, 1983). The combination of carp and lotus flower symbolizes continuity, carp and peony symbolize wealth and prosperity and a red koi represents good luck. The Chinese fishing culture has always valued sustainable development. Ancient Chinese people recognized that draining a pond to get all fish was a short-sighted and unsustainable way of industrial development and this was reflected in the No Fishing signage erected in many places. Historical legends based on the worship of fish in early history and fish-related religious beliefs are also important components of the spiritual culture of the freshwater fishing industry. The most widespread and far-reaching fishery-related religious beliefs are those of Mazu, whose blessings are not only sought by fishers at sea, but also by the temples and devotees of Mazu wherever there is water. There are also other fish-related beliefs in Buddhism.

Chinese ornamental fish culture has a long history. From the Song Dynasty, ornamental goldfish were popular at court and goldfish breeding emerged. By the time of the Ming Dynasty, goldfish breeding had become more common. With the development of people's aesthetic requirements, numerous freshwater fish species gradually joined the ranks of ornamental fish, showing different cultural connotations of stylistic beauty, artistic beauty and spiritual beauty. China is the world's earliest user of freshwater pearls, at more than 4 000 years ago. China's freshwater pearl culture technology began in the eleventh century during the Song Dynasty. Pearls in China have a deep cultural heritage and with economic and social development and improvements in people's living standards, consumer awareness of pearls has increased.

History of fishery science and education

Various museums have been established concerning the founding of the People's Republic of China, and most of the local museums contain information about the history of local fisheries. They contain aquatic specimens, paintings, sculptures, photographs and related works of art as well as examples of fishing gear, boat models and fishery histories among many other items related to cultural research. With the vigorous promotion of environmentally friendly fisheries, the dissemination of fishing culture information also helps to strengthen public awareness about environmental protection and ecological protection.

3.1.3 The history of production policy

Since the foundation of New China, China's fishery industry has continued to develop healthily, and the share of the fishery economy in general agriculture increased from 1.3 percent in 1952 to 9.27 percent in 2020, which is an important indicator of agricultural and rural economic development.

In the 70 years since the development of New China's fisheries, fisheries policies have played an important role in promoting the market for aquatic products, increasing fisheries production capacity, conducting significant green development of fisheries and gradually increasing the degree of fisheries science and technology.

Fisheries-related policies have always influenced the development of freshwater fisheries, both in the past (before the formation of fishery policy guidelines) and during the modern fisheries period (the development of fisheries policy after the foundation of New China). For example, the development of the fisheries industry is attributable in part to work undertaken during the Ming and Qing dynasties (Sun Gongfei, 2019).

There are few records of rural fish farming prior to the Ming and Qing dynasties, those that existed were mainly in the Hanshu and Qimin Yaoshu texts. There are many official documents relating to traditional methods, but the knowledge of freshwater fisheries is more limited.

During the Ming and Qing dynasties, China's freshwater fishery was at its peak, and many local documents (such as those for Taihu Lake, Jiangxi and Western Zhejiang) were prepared during this period. Public recognition of fisheries was high at that time, but no guiding fishery policy was developed.

After the foundation of New China, capture fisheries policies gradually evolved and can be divided into several key periods, such as the exploration period, the interim period, the reform and liberalization periods.

China's modern marine fishing ban policy began in 1980 with the piloting of the fishing moratorium implemented in the Yellow Sea and East China Sea (Zhou Jingjuan, 2007). This extended prohibition period began with pilot practice, subsequent comprehensive intensification and then modern governance; it is characterized by short-term to long-term fishing bans, and from local basin to basin-wide fishing bans (Table 3.2).

TABLE 3.2. Fishing closures in major inland watersheds

Basin	Year	Main content
Yangtze River	2002	For the first time, a systematic fishing ban was implemented in the Yangtze River, covering the main stream of the Yangtze River, some first-class tributaries and the Poyang Lake and Dongting Lake areas. The fishing ban upstream of Gezhou Reservoir lasted from 1 February to 30 April and downstream from 1 April to 30 June.
	2015	The fishing ban covered the main trunk streams, tributaries and important lakes of the Yangtze River, including the Minjiang, Tuojiang, Chishui, Jialing, Wujiang, Hanjiang and other important rivers and sections of the main stream of the Huaihe River. It consolidated and expanded the upstream and downstream fishing ban from 1 March to 30 June.
	2020	A ten-year ban on fishing in the Yangtze River was implemented on 1 January 2020, with productive fishing of natural fishery resources banned throughout the year in the Yangtze's main streams and important tributaries.
Yellow River	2018	A three-month basin-wide closed season system from 1 April to 30 June each year.
	2022	The Yellow River source area and upstream key waters from 1 April 2022 to 31 December 2025. A year-round ban on fishing in the Yellow River Ningxia section to the mouth of the sea; the closed period was extended by one month, that is, from 1 April to 30 June, and further extended from 1 April to 31 July.
Pearl River	2011	Implementation of the fishing ban system included the main streams, tributaries, through-river lakes, the Pearl River Delta river network and important independent tributaries into the sea. The fishing ban lasted from 1 April to 1 June.
	2017	The fishing ban was adjusted to 1 March to 30 June every year.
Qiantang River	2019	The main stream of the Qiantang River (including the north and south branches of the source) and all major tributaries, closed to fishing from 1 March to 30 June each year.
Songhua River	2019	Songhua River Basin and its tributaries, reservoirs, lakes etc. The ban lasted from 16 May to 31 July.
Huaihe River	2018–2020	The fishing ban on the main streams and tributaries of the Huaihe River extended from 1 March to 30 June.
Hai River	2019	The fishing ban on all waters of the main streams and tributaries of the Haihe River started on 16 May and ended on 31 July.
Liao River	2019	The fishing ban on the Liao River, the Daling River, the Little Ling River and the Yangtze River system started on 16 May and ended on 31 July.

Source: Authors' elaborations.

Exploration phase (1980–2003)

The policy of a summer fishing moratorium began in the Yellow Sea and the East China Sea, and was then fully implemented in the East China Sea, Yellow Sea, Bohai Sea and South China Sea with the continuous exploration and practical testing of its effects (Wang Zhongyuan, 2008). Based on the pilot practice of marine seasonal fishing moratoriums (Deng Jingyao, 2000), the inland waters fishing ban system was first tested in the Yangtze River Basin in 2002, officially implemented in 2003 and subsequently on a nationwide scale.

Intensification phase with extension to inland waters (2003–2018)

With the in-depth promotion of ecological civilization in China, especially the proposal and implementation of the Yangtze River's "Grasp the big protection, do not engage in big development", the restoration of the Yangtze River water environment, the protection of Yangtze River aquatic life and enhancement of the Yangtze River ecological safety index achieved unprecedented attention. In 2017, the former MoA issued the Notice on the Announcement of the List of Aquatic Biological Reserves in the Yangtze River Basin, which proposed to gradually implement a comprehensive ban on fishing in 332 aquatic biological reserves (including aquatic fauna and flora nature reserves and aquatic germplasm resource

reserves) in the Yangtze River after 1 January 2018. China's seven inland watersheds of the Yangtze River, Pearl River, Huaihe River and Yellow River basins had established a closed season system at the national level before 2018, with the Ministry of Agriculture and Rural Development issuing a circular on the implementation of the closed season system in four watersheds, including the Huaihe River, Liao River, Songhua River and Qiantang River, marking the establishment of a closed season system at the national level in seven key watersheds in China.

Modern governance stage of integration and linkage (2018 to the present day)

Along with the new development stage of China's modernization, China is committed to creating modernization of the harmonious coexistence of humanity and nature, which means that the focus of China's fishing moratorium policy will be to gradually explore the development of a modern governance policy system of coexistence between humans and aquatic life, in order to truly achieve the sustainable use and development of fisheries resources. The establishment and effective implementation of laws and regulations such as the Fisheries Law and the Yangtze River Protection Law, the design of the fishing moratorium policy and the integration of green shipping, watershed ecological compensation, healthy consumption and other policies, all provide important guarantees for improvement of modern governance effectiveness of the fishing moratorium policy (Chen Tinggui *et al.*, 2019; Gao Hucheng, 2021).

Progressive expansion from offshore basins to inland river basins

The seasonal fishing moratorium system is a control initiative to protect marine resources and environments in China, as outlined hereunder:

The Yangtze River spans more than ten provinces in China's inland eastern, central and western regions and is rich in fishery resources. However, these resources have been in serious decline for a long time due to pollution, reservoir construction and overfishing. In order to improve the fishery resources of the Yangtze River, the spring fishing ban system has been implemented in the Yangtze River Basin since 2002, with a three-month ban on fishing, drawing on China's offshore seasonal fishing moratorium system. In 2003, with the consent of the State Council, the whole Yangtze River Basin was closed to fishing for three months every year. Since then, the fishing ban system has been implemented in the basins of the Chishui River, Pearl River, Min River, inland waters of Hainan Province, the Hai River, Liao River, Songhua River and Qiantang River.

The duration of the fishing ban gradually changed from short-term to long-term cycles

Initially the fishing moratorium period of China's fishing ban system was three months, but there were differences in when the fishing bans began each year (Pan Peng and Li Weidong, 2016). According to the Notice of the Ministry of Agriculture on the Implementation of the Fishing Moratorium System of Yangtze River, the Yangtze River was divided into two river sections, and the fishing moratorium for each river section was three months, with different beginning and end time.

In order to enhance the effectiveness of the fishing ban, since 2016, the fishing ban in the Yangtze River Basin has become four months, from 1 March to 30 June every year.

The 2016 Circular of the Ministry of Agriculture on the Comprehensive Fishing Ban in the Chishui River Basin aimed at strong and effective improvement of the aquatic ecological environment and promotion of biodiversity conservation. This action pioneered the implementation of a comprehensive 10 year fishing ban in a river basin. This was followed

in January 2019, by the Ministry of Agriculture and Rural Affairs announcement of the Implementation Plan for the Fishing Ban and Establishment of Compensation System in Key Waters of the Yangtze River Basin. In January 2020, the Ministry of Agriculture and Rural Affairs announced the Ten-Year Fishing Ban Plan for the Yangtze River (Cao Wenxuan, 2022).

The scope of the fishing moratorium gradually changes from local basins to whole basins

The scope of China's fishing ban has experienced a gradual expansion from local to basin-wide development. As with the marine fishing moratorium, the scope of the closed season system for inland waters is also expanding:

- The scope of the fishing ban in the Yangtze River Basin changed from the main stream of the Yangtze River below Deqin County in Yunnan to the mouth of the Yangtze River (between Nanhuizui and Qidongzui) in 2002.
- The first-class tributaries of the Yangtze River such as the Hanjiang, Minjiang, Jialing, Wujiang and Chishui rivers, as well as the Poyang Lake area and Dongting Lake area, have been subject to a four-month fishing ban since 2016, including Qinghai Province.
- The main section of the Yangtze River below Qumalai County to the mouth of the Yangtze River as well as the main sections of the Minjiang, Tuojiang, Chishui, Jialing, Wujiang, Hanjiang rivers and other important rivers in Gansu Province, Shanxi Province, Yunnan Province, Guizhou Province, Sichuan Province, Chongqing Municipality and Hubei Province have all been affected by the fishing ban.
- The fishing ban also targeted the main section of the Dadu River in Qinghai Province and Sichuan Province, Poyang Lake, Dongting Lake and the main section of Huaihe River until 2020.

According to the Notice of the General Office of the State Council on the Effective Implementation of the Fishing Ban in the Yangtze River Basin, the scope of the fishing ban also includes:

- The 332 nature reserves and aquatic resource reserves, including the National Nature Reserve for Rare and Endemic Fish in the upper reaches of the Yangtze River.
- The main streams and important tributaries of the Yangtze River.
- Large riverside lakes.
- Other natural waters connected to the main streams.
- Important tributaries and large riverside lakes of the Yangtze River's key waters.

3.1.4 Comprehensive fishing ban in the Yangtze River

The importance of the fishery resources and aquatic biodiversity of the Yangtze River

The Yangtze River is one of the world's seven greatest rivers with rich aquatic biodiversity; it is the largest river in China, with numerous tributaries and a vast watershed area, accounting for about 50 percent of China's freshwater area (Cao Wenxuan, 2008). The Yangtze River is the mother river of China, one of the birthplaces of Chinese civilization and is instrumental in feeding more than one-third of the population in China. It not only straddles the three major economic zones in the east, middle and west, but is also an important strategic water source, ecological treasure trove and important waterway in China. It is important for maintaining national ecological security and promoting the green development of the Yangtze River Economic Belt (Cao Wenxuan, 2011).

The Yangtze River fishery is also the cradle of China's freshwater fisheries, a treasure trove of fish genes and the original seed base of economic fish species. Furthermore, the fry of the Yangtze River is characterized by superior germplasm, fast growth and strong resistance to

disease. Protecting the ecosystem of the Yangtze River is of great significance for maintaining biodiversity and ecological balance and guaranteeing national ecological security. According to statistics, there are more than 4 300 species of aquatic organisms distributed in the Yangtze River Basin, including more than 400 species of fish and more than 170 species of endemic fish, with 11 species of aquatic organisms under national protection such as the Chinese sturgeon, Yangtze sturgeon and the Yangtze finless porpoise.

The catch of natural resources in the Yangtze River Basin reached 450 000 tonnes in 1954, declined to 260 000 tonnes from 1956 to 1960, and was around 200 000 tonnes per year in the 1980s, with an average annual catch of about 100 000 tonnes around 2003. In the early 1960s, there were about 50 species of major economic fish in the upper reaches of the Yangtze River, but in the mid-1970s, the number shrank to about 30 species.

Over the long term, due to the influence of reservoir construction, water pollution, overfishing, channel regulation, Yangtze River shipping, water conservancy projects, sand quarrying and other high-intensity activities, the living environment of aquatic organisms in the Yangtze River has deteriorated, the biodiversity index continues to decline, the populations of rare and endemic species are in full decline, and the economic fish resources are close to depletion (Liu Longteng *et al*., 2019). Among them, overfishing is the most intuitive cause.

At present, the number of endangered fish species listed in the *China red data book of endangered animals* in the Yangtze River Basin has reached 92, and the number of species listed in the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora is close to 300 (Wang Hongzhu, 2019; Xu Lu'i, 2019). The endemic fishes of the Yangtze River, such as the Yangtze River dolphin, Chinese paddlefish, hilsa herring and long spiky-head carp have been declared functionally extinct; the Chinese sturgeon and Yangtze finless porpoise are critically endangered. The biodiversity and biological integrity index continue to decline, and the river has fallen into the predicament of "no fish" (Liu Fei *et al.,* 2019).

In the 1990s, the main fishery species were further reduced to about 20 species. Marine and freshwater migratory species and river and lake migratory species have become rare in the upper reaches of the Yangtze River and its major tributaries.

Therefore, the Yangtze River Fisheries Resources Management Committee, together with fishery administration and fishery supervision management agencies along the Yangtze River, organized all parties to conduct an extensive and in-depth investigation into the economic situation of the fisheries, fish production and the status of people engaged in fishing operations along the Yangtze River, and carried out a thorough study. Under this serious situation, the ecological restoration of the Yangtze River could no longer be delayed, and there were growing calls from the whole society for a complete fishing ban in the Yangtze River Basin.

Significance of the ten-year fishing ban

The fishing ban is an important move to effectively alleviate the crisis of the decline of biological resources and biodiversity in the Yangtze River. The survey shows that the "four major fish" usually grow for four years before sexual maturity, and it is only after ten years of continuous fishing ban that their population sizes are likely to increase significantly (Gulland, 1997). At the same time, the Yangtze River is home to valuable species such as the finless porpoise, Chinese sturgeon and Chinese paddlefish, which are located at the top of the biological chain in the Yangtze River and whose numbers reflect the health of the

Yangtze ecosystem. Therefore, in order to protect the good environment of the Yangtze River and to make the fish resources more abundant and sustainable, the ten-year fishing ban policy of the Yangtze River is imperative.

1. The scale of freshwater aquaculture in China is very large and has long exceeded the scale of wild fishing, so a complete fishing ban in the Yangtze River will have little negative impact on freshwater fish supply but will instead be conducive to the sustainable use of fisheries resources in the Yangtze River and help to unify standards and regulate the market.
2. Fish become degraded during captivity, while wild fish play a role in enriching the fish gene pool, so it is essential to protect wild fish.
3. The ten-year fishing ban will cover two to three reproduction periods for most fish species, in order to alleviate the current plight of fish in the Yangtze River, provide an opportunity for many creatures in the Yangtze River to survive and reproduce, and bring hope for the conservation of many rare species, including the Yangtze finless porpoise, so that the ecosystem condition of the Yangtze River Basin can be restored.

Related legislation

In November 2017, the former MoA published the Notice on the List of Aquatic Protection Areas in the Yangtze River Basin, deciding to take the lead in gradually implementing a comprehensive fishing ban in 332 aquatic protection areas, including the National Nature Reserve for Rare and Endemic Fish in the upper reaches of the Yangtze River, starting from 1 January 2018. In October 2018, the Opinions of the General Office of the State Council on Strengthening the Protection of Aquatic Organisms in the Yangtze River were officially introduced; it was the first document on aquatic organism protection issued at the national level for a single basin in China, indicating that a year-round fishing ban would be achieved in key waters of the Yangtze River Basin in 2020. On 11 January 2019 the Ministry of Agriculture and Rural Affairs and three other ministries jointly released the Implementation Plan for Fishing Ban and Establishment of Compensation System in Key Waters of Yangtze River Basin, which clearly proposed that in the future, the living aquatic resources of the Yangtze River would be completely protected from capture, and a ten-year ban on fishing would be implemented in the main streams and important tributaries of the Yangtze River. Later, it will be reassessed whether fishing should be permitted again. The Yangtze River Office of the Ministry of Agriculture and Rural Affairs issued an order that 332 nature reserves and aquatic resource reserves in the upper reaches of the Yangtze River will be completely banned from productive fishing after 1 January 2020. The natural waters in the main streams and important tributaries of the Yangtze River other than aquatic life nature reserves and aquatic resource reserves will be temporarily banned from fishing for ten years, during which time productive fishing of natural fishery resources will be banned.

For the natural waters of Poyang Lake, Dongting Lake and other large rivers and lakes other than reserves, the provincial fishery departments will designate the scope of the fishing ban and implement a temporary ten-year fishing ban. On 26 June 2020, the Ministry of Agriculture and Rural Affairs held a video conference on the fishing ban in key waters of the Yangtze River Basin to deploy the fishing ban in the Yangtze River. All departments were required to focus on key aspects, clarify tasks, map the baseline, improve the situation of fishers and fishing vessels that exited capture fisheries, and actively help these ex-fishers to switch to work in other industries, so as to strictly enforce the law and promote the Yangtze River fishing ban.

On 19 November 2020, with the consent of the State Council, the Ministry of Agriculture and Rural Affairs issued the Notice on Establishment of the Management Zone for Fishing Ban in the Yangtze River Estuary, which extended the no-fishing area in the Yangtze River Estuary from 122°east to 122°15′ east and established the management zone for the fishing ban in the Yangtze River Estuary, ranging from 122°15′ east, 31°41′36″ north, 30°54′ north forming a box-type area, bounded to the west by the water–land boundary.

Currently, the relevant departments in China have issued a package of policies to further improve the management of the Yangtze River fishing ban, including the key tasks of the ban, the Yangtze River aquatic life protection management scheme, the main responsibility of the Yangtze River fishing ban assessment mechanism and other aspects. However, there are still some questions that cannot be properly answered by existing policies, such as whether and how to catch fish after the ten-year fishing ban on the Yangtze River ends, the main responsibility of ecological compensation for water-related projects on the Yangtze River and how to develop ecotourism on the Yangtze River after the fishing ban. The continuous research and improvement of the Yangtze River fishing ban policy should accompany the ten-year fishing ban and continue to be promoted in depth according to different time points and different actual situations.

Initial effects of the fishing moratorium

Since the implementation of the fishing moratorium system in 1995, nearly 30 years have passed. The implementation of the fishing moratorium system has great significance and has strongly promoted the protection and scientific management of fishery resources (Yu Huiguo, Liang Zhenlin and Mu Yongton, 2007). Firstly, it has established the concept of ecological environment and fishery resources protection (Pang Jie and Le Leshan, 2020). Secondly, implementation of the closed season system has reduced fishing intensity and effectively protected fishery resources; the fishery resources have been given a good opportunity to recover during the closed season through the vigorous law enforcement of various management departments (Lin Guangji, 2005). In addition, the closed season system has also driven fishery management in various waters.

According to relevant surveys, the strict ten-year ban on fishing in the Yangtze River, which was officially launched less than two years ago, has already had significant effects:

- The number of endemic fish living in the Yangtze River has been continuously increasing, and some highly valued fish have also reappeared. For example, sharks that have not been surveyed for 20 years, have been monitored again in Dongting Lake.
- Surprisingly, finless porpoises, a relatively rare species in the Yangtze River, are frequently found in many places; for example, in the Wuhan River, finless porpoises were found four times in 2021, and all of them were found in groups, with the largest population of 12 finless porpoises.
- In the Chishui River, which took the lead in banning fishing in 2017, the number of endemic fish species increased from 32 to 37 species, with resources increasing 195 percent above the pre-ban level.
- Qinghai Lake, which has had a zero-fishing policy for 20 years, has seen a 40-fold increase in naked carp resources, showing the significance of the fishing ban system for the protection of aquatic resources.

3.1.5 The history of inland capture fishery enhancement and culture-based fisheries

The purpose of stocking practices

In recent years, with the intensification of the decline of fishery resources and the increased general awareness of the need for fishery resources environmental protection, the

conservation of aquatic resources has received increasing attention and stocking activities have been flourished throughout the country.

Stocking refers to the use of artificial methods to release larvae (or adults or eggs, etc.) of fish, shrimp, shellfish, algae and other aquatic organisms into natural waters to increase the population size and optimize the community structure of fishery resources, thereby increasing fishery resources, improving the water environment and maintaining ecological balance (Tierenberg, 1992).

China has been carrying out various types of fishery resource enhancement activities since 1950 and has achieved significant social, economic and ecological benefits as important measures to restore fishery resources.

Enhancement: Fish stocking can replenish and restore communities of biological resources. Through breeding, stocking and artificial replenishment of biological resources, the population structure of aquatic resources is improved, and their diversity can be maintained. There are some endangered species whose numbers can be increased through augmentation and release, which serve to protect these endangered species. For example, owing to river barriers, the number of Chinese sturgeons has declined sharply, and since 1984, more than 10 000 Chinese sturgeons have been released into the Yangtze River every year, and the Chinese sturgeon population has been maintained.

Bioremediation: Fish stocking can improve water quality and the ecological environment of waterbodies. Some of the filter-feeding species released, such as fish and shellfish, filter the algae and plankton in the water, and through this action they can purify and improve the water quality. Also, aquatic organisms, including fish, shellfish and algae, have a carbon sink role, absorbing carbon dioxide from the water, which the air can then break down into the water, a unique role for aquatic organisms.

Increasing economic returns: Increasing fishers' income. The yield benefits of fishers' catches will be enhanced by the large-scale release of aquatic economic species such as prawns, *Portunus trituberculatus* and jellyfish (Tang, Yi and Liu Jinhong, 2007). The effect of the release is very obvious and the ratio of input to output is high. Fish stocking has a very good social benefit and by carrying out release activities, it expands social impact and enables the whole of society to care about the problems facing aquatic biological resources, as well as their ecological environments. At present, in many lakes, reservoirs and other waterbodies in China, the main fishing species of *Hypophthalmichthys molitrix* and *Hypophthalmichthys nobilis*, for example, basically rely on artificial breeding (Liu Ensheng *et al.*, 2007); some indigenous fish also rely on breeding and stocking to increase populations. Overall, stocking is an efficient ecological fishery measure that benefits the contemporary industry, and the economic, ecological and social benefits are highly significant.

History of stocking

Preliminary exploration period (1950–1978): In the 1950s, when New China was experiencing food and material scarcity, increasing fish production was the main objective of fisheries development. In February 1950, the First National Fishery Conference was held in Beijing, which established the policy of restoring (both marine and inland) fishery production and made plans for the restoration of fishery production. At the same time, the State Council and the national fisheries authorities promulgated relevant fisheries regulations and circulars and instructions. In 1957, the Ministry of Fisheries promulgated the Interim Regulations on the Protection of Aquatic Resources Breeding (Draft), and in 1962 the State Council allowed the Ministry of Fisheries to develop Pilot Measures for the Protection of Shrimp Resources

Breeding in the Bohai Sea Area; in 1964 the State Council approved the pilot Regulations on the Protection of Aquatic Resources Breeding (Draft). In parallel with the restoration and development of fisheries production, aquatic life enhancement and stocking activities, mainly of Chinese carps (*Mylopharyngodon piceus*, *Ctenopharyngodon idella*, silver carp and *Hypophthalmichthys nobilis*) was carried out and corresponding research work on fisheries resources was conducted.

Stocking activities to restore fishery resources (1980–2010): Since the 1980s, in order to restore the population of fishery resources in natural waters, China carried out the first stocking of Chinese shrimp in Bohai Bay, and subsequently carried out scaled stocking of fishery resources in both coastal and inland waters. In 1986, the Fisheries Law of the People's Republic of China was promulgated and the government encouraged and supported the relevant sectors to take measures to increase fishery resources. In 1990, China's total fish production reached a record level of 12.37 million tonnes, with a significant increase in the effective supply of fish, and the problem of "limited availability of fish to eat" had been basically solved. In 2006, the State Council issued the Outline of Action for the Conservation of Aquatic Life Resources in China, taking aquatic life enhancement and marine pasture construction as one of the most important measures to conserve aquatic life resources. In 2009, the Aquatic Life Enhancement and Release Management Regulations redefined the content of enhancement and release, encouraging social funds to support the cause of aquatic life resource conservation and enhancement and release, and for the first time, China and Taiwan Province of China collaborated to carry out fish fry enhancement and release activities.

Stocking activities to promote aquatic biodiversity (2010 to present): With the increase of government support, all regions of the country have successively increased the intensity of breeding and stocking. While restoring the population of species, more attention should be paid to the release of aquatic biodiversity and the protection of ecosystems from destruction. In 2010, the MoA issued the National Master Plan for the Proliferation and Stocking of Aquatic Organisms (2011–2015) and the Regulations for the Proliferation and Stocking of Aquatic Organisms, formulating the guiding ideology, target tasks, suitable species, suitable waters, regional layout and safeguard measures for the proliferation and stocking of aquatic organisms in China from 2011 to 2015, and promoting the scientific, standardized and orderly development of the breeding and stocking of aquatic organisms. In March 2022, the Ministry of Agriculture and Rural Affairs issued the Guidance on Aquatic Life Enhancement and Release Work in the 14th Five-Year Plan, which provided a list of 120 major economic species for freshwater enhancement. According to the fishing questionnaire for fishers conducted in the Qiantang River Basin from 2016 to 2018, more than 60 percent of their catch in the Qiantang River Basin was stocked bighead carp and other resources, which effectively increased their income and the overall benefit of fisheries.

Preliminary effect

Data show that in 2021, China conducted more than 2 700 stocking activities for various types of aquatic organisms, releasing 44.053 billion units of seedlings of various aquatic organisms. In this context, 12.018 billion units of freshwater aquatic organisms such as *Mylopharyngodon piceus* and *Ctenopharyngodon idella* were released, and 73 million units of rare and endangered aquatic organisms such as *Acipenser sinensis* were released. This promoted the recovery of fishery stock resources and improved the ecological environment of the waterbodies.

Taking the naked carp of Qinghai Lake as an example, the resource reserves of this species have now reached 100 400 tonnes, an increase of nearly 39 percent compared to before the implementation of stocking, and the contribution of stocking to the recovery of resources has reached 25 percent.

According to estimates from the Taihu Lake bighead carp fishery, the annual removal of nitrogen and phosphorus through the fishery was 0.94 $g.m^{-2}$ and 0.06 $g.m^{-2}$ from 2005 to 2018, generating significant ecological benefits in terms of nutrient reduction. Fishery resources are effectively replenished year on year and fishers have increased their production and income.

The overall picture shows that stocking is an important initiative for the conservation of aquatic biological resources in China and is of great significance for the conservation and rational use of aquatic biological resources, promoting the sustainable development of fisheries and maintaining national ecological security.

The 14th Five-Year Plan for Breeding

During the 14th Five-Year Plan period, the national aquatic life enhancement and release work was carried out in an in-depth and sustainable manner, and the scale and social impact of the release continued to expand. The mission states: "The overall goal of the 14th Five-Year Plan is to maintain the planned number of aquatic organisms to be released at around 150 billion by 2025, and gradually build a system of supplying seedlings with distinctive regional characteristics, clear target positioning, scientific and reasonable layout, and standardized and orderly management; identify a number of social release platforms, and standardize and guide social release activities; establish a preliminary technical support system to match the work of release, and enhance the scientific and technological support capability of release". It has become an important initiative and a key instrument for restoring fisheries resources, protecting precious and endangered species, improving the ecological environment and increasing fishers' income.

In 2022, the Ministry of Agriculture and Rural Affairs issued the Guidance on the Work of Releasing Aquatic Organisms in the 14th Five-Year Plan, stating that during the 14th Five-Year Plan period, 286 species of aquatic organisms were suitable for release nationwide and 410 waterbodies were identified as suitable for the release of aquatic organisms. The objectives are to follow the principle of "release where you get it", ensure the purity of the seed quality and avoid ecological risks caused by cross-basin and cross-sea releases. Before the implementation of stock enhancement work, the evaluation of the suitability of stock enhancement should be carried out carefully, and suitable waters, species, scale, structure, time and methods of stock enhancement should be determined on the basis of scientific evidence. While carrying out stocking, it is necessary to speed up the development of the system and strengthen the support for and guarantee of stocking; standardize supervision and management to ensure the effectiveness of stocking; widely disseminate and exchange information to expand the social impact of stocking; and strengthen organization and leadership to ensure that the effect of stocking is showcased.

3.2 CHARACTERISTICS AND SIGNIFICANCE OF INLAND FISHERIES

China's freshwater capture fishery industry cannot be completely separated from aquaculture, as there is considerable use of stocking of open natural and artificial waterbodies. Some of this is true culture-based fisheries (which would be statistically recorded as aquaculture) while other forms are enhanced capture fisheries. This reliance on stock has led to the development of considerable national resources, both infrastructural and genetic, for the management of freshwater fisheries.

3.2.1 Categories of inland fishery development

Natural wild fisheries: China has extremely diverse topography and a high degree of water diversity, with myriad rivers, lakes, reservoirs and other natural waters. Although there are

no accurate statistics for freshwater fisheries catches in these waterbodies, there are more accurate catch statistics for some freshwater species.

In 2020, the national freshwater fisheries output was 1.46 million tonnes, which was a decrease of 20.84 percent over the previous year. Finfish accounted for the greatest proportion of the freshwater fisheries production, reaching 1.11 million tonnes, followed by shellfish and crustaceans at 171 000 tonnes and 161 000 tonnes respectively, while catches of other taxonomic groups were lower.

The inland capture fisheries industry is mostly concentrated around natural rivers and lakes which generally have no artificial disturbance except for special fishing behaviour, that is, there are no artificial stockings in the waters, and the yields depend entirely on the natural recovery ability of the biological populations. Moreover, the fishers are either from individual households or part of fishing companies.

The conservation fisheries industry: Most reservoirs and lakes have been used for green fisheries since the onset of the New China. The coordinated development of fishery utilization and ecological protection through artificial proliferation and scientific fishing rotation is one of the main directions of the development of fisheries in large waterbodies.

Taihu Lake is one of the five largest freshwater lakes in China. It is a large shallow lake in the Yangtze River Basin (Wu Rui, 2020). The water surface is 2 338 km^2 and the average water depth is 1.9 m (Li Qianqian, 2013). It has an important freshwater fishery with rich fishery resources. Before the comprehensive fishing ban, there were 3 400 fishers and 6 400 fishing boats. In 2018, the fisheries output of Taihu Lake reached approximately 70 000 tonnes. Silver carp and bighead carp were the main species caught as well as lake anchovy (*Coilia nasus*) (Ni Yong and Zhu Chengde, 2005) of which silver carp and bighead carp basically relied on hatchery propagation and stocking in the open water to maintain their populations.

With the introduction of the ten-year fishing ban in the Yangtze River, Taihu Lake has also begun a new phase of fisheries transformation. The mode of individual fishing was fully launched in 2020, and it is expected that environmentally friendly fisheries for ecological protection and restoration will be initiated.

The Qiandao Lake environmentally friendly fishery model is one of the models for the development of an environmentally friendly fishery management approach for a large waterbody in China. Based on the proliferation and fishing of silver carp and bighead carp, it has established a whole industry chain integrating breeding, management, fishing, processing, sales, scientific research, cooking, tourism and cultural creation (Song Quanli, 2020).

The 14th Five-Year Plan for silver carp and bighead carp fisheries reached 8 000 tonnes, with a direct output value of CNY 0.3 billion, which made an excellent case for aquatic biological protection and restoration of the Yangtze River in 2021 and also guided the green development of environmentally friendly fishery in other large waterbodies.

Recreational fishery: Recreational fishery is another fishery development thrust in China. Data showed that the output value of recreational fishery in China in 2019 reached CNY 94.32 billion but decreased by 17.2 percent in 2020 due to the COVID-19 pandemic, with an output value of CNY 78.06 billion.

Overall, the development prospects for recreational fishery are very good. China's recreational fishery can be disaggregated *inter alia* into the tourism-oriented recreational

fishery, the recreational fishing and gathering and the ornamental fish industry. Among them, the tourism-oriented recreational fishery and the recreational fishing and gathering are the leading subdivisions. They are mainly found in freshwater waterbodies.

Statistics show that currently there are 110 000 recreational fishery operators, 683 000 recreational fishery practitioners with 220 million visits.

Recreational fishery has become an important mechanism for promoting fishery quality and efficiency, developing aesthetic and prosperous fishing villages and increasing fishers' employment opportunities and income.

In recent years, the state and local government have attached great importance to recreational fisheries and have issued a series of policies to promote their healthy development.

In 2012, the former MoA issued the Guidance on Promoting the Sustainable and Healthy Development of Leisure Fisheries and set out the guiding ideology, basic principles and important measures to promote the healthy development of recreational fishery. Some local governments have formulated and issued development plans and policies to promote the development of recreational fishery; some have also introduced measures to standardize the management of recreational fishing vessels. The revision of the Fisheries Law of the People's Republic of China in 2014 fully considers the need for the development and supervision of recreational fishery, requires recreational fishery to be written into the general provisions of the draft and lists recreational fishery as one of the five major fishing industries, providing legal reference for the development of recreational fishery. In addition, the Ministry of Agriculture and Villages is formulating regulations on the management of recreational fisheries vessels and has completed a preliminary draft, which is being revised according to the opinions of various localities. Fishery ship inspection agencies have also formulated inspection rules for fishing vessels. In the next step, China will continue to strengthen research and coordination, and strive to introduce a management system and technical requirements for recreational fishing vessels as soon as possible, so as to effectively meet the development needs of recreational fisheries.

3.2.2 Main characteristics of inland capture fisheries

Fishing species are relatively concentrated

Table 3.3 shows that China produced 1 457 500 tonnes of freshwater capture fishery products in 2020, of which fish accounted for 1 108 900 tonnes, or 76 percent, of the total. Other types, including freshwater molluscs, freshwater crustaceans, freshwater algae and other freshwater species, accounted for 24 percent of the total.

TABLE 3.3. Inland fishing yields of different freshwater capture fishery products in China in 2020

Types	2020 production (tonnes)	% of total
Freshwater fish	1 108 900	76.1
Freshwater molluscs	171 700	11.8
Freshwater crustaceans	161 800	11.1
Other freshwater species	15 200	1.0
Freshwater algae	0.02	0.01
Total	**1 457 500**	**100**

Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. *China fishery statistics yearbook*. China Agricultural Press.

Unbalanced fishing areas

The top ten provinces and cities in terms of China's freshwater capture fishery production in 2020 are listed in Table 3.4. A total of 1 184 400 tonnes was produced by the top ten provinces and cities, or 81 percent of the total. The middle and lower portions of the Yangtze River are home to most of the country's 31 provincial-level administrative areas, with Jiangsu, Zhejiang, Anhui and Henan each producing more than 100 000 tonnes of freshwater fish annually.

TABLE 3.4. The top ten provinces in China for freshwater capture fishing production in 2020

Order	Province	Production	Order	Province	Production
1	Jiangsu	259 400	6	Shandong	95 600
2	Zhejiang	169 800	7	Guangxi	87 700
3	Anhui	144 000	8	Hubei	75 300
4	Henan	111 500	9	Jiangxi	72 200
5	Guangdong	98 700	10	Fujian	70 200

Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. China fishery statistics yearbook. China Agricultural Press.

Freshwater capture fishing production is declining

China's freshwater capture fishery output declined from 2013 to 2020, particularly from 2017 to 2020 (Figure 3.4). By 2020, China's freshwater fisheries output had decreased to 1 457 500 tonnes, a 21 percent year-over-year decrease. With ever-increasing freshwater aquaculture production, the proportion of freshwater capture fishing has gradually decreased over the past ten years and has been stable at around 5 percent. In 2020, freshwater capture fishing accounted for 4.5 percent of total freshwater fisheries production.

Gradual reduction of traditional fishers and production materials

Since the implementation of the increasingly strict fishing ban policy from 2016 to 2017, the fishing population, particularly traditional fishers, has gradually decreased in the total population of fishers.

New models of inland fisheries such as recreational fishing are developing rapidly

The rapid growth of recreational fisheries in recent years has become a key factor in the integrated development of the fishing industry and green, high-quality development, and it has significantly assisted the implementation of the rural revitalization strategy by increasing employment and income for farmers and fishers and addressing the aspirations of both urban and rural residents for a better quality of life.

Recreational fisheries have strong development potential now that the pandemic is effectively under control. The recreational fishing sector in China includes various subsectors, including those focused on tourism, recreational fishing and collecting, ornamental fish, fishing tackle and bait, ornamental fish medicine and aquarium equipment. The leading disaggregated industries among them are the tourism-oriented recreational fishery and the recreational fishing and collecting industry, with output values of CNY 30.13 billion and CNY 25.727 billion in 2020, respectively, accounting for 38.6 percent and 33 percent of the total output value of recreational fishery.

The freshwater-based industries of the tourism-oriented recreational fishery, recreational fishing and collecting, and ornamental fish were all worth CNY 17.953 billion, CNY 21.032 billion and CNY 7.638 billion in 2020, respectively, accounting for 59.6 percent, 81.8 percent and 85.0 percent of total output.

Transition from maximizing aquatic production towards sustainable use of aquatic resources for multiple purposes

Conservation-based fisheries in large waterbodies such as lakes, reservoirs and rivers has grown quickly in recent years, generating both economic and ecological benefits. It is a significant source of high-quality aquatic goods. In China, lakes, reservoirs and other large waterbodies also play a significant role in freshwater fisheries. In 2019, China's enormous area of enhanced fisheries accounted for for 42.8 percent of the overall area of freshwater aquaculture and 12.4 percent of its total production. Since the creation of New China, China has witnessed natural fishing, mixed with farming and fishing, primarily to increase production as well as environmentally friendly fisheries and other approaches.

Distinct historical periods of China's fisheries have clearly different goals. Large waterbody fisheries started to transition from intensive aquaculture to environmentally friendly fisheries at the beginning of the twenty-first century. The emphasis has also shifted from fish farming to water management not only providing high-quality aquatic products but also contributing to ecological restoration and biodiversity maintenance (Sun Linjie, Ge Yuming and Wu Zhuoliang, 2008).

The key national research and development programme, Blue Granary Science and Technology Innovation, key special projects such as the Lake Ecological Enrichment Technology and Model and Typical Lake Water Purification Fishery Model Demonstration have been established. The Yangtze River Special Project, Northwest Special Project, Northeast Special Project and Baiyang Lake Special Project, supported by special agriculture financing projects, such as fishery resource environment investigation and restoration work, have been conducted resolutely.

A number of coordinated water environment and fishery resource development endeavours in important waterbodies, including Liangzi Lake, Xinjiang Bosten Lake, the Three Gorges Reservoir, Chagan Lake and Qiandao Lake have been conducted. Additionally, a number of ecological and habitat restoration techniques have been developed and ecological enrichment models for various types of lakes and reservoirs have been created.

3.2.3 Inland fishery development benefits

China is an agricultural country with a long history. For a long time, it has been customary to regard fishery as part of large-scale agriculture, and therefore the study of its social aspects as well as economic activity, simply falls into the category of agricultural economy. With the continuous improvement of the level of social productivity and the development of fishery production specialization and socialization, the division of labour and its cooperative relationship within the fishery has also developed day by day, and worldwide, China is recognized as a country with highly developed fishery production. The fishery sector has become an indispensable and important part of China's national economy, playing an increasingly important role as an important producer and having important significance in all aspects of social economy.

Ensuring food supply

New China adheres to the people-oriented development concept, with constant attention to meeting people's material and cultural needs and a better quality of life. Most Chinese people born before the 1960s experienced food supply deficits and inadequate access to fish. In 1982, the Central Committee of the Communist Party of China and the State Council pointed out that fish was one of the scarcest food products and stated the need for developing aquaculture in the Report on Accelerating the Development of Freshwater Fisheries to the Ministry of Agriculture, Animal Husbandry and Fisheries. They wanted Party committees and governments at all levels to pay attention to the use of waterbodies as much as arable land.

At the beginning of reform and liberalization, the state implemented a unified pricing and unified purchase system for aquatic products; freshwater fishing production was not high, and even decreased – freshwater fishing reached 668 000 tonnes in 1960 but was less than 300 000 tonnes in 1978. Since 1979, with the gradual implementation of a combination of distribution and bargaining, as well as the opening of the aquatic fair trade "dual system", freshwater fisheries production began to increase. In the 1990s it exceeded 1 million tonnes and at the beginning of the twenty-first century it reached 2 million tonnes. Currently it is close to 1.2 million tonnes. In the past seven decades, China's population has increased dramatically and per capita consumption of aquatic products has increased more than 50 times. For the general public, diverse fish species have become available and the freshwater fishing industry provides many high-quality aquatic products. General Secretary Xi Jinping, when visiting members of the agricultural, social welfare and social security circles attending the Fifth Session of the 13th National Committee of the Chinese People's Political Consultative Conference in 2022, stressed the need to establish a "big" food concept, starting from better meeting people's needs for a better life, grasping the changing trend in people's dietary habits and ensuring the supply of meat, vegetables, fruits, aquatic products and other types of food. As such, the fishery industry has made an important contribution to sustaining the supply of China's agricultural market and food safety, and effectively improving the nutritional dietary structure of urban and rural residents.

Reform of the industrial agriculture structure

China has a huge population and the per capita occupation of arable land is very small. So the expansion of urban and rural infrastructure, power projects, transportation network development and other factors continue to compete with farmers for land; with the rising population, the per capita occupation of arable land continues to decline (Su Xin, 2009). At present, China has nearly 200 000 km^2 of natural and artificial inland waterbodies, which need development and utilization. Accordingly, effective development of these vast waterbodies that neither competes with grain from arable land nor with animal husbandry on grassland requires the promotion of aquaculture. This requires planning and developing low-lying land, wasteland and saline alkali areas that are not suitable for cropping or grazing to promote fishery production (Deng Yunfeng and Song Liqing, 2005).

Enhancing nutrition

Fish is an important source of animal protein and trace elements, such as calcium, vitamin A and iron. It is also an important source of some fatty acids, which are fundamental for a proper nutrition. Fish is not only important for the normal growth and development of human beings, but also has certain effects on disease prevention. Although the total volume of aquatic products in China ranks first in the world, the per capita consumption of aquatic products is still at a low level. According to statistics, in 2019, the per capita consumption of aquatic products in China was only 13.6 kg, while the global per capita consumption of aquatic products was 20.5 kg, so there is still a lot of room for growth in China's per capita consumption of aquatic products.

On 26 April 2022, the Chinese nutrition society released the *Chinese dietary guidelines*, which clearly emphasized the importance of fish in diets. It indicated that for the Chinese people's dietary structure, protein intake had improved considerably, but needed more consumption of fish and shrimp. The guidelines put forward for the first time the "oriental healthy diet mode" and pointed out that human health is affected by food variety so Chinese people should eat aquatic products at least twice a week. In 2022, General Secretary Xi Jinping put forward the Big Food Perspective, which will ensure diversified food supply and enrich people's nutritional structure, further reflecting the importance of aquatic products protection.

Enhance the comprehensive benefits of fisheries

Economic benefits: Based on the annual report data of the NBS, regarding fishery output value, the output value of freshwater fishing in 2020 was CNY 40.39 billion. The national total output of aquatic products was 65.49 million tonnes, an increase of 1.06 percent over the previous year, including 13.25 million tonnes of fishing output, a decrease of 5.46 percent year-over-year.

Ecological benefits: The coordinated development of waterbody conservation with fisheries development has achieved remarkable ecological, economic and social benefits. Two examples are:

- The environmentally friendly fishery technology model in Qiandao Lake. Taking Zhejiang Province as an example, there are 30 lakes exceeding 100 ha in size and nearly 3 500 reservoirs, including 30 large reservoirs. More than 90 percent of the lakes and reservoirs use the environmentally friendly fishery technology model of Qiandao Lake, and the direct economic output value of fishery is more than CNY 1 billion annually.
- The water purification fishery model of Lihu Lake has been extended to Taihu Lake, Gehu Lake, Yangming Lake, Lushan West Sea Reservoir and other waterbodies, making positive contributions to the coordinated development of local environmental protection and environmentally friendly fishery.

The development of environmentally friendly fishery not only plays a significant role in promoting the ecological health of local waterbodies, but also plays an important role in the restoration of aquatic biodiversity in related waters.

Social benefits: Driven by the showcasing of famous fish-producing areas such as Qiandao Lake and Chagan Lake, the annual benefits of silver carp and bighead carp culture in China have been significantly highlighted. This has played a positive role in promoting the development of lake and reservoir fishery and increasing the income of fishers in these areas.

At the same time, some areas have explored and promoted the creative industry of fish culture through the combination of environmentally friendly fishery and recreational fishery.

In addition to the cultural and industrial value of environmentally friendly fishery, the development of recreational fishery has played a positive role in alleviating the surplus labour force in China for many consecutive years. At the same time, the development of the recreational fishing industry and ornamental fishing industry has benefited many people. With ornamental fish, goldfish for example, a pair of parent fish can hatch thousands to tens of thousands of fish seedlings in a year. A goldfish farm operated by two brothers in Pudong, Gushan Township, Fuzhou, has a net annual income of around CNY 10 000 (equivalent to about USD 1 380) per Mu (unit of area, equivalent to about 666.67 square metres).

There are dozens of species bred by 18 farmers in Changhe Township, Xiaoshan City, Zhejiang Province. They are airlifted and sold in Japan, the United States of America and Hong Kong, Special Administrative Region with annual net income of millions of dollars.

At present, Shanghai uses the flower, bird, fish and insect market of Jiangyin Road. It has more than 300 ornamental fish farms, more than 1 600 agents, retailers and wholesalers, and 2 000 aquatic equipment, medicine and bait distributors in the environs. With the improvement of people's living levels and the development of tourism, the region has increasingly demonstrated the vigour and vitality of emerging industries.

In addition, ornamental fish in home aquaria have always been immensely popular among the general public.

3.3 FISHERIES PRODUCTION REPORTING SYSTEMS AND PRODUCTION OVERVIEW

3.3.1 The fisheries statistics system

Fisheries statistics, as an important element of fisheries information work, provide basic data for the government's fisheries management decisions. They are of great importance for the correct analysis of the development trend of fisheries, the optimization of industrial structure and the management and protection of fisheries resources. Fishery statistics are used to reflect the situation of fishery production; therefore, the authenticity and accuracy of data are fundamental to this work. The legal basis of China's fisheries statistics system is mainly the Statistics Law, the Fisheries Law and the Regulations on Fisheries Statistics. At present, a combination of comprehensive statistical surveys and sample surveys is mainly used to obtain basic fisheries data. Fishery production data are summarized at each level of the administrative hierarchy, starting from the grassroots organization where the fishing village or fishing vessel is located and through a bottom-up cascade of reporting. At the same time, to meet the needs of the market economy and to take the initiative to align with international agencies such as FAO, some adjustments have been made to the system of calculating fishery production and fishery statistics indicators.

China's fisheries statistics system combines two different types of statistics, namely centralized statistics and decentralized statistics, and is based on the principle of "reasonable division of labour, joint collaboration and sharing of results". Different layers of analysis are conducted and there is submission of information and data directly from the grassroots level to the fisheries departments and the NBS. According to the Regulations on Fishery Statistics, the statistical agencies or personnel designated by the village (town) people's local governments obtain first-hand information from the basic units and, after confirmation by the basic units surveyed, submit fishery statistical reports to the village (town) people's local governments, the fisheries administrative departments at or above the county level on a monthly, half-yearly and annual basis, and to the fisheries administrative departments at the provincial level in accordance with the fishery statistical reporting system approved by the NBS. The statistical reporting system is reported to the MARA in two ways: online materials and hard copy materials.

Although the functions of each department are different, the organizational structure is similar, with the national fisheries statistics survey being the responsibility of the comprehensive department of the Fisheries Bureau of MARA and the planning and finance departments within the fisheries departments in each province (city and autonomous region); at the county and district levels, the fisheries departments have a head of fisheries statistics, establish relatively complete fisheries statistics and a database, calculate total fisheries production and total output value, and conduct comprehensive statistical analysis of the economic operation of the fisheries industry.

However, the data and information published and quoted to the public are mainly those of the NBS. On this basis, sample surveys, key surveys, special surveys, year-end surveys, as well as fishery collection and remote monitoring are also carried out to supplement the data reported by the fisheries industry.

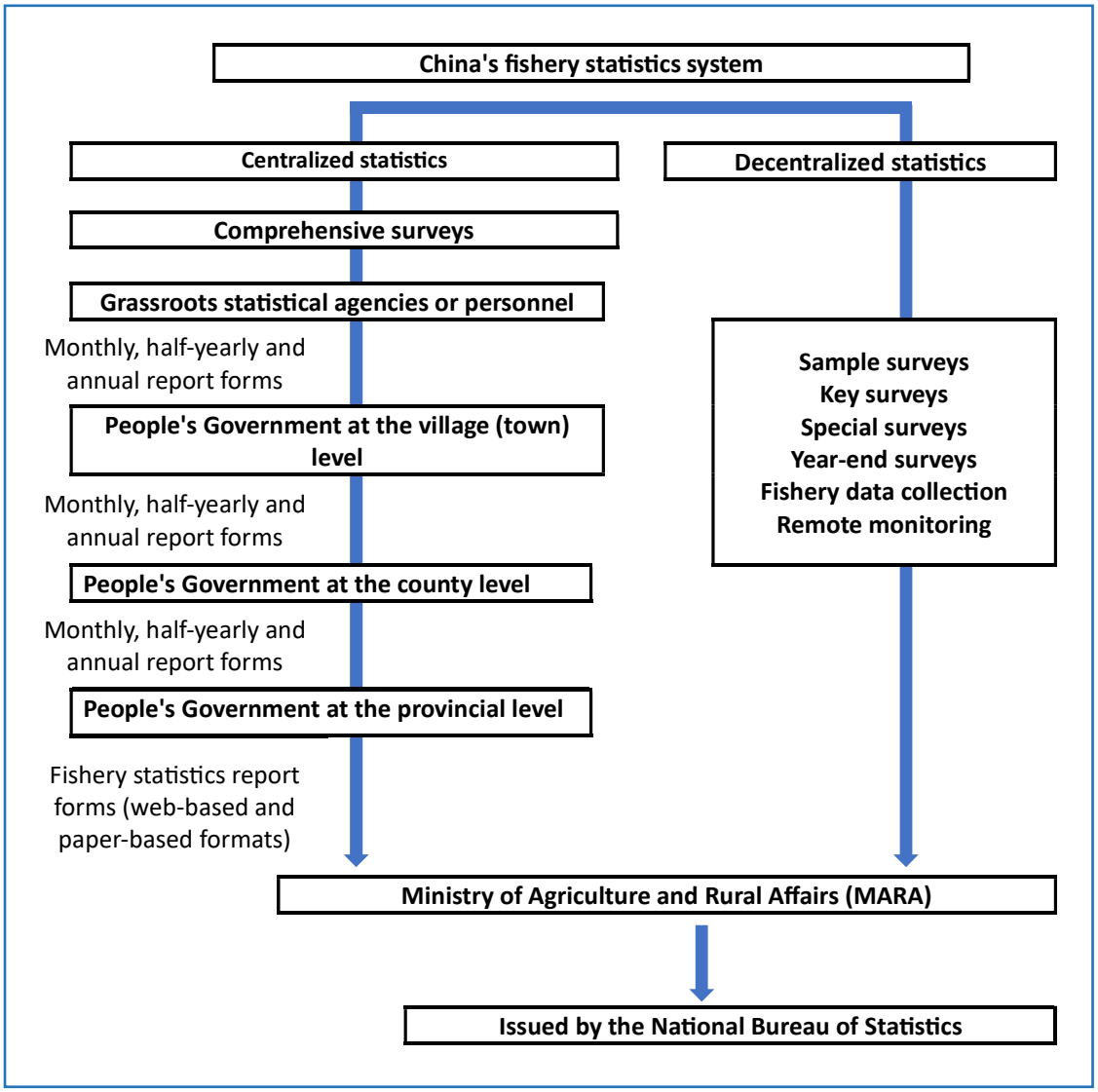
There are many problems with the survey method of fisheries statistics based on comprehensive surveys and many suggestions have been made for the improvement of fisheries statistics methods in terms of systems and measures.

In recent years, to improve the reliability of statistical data, the national fisheries management authorities have organized the construction of a national fisheries dynamics information collection network, supported by stratified sampling techniques and based on independent survey information sources, with sampling surveys as a basis for assessing the status of the fisheries industry.

In fisheries statistics, according to the principles and methods of stratified sampling, the sample size of each stratum is reasonably determined in accordance with the requirements of sampling accuracy and reliable inferences are made about the overall characteristics; stratified sampling surveys can greatly reduce workload, save on survey costs and improve sampling accuracy (Figure 3.1).

In freshwater capture fisheries, although the operating fishing vessels are small in horsepower, the number of operating vessels is huge, and the statistical indicators and data volume are very complex.

FIGURE 3.1. Flow chart of China's fisheries statistics system



Source: FFRC using data from the Statistics Law of the People's Republic of China, Fisheries Law of the People's Republic of China and Fishery Statistics Regulations (Ministry of Agriculture and Rural Affairs of the People's Republic of China).

3.3.2 Relevant technical standards

According to statistics, China has strengthened the planning and construction of fisheries standards system since 2004. More than 350 national standards and industry standards have been formulated and released, with a focus on aquatic product quality and safety standards, and the number of fisheries national standards and industry standards has now reached 804. At the same time, regarding the pace of construction of local standards systems around the country, mainly for aquaculture, the number of standards has increased significantly to 1 139, and more than 280 local standards are being developed.

At present, China's fisheries standards system has taken shape, with national standards and industry standards as the mainstay and local standards and enterprise standards remaining in conjunction with each other. The system covers various domains such as fisheries resources, environmental management, breeding, processing, fishing vessels, fishing technology, fishing gear, engineering, providing technical guarantees for regulating fisheries production, management and trade activities.

At the same time, as the basis of China's fisheries development, the standardization of fisheries has also made great progress. As early as the early 1970s, China started with standards for fishing vessels, and successively established the standardized technical units and corresponding standard review committees for fishing vessels, technology, instruments, gear and gear materials, aquatic products processing, freshwater aquaculture and mariculture. On this basis, the National Technical Committee for Fishery Standardization and the National Technical Committee for Fishing Vessel Standardization were formed in 1990, and subsequently, seven technical subcommittees and one working group for standardizing aquatic animal disease prevention was established for each specialty. Some of the technical regulations for fish resource surveys are listed Table 3.5.

TABLE 3.5. Technical standards for fish stock surveys

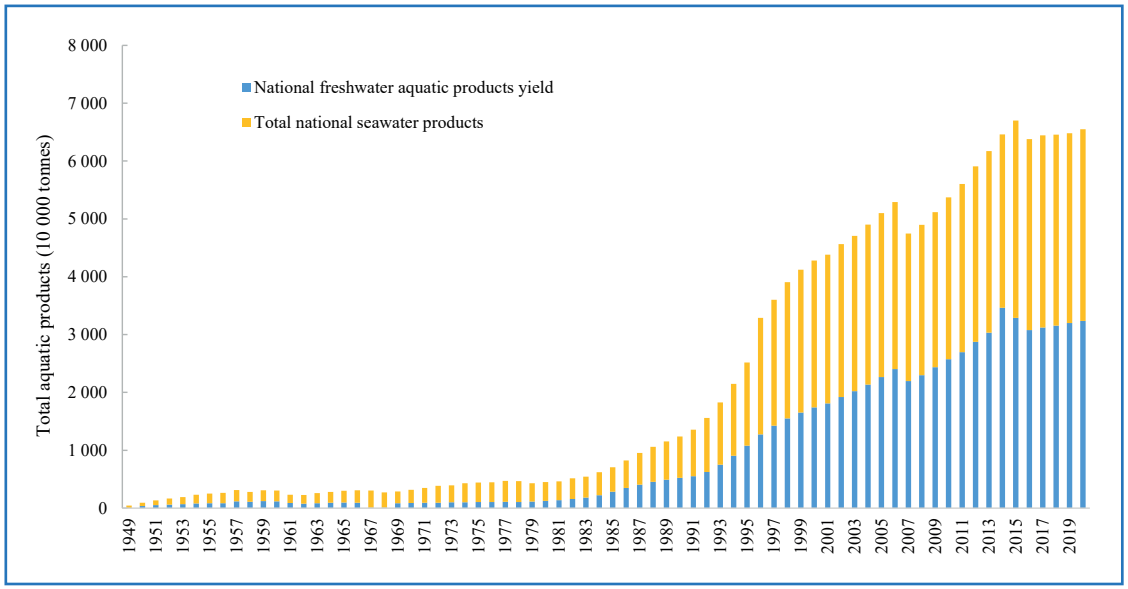
Category	Name	Issuing unit/issuer	Year of issue
National standards	Specification for Survey of Freshwater Fisheries Resources - Rivers	Ministry of Agriculture and Rural Affairs of the People's Republic of China	2019
Industry standards	*Manual for survey of fisheries natural resources in inland waters*	Zhang Juemin, He Zhihui	1991
	Technical Provisions for Survey and Assessment of Inland Fish Diversity	Ministry of Ecology and Environment of the People's Republic of China	2021
	Specification for Survey of Fish Resources in Inland Waters	Bureau of Quality and Technical Supervision, Jiangsu Province	2013
	Technical Specification for Acoustic Survey of Fish Resources in Henan Section of Yellow River	Bureau of Quality and Technical Supervision, Henan Province	2018
Normative references	*Technical specification for lake survey*	Nanjing Geography and Lakes Research Institute, Chinese Academy of Sciences	2015
	Observation and analysis of ecological survey of lakes	Standards Press of China	2000
Fish species identification	*Search list of China's freshwater fishes*	Zhu Songquan	1995
	Fauna Sinica Osteichthyes Cypriniformes, Volume I	Chen Yiyu *et al.* Beijing: Science Press	1995
	Taxonomy of fishes	Meng Qingwen	1996
	Fauna Sinica Osteichthyes Cypriniformes, Volume II	Le Peiqi *et al.* Beijing: Science Press	2000
	Journal of Fishes in Jiangsu Province	Ni Yong	2006

Source: Authors' elaborations.

3.3.3 Fisheries production

With the continuous improvement of the living standards in China and the continuous optimization and improvement of the consumption structure, the proportion of aquatic products in the dietary structure has been increasing. The continuous growth of demand has driven up the total production of aquatic products in China. According to the NBS, since the founding of the country, China's freshwater and seawater products have maintained a parallel development trend of continuous growth (Figure 3.2).

FIGURE 3.2. Interannual variation in total national fish production

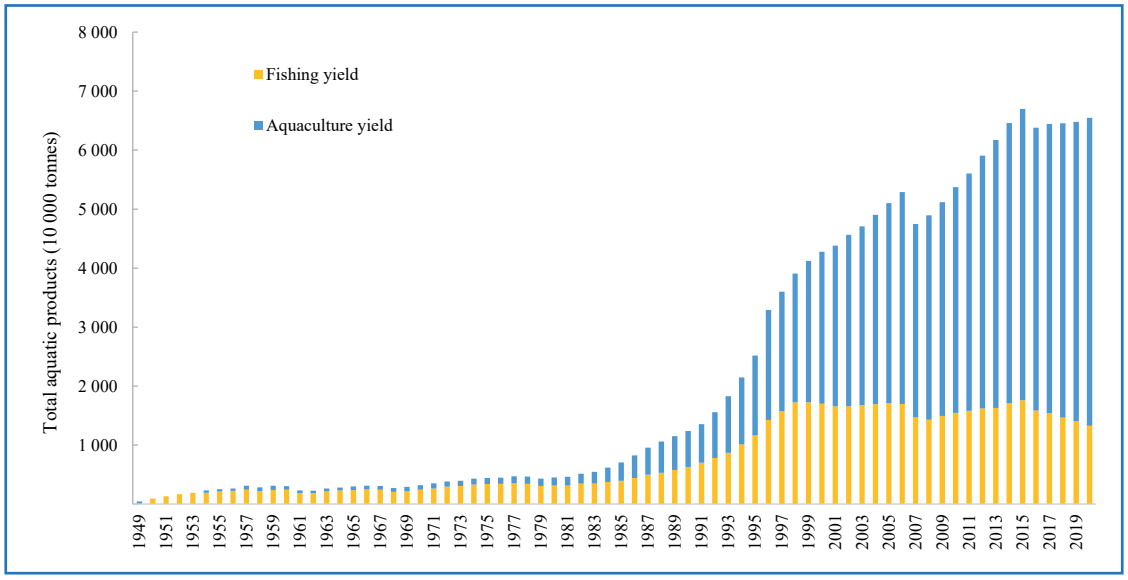


Source: FFRC using data from the *China fishery statistics yearbook* for this review.

In terms of fish production, in the early years of the New China (1950–1960), China's fisheries production gradually increased, while the production of aquaculture was very small. However, against the background of social development and growing population, the ecological environment was deteriorating, fishery resources were gradually decreasing and people's lives were becoming increasingly difficult. Therefore, optimizing traditional farming concepts and techniques, establishing modern scientific farming concepts, emphasizing the use of a variety of new technologies, scientifically regulating the proportion of mixed farming and improving yields were top priorities for improving the total production of aquatic products. Since the 1990s, there has been a gradual "one increase and one decrease" in farming and fishing production respectively (Figure 3.3).

In particular, since the beginning of the twenty-first century, under the general objective of "improving quality and efficiency, reducing quantity and increasing income, green development and enriching fishermen", measures to deepen the structural reform of the supply side of fisheries and promote high-quality development of fisheries have been further implemented, and the structure of the fisheries industry has been further optimized. In 2020, China's fish farming production had grown to 3.94 times that of the fisheries production.

FIGURE 3.3. Interannual variation in national fishing production and farming production



Source: FFRC using data from the *China fishery statistics yearbook* for this review.

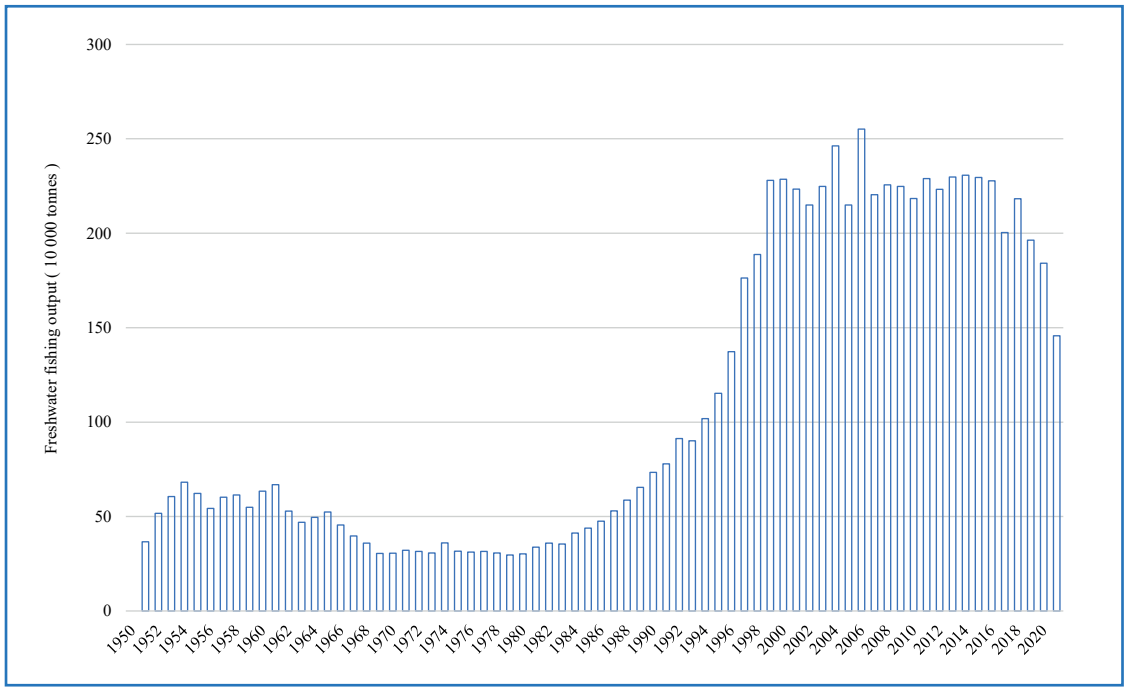
Aquatic products are important sources of food for people and occupy a key position in the food structure. China has a long history of aquaculture as well as culture-based fisheries.

In 1949, China's freshwater fisheries industry entered the development track under the guidance of the Common Program and the government targeted the organization of farmers and all labourers who could enrich agriculture and develop agricultural production as the central task (Communist Party of the People's Republic of China, 1950). The total output of freshwater and seawater fisheries at that time was 448 000 tonnes. From 1950 onwards, freshwater fisheries output and marine fisheries output were counted separately. Freshwater fisheries output slowly increased, although there were fluctuations, but basically was maintained at about 500 000 tonnes. From 1965 onwards, freshwater fisheries production continued to decline, with production basically maintained at 300 000 tonnes to 400 000 tonnes; along with the reform and liberalization, the aquatic industry developed rapidly, and the total freshwater fishery production continued to rise, especially in the 1990s, with freshwater fishing production reaching more than 1 million tonnes. After 1999, China's freshwater fisheries production stabilized at about 2 million tonnes, reaching the highest inland fisheries production (2.5 million tonnes) in 2005.

With the rapid development of the economy, ecological and environmental problems have become increasingly serious, and in order to protect aquatic biological resources, the state vigorously promotes the concept of green development, and has issued relevant policies and measures for the development of ecological fisheries, such as the introduction of the "double control" system, the fishing moratorium system, the fishing ban system, aquatic life protection measures and the establishment of aquatic germplasm resource reserves to ensure the green and sustainable development of water resources.

Therefore, inland fisheries production has gradually decreased since 2010, especially from 2016 onwards, with the release of various fishing ban policies and the strengthening of enforcement actions. After the implementation of the ten-year fishing ban on the Yangtze River and the fishing ban on major lakes, inland fisheries production dropped sharply from 2.003 million tonnes in 2016 to 1.457 million tonnes in 2020. The output management effect of freshwater fisheries is obvious (Figure 3.4). In the future, with the increased awareness of ecological protection in large waterbodies, the implementation of the fishing ban policy and the strengthening of law enforcement, inland fisheries production will further decline.

FIGURE 3.4. Fishing production of freshwater aquatic products



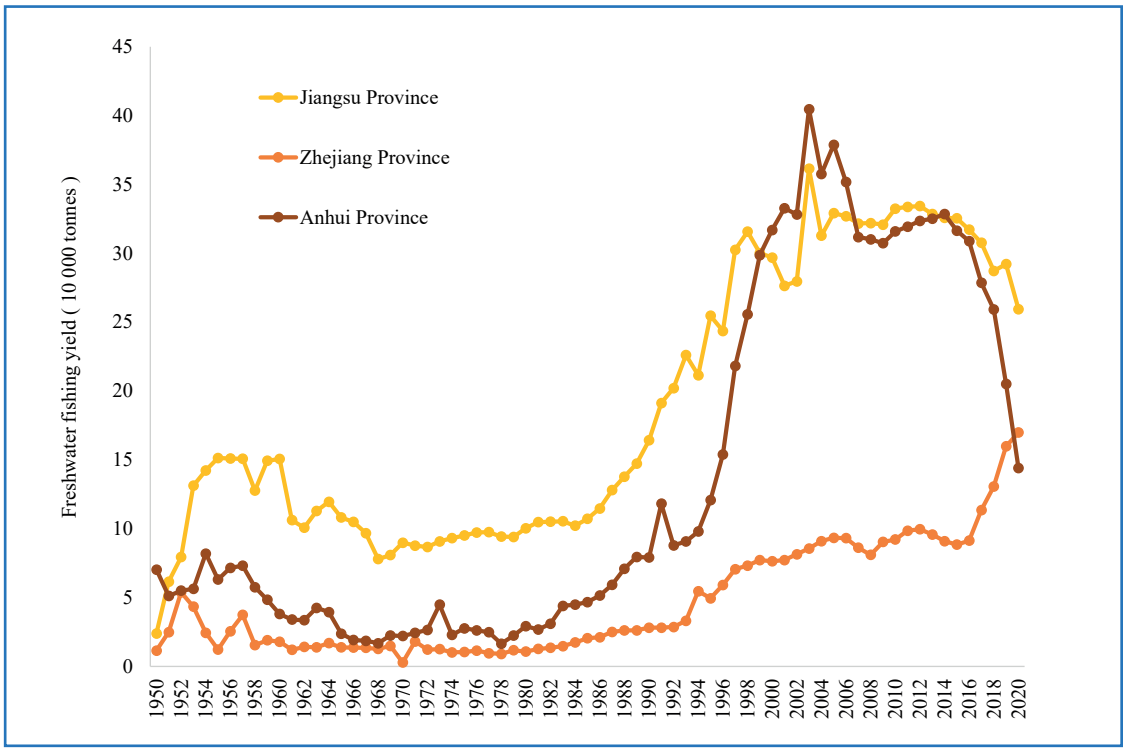
Source: FFRC using data from the *China fishery statistics yearbook* for this review.

3.3.4 Main fishing provinces

Jiangsu, Anhui and Zhejiang provinces are the main fishing provinces (Figure 3.5). The freshwater fisheries production in Jiangsu Province has long been at a high level. The freshwater fisheries production of Jiangsu Province and Anhui Province increased rapidly in the early years of China's development, and then decelerated from the 1960s to the 1990s. Anhui Province's freshwater fisheries production was also at a low level until the 1990s. After the 1990s, freshwater fisheries production in Jiangsu and Anhui provinces grew rapidly, reaching a peak in 2003, with 361 445 tonnes in Jiangsu and 404 616 tonnes in Anhui. At the beginning of the twenty-first century, with the implementation of various ecological protection measures and fishing ban policies, especially after 2015, with the implementation of the ten-year fishing ban on the Yangtze River and Taihu Lake, the freshwater fisheries production of the two provinces showed a significant and sustained decline.

The growth of freshwater fisheries production in Zhejiang Province was extremely unstable in the early years of the country, with occasional highs and lows, falling to a low value of 2 775 tonnes in 1970, and continuing at a low level of no more than 40 000 tonnes until 1993. After 1994, freshwater fisheries production in Zhejiang Province developed slowly and never exceeded 100 000 tonnes. With the development of environmentally friendly fisheries, inland fisheries production in Zhejiang Province significantly increased after 2016, and in 2020, it had reached 169 795 tonnes (Table 3.6).

FIGURE 3.5. Freshwater fishing production in Jiangsu, Anhui and Zhejiang provinces



Source: FFRC using data from the *China fishery statistics yearbook* for this review.

TABLE 3.6. Inland fisheries capture production statistics of major fishing provinces from 2019 to 2021 (tonnes)

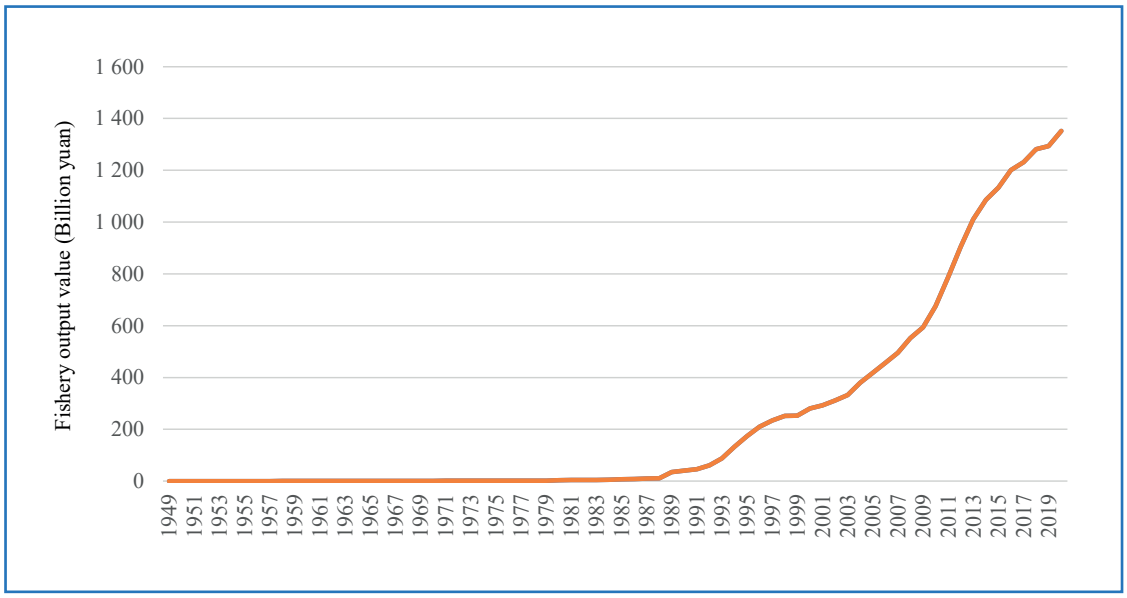
Rank	2019		2020		2021	
1	Jiangsu	292 062	Jiangsu	259 359	Jiangsu	177 968
2	Anhui	20 079	Zhejiang	169 795	Zhejiang	156 282
3	Jiangxi	167 567	Anhui	143 951	Anhui	122 838
4	Hubei	161 750	Henan	111 465	Henan	109 964
5	Zhejiang	159 809	Guangdong	98 682	Shandong	95 733
6	Henan	112 255	Shandong	95 634	Guangdong	89 067
7	Guangdong	108 998	Guangxi	87 677	Guangxi	85 469
8	Guangxi	91 050	Fujian	75 272	Fujian	71 847
9	Shandong	89 290	Jiangxi	72 166	Liaoning	36 979
10	Hunan	80 905	Fujian	70 235	Hebei	35 065

Source: FFRC using data from the *China fishery statistics yearbook* for this review.

3.3.5 Fish production value

According to the *China fishery statistics yearbook*, after the founding of the People's Republic of China, the fisheries industry has enjoyed unprecedented development. After more than 70 years of development, China's total national fishery output value had grown from CNY 0.6 billion in 1949 to approximately CNY 135 billion in 2020, an increase of 22 528 percent. From the development stage, the first 40 years of slow development, the total output value was below CNY 10 billion. From the 1990s onwards, China's total national fishery production capacity has increased significantly owing to the rapid development of fishery resources, the growing variety of aquatic products and the rapid increase in fishery output value. In 2007 it exceeded CNY 500 billion, in 2013 it exceeded CNY 1 trillion and it is now worth more than CNY 1.3 trillion (Figure 3.6).

FIGURE 3.6. Total national fishery production value



Source: FFRC using data from the *China fishery statistics yearbook* for this review.

Since 2004, the *China fishery statistics yearbook* has published data on the output value of freshwater fisheries products. In 2005, the output value of freshwater capture products in China has exceeded CNY 20 billion, reaching a peak of CNY 46.577 billion in 2018 (<4 percent of total fishery value). Since then, with the gradual expansion of closed areas and the gradual extension of closed periods, the output value of freshwater fisheries products in China has declined to a certain extent (Table 3.7).

TABLE 3.7. Total value of inland fishing in the top ten fishing provinces from 2019 to 2021 (CNY 10 000)

Rank	2019		2020		2021	
1	Jiangsu	761 292	Jiangsu	1 558 391	Jiangsu	1 340 995
2	Anhui	646 402	Anhui	487 274	Anhui	393 653
3	Jiangxi	449 800	Zhejiang	345 776	Shandong	203 002
4	Zhejiang	326 015	Jiangxi	269 195	Zhejiang	202 063
5	Hubei	272 000	Guangdong	175 784	Guangdong	185 014
6	Guangdong	176 524	Shandong	173 314	Fujian	160 260
7	Shandong	159 578	Fujian	148 171	Heilongjiang	126 137
8	Fujian	155 683	Hubei	121 824	Jiangxi	114 705
9	Heilongjiang	125 335	Heilongjiang	109 222	Henan	83 180
10	Sichuan	121 526	Guangxi	79 757	Hubei	77 982

Source: FFRC using data from the *China fishery statistics yearbook* for this review.

3.3.6 Main fishing species

The main composition of freshwater capture fishery products in China is shown in Table 3.8. Since 2003, freshwater fishing production has been separated by category, as shown in Figure 3.7. On 5 January 2016, General Secretary Xi Jinping pointed out at the Symposium on Promoting the Development of the Yangtze River Economic Belt that the Yangtze River has a unique ecosystem and is an important ecological treasure trove in China.

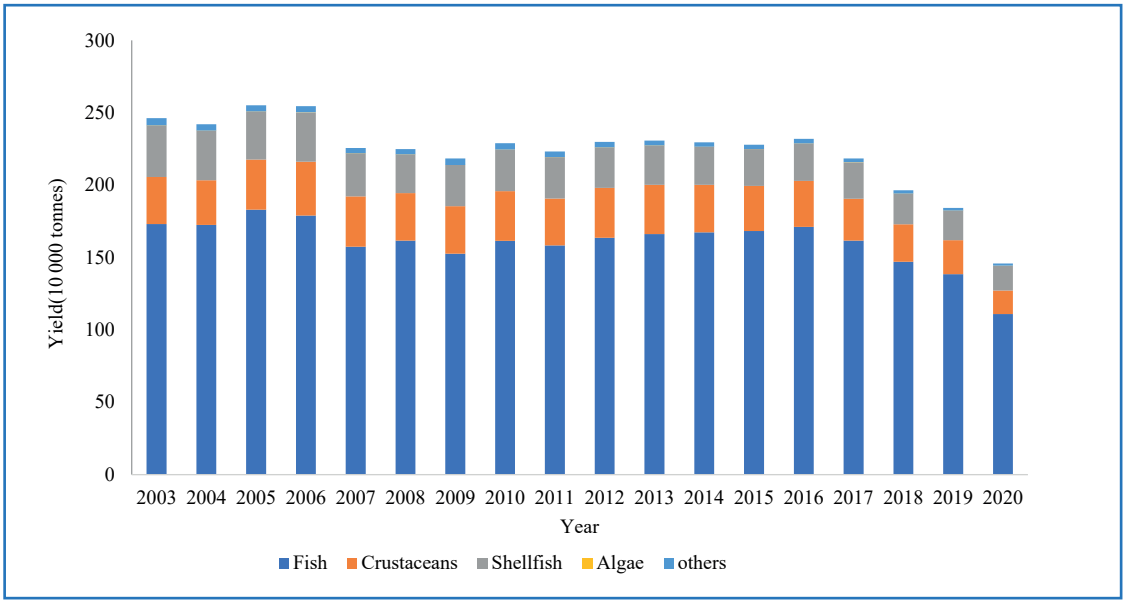
TABLE 3.8. The main composition of freshwater fishing products

Category	Name	Category	Name
Fish	*Hypophthalmichthys molitrix*	Fish	*Perca fluviatilis*
	Hypophthalmichthys nobilis		*Channa argus*
	Ctenopharyngodon idella		*Oreochromis mossambicus*
	Mylopharyngodon piceus		*Anguilla japonica*
	Cyprinus carpio	Crustaceans	*Macrobrachium rosenbergii*
	Carassius auratus		*Macrobrachium nipponense*
	Parabramis pekinensis		*Procambarus clarkii*
	Misgurnus anguillicaudatus		*Litopenaeus vannamei*
	Silurus asotus		*Eriocheir sinensis*
	Tachysurus dumerili	Shellfish	Unionidae
	Tachysurus fulvidraco		*Sinotaia aeruginosa*
	Takifugu obscurus		*Corbicula fluminea*
	Monopterus albus	Others	Testudoformes
	Siniperca chuatsi		Ranidae
	Protosalanx hyalocranius		

Source: FFRC using data from the inland fishing survey conducted for this review.

At present and for a considerable period of time in the future, it is necessary for the restoration of the Yangtze River's ecological environment to take an overriding position and to grasp the need for major protection without engaging in large-scale development. Therefore, various fishing ban policies have been gradually implemented since 2016, and fisheries production in all categories of freshwater, continued to decline from 2016 to 2020.

FIGURE 3.7. Interannual variation in freshwater fishing production by category



Source: FFRC using data from the *China fishery statistics yearbook* for this review.

According to the requirements of the Notice of the General Office of the Ministry of Agriculture on the Pilot Work of the 2015 Inland Fishing Statistical Sampling Survey, sampling statistics were carried out on China's inland fishing output for three consecutive years from 2016 to 2018, and the fishing products and varieties of major provinces were investigated. Sample vessels in Jiangsu Province lakes caught 17 species, mainly lake anchovy (52.02 percent) and crucian carp (10.88 percent) (Table 3.9). Lakes in Anhui Province recorded 19 species caught by sample boats, dominated by *Coilia nasus*, followed by *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis* and other fish.

TABLE 3.9. Production ratios by living aquatic resources in sample boats from lakes in Jiangsu, 2016–2018

Species	2016		2017		2018	
	Yield (kg)	Production ratio (%)	Yield (kg)	Production ratio (%)	Yield (kg)	Production ratio (%)
Coilia nasus	22 401	52.0	28 990	44.7	21 367	34.0
Carassius auratus	4 686	10.9	8 464	13.0	6 931	11.0
Hypophthalmichthys nobilis	2 642	6.1	3 211	5.0	11 745	18.7
Ctenopharyngodon idella	2 509	5.8	3 494	5.4	3 634	5.8
Miscellaneous fish	2 130	5.0	1 571	2.4	2 930	4.7
Exopalaemon modestus	2 044	4.8	5 403	8.3	4 429	7.0
Hypophthalmichthys molitrix	1 970	4.6	3 308	5.1	6 177	9.8
Hemisalanx prognathus Regan	1 908	4.4	7 600	11.7	2 264	3.6
Cyprinus carpio	1 078	2.5	1 044	1.6	1 098	1.8
Tachysurus fulvidraco	669	1.6	517	0.8	325	0.5
Eriocheir sinensis	372	0.9	179	0.3	279	0.4
Macrobrachium nipponense	341	0.8	416	0.6	672	1.1
Parabramis pekinensis	177	0.4	382	0.6	278	0.4
Mylopharyngodon piceus	73	0.2	124	0.2	339	0.5
Culter alburnus	44	0.1	201	0.3	332	0.5
Siniperca chuatsi	13	0.0	1	0.0	91	0.1
Channa argus	6	0.0	3	0.0	0	0.0
Hemiculter leucisculus	0	0.0	0.5	0.0	0	0.0
Procambarus clarkii	0	0.0	1.4	0.0	0	0.0

Source: FFRC using data from the Notice of the General Office of the Ministry of Agriculture on the Pilot Work of the 2015 Inland Fishing Statistical Sampling Survey for this review.

3.3.7 Limitations of the statistical system

The development of Chinese fisheries has entered a new era, which has increased the need for more accurate and detailed fishery statistics. Improving fisheries statistics is also a important for implementing China's rural revitalization strategy of the "three major battles" that will address risks to the economy, poverty reduction, and control of pollution (Yue Dongdong and Wang Lumin, 2013). However, the foundation of fisheries statistics is still relatively weak, the management system and work system need to be further improved and the work level and capacity need to be further enhanced.

To meet the requirements of fisheries development in the new era, there is an urgent need to further strengthen fisheries statistics to meet the requirements of deepening the reform of the statistical management system and the transformation and upgrading of fisheries and high-quality green development.

High workload for grassroots statisticians

Some of the grassroots statistical units are not in place for the implementation of statistical analyses; most of the statisticians are working in several jobs, there are frequent changes and there is poor stability. A survey showed that the statistical work of large and medium enterprises and institutions was relatively standardized, with special statistical agencies and full-time statistical staff, while some small units or organizations, with fewer staff at the grassroots level, had most of their statistical staff doing several jobs; their statistical work was only incidental and statistical data might have been omitted. Moreover, some of the grassroots statisticians may lack systematic training, and their ideology, working ideas and the choice of different parameters in the projection process may lead to deviations in statistical results.

In addition, some grassroots statistical units have not established standardized statistical ledgers and statistical systems, and some private and individual enterprises do not fully cooperate with the statistical work, so that the statistics they provide may be biased. Furthermore, the funding and security conditions necessary to carry out statistical work at the grassroots level cannot be fully guaranteed.

Statistical indicators are insufficiently specific and need to be further detailed

Statistical survey methods are relatively outdated, comprehensive surveys lack focus and sample surveys have difficulty in achieving typical coverage; in practice, all have certain limitations. For statistical sampling at the grassroots level, it is difficult for grassroots statisticians to ensure the randomness and representativeness of each survey sample, which may affect the accuracy of the survey sample data and enlarge the sampling error. In addition, the existing statistical indicators are not specific enough; for example, natural fishing, enhancement fishing and recreational fishing are not counted separately, which makes it difficult to make parallel comparisons with other countries.

The information system needs to be further strengthened

At present, the operational system of China's fisheries statistics information system is not sound enough, especially the fishing logbooks of fishing vessels and the data information related to the aquatic products trading market, which makes it difficult to ensure the integrity and accuracy of statistical data from the source. It is necessary to make full use of the internet of things, big data and other technical means, innovate ways and methods of information collection, expand data collection channels, and connect with local and central fisheries statistics networks; this will not only raise the efficiency of statistical management, but also validate the accuracy of catch statistics, and lay a good foundation for the implementation of resource protection management and utilization.

Therefore, it is necessary to accelerate the development of fisheries statistical information networks, underpin fisheries regulations, standardization and scientific study, gradually realize the collection, processing, application and management networks for fisheries information, narrow the gap with international statistical standards and generally improve the level of fisheries statistical information. At the same time, the construction of cooperative economic organizations and fish sales market systems should be accelerated, and the system of statistical surveys on the fishing household economy, fish production fees, fish circulation conditions and prices should be broadened to effectively grasp the trends of the fishery economy and ensure the smooth implementation of the fishery statistics system.

3.4 STATISTICAL ANALYSIS OF INLAND CAPTURE FISHERIES PRODUCTION

This section provides a snapshot of some inland fisheries in China to provide an idea of the nature of fisheries and their status, employment and involvement issues, the types of yields and values which are obtained and some of the issues facing these fisheries.

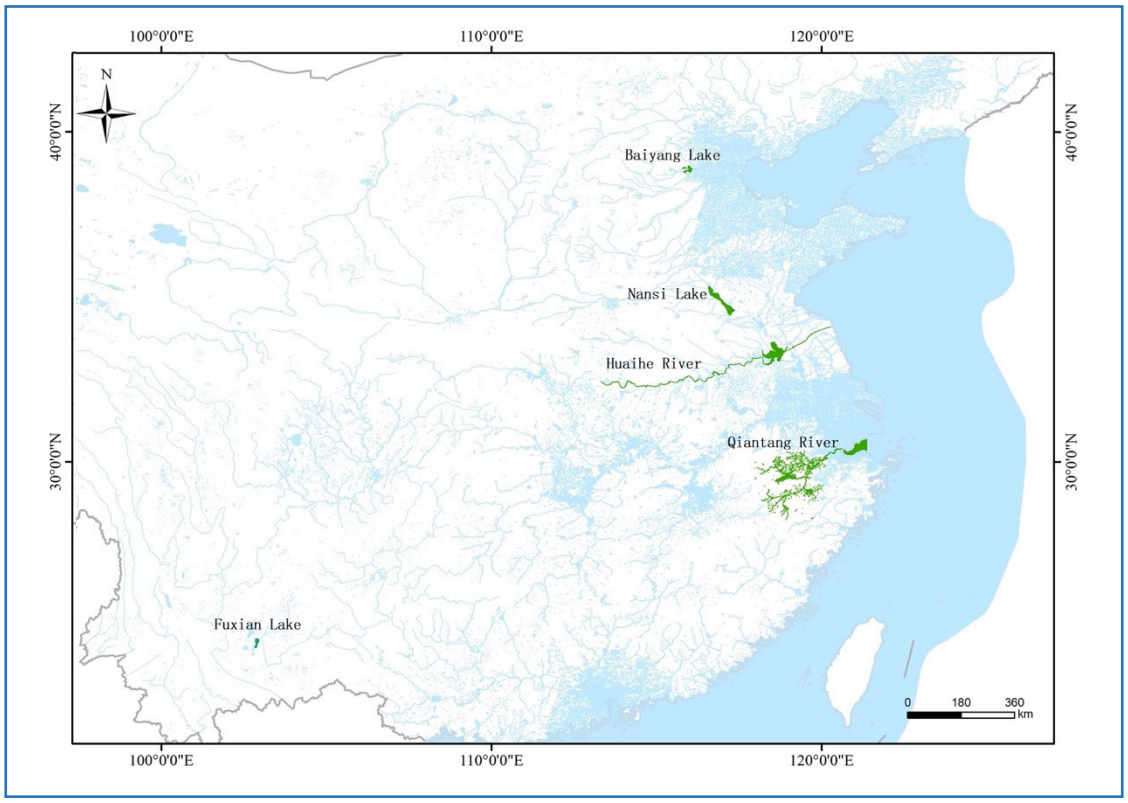
3.4.1 Inland fishing survey of case study locations

Aggregated provincial statistics may not reveal much about the status or nature of inland fisheries in China. There is also the issue of mixing of data between different types of waterbodies. To undertake a comprehensive census-type survey of all inland waterbodies of China was not feasible in this review, but to provide a more detailed picture of the trends and issues that are occurring in Chinese inland fisheries, a number of case studies of inland fishing resource surveys were undertaken using a sampling approach.

Aquatic ecosystems, mainly their aquatic species, play an important role in maintaining the natural material cycle and cleansing the ecological environment of waterbodies, and are an important basis for ensuring national ecological security. In order to strengthen the protection of aquatic biological resources, the Fisheries Law clearly requires fisheries departments to implement a closed area and closed season system in important fisheries waters. The closed season system is a protective measure that prohibits fishing operations during the critical period when fish spawning and breeding are concentrated Since 2002, closed season systems have been established at the national level in each of China's key watersheds. By January 2019, the fishing ban system had been implemented in all seven major inland river basins (Yangtze River, Pearl River, Huaihe River, Yellow River, Haihe River, Liaohe River, Songhua River) and important rivers and lakes.

Based on factors such as high inland fisheries production, wide geographical distribution and the possibility of fishing under the closed season system, five waterbodies (Baiyangdian Lake, Nansi Lake, Fuxian Lake, Huaihe Rive and Qiantang River) where inland fisheries continue to be practised, were selected for inland fishing sampling as they are the top inland fishery producers in China. Their locations are shown in Figure 3.8.

FIGURE 3.8. The five inland waterbodies involved in the inland fishing sample survey



Source: Produced by FFRC using GIS software for this review.

3.4.2 Survey of fishing yields in each sample area

Baiyangdian Lake

Baiyangdian Lake in the Haihe River Basin in Hebei Province, and part of the southern branch of the Daqing River, is the collective name of 143 interconnected lakes, with a total area of 366 km^2 and average annual water storage of 1.32 billion m^3, making it the largest lake in Hebei Province, as well as the largest lake in the North China Plain. Baiyangdian has vast waters and rich aquatic plant and animal resources, with 27 species of fish in 11 families, the most numerous being Cypriniformes, which account for about 6 percent of the economic fish (Zhao Chunlong *et al.*, 2007). The main species are *Cyprinus carpio*,

Hypophthalmichthys molitrix, *Hypophthalmichthys nobilis* and *Ctenopharyngodon idella* (Table 3.10). It is also famous for aquatic products such as green shrimp and river crabs. In addition to fishing, Baiyangdian is also an important freshwater aquaculture base in northern China. Over the years, in addition to focusing on stocking *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, *Ctenopharyngodon idella* and *Cyprinus carpio*, Baiyangdian Lake has also increased the stocking of species such as *Siniperca chuatsi*, *Mylopharyngodon piceus*, *Parabramis pekinensis* and *Culter alburnus.*

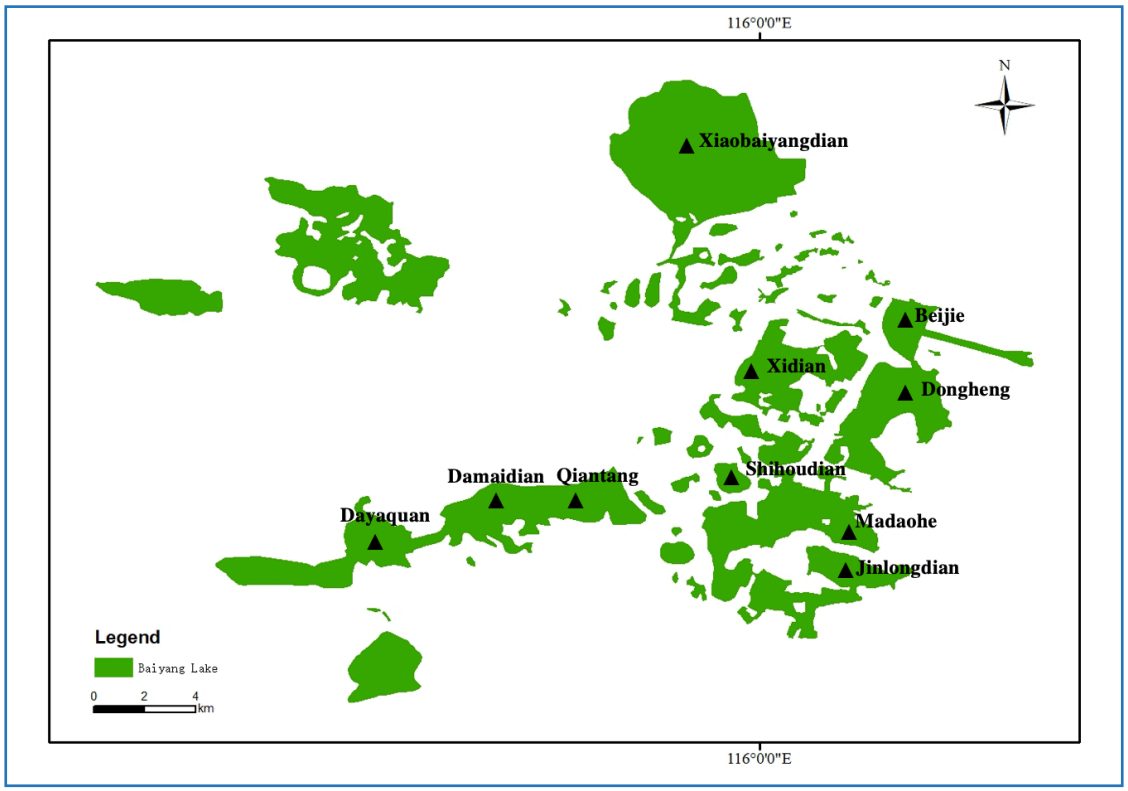
TABLE 3.10. Major economic fish in Baiyangdian Lake

Order/family/subfamily/species	
Cypriniformes	**Siluriformes**
Cyprinidae	**Siluridae**
Cyprinus carpio Linnaeus	*Silurus asotus* Linnaeus
Carassius auratus (Linnaeus)	**Anabantiformes**
Megalobrama mantschuricus (Basilewsky)	**Channidae**
Hypophthalmichthys nobilis (Richardson)	*Channa argus* (Cantor)
Hypophthalmichthys molitrix (Valenciennes)	
Ctenopharyngodon idellus (Valenciennes)	

Source: FFRC using data from the inland fishing survey conducted for this review.

Fishing methods: Taking into account the closed period system and the actual production status of fishers, the fishing period of Baiyangdian Lake sample vessels in this survey took place from 1 March to 31 October 2021. A total of ten sample vessels were randomly selected and their locations are shown in Figure 3.9. Among them, five sample vessels fished with multimesh gillnets and were located in Beijie, Damaidian, Dayaquan, Jinlongdian and Qiantang regions; five sample vessels fished with fixed tandem cage pots and were located in Dongheng, Madaohe, Shihouian, Xidian and Xiaobaiyangdian regions.

FIGURE 3.9. Fishing locations of sample vessels in Baiyangdian Lake



Source: Produced by FFRC using GIS software for this review.

Fishing yields: The yields of the sample vessels in Baiyangdian Lake from March to October 2021 are given in Table 3.11 and Table 3.12.

TABLE 3.11. Multimesh gillnet production in Baiyangdian Lake by region in 2021 (kg)

Month	Beijie	Damaidian	Dayaquan	Jinlongdian	Qiantang	Mean	Total
March	202	336	303	387	359	317	1 586
April	283	302	327	328	389	326	1 628
May	337	363	327	363	366	351	1 754
June	353	324	351	338	390	351	1 755
July	376	297	332	311	368	337	1 683
August	381	319	242	373	327	328	1 641
September	324	303	198	287	261	274	1 372
October	225	314	195	199	216	230	1 148

Source: FFRC using data from the inland fishing survey conducted for this review.

From March to October 2021, the average monthly fishing output of multimesh gillnet sample vessels in various regions of Baiyangdian Lake was 229.6 kg to 350.9 kg, the lowest catches being in October and the highest catches in June. The average monthly fishing output of the fixed tandem cage pot sample vessels was 170 kg to 371.2 kg, the lowest catches occurring in April and the highest in July.

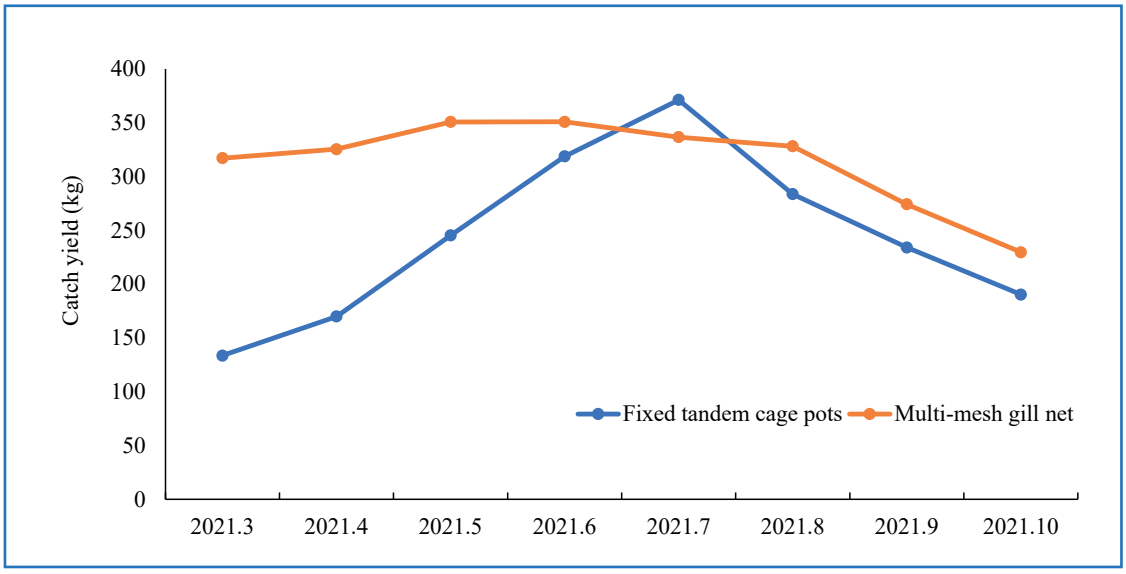
TABLE 3.12. Fixed tandem cage pot production in Baiyangdian Lake by region in 2021 (kg)

Month	Dongheng	Madaohe	Shihoudian	Xidian	Xiao Baiyangdian	Mean	Total
March	139	137	115	148	130	134	668
April	190	142	150	181	189	170	850
May	263	241	271	191	261	245	1 226
June	347	312	311	303	323	319	1 594
July	419	371	349	356	362	371	1 856
August	292	373	268	206	281	284	1 419
September	230	372	261	119	190	234	1 171
October	150	308	233	128	134	190	952

Source: FFRC using data from the inland fishing survey conducted for this review.

The average monthly catches of different fishing methods in Baiyangdian Lake differed in trend (Figure 3.10), with multimesh gillnets showing relatively little change from March to August and a rapid decline in September and October, with overall catches higher than those of fixed tandem cage pots; catches of fixed tandem cage pots increased rapidly from March to July and were higher than those of multimesh gillnets in July, and then showed a rapid decline from August to October in line with that of multimesh gillnets. The catches from August to October showed a rapidly decreasing trend in line with the multimesh gillnets.

FIGURE 3.10. Average monthly catch using different methods in Baiyangdian Lake



Source: FFRC using data from the inland fishing survey conducted for this review.

Fishery survey population: The fishing personnel in Baiyangdian Lake were all local full-time fishing personnel. The population of fishery employees in Baiyangdian Lake, Hebei Province in 2020 is shown in Table 3.13. Among the 48 410 inland fishery employees (all the fishers, both marine and inland, and both full time and part time) in Hebei Province, there were 24 547 full-time employees, including 8 499 full-time inland capture fishery employees.

TABLE 3.13. Overview of the fishery population and employees in Hebei Province in 2020

	Fishery townships	Fishery villages	Fishery households	Fishers	Full-time fishers	Women employees	Captur employees
Total	**28**	**158**	**51 280**	**17 928**	**84 471**	**17 206**	**3 263**
Inland	17	91	14 965	48 410	24 547	14 380	8 499

Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. *China fishery statistics yearbook.* China Agricultural Press.

Nansi Lake

Nansi Lake, one of the largest freshwater lakes in China, located in Weishan County, southern Shandong Province, is the general name of four connected lakes – Weishan Lake, Zhaoyang Lake, Dushan Lake and Nanyang Lake. The whole lake covers an area of 1 266 km^2, with average annual storage of 4.7 billion m^3, making it the largest lake in Shandong Province. The lake is a shallow eutrophic lake, rich in natural resources – fish, shrimp and other economic species (Wei Xun, 2016). It is the most important freshwater fish industry base in Shandong Province. Since the gradual implementation of fishery resources restoration in Shandong Province in 2005, Nansi Lake has been continuously undergoing stocking, which has achieved good economic, social and ecological benefits. Survey statistics show that the main catch of the stock in Nansi Lake in 2018 was about 22 492.50 tonnes, about 20 003.56 tonnes in 2019 and about 10 407.09 tonnes in 2020 (Jian Kang, 2022). The main species released in Nansi Lake are *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, *Ctenopharyngodon idella*, *Cyprinus carpio* and *Carassius auratus* (Table 3.14).

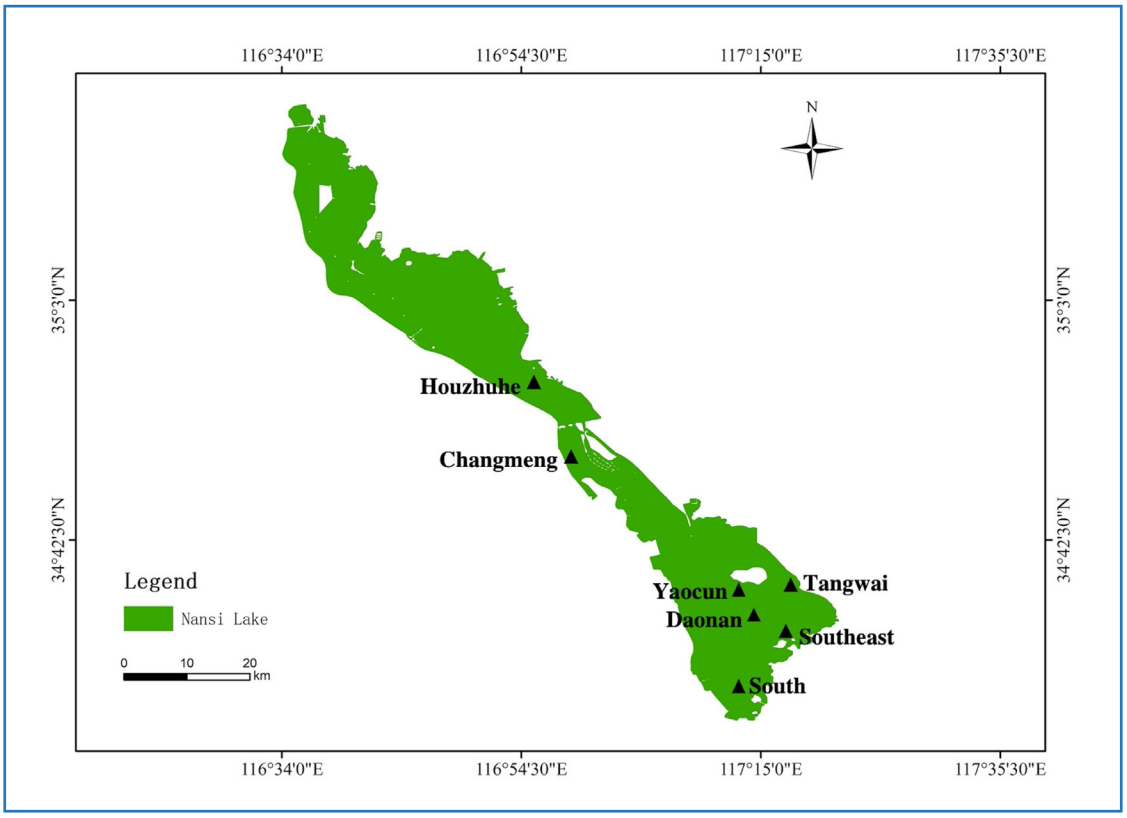
TABLE 3.14. Major economic fish in Nansi Lake

Order/family/subfamily/species	
Siluriformes	**Cypriniformes**
Siluridae	**Cyprinidae**
Silurus asotus Linnaeus	*Cyprinus carpio* Linnaeus
Bagridae	*Carassius auratus* (Linnaeus)
Tachysurus fulvidraco (Richardson)	*Chanodichthys erythropterus* (Basilewsky)
Anabantiformes	*Parabramis pekinensis* (Basilewsky)
Channidae	
Channa argus (Cantor)	
Perciformes	
Eleotridae	
Siniperca chuatsi (Basilewsky)	

Source: FFRC using data from the inland fishing survey conducted for this review.

Fishing methods: Taking into account the closed period system and the actual production status of fishers, the fishing period of the sample vessels in Nansi Lake in this survey was from 1 June 2021 to 28 February 2022. A total of seven sample vessels were randomly selected and their locations are shown in Figure 3.11. Four of the sample vessels fished with multimesh gillnets and three sample vessels fished with fixed tandem cage pots.

FIGURE 3.11. Fishing locations of the sample vessels in Nansi Lake



Source: Produced by FFRC using GIS software for this review.

Fishing yields: The yields of the sample vessels in Nansi Lake from June 2021 to February 2022 are shown in Table 3.15 and Table 3.16.

Statistics show that the average monthly catch yields of sample vessels using multimesh gillnets from June 2021 to February 2022 in all regions of Nansi Lake were 205 kg to 560 kg, the lowest catch being in June 2021 and the highest in July 2021; the average monthly catch

yields of sample vessels of fixed tandem cage pots were 104 kg to 173 kg, the lowest being in October 2021 and the highest in August 2021.

TABLE 3.15. Multimesh gillnet production in Nansi Lake by region in 2021/2022 (kg)

Month	Southeast	Tangwai	South	Daonan	Mean	Total
June	190	–	225	200	205	615
July	215	1 600	250	175	560	2 240
August	200	1 400	290	210	525	2 100
September	225	1 350	210	225	503	2 010
October	134	1 100	300	102	409	1 635
November	231	1 121	332	259	486	1 944
December	243	1 225	348	282	524	2 097
January (2022)	248	1 323	294	260	531	2 124
February (2022)	213	1 439	208	242	525	2 102

Source: FFRC using data from the inland fishing survey conducted for this review.

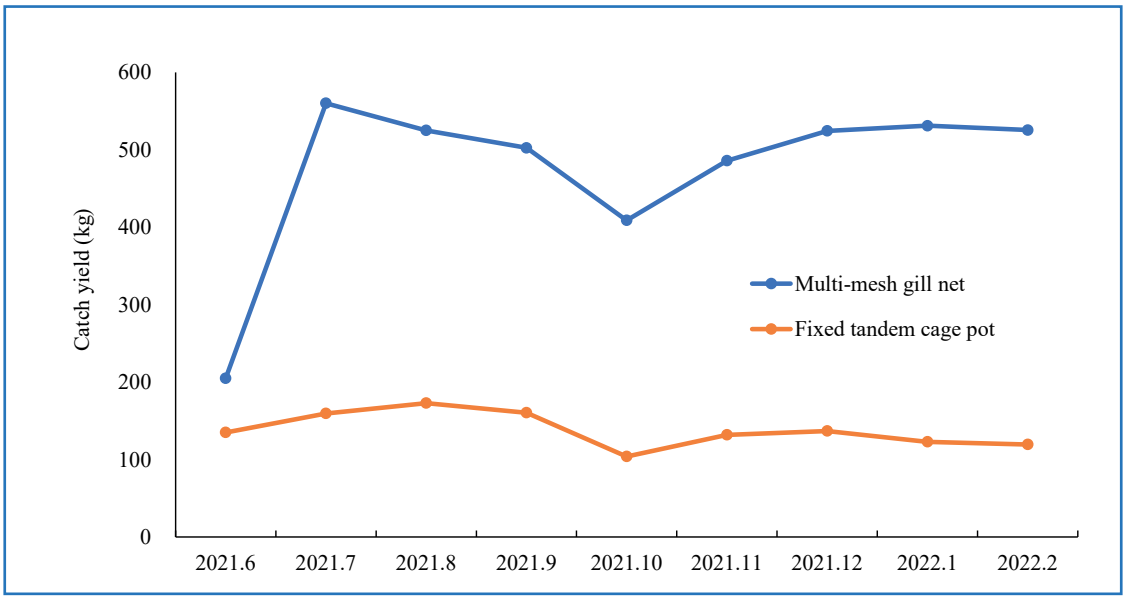
TABLE 3.16. Fixed tandem cage pot production in Nansi Lake by region in 2021/2022 (kg)

Month	Changmeng	Houzhuhe	Yaocun	Mean	Total
June	148	-	123	135	270
July	156	163	161	160	479
August	162	183	174	173	519
September	153	171	158	161	482
October	71	176	65	104	312
November	116	139	142	132	396
December	131	147	134	137	411
January (2022)	122	139	109	123	369
February (2022)	107	143	109	120	359

Source: FFRC using data from the inland fishing survey conducted for this review.

The monthly average catch in Nansi Lake varied greatly (Figure 3.12). The yield variation of multimesh gillnet and fixed tandem cage pot fishing was similar and relatively stable during the fishing period. On the whole, except for the similar output in June, the output of the multimesh gillnet method during the whole fishing period was about four times that of the fixed tandem cage pot method.

FIGURE 3.12. Average monthly catch using different methods in Nansi Lake



Source: FFRC using data from the inland fishing survey conducted for this review.

Fishery survey population: The fishers in Nansi Lake were all local full-time fishers. Nansi Lake belongs to Shandong Province and the fishery population in Shandong in 2020 is shown in Table 3.17. Among the 356 608 inland fishery employees in Shandong, there were 233 057 professionals, including 63 206 full-time inland capture fishery employees.

TABLE 3.17. Overview of the fishery population and employees in Shandong Province in 2020

Fishery and aquaculture							Capture
	Fishery townships	Fishery villages	Fishery households	Fishery employed	Full-time fishery	Women employed	Inland capture fishers employed
Total	**94**	**1 198**	**423 776**	**1 253 687**	**635 075**	**115 815**	**186 028**
Inland	33	395	137 757	356 608	233 057	45 066	63 206

Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. *China fishery statistics yearbook*. China Agricultural Press.

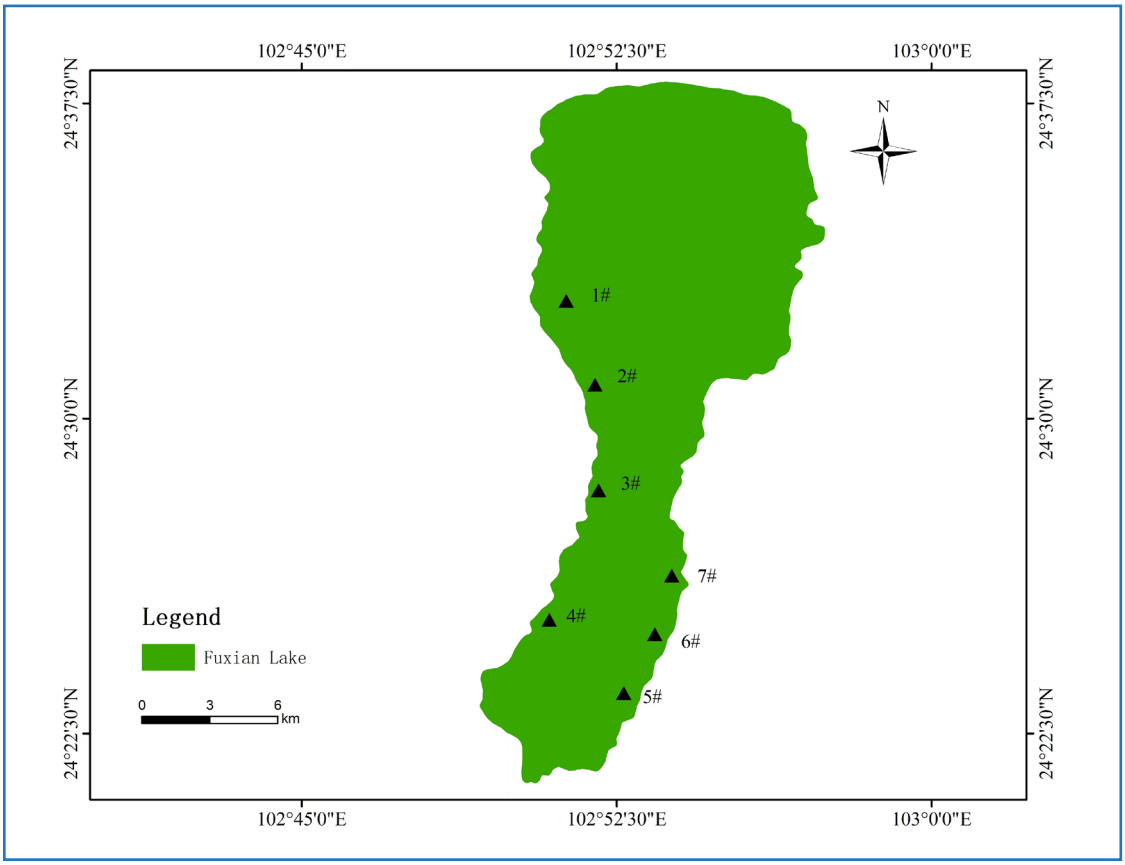
Fuxian Lake

Fuxian Lake encompasses Chengjiang, Jiangchuan and Huaning counties in Yunnan Province. It has the largest water storage, the largest deep-water plateau and is the second deepest waterbody in China. The water area is about 216.6 km^2, the length of the lake is about 31.4 km and the widest part of the lake is about 11.8 km. The total length of the lake shoreline is about 100.8 km, the maximum water depth is about 158.9 m, the average water depth is about 95.2 m and the capacity of the lake is about 20.62 billion m^3.

At present, the fishery in Fuxian Lake mainly targets *Neosalanx taihuensis* and in the early 1980s, fish production in Fuxian Lake was maintained between 400 tonnes and 600 tonnes, with *Anabarilius grahami* being the main fish produced, accounting for about 8 percent of the total production, up to 500 tonnes. In the late 1980s, the *Anabarilius grahami* population declined year by year. In 1989, *Neosalanx taihuensis* production exceeded *Anabarilius grahami* for the first time and replaced *Anabarilius grahami* as the main fish of Fuxian Lake (Li Zaiyun, Chen Yinrui and Yang Junxing, 2003). In 1990, the fish production of Fuxian Lake exceeded 1 000 tonnes, reaching more than 1 500 tonnes, including 1 232 tonnes of *Neosalanx taihuensis* and 281.9 tonnes of *Anabarilius grahami*. After 2000, the annual production of *Anabarilius grahami* was less than 1 tonne, and the production of *Neosalanx taihuensis* was maintained at about 1 600 tonnes. In 2009, the production of *Neosalanx taihuensis* was 1 740 tonnes and the production of *Anabarilius grahami* was 1 tonne. The fishing method of *Anabarilius grahami* in Fuxian Lake is a unique way of fishing in the waters of Fuxian Lake. It mainly takes advantage of the gathering of *Anabarilius grahami* during the breeding season and spawning in the ditches and caves along the lake. *Neosalanx taihuensis* is mainly caught by gillnetting.

Fishing methods: Taking into account the closed period system and the actual production status of fishers, the fishing period of the sample vessels in Fuxian Lake in this survey was from 1 July 2021 to 31 December 2021. A total of seven sample vessels were randomly selected and their locations are shown in Figure 3.13. In Fuxian Lake, only *Neosalanx taihuensis* can be caught. Since transfer to Fuxian Lake from Taihu Lake in the 1980s, *N. taihuensis* has formed a stable population, and in recent years, production has been high without stocking. Hence, only multimesh gillnetting is used.

FIGURE 3.13. Fishing locations of sample vessels in Fuxian Lake



Source: Produced by FFRC using GIS software for this review.

Fishing yields: The yields of the sample vessels in Fuxian Lake from July 2021 to December 2021 are shown in Table 3.18.

Statistics show that the average monthly catch of sample vessels in each region of Fuxian Lake ranged from 83 kg to 492.93 kg, with the lowest catch in November and the highest in September.

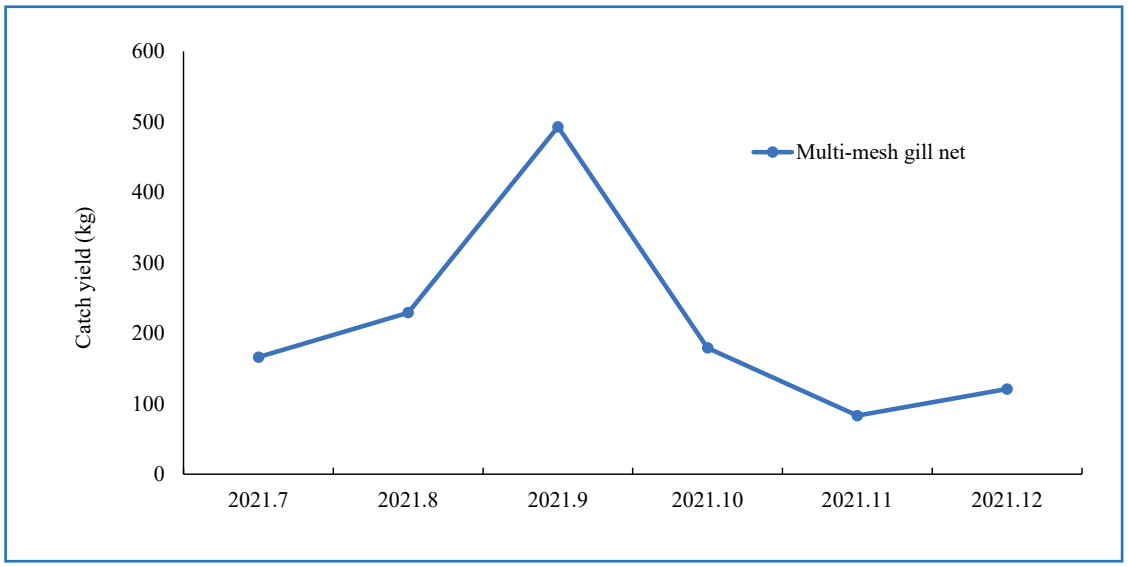
TABLE 3.18. Multimesh gillnet production in Fuxian Lake by region in 2021 (kg)

Month	1	2	3	4	5	6	7	Mean	Total
July	148	67	-	-	311	299	5	166	830
August	49	229	153	90	324	529	-	229	1 374
September	579	348	399	397	505	1 201	22	493	3 451
October	270	122	193	162	269	195	43	179	1 254
November	171	50	88	67	-	-	39	83	415
December	86	81	109	105	-	-	223	121	604

Source: FFRC using data from the inland fishing survey conducted for this review.

The sample boats in Fuxian Lake used only multimesh gillnets (Figure 3.14) and could only fish for *Neosalanx taihuensis*. Throughout the fishing period, the *Neosalanx taihuensis* fishing yield increased in the first three months and then decreased. The maximum fishing yield was in September, which was about 5 percent higher than the lowest fishing yield month.

FIGURE 3.14. Average monthly catch of multimesh gillnet fishing in Fuxian Lake



Source: FFRC using data from the inland fishing survey conducted for this review.

Fishery survey population: The fishing personnel in Fuxian Lake were all local full-time fishers. Fuxian Lake belongs to Yunnan Province and the population of fishery employees in 2020 is shown in Table 3.19. Among the 224 849 inland fishery employees in Yunnan Province, there were 83 282 full-time employees, including 1 700 inland capture fishery professionals.

TABLE 3.19. Overview of the fishery population and employees in Yunnan Province in 2020

Fishery and aquaculture							Capture
	Fishery townships	Fishery villages	Fishery households	Fishery	Full-time fishery	Women employed	Inland capture fishers employed
Total	**0**	**0**	**61 954**	**224 849**	**83 282**	**14 753**	**14 700**
Inland	0	0	61 954	224 849	83 282	14 753	14 700

Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. *China fishery statistics yearbook.* China Agricultural Press. www.purpleculture.net/china-fishery-statistics-yearbook-2021-p-32870

Huaihe River

The Huaihe River is one of the seven major rivers in China. Originating in Henan Province, the main stream of the Huaihe River flows from west to east through Hubei, Henan, Anhui and Jiangsu provinces, entering the river at Sanjiangying, Yangzhou (Wang Song *et al.*, 2009). The total length of the main stream of the Huaihe River is about 1 000 km and the basin area is about 270 000 km^2. The Anhui section of Huaihe River belongs to the middle reaches of the Huaihe River, flowing through Fuyang, Lu 'an, Huainan, Bengbu and Chuzhou prefectures for about 430 km. The main fishing gears in the Anhui section of the Huaihe River include trawls, gillnets, set nets and seines. In the survey of fish resources in the Anhui section of the Huaihe River Basin conducted by Wang *et al.* (2007), 65 species of fish were collected, belonging to 8 orders and 17 families, of which the largest number of species was Cypriniformes (39 species), followed by Perciformes (12 species). The major economic fish in Huaihe River are listed in Table 3.20.

Since 2008, Huainan has carried out the first stocking in the Huaihe River and has continued to do so every year since. The main species released in Huaihe River include *Tachysurus dumerili*, *Tachysurus fulvidraco*, *Hypophthalmichthys molitrix* and *Hypophthalmichthys nobilis*. Artificial stocking and release activities are conducted to increase the number of traditional and famous fish species in the Huaihe River in a targeted manner and to expand the population size (Lou Weili, 2019).

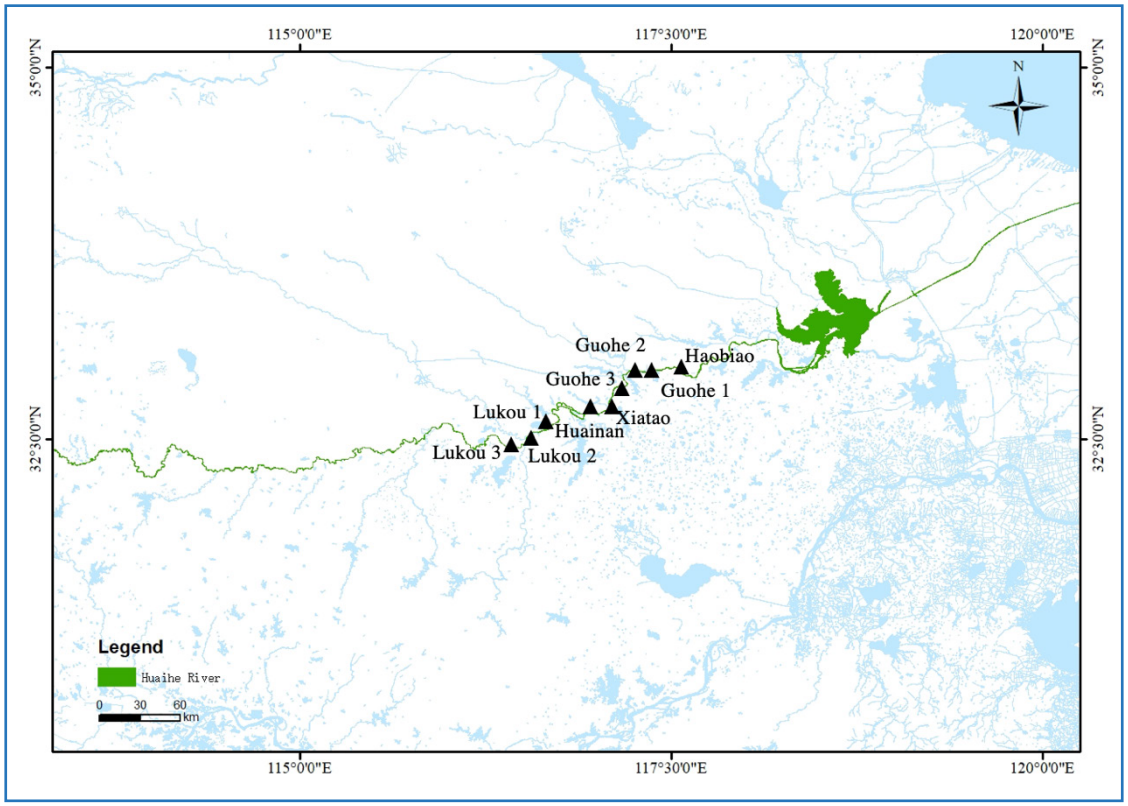
TABLE 3.20. Major economic fish in Huaihe River

Order/family/subfamily/species	
Cypriniformes	Clupeiformes
Cyprinidae	Engraulidae
Hemibarbus maculatus (Bleeker)	*Coilia nasus* Temminck and Schlegel
Cyprinus carpio Linnaeus	Siluriformes
Chanodichthys erythropterus (Basilewsky)	Siluridae
Chanodichthys dabryi (Bleeker)	*Silurus asotus* Linnaeus
Chanodichthys mongolicus (Basilewsky)	Bagridae
Culter alburnus (Basilewsky)	*Tachysurus fulvidraco* (Richardson)
Parabramis pekinensis (Basilewsky)	*Tachysurus nitidus* (Sauvage and Dabry de Thiersant)
Hypophthalmichthys nobilis (Richardson)	Anabantiformes
Hypophthalmichthys molitrix (Valenciennes)	Channidae
	Channa argus (Cantor)
	Perciformes
	Sinipercidae
	Siniperca chuatsi (Basilewsky)

Source: FFRC using data from the inland fishing survey conducted for this review.

Fishing methods: Taking into account the closed period system and the actual production status of fishers, the fishing period of Huaihe River in this survey was conducted from 1 September 2021 to 28 February 2022. A total of nine sample vessels were randomly selected and their locations are shown in Figure 3.15. Six sample vessels used multimesh gillnets; they were located separately in Haobiao, Huainan, Guohe 1, Guohe 2, Guohe 3 and Xiatao; the other three sample vessels used fixed tandem cage pots; they were located in Lukou 1, Lukou 2 and Lukou 3, separately.

FIGURE 3.15. Fishing locations of sample vessels in Huaihe River



Source: Produced by FFRC using GIS software for this review.

Fishing yields: The yields of the sample vessels in Huaihe River from September 2021 to February 2022 are shown in Table 3.21 and Table 3.22. Statistics show that the average monthly catch yield of the multimesh gillnet vessels in each region of Huaihe River from September 2021 to February 2022 was 74.25 kg to 275.83 kg, with the lowest occurring in September 2021 and the highest in December 2021.

TABLE 3.21. Multimesh gillnet production in Huaihe River by region in 2021/2022 (kg)

Month	Haobiao	Huainan	Guohe 1	Guohe 2	Guohe 3	Xiatao	Mean	Total
September	89	–	–	–	–	60	74	149
October	94	–	360	352	351	114	254	1 271
November	84	359	357	444	341	59	274	1 642
December	103	380	419	368	326	61	276	1 655
January (2022)	105	274	395	358	324	109	261	1 564
February (2022)	125	191	–	–	–	72	129	387

Source: FFRC using data from the inland fishing survey conducted for this review.

The average monthly catch yield of fixed tandem cage pots in each region of Huaihe River from October 2021 to February 2022 was 82 kg to 592.67 kg, with the lowest occurring in February 2022 and the highest in December 2021.

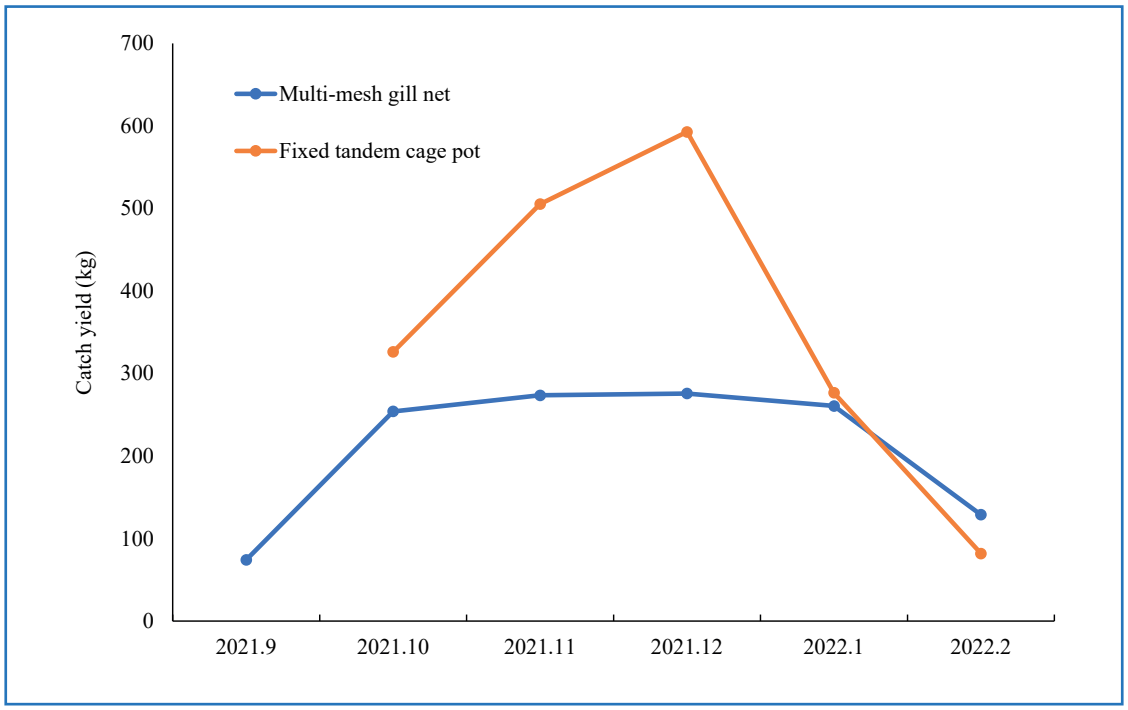
TABLE 3.22. Fixed tandem cage pot production in Huaihe River by region in 2021/2022 (kg)

Month	Lukou 1	Lukou 2	Lukuo 3	Mean	Total
September	–	–	–	–	–
October	–	285	368	326	653
November	634	467	415	505	1 516
December	724	588	467	593	1 778
January (2022)	247	418	166	277	830
February (2022)	82	–	–	82	82

Source: FFRC using data from the inland fishing survey conducted for this review.

The average monthly catch of different methods in the Huaihe River varied greatly, and it can be seen from Figure 3.16 that the catch of both multimesh gillnets and fixed tandem cage pots increased first and then decreased during the fishing period, with multimesh gillnets being used one month earlier than fixed tandem cage pots. Relatively speaking, the fishing yield of the multimesh gillnets was more stable and did not change much between October 2021 and January 2022; the fishing yield of fixed tandem cage pots varied more and was generally higher than that of multimesh gillnets.

FIGURE 3.16. Average monthly catch using different methods in Huaihe River



Source: FFRC using data from the inland fishing survey conducted for this review.

Fishery survey population: The fishing personnel in Huaihe River were all local full-time fishers and their fishing areas were all within the territory of Anhui Province. The fishery population in Anhui in 2020 is shown in Table 3.23. Among the 558 577 inland fishery employees in Anhui, there were 269 502 full-time employees, including 35 299 full-time inland capture fishery employees.

TABLE 3.23. Overview of the fishery population and employees in Anhui Province in 2020

	Fishery and aquaculture						Capture
	Fishery townships	Fishery villages	Fishery households	Fishery	Full-time fishery	Women employed	Capture fishers employed
Total	**9**	**91**	**152 556**	**558 577**	**269 502**	**58 265**	**35 299**
Inland	9	91	152 556	558 577	269 502	58 265	35 299

Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. *China fishery statistics yearbook*. China Agricultural Press.

Qiantang River

The Qiantang River, one of the major rivers in the southeastern coastal region of China, is the largest river in Zhejiang Province, with a total length of 589 km. From its source, it flows through the southern parts of Anhui and Zhejiang provinces, with a basin area of 55 058 km^2 and an average annual flow of 44.25 billion m^3. It discharges into the East China Sea via Hangzhou Bay. The main stream of the river basin includes Xin'an River, Lanjiang River, Fuchun River and Qiantang River, and the main tributaries include Wuxi River, Wuxiang River, Fenshui River, Puyang River and Cao'e River. The Qiantang River Basin is rich in fish resources, with montane fish in the upper reaches, many riverine fish in the middle reaches and many migratory fish seasonally inhabiting the lower reaches, making it one of the most important freshwater fishery sites in China. Cyprinidae is the dominant fish family in the Qiantang River Basin. Chen *et al.* (1990) conducted a relatively systematic survey of fish resources in the main stream of the Qiantang River and found 202 species of fish belonging to 55 families.

The fish resources in the Qiantang River Basin are rich, but due to overfishing and heavy exploitation, they have declined seriously, so identifying a way to carry out reasonable and scientific research on fishery stocking has been a concern for some time (Chu Yujiang and Feng Xiaoyu, 2020). As early as 1958, scientific and technical personnel from the Zhejiang Freshwater Aquatic Research Institute went deep into the fishing areas along the river and stocked a small population of *Hypophthalmichthys molitrix* and *Hypophthalmichthys nobilis*. After the success of the small trial, the provincial and municipal authorities continued to carry out stocking work, with remarkable results, and the proportion of production of the four major fish in the Fuchun River reservoir area rose from 7 percent before stocking to 40 percent (Wu Chenggen, 1983). For more than half a century, the main species stocked in Qiantang River have included *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, *Megalobrama terminalis*, *Xenocypris davidi*, *Hemibarbus maculatus* and *Trachidermus fasciatus* (Table 3.24).

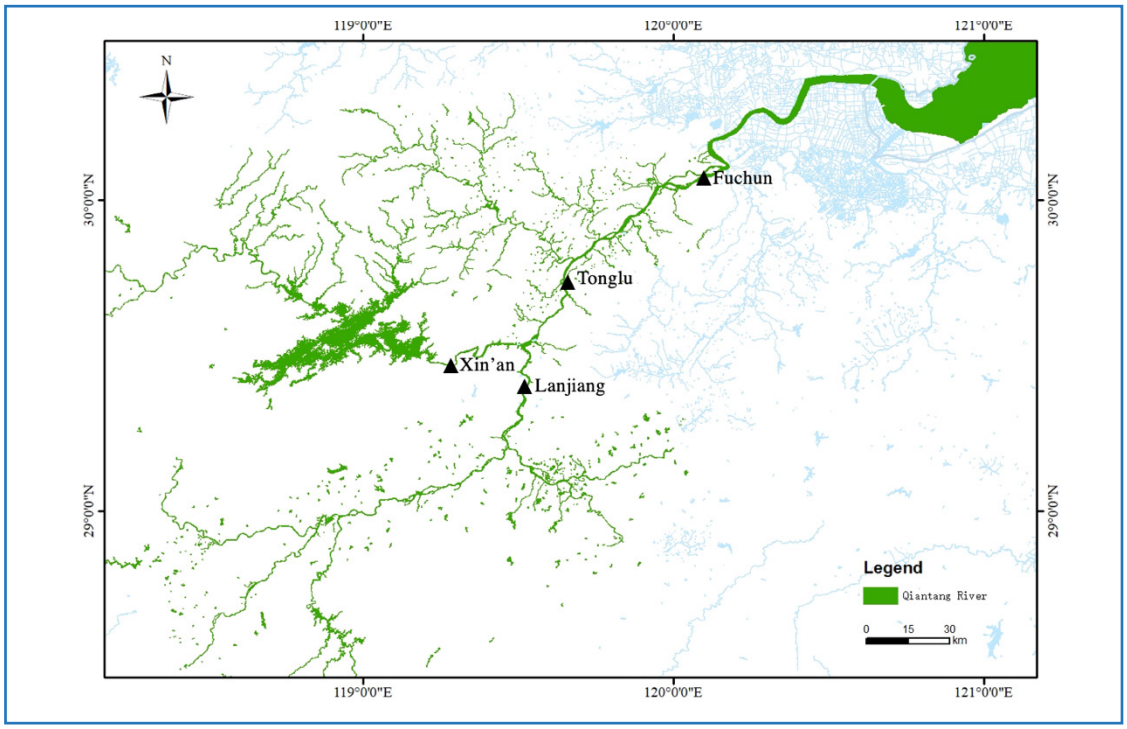
TABLE 3.24. Major economic fish in Qiangtang River Lake

Order/family/subfamily/species	
Cypriniformes	**Mugiliformes**
Cyprinidae	**Mugilidae**
Hemibarbus maculatus (Bleeker)	*Mugil cephalus* (Linnaeus)
Culterinae	**Perciformes**
Chanodichthys erythropterus (Basilewsky)	**Percichthyidae**
Megalobrama mantschuricus (Basilewsky)	*Lateolabrax japonicus* (Cuvier)
Chanodichthys mongolicus (Basilewsky)	
Culter alburnus Basilewsky	
Parabramis pekinensis (Basilewsky)	
Hypophthalmichthyinae	
Hypophthalmichthys nobilis (Richardson)	
Hypophthalmichthys molitrix (Valenciennes)	
Leuciscinae	
Ctenopharyngodon idella (Valenciennes)	
Mylopharyngodon piceus (Richardson)	

Source: FFRC using data from the inland fishing survey for conducted this review.

Fishing methods: Taking into account the closed period system and the actual production status of fishers, the fishing period in the Qiantang River in this survey occurred from 1 September 2021 to 28 February 2022. Five sample vessels were randomly selected and their locations are shown in Figure 3.17. Four of the sample vessels fished with the multimesh gillnets in Fuchun, Lanjiang, Tonglu and Xin'an regions; the other vessel used fixed tandem cage pots and was located in Xin'an.

FIGURE 3.17. Fishing locations of sample vessels in Qiantang River



Source: Produced by FFRC using GIS software for this review.

Fishing yields: The yields of the sample vessels in Qiantang River from September 2021 to February 2022 are shown in Table 3.25 and Table 3.26.

The average monthly catch of sample vessels with multimesh gillnets in all regions of the Qiantang River from September 2021 to February 2022 ranged from 132.54 kg to 976.8 kg, with the lowest catch in January 2022 and the highest in October 2022. The catch of sample vessels with fixed tandem cage pots at the Xin'an tributary of the Qiantang River from October 2021 to February 2022 ranged from 292 kg to 846.5 kg, with the lowest catch in February 2022 and the highest catch in November 2021.

TABLE 3.25. Production of multimesh gillnets in Qiantang River by region in 2021/2022 (kg)

Month	Fuchun	Lanjiang	Tonglu	Xin'an	Mean	Total
September	-	526	-	1 397	961	1 922
October	50	723	41	3 093	977	3 907
November	248	189	65	459	240	960
December	125	378	58	860	355	1 420
January (2022)	146	158	57	170	133	530
February (2022)	157	163	52	174	136	545

Source: Table compiled by FFRC using data from the inland fishing survey conducted for this review.

TABLE 3.26. Production of fixed tandem cage pots in Xin'an region 2021/2022 (kg)

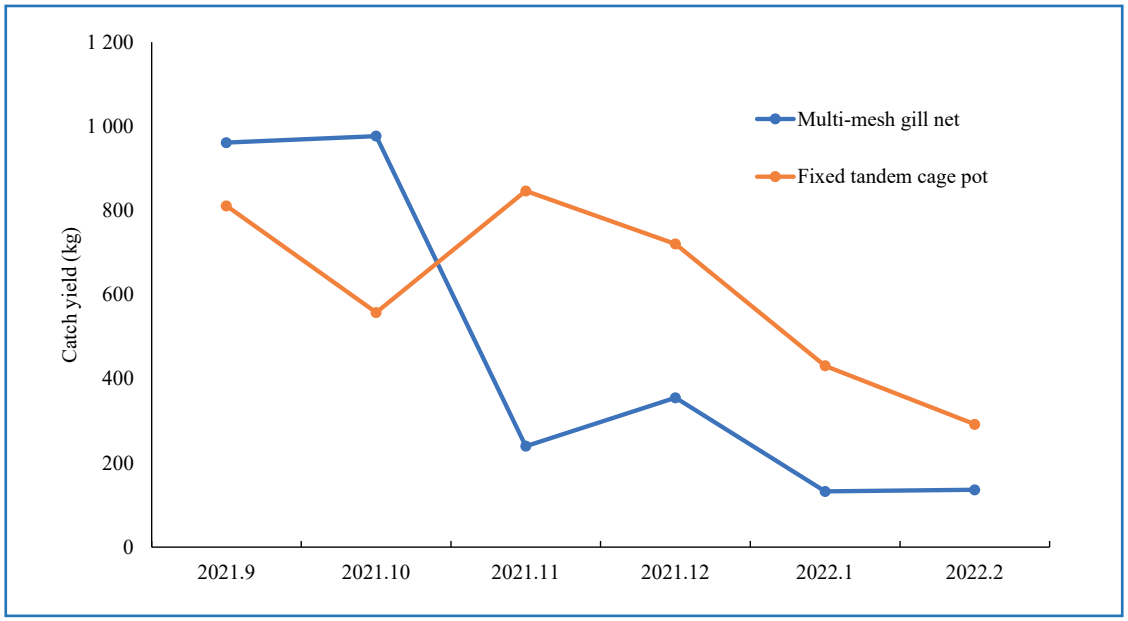
Region	September	October	November	December	Jan. (2022)	Feb. (2022)	Total
Xin'an	811	558	847	721	431	292	3 659

Source: FFRC using data from the inland fishing survey conducted for this review.

The average monthly catch using different methods in Qiantang River decreased throughout the fishing period (Figure 3.18). The catch of multimesh gillnets was higher in September

and October 2021 and then declined sharply from November 2021 to February 2022, when it remained at a lower level. The overall downward trend in the catch of fixed tandem cage pots was slower after November 2021 through February 2022. Due to the impact of high-intensity fishing, the fishery resources of Qiantang River are gradually decreasing, coupled with the drop in temperature and the weakening of fish activity; this has resulted in the reduction of fishing volume.

FIGURE 3.18. Average monthly catch using different methods in the Qiantang River



Source: FFRC using data from the inland fishing survey conducted for this review.

Fishery population survey: The fishers of the sample vessels in the Qiantang River were all local full-time fishers and their fishing areas were all within the territory of Zhejiang Province. The population of fishery employees in Zhejiang in 2020 is shown in Table 3.27. Among 303 742 inland fishery employees in Zhejiang, there were 161 191 full-time employees, including 23 471 full-time inland capture fishery employees.

TABLE 3.27. Overview of the fishery population and employees in Zhejiang Province in 2020

	Fishery townships	Fishery villages	Fishery households	Fishery personnel	Full-time personnel	Women employees	Capture employees
Total	**91**	**647**	**297 961**	**654 384**	**404 127**	**72 259**	**145 419**
Inland	12	131	98 817	303 742	161 191	39 471	23 471

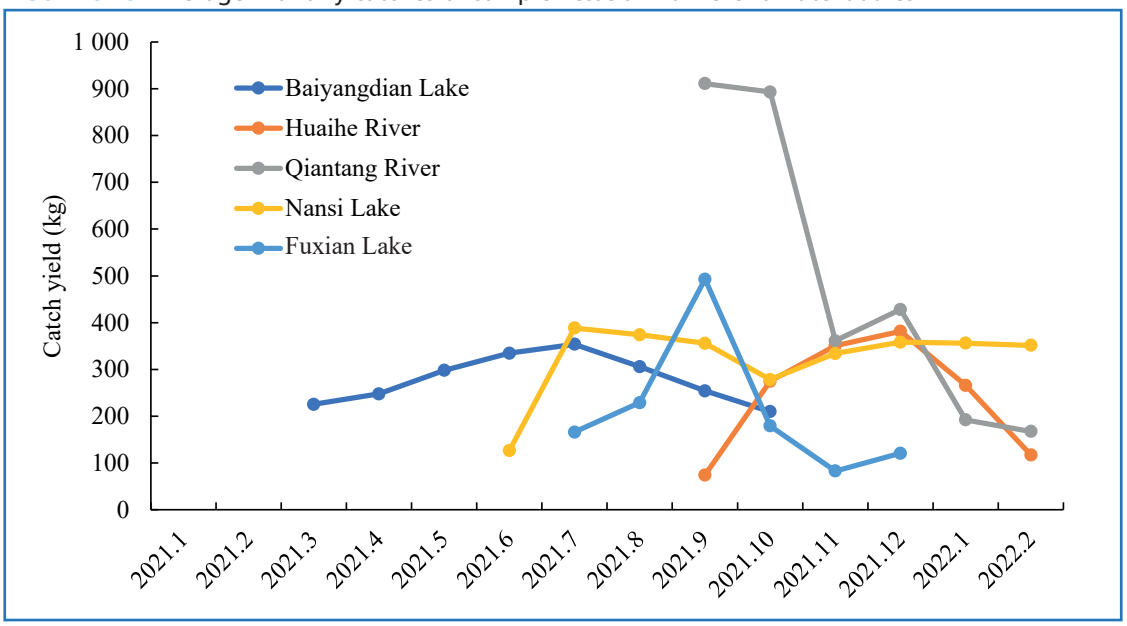
Source: Fisheries Administration of the Ministry of Agriculture and Rural Affairs. 2021. China fishery statistics yearbook. China Agricultural Press. www.purpleculture.net/china-fishery-statistics-yearbook-2021-p-32870

3.4.3 Comparative analysis of data from different surveyed waters

Due to the different fishing closure systems, actual production status of fishers, fishing methods and fishery resources, the fishing yields in different surveyed waters were bound to vary. The survey took place from March 2021 to February 2022 and the average monthly catch trends of the sample vessels in Baiyangdian Lake, Nansi Lake, Fuxian Lake, Huaihe River and Qiantang River are shown in Figure 19, which reveals that:

1. The length of the fishing period varied among the surveyed waters, which was mainly influenced by the closed period system and climate. The longest fishing period was nine months (June 2021 to February 2022) in Nansi Lake, followed by Baiyangdian Lake with eight months (March to October 2021) and six months in Huaihe River, Qiantang River and Fuxian Lake.
2. The start of the fishing season varied among the investigated waters. Among the lakes, Baiyangdian Lake was the earliest (March 2021), followed by Nansi Lake (June) and Fuxian Lake (July) indicating that the fishing started later as the latitude gets lower. The opening period of the two major rivers (Qiantang River and Huaihe River) was the same, both in September 2021.
3. The fishing yield varied among the surveyed waters. Overall, the highest yield was found in Qiantang River, mainly due to its high catch yield in September and October 2021, while the rest of the months were similar to the other surveyed waters. If the high yield months of Qiantang River are excluded, the overall average monthly yield of the five waters is similar, roughly around 300 kg. In the later part of the fishing period, the catches were all reduced to different degrees, partly due to the climate, which led to the weakening of fish activities due to the lower temperature, and partly due to the reduction of fishery resources in the waters, which led to the reduction of catches to different degrees.

FIGURE 3.19. Average monthly catches of sample vessels in different waterbodies



Source: FFRC using data from the inland fishing survey conducted for this review.

3.4.4 Analysis of sales of inland fish catches from the case study locations

Introduction to sales methods

In China, when inland fishers land their fish, they return to their appointed landing site or go to commercial landing sites, depending on how they sell their catch. The fishers will trade their catch in a variety of ways, and there are three main types of sales:

1. Direct sales by fishers. In China, the most common method of selling inland fish is for the fishers sell their catch themselves where they dock their boats or at market stalls, depending on local conditions.
2. Sell to traders. In China, the highest volume of fish is sold to traders according to the real-time market price. Fishers moor at local jetties and the traders come and collect

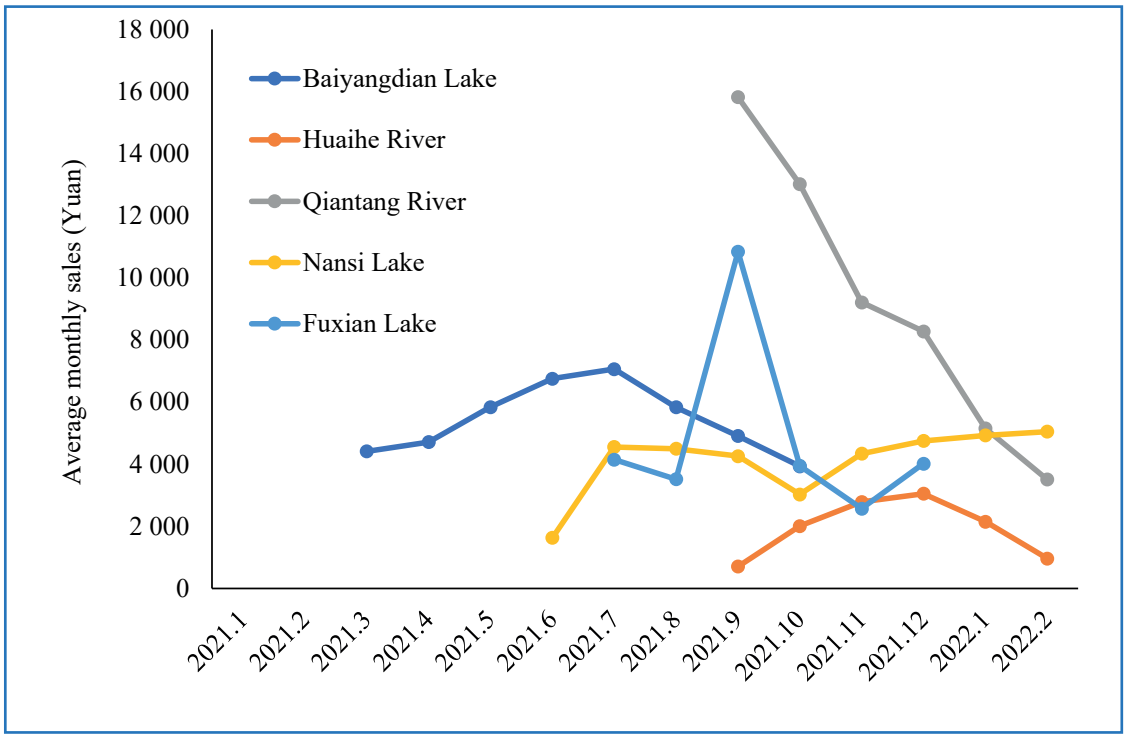
the catches. The catches purchased by the traders then go to the wholesale market and then further to the retail market and supermarkets. In addition, the traders may also sell the catches to large restaurants.

3. Frozen and then sold. As the quality of freshwater products is affected after freezing, the proportion of fish which is traded this way is smaller. However, a small portion of fish such as *Neosalanx taihuensis* (Yangtze icefish), for which freezing has less impact on quality, is easier to sell after freezing using small-scale freezers. Species that are difficult to sell are also frozen.

Sales analysis of sample vessels

In this survey, except for Fuxian Lake, where the vendors bought the catch on site, fishers in the other four waterbodies used both direct sales by fishers and sales to vendors.

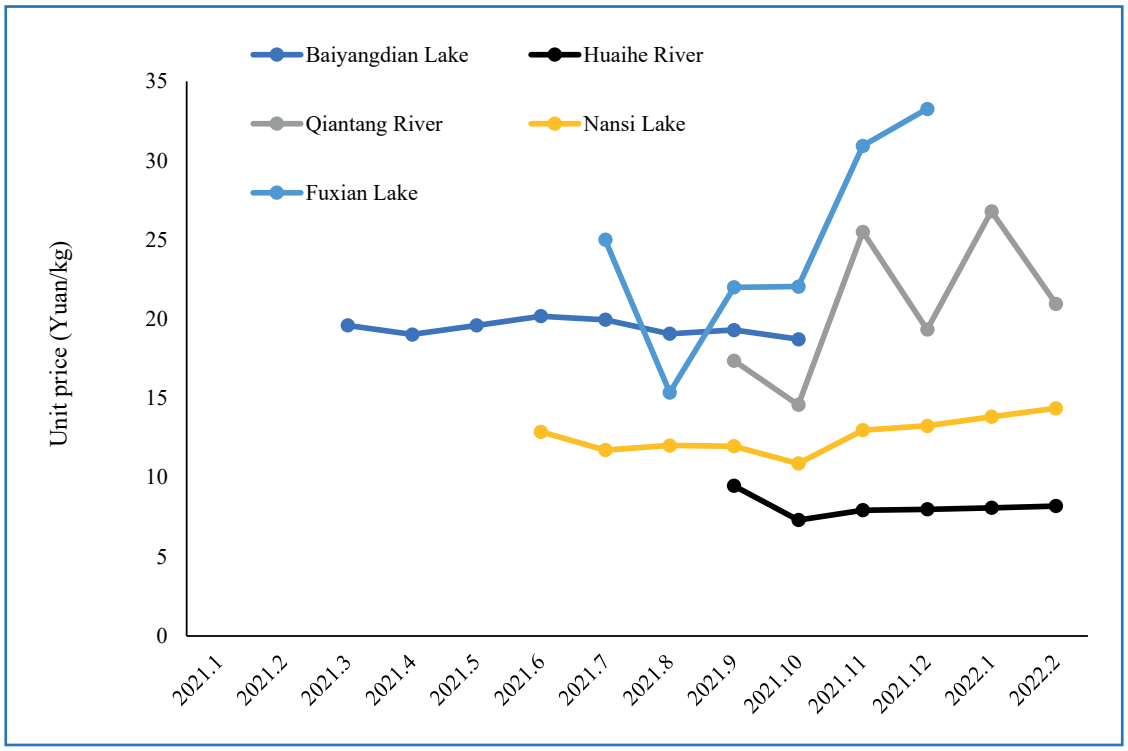
FIGURE 3.20. Trends of average monthly sales by waterbodies



Source: FFRC using data from the inland fishing survey conducted for this review.

As Figure 3.20 indicates, there is a clear difference in the sales proceeds of the catches in different surveyed waters. This difference arises not only from the differences in catch volume as shown earlier but also due to the different unit prices of the same species in different locations, and the prices of different species (Figure 3.21). Overall, the highest average monthly sales for the sample boats were in the Qiantang River and the lowest were in the Huaihe River. Relatively, the unit price of the catch was highest in Fuxian Lake because *N. taihuensis* is valuable, and lowest in Huaihe River as the major species of the capture were low value.

FIGURE 3.21. Unit price trend of the monthly average catches of sample vessels by waterbodies



Source: FFRC using data from the inland fishing survey conducted for this review.

Qiantang River: During the whole fishing period, the monthly average sales from sample vessels in Qiantang River continued to drop sharply, from CNY 15 824 per vessel in September 2021 to CNY 3 508 per vessel in February 2022. CNY 15 824 per vessel was also the highest average monthly sales in all the investigated waters. The income status of Qiantang River fishers varied greatly from month to month as a result. Most of the income was concentrated in the first two months. However, the unit price of the Qiantang River catch in these two months was the lowest in the whole fishing period. It is speculated that it was affected by the supply–demand relationship.

Nansi Lake: The overall catch of Nansi Lake was between 300 kg/month to 350 kg/month, and the unit price of the catch month-wise in Nansi Lake fluctuated only slightly, generally within the range of CNY 10/ kg to CNY 15/ kg, which was only higher than that of Huaihe River, so the average monthly sales of sample vessels in Nansi Lake were also generally higher than those of Huaihe River, with the highest in February 2022, reaching CNY 5 048 and the lowest in June 2022 at only CNY 1 628. The average was CNY 4 000. As the catch price of Nansi Lake was relatively stable, the trend of its average monthly sales was almost the same as that of the average monthly production.

Huaihe River: The unit price of catch in the Huaihe River was the lowest among the five waterbodies, and except for the first month of fishing (September 2021), which was CNY 9.48 /kg, the unit price of catches in the other months was stable at about CNY 8 / kg, so its average monthly sales also had a similar trend of increasing first and then decreasing monthly, with the highest value in December 2021, which was CNY 3 048 per vessel and the lowest value in September 2021, which was only CNY 703.75 per vessel. In contrast, the average monthly sales income of fishers in the Huaihe River was the lowest among the five waterbodies.

Baiyangdian Lake: The unit price of catch in Baiyangdian Lake was relatively stable, remaining between CNY 18.82 / kg and CNY 20.17 / kg throughout the fishing period, so the average monthly sales of sample vessels in this waterbody had a similar trend of increasing first and then decreasing with the highest price being CNY 7 062 per vessel in July 2021 and the lowest being CNY 3 931.5 per vessel in October 2021.

Fuxian Lake: The catch in Fuxian Lake was only *Neosalanx taihuensis*, a fish species with a relatively high unit price, but with the influence of supply and demand during the fishing period, its unit price also fluctuated dramatically. In the first month of fishing (July 2021), it reached CNY 25 / kg but dropped to a low of CNY 15.36 / kg in the following month, and then increased to a maximum of CNY 33.26 / kg in the last fishing month (December 2021). By and large, the average monthly sales of the sample vessels in Fuxian Lake followed a similar trend to the average monthly production, reaching the highest point of CNY 10 844 per vessel and dropping to the lowest point of CNY 2 567 per vessel in November 2021. Late in the fishery, probably due to lower production and influenced by supply and demand, the price of *Neosalanx taihuensis* showed a substantial increase.

3.4.5 Yield projection

Based on the average yield of the sample vessels in each waterbody between 2021 and 2022, the total inland fishing yield of each waterbody was projected according to the sampling rules, combined with the relevant data obtained from the research and feedback (Table 3.28). The inland yield data of each waterbody were compared and analysed.

Baiyangdian Lake: The annual fishing production of a single vessel in 2021 was 2 229.95 kg. The survey indicated that there were about 6 000 registered fishing vessels, and the total reported fishing production was about 13 725 tonnes. According to the survey, about 88 percent of these registered fishing vessels were engaged in long-term fishing activities, and the output of the registered fishing vessels accounted for about 90 percent of the total fishing production (a small amount of production came from other means such as non-fishing vessels). Therefore, estimated based on 6 000 registered fishing vessels, the total fishing production of Baiyangdian Lake should be 13 082.4 tonnes, representing a difference of -4.7 percent compared with the total production reported.

Nansi Lake: The annual fishing production of a single vessel between 2021 and 2022 was 2 585 kg (March to June is the closed season). The survey indicated that there were about 6 500 registered fishing vessels, and the total reported fishing production was about 24 965 tonnes. According to the survey, the output of the registered fishing vessels accounted for about 75 percent of the total fishing production. Therefore, estimated based on 6 500 registered fishing vessels, the total fishing production of Nansi Lake should be around 22 411.1 tonnes, representing a difference of -10.2 percent compared with the total production reported.

Fuxian Lake: The annual fishing production of a single vessel in 2021 was 1 132.5 kg. Currently, Fuxian Lake only allows fishing for *Neosalanx taihuensis*, the fishing period is from July to December every year and the fishing licence is issued annually. A total of 781 special fishing licences for silverfish were issued in 2021 and the total fishing output reported was 732 tonnes. The survey revealed that about 80 percent of the fishing vessels with fishing licences engaged in long-term fishing. The capture output of fishing vessels engaged in long-term fishing accounted for about 96 percent of the total fishing output (some fishing vessels had fewer fishing activities), so it was estimated that the total fishing output of *Neosalanx taihuensis* in Fuxian Lake was 737.1 tonnes, with a variation of 0.7 percent compared with the value of the total output reported. The difference between estimation and survey is small as the fishing activities were only for *Neosalanx taihuensis*, which was easy to quantify.

Huaihe River (Anhui): Due to the complete ban on fishing activities in Jiangsu Province, Hongze Lake, an important contributor to the fisheries output of the Huaihe River, is in a closed state. Therefore, the sample vessels in this study were concentrated in the Anhui section of the Huaihe River and the fisheries output per vessel in 2021 to 2022 was 1 280.5 kg. However, it should be noted that March to June is the closed period; July to August and some September monthly data were missing, only a portion of the September, October–December and January–February data was collected. The research revealed that there were only 42 fishing vessels engaged in fishing in the Fuyang section of Huaihe River, and the total fisheries output reported was 215 tonnes. The data collected were based on the Fuyang section of Huaihe River. Combining the survey with the data (the personnel of the fishery resources survey in Anhui section of Huaihe River were very experienced in this respect), fisheries production during the three months after the start of fishing (July to September) accounted for approximately 70 percent of the annual fishing production, and the production of fishing vessels accounted for about 85 percent of the total fishing production. Therefore, the total fisheries production of the Anhui Fuyang section of Huaihe River is estimated to be 210.9 tonnes, with a variation of -1.9 percent compared with the total production value reported.

Qiantang River: According to the survey, the upper Anhui section of the Qiantang River has been completely closed to fishing; fishing activities are mainly concentrated in the Zhejiang section, including Jiande City and Hangzhou City. These statistics did not include the main stream of Xin'anjiang Reservoir (Qiandao Lake Reservoir, mainly a bighead carp stocking fishery). According to this survey of the main stream of the Qiantang River, the annual fishing production of a single vessel in 2021 to 2022 was 2 588.7 kg. However, it should be noted that March to June is the closed period, July to August and some September monthly data were missing, and only a portion of the September, October–December and January–February data was collected. Accordingly, fishing production during the three-month period after the opening of the fishing period (July to September) accounted for about 48 percent of the annual fishing production (the personnel of the fishery resources survey of Qiantang River were very experienced). About 90 percent of the fishing vessels were engaged in long-term fishing and their fishing accounted for about 90 percent of the total fisheries production. Therefore, it is projected that the total of Qiantang River fishing production was 4 246.5 tonnes, with a variation of -1.2 percent compared with the total production value reported.

TABLE 3.28. Projected inland fishing production by waterbodies

Sampled waterbodies	Months of data	Average yield of sample vessels (kg)	Projected production (tonnes)	Total production reported by each region (tonnes)	Variation (%)
Baiyangdian Lake	March to October 2021	2 230	13 082	13 725	-4.7
Nansi Lake	June 2021 to February 2022	2 586	22 411	24 965	-10.2
Huaihe River (Anhui Fuyang)	September 2021 to February 2022	1 281	211	215	-1.9
Qiantang River (Zhejiang)	September 2021 to February 2022	2 588.7	4 246.5	4 300	-1.2
Fuxian Lake	July to December 2021	1 132.5	737.1	732	0.7

Source: FFRC using data from the inland fishing survey conducted for this review.

The results revealed that the yield extrapolated from the data reported by the sample vessels was slightly lower than the reported value, which may be related to the fishing activities among the individual vessels (different fishing methods, time and techniques among individual fishers), and the overall difference was not significant, with the variation value below 5 percent and the average value of -3.5 percent. The variations of Nansi Lake and Baiyangdian Lake were slightly higher when compared to those of the river-type waterbodies with a slightly smaller difference, probably due to the many fishing vessels (more than 6 000 vessels and more obvious differences between individuals) and uneven distribution of regional catches.

4. Current status and future plans for China's inland fisheries management

4.1 OVERVIEW OF FISHERIES MANAGEMENT AUTHORITIES AND MANAGEMENT POLICIES

4.1.1 Overview of management authorities

Fisheries management in China has a history of several thousand years. As early as the Xia and Shang dynasties, there were officials for fishing (Wu Xianzhu, 2002). Both in the *Rites of the Zhou Dynasty* and *The book of rites*, the officials in charge of fishing were mentioned. During the Ming Dynasty (Yin Lingling, 2003) and Qing Dynasty (Yu Hangui, 1992), fishing facilities and fisheries administration were further developed. During the period of the Republic of China, The Fisheries Law, 1929 was also enacted, which included fishery administration (Su Xueling, 2011; Jing Wei, 2013).

After the establishment of the People's Republic of China, fishery administration was provided for in the fishery regulation formulation, and fishery administration agencies at all levels were established with corresponding personnel and facilities (Yan Xuesong, 2008).

Currently, China has various fishery administration organs and institutions of different sizes, levels and responsibilities, including fishery administration, fishing port supervision, fishing vessel inspection, radio communications agency, aquatic animal and plant nature reserve management agencies, and so forth (Table 4.1). Some are specialized fishery administration subjects, while others are composed of several departments with similar functions, which enjoy the management rights of public affairs other than fishery management rights. According to their decision-making power, these fishery administration departments can be divided into central fishery administration organs, local fishery administration organs, fishery administration institutions authorized by laws or regulations, other organizations and organizations entrusted by fishery administration organs or institutions. The central fishery administration organs and agencies include the State Council, the Ministry of Agriculture and Rural Affairs and its affiliated fisheries administration agencies. Local fishery administration organs and agencies include local people's governments at all levels and their fishery administrative departments and affiliated agencies. At present, many fishery administration institutions belong to institutions with fishery administration functions and have certain management authority over the fishing behaviour of inland fisheries.

TABLE 4.1. Fishery management agencies in various regions (by nature of agency)

Region	Number of fisheries enforcement agencies	Number (units)			
		Administrative units	Units under civil service management	Business units	Other
National total	2 609	458	600	1 551	
Directly under the ministry	2	2			
Beijing	16	5	1	10	Inland
Tianjin	11	1	2	8	Inland
Hebei	105	18	7	80	Inland
Shanxi	55	6	1	48	
Inner Mongolia	97	12	23	62	
Liaoning	75	5	7	63	Inland+marine
Jilin	58	8	8	42	
Heilongjiang	91	6	12	73	
Shanghai	10	2	8		
Jiangsu	93	4	56	33	
Zhejiang	97	8	77	12	
Anhui	111	15	8	88	
Fujian	86	3	59	24	
Jiangxi	93	1	12	80	
Shandong	158	30	13	115	
Henan	114	33	3	78	
Hubei	101	5	13	83	
Hunan	120	9	28	83	
Guangdong	123	116	4	3	
Guanxi	107	5	91	11	
Hainan	21	1	4	16	
Chongqing	40	1	30	9	
Sichuan	202	65	65	72	
Guizhou	97		9	88	
Yunnan	149	17	10	122	
Xizang	57	22	2	33	
Shanxi	112	17	8	87	
Gansu	83	15	10	58	
Qinghai	38	2	6	30	
Ningxia	22	1		21	
Xinjiang	65	23	23	19	

Note: Data as of May 2020.
Source: FFRC using data from the *China fishery statistics yearbook* for this review.

The State Council

According to Article 89 of the Constitution of the People's Republic of China and the Organic Law of the State Council, the State Council is the highest organ of state administration and has the power to prescribe the tasks and duties of the ministries and commissions of the State Council, while local people's governments at all levels throughout the country are organs of state administration under the unified leadership of the State Council and are subordinate to it. The State Council is the highest decision-making organ in public administrative affairs of the fisheries industry and may promulgate administrative regulations, decisions, orders and other normative documents on fisheries management in accordance with the law. The Ministry of Agriculture and Rural Affairs shall seek instructions from and report to the State Council on guidelines, policies, plans and major administrative measures on fisheries management, which shall be decided by the State Council.

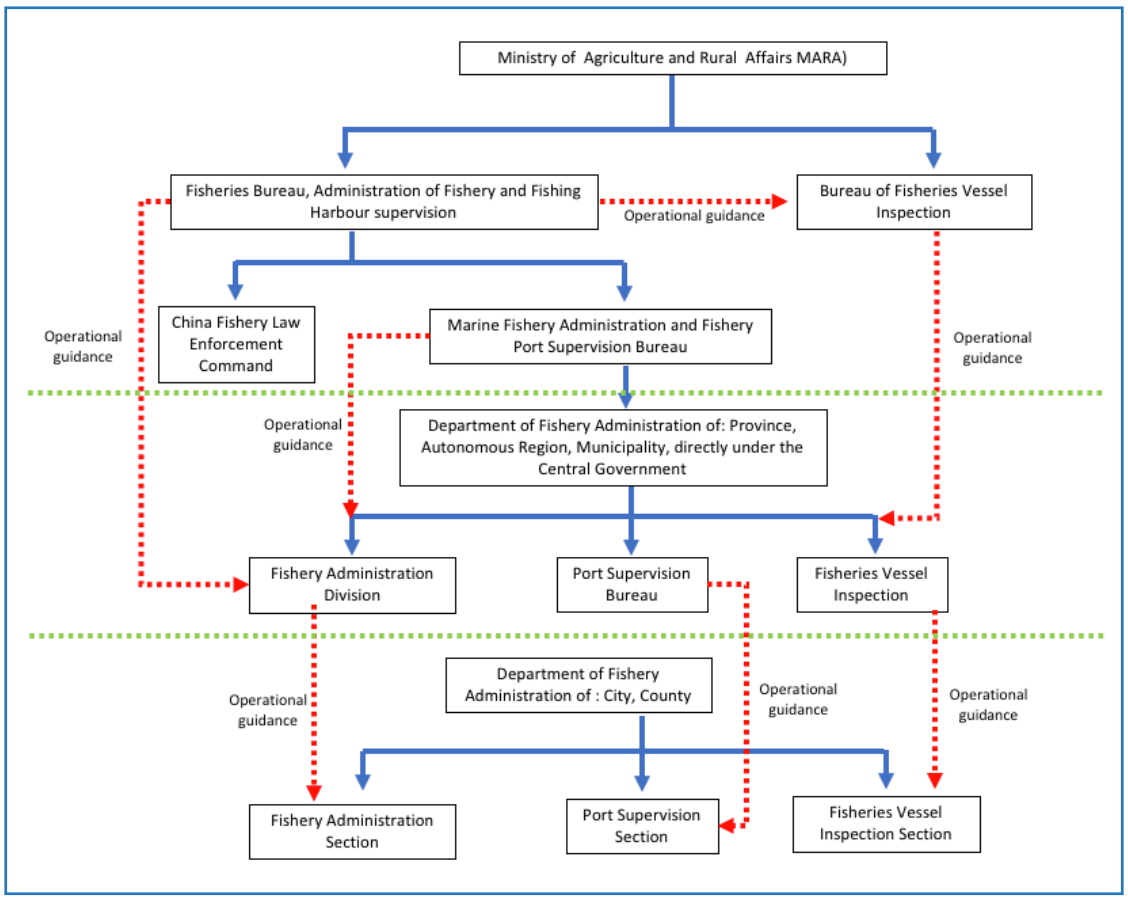
The Ministry of Agriculture and Rural Affairs and its affiliated agencies

The Ministry of Agriculture and Rural Affairs is in charge of national fisheries work in accordance with the Fisheries Law of the People's Republic of China and the State Council's Three Decisions Programme (Figure 4.1). It is responsible for researching, formulating and implementing fisheries development strategies, plans and major measures; guiding the development and utilization of fisheries biological resources, fisheries waters and mudflats; protecting the ecological environment of fisheries waters and aquatic animal and plant resources; safeguarding national fisheries rights; and exercising the right to inspect fishing vessels and supervise and manage fisheries administration and fishing ports. The specific work will be undertaken by the Bureau of Fisheries and Fishery Administration of the Ministry of Agriculture and Rural Affairs.

The Bureau of Fisheries and Fishery Administration of the Ministry of Agriculture and Rural Affairs, which is the highest leading agency for fisheries management, is responsible for implementing the Fisheries Law and other fisheries laws and regulations nationwide, and has the responsibility for guiding the Administration of Fishery and Fishing Harbour Supervision of the Ministry of Agriculture and Rural Affairs and the fishery administrative departments and agencies under local people's governments at all levels (Zhuo Youzhan, 1996). In addition, the Ministry of Agriculture and Rural Affairs has also established the Bureau of Fisheries Vessel Inspection, which is responsible for implementing laws, regulations and rules concerning fisheries vessel inspection, fulfilling obligations under relevant international conventions, handling cases of violations in relation to, *inter alia*, the manufacture, repair and inspection of fishing vessels and providing leadership and guidance to the work of fishing vessel inspection agencies of local people's governments at all levels.

In addition, the Fisheries Supervision and Administration Office of the Yangtze River Basin is the first inland basin fisheries administration and management agency in China, and the first administrative agency dispatched by the Ministry of Agriculture and Rural Affairs. It is mainly responsible for the fisheries management and conservation of aquatic resources in relevant watersheds, important waterbodies and border waters south of the Yellow River Basin, covering the Yangtze River, Pearl River, Yarlung Tsangpo River, Huaihe River, Lancang River, Nujiang River, Min River, Qiantang River and other watersheds and border waters, as well as lakes such as Poyang Lake, Dongting Lake, Taihu Lake, Namucuo Lake and Chaohu Lake, involving 20 provinces, autonomous regions and municipalities including Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shanxi, Gansu and Qinghai.

FIGURE 4.1. Organizational structure of the Ministry of Agriculture and Rural Affairs



Source: FFRC using data generated for this review.

Local fisheries administrative authorities and affiliated agencies

According to the Organic Law of Local People's Congresses and Local People's Governments and the Fisheries Law and other relevant laws and regulations, local people's governments are responsible for fisheries management within their own administrative regions, and lower-level governments shall be responsible and report to higher-level governments. For fisheries activities that straddle administrative regions, they shall be managed by consultation between the local governments concerned or by decision of the people's governments at the common higher level. The fisheries administrative authorities of local people's governments and their affiliated agencies are functional departments of the people's governments at the same level. They are in charge of the fishery management work of their own administrative regions, under the leadership of the people's governments at that level, and subject to the operational guidance or leadership of the fishery administrative departments of the people's governments at higher levels and the Ministry of Agriculture and Rural Affairs and its affiliated agencies in accordance with the laws and regulations.

The people's governments of townships (including ethnic townships and towns) are the lowest level of people's governments and also enjoy certain fisheries administration powers in accordance with the Organic Law of Local People's Congresses and Local People's Governments and other laws and regulations. Street offices, which are organs dispatched by the people's governments of municipal districts and cities not divided into districts, have responsibilities similar to those of people's governments at the township level and also enjoy certain fishery management powers. However, the fisheries management acts that can be carried out by township governments and street offices are extremely limited, and they do not have the power to issue fishery documents such as farming and fishing licences.

Organizations authorized by law to exercise fisheries management powers

Under the explicit authorization of laws and regulations, certain organizations that are not part of the fisheries management organs or agencies may also manage certain fisheries public affairs in accordance with the law. These mainly include mass self-governing organizations, aquaculture technology promotion agencies, aquaculture research and education institutions, industry associations and professional technical committees.

Village committees, which are grassroots mass self-governance organizations for villagers to self-manage, self-educate and self-serve, can manage some local fishery affairs in accordance with laws and regulations, and receive operational guidance from township and street offices, local people's governments at or above the county level and their fishery administrative departments and affiliated agencies. At present, China has established a five-level aquatic technology promotion system at national, provincial, municipal, county and township levels, and under the Agricultural Technology Promotion Law, aquatic technology promotion agencies at all levels enjoy a certain degree of authority over fisheries management. Fisheries industry associations established by law also enjoy a certain degree of fisheries management authority under the guidance of fisheries authorities and agencies, in accordance with Article 9 of the Implementing Rules of the Fisheries Law (1987) and Article 27 of the Law on Quality and Safety of Agricultural Products (2006). As certain fisheries management activities have strong professional and technical attributes that are inconvenient for the fisheries authorities to exercise, laws and regulations also expressly authorize the exercise of these powers to specialized technical committees. For example, Article 16 of the Fisheries Law (1986) stipulates that the validation of new varieties of aquatic products is the responsibility of the National Committee for the Validation of Original and Good Species of Aquatic Products. Organizations authorized by laws and regulations have the same status of administrative subjects as fisheries administrative organs and agencies and can exercise in their own name the fishery management powers granted by laws and regulations in accordance with the law and bear the legal responsibilities arising therefrom on their own.

Organizations entrusted by the fisheries authorities to exercise specific management powers

In order to facilitate management, fisheries administrative organs or agencies may also delegate certain fisheries management powers to other administrative organs, institutions, social groups, industry associations and mass self-governance organizations with management capabilities.

For example, Article 17 of the Regulations for the implementation of wild aquatic animal protection (1993) provides that the fisheries administrative departments may delegate the issuance of licences for the domestication and breeding of aquatic wildlife under national key protection to the administrative department of construction at the same level.

The administrative entrustment of fisheries must be based on statutory grounds, carried out in accordance with statutory procedures and announced to the public. The organization to be entrusted should be established in accordance with the law and have the required personnel and technical conditions, such as the establishment of a fisheries industry association which has to be examined and approved by the fisheries administrative authorities, have the conditions of a legal entity and be registered in accordance with the Regulations on the Registration and Management of Social Organizations.

Related fisheries research institutes

The Chinese Academy of Fisheries Science (CAFS) is a comprehensive fishery research institution directly under the Ministry of Agriculture and Rural Affairs and is responsible for the major basic and applied research as well as high-tech industrial development

research in the national fishery industry. It also plays a role in the development of science and technology, the training of high-level scientific research talent and the development of domestic and international exchanges and cooperation in fisheries science and technology.

The CAFS has three marine research institutes, four watershed research institutes, two professional research institutes, four breeding experimental stations and a total of 14 units in the academy; five research institutions have been jointly established with local communities. Among them, the inland watershed research institutes are the Heilongjiang Fisheries Research Institute, the Yangtze River Fisheries Research Institute, the Pearl River Fisheries Research Institute and the Freshwater Fisheries Research Centre of the CAFS. Table 4.2 provides an overview of the fishery management units currently operating in China.

Other fishery conservation institutions

Fishery resource protection institutions such as fishery resource monitoring stations, protected area management stations and stock enhancement stations are set up in accordance with the Fisheries Law of the People's Republic of China, the Wildlife Protection Law of the People's Republic of China and relevant regulations to enhance the protection, enhancement and utilization of fishery resources.

TABLE 4.2. Overview of fishery management units in China

National level			
Name		**Responsibilities**	
State Council		The highest decision-making organ of public administration for fisheries	
Ministry of Agriculture and Rural Affairs and its affiliated agencies			
Time	**Name**	**Region**	**Responsibilities**
1958	China Fisheries Magazine	National	Publicity, promotion and science education
May 2000	Bureau of Fisheries, Ministry of Agriculture and Rural Affairs	National	Lead agency for national fisheries development
October 2014	Fisheries Supervision and Administration Office of the Yangtze River Basin, Ministry of Agriculture and Rural Affairs	Related basins south of the Yellow River Basin	Manage inland fisheries
December 2015	China Fisheries News	National	Promote Party and national fisheries policies
Local fishery administrative authorities and affiliated agencies at all levels (some provincial authorities)			
Name	**Region**	**Name**	**Region**
Department of Fisheries Administration, Hebei Province	Rivers in the territory	Bureau of Fisheries, Department of Water Resources, Shanxi Province	The Yellow River and Hai River Basin, etc. in the territory
Bureau of Fisheries, Jilin Province	The Songhua River, Liao River, Tumen River, Suifen River, etc. in the territory	Bureau of Fisheries and Fishery Administration, Department of Agriculture and Rural Affairs, Heilongjiang Province	The Songhua River, the Huma River and the Ussuri River, etc. in the territory
Bureau of Ocean and Fisheries, Jiangsu Province	The Huaihe River, Yangtze River, Taihu Lake system, etc. in the territory	Bureau of Ocean and Fisheries, Zhejiang Province	The major waterways of the Qiantang River, the Ouhe River and the Yong River, etc. in the territory
Bureau of Fisheries, Department of Agriculture and Rural Affairs, Anhui Province	The Huaihe River, Yangtze River, etc. in the territory	Bureau of Ocean and Fisheries, Fujian Province	The Min River, the Jiulong River, the Jin River and the Mulan River, etc. in the territory

TABLE 4.2. (*Continued*)

Local fishery administrative authorities and affiliated agencies at all levels (some provincial authorities)			
Name	**Region**	**Name**	**Region**
Fisheries and Fishery Bureau, Department of Agriculture and Rural Affairs, Jiangxi Province	The Ganjiang River, Xinjiang River, Xiuhe River, Poyang Lake, etc. in the territory	Ocean and Fisheries Department, Shandong Province	The Yellow River, the Huaihe River and the Hai River Basin, etc. in the territory
Bureau of Fisheries, Department of Agriculture and Rural Affairs, Henan Province	Cross-sea rivers, the Yellow River, the Huaihe River, the Yangtze River in the territory	Bureau of Aquaculture, Hubei Province	The Yangtze River, Hong Lake, Liangzi Lake, Axe Lake, etc. in the territory
Bureau of Animal Husbandry and Fisheries, Hunan Province	The Xiangjiang River, the Zijiang River, the Yuanjiang River, etc. in the territory	Bureau of Ocean and Fisheries, Guangdong Province	The Pearl River system in the province
Ocean and Fisheries Department, Hainan Province	The Nandu River, the Changhua River, etc. in the territory	Department of Fisheries and Fishery Administration, Department of Agriculture and Rural Affairs, Sichuan Province	The Jinsha River, the Anning River, the Yangtze River, the Jialing River, etc. in the province
Bureau of Fisheries, Guizhou Province	The Yangtze River, the Pearl River Basin, etc. in the territory	Bureau of Fisheries, Yunnan Province	The Yangtze River, the Pearl River, the Lancang River, the Dianchi River, the Erhai Sea, etc. in the province
Organizations authorized by law to exercise management powers			
Established	**Name**	**Region**	**Responsibilities**
August 1984	Administration of Poyang Lake, Jiangxi Province	Poyang Lake	Integrated lake management
December 1984	Administration of Taihu Lake, Ministry of Water Resources	Taihu Lake	Monitor and protect water resources in the basin
June 2001	Office of Committee on Fisheries Management of the Hongze Lake, Jiangsu Province	Hongze Lake	Integrated lake management
March 2012	Administration of Chaohu Lake, Anhui Province	Chaohu Lake	Integrated lake management
May 2016	Office of Fisheries Resources Management of the Huaihe River Basin	The Huaihe River Basin	Fisheries management platform
November 2016	Committee on Fisheries Resources Management of the Yangtze River Basin	The Yangtze River Basin	Fisheries management platform
November 2016	Committee on Fisheries Management of the Pearl River Basin	The Pearl River Basin	Fisheries management platform
October 2021	Committee on Fisheries Resources Management of the Yellow River Basin	The Yellow River Basin	Fisheries management platform
Organizations entrusted by the fisheries authorities to exercise specific fisheries management powers			
Established	**Name**	**Region**	**Responsibilities**
February 1978	Fisheries Association of Jiangsu Province	Jiangsu Province	Assisting in fisheries management, regulating the behaviour of the industry, reporting opinions and requirements to the government, providing training and advice on business management and fisheries technology, exchange and promotion, scientific and technological exchange and economic and technical cooperation.
December 2000	Fisheries Association of Heilongjiang Province	Heilongjiang Province	
May 2001	China Fisheries Association	National	
April 2007	Fisheries Association of Anhui Province	Anhui Province	
December 2020	Fisheries Association of Sichuan Province	Sichuan	

TABLE 4.2. (*Continued*)

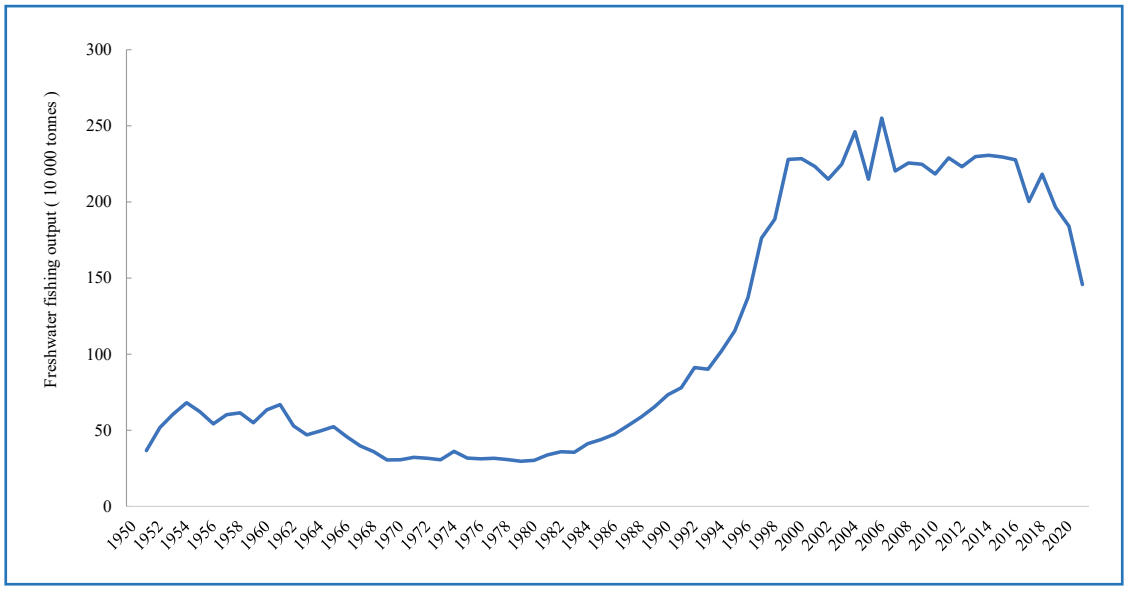
Related fisheries research institutes			
Established	**Name**	**Researchers**	**Main research areas**
June 1950	Heilongjiang River Fisheries Research Institute, CAFS	Sun Xiaowen, Liang Liqun *et al.*	Research on the Heilongjiang River Basin and cold regions of the north
1953	Pearl River Fisheries Research Institute, CAFS	Wang Guangjun, Zhu Huaping, *et al.*	Research on major basic applications of fisheries in the Pearl River Basin and tropical and subtropical regions
1958	Yangtze River Fisheries Research Institute, CAFS	Ai Xiaohui, Wei Qiwei *et al.*	Research on the conservation and use of fishery resources in the middle and upper reaches of the Yangtze River
May 1963	Fishery Machinery and Instrument Research Institute, CAFS	Chen Jun, Ni Qi *et al.*	Research in the field of fisheries equipment and engineering
1978	Freshwater Fisheries Research Center, CAFS	Xu Pao, Ge Xianping *et al.*	Research on the conservation and utilization of fishery resources in the middle and lower reaches of the Yangtze River
1978	Fisheries Engineering Research Institute, CAFS	Chen Jinfa, Cui Guohui *et al.*	Research on the construction of fishing ports and fish farms, fishery facilities and other engineering projects
Relevant fisheries protection agencies			
1986	Yangtze River Fisheries Resources Monitoring Station		Integrated technical platform for survey, assessment and conservation of fishery resources in the lower Yangtze River
2017	Danjiangkou Reservoir Stock Enhancement Station		Resource protection such as fishery stock enhancement

Note: Sun Xiaowen, Liang Liqun *et al.*, principal investigators, non-quoted; Ai Xiaohui, Wei Qiwei *et al.*, principal investigators, non-quoted; Wang Guangjun, Zhu Huaping *et al.*, principal investigators, non-quoted; Xu Pao, Ge Xianping *et al.*, principal investigators, non-quoted; Chen Jun, Ni Qi *et al.*, principal investigators, non-quoted; Chen Jinfa, Cui Guohui *et al.*, principal investigators, non-quoted. *Source:* FFRC using data generated for this review.

4.1.2 Overview of management policies

Fisheries policy is a standardized national regulation of the objectives, guidelines to be followed, tasks to be accomplished, ways to be implemented and specific measures to be taken for the development of the fisheries industry within a certain stage of development. This includes policies on the utilization and protection of fisheries resources, policies on the development of fisheries industries, policies on the protection of fisheries waters, policies on fisheries management, policies on fisheries finance, policies on fisheries subsidies and a very wide range of other policies. In the more than 70 years since the founding of New China, the total output of China's capture fisheries has increased significantly and fisheries management policies have been changing with the times (Figure 4.2). In general, China's capture fisheries policies have been adjusted and improved over more than 70 years, gradually forming a policy system with input control, output control, technical control and supporting policies as the core measures. However, due to the constraints of the management system, the lack of fishery resource data, the large group of fishers and their unclear classification, advanced fishery management policies such as the total allowable catch and individual transferable quota systems have not yet been implemented nationwide.

FIGURE 4.2. Freshwater fishery catches from 1949 to 2020



Source: FFRC using data from the *China fishery statistics yearbook* for this review.

Policy exploration

At the early stage of the founding of New China (1949–1957), the Three Great Transformations policy was born, which established the policy of "fishing as the mainstay", and the development of China's fisheries began to recover after a long period of war. In the meantime, state-run fishing enterprises were established and the fishery cooperation movement was launched.

Under the guidance of the policy, 14 state-run fishing enterprises had been established nationwide by 1957, with the Luda Fisheries Company, Yantai Fisheries Company, Qingdao Fisheries Company, Shanghai Fisheries Company and the state-run Nanhai Fisheries Company becoming the backbone of China's fishing and fishery enterprises. The development of freshwater fisheries was relatively slow, basically remaining between 500 000 tonnes and 600 000 tonnes annually.

In the early days of New China, there was a vast number of poor fishers, who owned only 2 percent to 3 percent of the means of production, and thus the fishery cooperative movement was established. In 1952, the Central Committee of the Communist Party of China issued the Instruction on the Work of Fishermen, the main content of which was to gradually carry out democratic reforms in fishing areas, to defeat the remaining feudal reactionary forces, to establish new fishing associations and trade unions, and to eliminate the exploitation of fishers' groups. The democratic reforms in fishing areas fully mobilized the productive enthusiasm of fishers. In 1953, the Resolution on Mutual Aid and Co-operation in Agricultural Production was formally issued, and fishery cooperatives were further developed. A total of 1 054 primary fishery cooperatives were established in 1954, an increase of 1 000 over 1953, and fishers' incomes increased significantly. By 1957, a total of 932 546 fishers participated in the cooperation movement, accounting for more than 95 percent of the fisher demographic and the socialist transformation of individual fishing by fishers was basically complete. Data show that in 1950, the freshwater fisheries output was 366 000 tonnes a year and the freshwater fishery involved a population of about 1.13 million people; by 1960, the inland fisheries output had reached 668 000 tonnes a year and the freshwater fishery involved a population of about 1.8 million people. Table 4.3 outlines policies related to the initial exploration period of freshwater fisheries in China.

TABLE 4.3. Policies related to the initial exploration period of freshwater fisheries in China

Year	Freshwater fisheries policy and related governance	Main content and significance
1952	Joint Instruction on the Agreement of Commissioning the Supply of Salt for Freshwater Fisheries.	Solved the problem of salt use in freshwater fisheries.
1955	Instructions on the Aquatic Production, Processing, Transportation and Marketing Enterprises Under the Unified Leadership of the Ministry of Commerce (Zhou Enlai, 1955).	Achieved unified management; fisheries-related management transferred to the jurisdiction of the commercial sector (Ministry of Commerce of the People's Republic of China, 1956).
1956	President Mao Zedong conveyed the policy of Three Mountains, Six Waters and One Field, the Fishing Industry Has Great Potential to the head of the Ministry of Fisheries.	Brought fisheries development to an important level.

Source: FFRC using data generated for this review.

Period of political turbulence (1958–1976)

From 1958 to 1976, there was a period of turbulence in Chinese society. The prevalence of egalitarianism and lack of incentives during the Great Leap Forward and the People's Commune period led to a decline in fisheries output instead of an increase. In order to solve the continuous decline of the fishing industry, in 1962, the Fisheries Department drafted the Supplementary Provisions of the Central Committee of the Communist Party of China on Certain Policy Issues of the Rural People's Commune Fisheries. After adjustment, most of the people's fisheries communes were adjusted to a three-tier ownership system, and the capture fisheries gradually recovered, but the turbulent background of the times made the overall fisheries develop slowly (Table 4.4). Data show that freshwater fisheries production continued to decline to less than 300 000 tonnes in 1978, and the freshwater fishing population fell to about 800 000 fishers.

TABLE 4.4. Freshwater fisheries policies during the political turbulence period

Year	Freshwater fisheries policy and related governance	Main content and significance
1958	Notice on the Collection of Parental Fish for Spawning and Hatching and Release During the Fall and Winter Adult Fishery	The first attempt to breed seedlings in captivity on a large scale.
1964	The Ministry of Aquatic Products applied to the State Council for approval of the pilot Aquatic Resources Reproduction Protection Regulations	For the first time, the protection of natural fishery resources was proposed at the national policy level.
1966	Report on Accelerating the Socialist Transformation of the Lianjia[1] Fisheries	Unified management and assistance for independent fishers.
1973	Notice on Raising the Purchase Price of Freshwater Fish	Increased the purchase price of freshwater fish.

[1] These fishers lived in their boats and the fishing boats were not only their means of production, but also their living quarters.
Source: FFRC using data generated for this review.

The early stage of reform and liberalization

China's reform and development policy began in 1978 and was a turning point in the development of various industries in China. In this period the country attached importance to freshwater fishery production and reform effort and related policies were more intensive (Table 4.5). China issued three important policies in 1978, advocating reform from the supply side of the production base for construction and security, while the state fisheries were targeted as a base for the production of non-staple food. Reform and liberalization continued to energize the economic development of China's freshwater fisheries. Freshwater fisheries production in 1978 was only 296 000 tonnes but gradually increased to 338 000 tonnes in 1980 and 530 000 tonnes in 1986. During this period, freshwater fisheries production increased rapidly.

TABLE 4.5. Freshwater fisheries policy at the beginning of reform and liberalization

Year	Freshwater fisheries policy and related governance	Main content and significance
1979	Aquatic Resources Reproduction Protection Regulations	Presented a paper to promote natural breeding of fish.
1979	Notice on the Issuance of Fishery Water Quality Standards	Regulated water use in fisheries.
1980	National Fishery Natural Resources Survey and Fishery Zoning Study Implementation Plan	A systematic survey of natural fishery resources was conducted.
1980	Report on Fish Farming in Reservoirs and the Development of Integrated Management	Promoted the development of environmentally friendly fisheries in large waterbodies.
1982	Notice of the Report on Accelerated Development of Freshwater Fisheries	Further development of freshwater fisheries planning.

Source: FFRC using data generated for this review.

Continuous development period

In 1986, the Fisheries Law of the People's Republic of China (hereafter referred to as the Fisheries Law) was adopted, and since then, the development of freshwater fisheries in China entered a period of rapid development under its impetus, forming a legal protection + expert guidance + institutional certification development model (Table 4.6). The Ministry of Agriculture, Animal Husbandry and Fisheries established the National Advisory Group on Aquaculture and Enrichment in Large and Medium-sized Waters, which made recommendations to the Ministry of Agriculture, Animal Husbandry and Fisheries on the development and utilization of aquaculture in large and medium waterbodies and was entrusted with the responsibility of production inspection and consultation.

The establishment of an authoritative body for certification, the National Aquatic Original Species Validation Committee, was formally established in 1990 under the leadership of the MoA. On 9 April 1988, the first meeting of the Seventh National People's Congress had decided to change the name of the Ministry of Agriculture, Animal Husbandry and Fisheries to the Ministry of Agriculture, which was mainly responsible for: (1) implementation of the laws and policies promulgated by the state on aquatic germplasm and seed production management; (2) production validation at country, watershed and regional levels. In 1999, the State Administration of Quality and Technical Supervision appointed the China Aquatic Products Quality Certification Management Committee and the China Aquatic Products Quality Certification Center. In 1999, the State Administration of Quality and Technical Supervision appointed the China Aquatic Products Quality Certification Management Committee and China Aquatic Products Quality Certification Center, which were formally established in Beijing where work on aquatic products quality certification was carried out. During this period, with legal protection, expert guidance, institutional certification and determination of characteristics of freshwater fisheries, China's freshwater fisheries developed rapidly, enjoying a steady increase in fisheries output at 530 000 tonnes in 1986, 790 000 tonnes in 1990, more than 1 018 800 tonnes in 1993 and reaching 2.28 million tonnes in 1998.

TABLE 4.6. Freshwater fisheries policy during the period of deepening reform and liberalization

Year	Freshwater fisheries policy and related governance	Main content and significance
1986	Fisheries Law of the People's Republic of China	China fisheries programmatic document.
1987	Fisheries Law Implementation Rules of the People's Republic of China	Supplementary to the specific implementation of the fisheries law.
1988	Wildlife Protection Law of the People's Republic of China Supplementary Provisions of the Standing Committee of the National People's Congress on the Punishment of Hunting and Killing of Precious and Endangered Wild Animals under National Protection.	Precious and endangered species protection.

Source: FFRC using data generated for this review.

Sustainable development period

With the development of fishing technology and the increase in fishing intensity, overfishing led to a sharp decline in the production of natural economic fish, and the issue of fishery resources sustainability had become a critical issue. China's freshwater fishery policy formulation began to change in the direction of achieving sustainability in 1999. This involved the need for industrial restructuring – changing the focus from expansion of quantity to improvement of quality and efficiency as well as strengthening the protection of fishery resources and the environment. In other words, the sustainable development of China's fisheries was promoted (Table 4.7). During this period, policy formulation was mainly in terms of "safety, transformation and green" for freshwater fisheries.

Regarding safety, instruments were the People's Republic of China Production Safety Law, Regulations of the People's Republic of China Fishing Vessel Inspection and other provisions on the safety of fisheries production. With respect to reform, in 2016 the MoA issued a notice to accelerate the transformation of fisheries and adjust the structure of the guiding opinions. In 2017 the MoA promulgated the implementation of the supply-side structural reform of agriculture and advocated fisheries development reform and transformation. For green development, the Guidance on Promoting the Development of Ecological Fisheries in Large Waters (2019), the National Agricultural Green Development Rules for the 14th Five-Year Plan, the 14th Five-Year National Fisheries Plan (2021) and the concept of ecological fisheries gradually became the main vehicles for fisheries development. From 1999 to 2019, China's freshwater fisheries production varied between 2.00 million tonnes to 2.38 million tonnes, reaching its highest value in 2016, with fisheries production of 2.38 million tonnes. However, this was followed by a yearly decline, falling to 2 million tonnes or less in 2018, with freshwater fisheries production at only 1.198 million tonnes in 2021.

At present, China's economy has shifted from high-speed development to medium-speed development. The main contradictions of China's fisheries industry are between the people's demand for high-quality and safe aquatic products and aesthetic waterbody environments, and the unsustainable supply of aquatic products and the excessive use of resources and the environment by the fishing industry. In the next stage, China's fisheries development thrust will be to promote quality and efficiency, reduce expenditure, practise green development and enhance fishers' income.

TABLE 4.7. Freshwater fisheries policies in the sustainable development period

Year	Freshwater fisheries policy and related governance	Main content and significance
1999	Guidance on the Restructuring of the Fisheries Industry	The new period was the first endeavour to advocate the fisheries industry structure for adjustment and upgrading.
2003	Aquaculture Quality and Safety Management Regulations	Promoted the standardization of freshwater aquaculture.
2015	General Office of the Ministry of Agriculture accelerated the "three certificates in one" reform of inland fishing vessels for the new version of the certificate issue notice	Standardized management for fishing production vessels.
2016	Guidance on Accelerating the Transformation of Fisheries and Restructuring	Transformation and reform of fisheries.
2018	Technical Guidelines for Green Development of Agriculture (2018–2030)	Agricultural green development of the sector.
2019	Guidance on Promoting the Development of Ecological Fisheries in Large Waters	Inland large waterbody fisheries special guidance document.
	Notice on the Implementation of the Haihe, Liaohe, Songhua River and Qiantang River and other Four Basin Closed Season System	Seven major watersheds are fully prohibited from fishing.
2020	Ten-year Fishing Ban on the Yangtze River	Ten-year ban on fishing in the Yangtze River main stream.

Source: FFRC using data generated for this review.

Major policies

Input control policy: The fishing licence and boat and net tool indicator control system – Fishing License Management Regulations – issued in 2002 with five revisions up to 2020, reveals that China's fishing licences are divided into eight categories. It also covers the type of operations and operating sites, including inland fisheries fishing licences, special (licensed) fisheries fishing licences, temporary fisheries fishing licences, recreational fishing permits and fishing auxiliary vessel permits related to inland capture fisheries activities. From 2020 to 2021, the state issued the following relevant documents in succession: Further Strengthening the Implementation Plan for the Ban on Fishing in Key Waters of the Yangtze River Basin and the Resettlement and Protection of Retired Fishermen; Notice on the Work Related to the Transfer of Retired Fishermen to Other Industries and Livelihood Protection; On the Implementation of the Resettlement and Protection of Retired Fishermen in Key Waters of the Yangtze River Basin.

Output control system: So far, China has only introduced one policy measure for output control of marine fishing – the fishing quota system; freshwater capture fisheries have developed more slowly and basically have no output control system. With the development of environmentally friendly fisheries in recent years, total control is gradually applied to large inland environmentally friendly fisheries; for reservoirs, lakes and other large waterbody fisheries, planning the fishing quota in advance is a prerequisite.

Technical control policies: The main mechanisms in technical policies for fisheries management are: (1) the closed season system, which has been implemented in almost all large inland waters; 2) stocking and releasing, which has become one of the main measures to sustain capture fishery production in various waterbodies in China; (3) the minimum size and minimum catchable standard, which has been issued by the former MoA. The Notice on the Implementation of the Minimum Size System for Fishing Gear and Transitional Fishing Gear in the Main Stream of Yangtze River (MARA, 2017), the Notice of the Ministry of Agriculture on the Prohibition of the Use of Single-boat Trawl and Fourteen Other Fishing Gears in the Main Stream of Yangtze River and the Notice on the List of Prohibited Fishing Gear in the Key Waters of Yangtze River Basin, stipulating the relevant fishing gear and their parameters; and (4) the resource protection zones. Currently there are 220 nature reserves, covering 100 000 km^2. There are also national aquatic germplasm reserves and so far 11 batches of 535 species have been distributed in 30 provincial administrative regions, including 471 freshwater species (with 400 protected species).

Other related policies: The fishing vessel fuel subsidy policy was introduced by the State Council in 2006. The government allocated a fuel subsidy for fishers according to their types of fishing licence to motivate fishing operations, which had basically been abolished. Otherwise, the mutual insurance policy for fishing vessels, the fishing vessel safety production policy, the establishment of a safe fishing production system, the ecological compensation mechanism for waterbodies, fisheries law enforcement management, ecological restoration of waterbodies, fish habitat protection and many other protection measures have been introduced.

4.2 OVERVIEW OF INLAND FISHERIES DEVELOPMENT PLANNING

4.2.1 Inland fishery planning

Relevant national planning documents: In the early days of the founding of New China, China's fishery production came mainly from marine and freshwater capture fisheries. In 1959, in accordance with the spirit of the Second Plenary Session of the Eighth Central Committee, China's fishery industry adopted the policy of developing breeding and fishing simultaneously.

In order to propagate and protect aquatic resources and develop aquatic production, the Ministry of Fisheries officially implemented the Regulations on Propagation and Protection of Aquatic Resources in 1979. In 1980, the State Council agreed to the Report on Reservoir Fish Farming and Integrated Operations, encouraging the strengthening of unified management and the joint development of reservoir fish farming and integrated management.

In 1999, the Guidance on Adjusting the Structure of the Fisheries Industry was issued to inform the general public on how the structure of the fisheries industry would be adjusted and optimized according to the objective laws of fisheries development and market demand.

In 2017, the former MoA issued the Specification for the Preparation of Planning of Aquaculture Waters and Mudflats and the Outline for the Preparation of Planning of Aquaculture Waters and Mudflats, requiring the reasonable layout of aquaculture production and the delineation of prohibited areas, restricted areas and breeding areas.

In December 2019, the Ministry of Agriculture and Rural Affairs, the Ministry of Ecology and Environment and the Bureau of Forestry and Grassland issued the Guidance on Promoting the Development of Ecological Fisheries in Large Waters, which is a programmatic document to guide the development of environmentally friendly fisheries in large waterbodies in the new period.

From 2007 to 2022, the Ministry of Agriculture and Rural Affairs issued the 11th to 14th five-year plans for the development of national fisheries development. Based on the summary of the previous development achievements and the current situation, the guiding ideology, basic principles and development objectives for fisheries development were clarified, and safeguard measures were implemented at all levels to comprehensively promote the work (Table 4.8).

TABLE 4.8. Relevant planning documents for China's fisheries development

Year	Development planning
1956	Instruction on Several Urgent Issues in Marine and Freshwater Aquaculture
1979	Regulations on Propagation and Protection of Aquatic Resources
1980	Implementation Plan for the National Fisheries Natural Resources Survey and Fisheries Zoning Study
1982	Notice of Report on the Accelerated Development of Freshwater Fisheries
1999	Guidance on Adjusting the Structure of the Fisheries Industry
2007	The 11th Five-Year Plan for National Fisheries Development (2006–2010)
2011	The 12th Five-Year Plan for National Fisheries Development
2017	The 13th Five-Year Plan for National Fisheries Development
2019	Guidance on Promoting the Development of Ecological Fisheries in Large Waters
2021	The 14th Five-Year Plan for National Agriculture Green Development
2022	The 14th Five-Year Plan for National Fisheries Development

Source: FFRC using data generated for this review.

Provincial planning: The planning documents related to inland capture fisheries in Jiangsu show the changes in policies related to major lakes, rivers or endemic species in recent years. They reveal a change in management policies of China's capture fisheries – from the simple pursuit of yield growth to sustainable development, from a focus on developing capture fisheries to a focus on aquaculture, complemented by capture fisheries (Table 4.9).

Moreover, the focus of fisheries management has also changed from controlling the volume of biological resources to safeguarding the rights and interests of fishers, with more emphasis on the overall enhancement of ecological, economic and social benefits.

TABLE 4.9. Fisheries-related planning documents of Jiangsu

Year	Development planning	Main contents
2006	The 11th Five-Year Plan for Fisheries Development in Jiangsu Province	Review of the 11th Five-Year Plan, and development ideas, strategic objectives and major tasks for the 11th Five-Year Plan.
2010	Notice on Strengthening Management of the Specialized Fishing of Yangtze Japanese Grenadier Anchovy in 2010	Requirements for specialized fishing licences for Japanese grenadier anchovy and tapertail anchovy.
2011	Fishery Aquaculture Plan for Gehu Lake in Jiangsu Province (2011–2020)	Based on the current development of fisheries in Gehu Lake, set up areas for fish farming, protection of germplasm resources and protection of water sources, etc.
	Fishery Aquaculture Plan for Hongze Lake in Jiangsu Province (2011–2020)	Based on the current situation of fishery development in Hongze Lake, set up areas for fishery breeding, germplasm resource protection and ecological restoration, etc.
	Fishery Aquaculture Plan for Waters and Mudflats in Jiangsu Province (2011–2020)	Utilization evaluation and functional zoning of aquaculture waters and mudflats, etc.
	The 12th Five-Year Plan for Fisheries Development in Jiangsu Province	Development achievements during the 11th Five-Year Plan period, the development ideas, strategic objectives and main tasks for the 12th Five-Year Plan.
2016	Notice on Strengthening Management of the Specialized Fishing of Yangtze Japanese Grenadier Anchovy and Tapertail Anchovy in 2016	Requirements for specialized fishing of Yangtze Japanese grenadier anchovy and tapertail anchovy.
2017	The 13th Five-Year Plan for Fisheries Development in Jiangsu Province	Development achievements during the 12th Five-Year Plan period, the development ideas, strategic objectives and main tasks for the 13th Five-Year Plan.
2018	Notice on Clarifying the Scope of the Main Stream Areas in the Yangtze River and Huaihe River Basins during the Closed Fishing Period	Related matters on defining the scope of the main stream areas in the Yangtze River and Huaihe River basins in Jiangsu Province during the closed fishing period.
2022	Plan for Aquaculture Waters and Mudflats in Jiangsu Province (2020–2030)	Utilization evaluation, functional zoning and safeguard measures of aquaculture waters and mudflats.
	The 14th Five-Year Plan for Fisheries Development in Jiangsu Province	The guiding ideology, strategic objectives and main tasks for the 14th Five-Year Plan.

Source: FFRC using data generated for this review.

Capture fisheries development in Taihu Lake

In 1953, Taihu Lake began to try the closed season system, and in 1967, Taihu Lake took the lead in promulgating the Implementing Rules for the Proliferation and Reproduction Protection of Aquatic Resources in Taihu Lake (Draft), which became the first comprehensive regulation dealing with the proliferation and reproduction protection of aquatic resources in China's inland lakes, clearly specifying the objects of protection, the closed season, the closed areas and the starting catch specifications.

In 1980, the Rules for the Propagation Protection of Aquatic Resources and Fishery Production Management in Taihu Lake (Draft) were further revised on this basis.

In 1984, the Fisheries Bureau of Jiangsu Province promulgated the Interim Regulations on the Half-Year Closure of Taihu Lake, after which the Fishery Management Committee of Taihu Lake adjusted the closure time every year according to the status of fishery resources. In 1985, the Management Rules for Fishing Licenses in Taihu Lake were formulated, which registered all types of fishing vessels and fishing gears used in the lake area and developed an associated database (Zhang Zhenzhen, 2019).

From 2007 to 2012, national aquatic germplasm reserves for silver fish, top mouth culter, Chinese white shrimp, Japanese marsh shrimp, Chinese mitten crab, bigmouth grenadier anchovy and Asian clam in Taihu Lake were established.

In 2019, the Ecological Fisheries Planning of Taihu Lake in Jiangsu Province was endorsed, and now there is a professional plan for the development of environmentally friendly fisheries in Taihu Lake.

In 2020, according to the Jiangsu Provincial Department of Agriculture and Rural Affairs Announcement (No. 12), fishing operations in Taihu Lake will be completely stopped from 1 October and more scientific planning will be made for the development of augmentation and environmentally friendly fisheries in Taihu Lake in the future.

Development objectives: In terms of long-term development, innovation or introduction of more advanced fisheries management concepts (Anderson, 1986), reasonable arrangements for the open and closed seasons, and the establishment of a more effective inland fisheries capture management system will be the focus for a considerable period of time in the future.

First, a fishing quota system should be introduced. Based on the principle that the amount of fishing is lower than the amount of resource growth, the total allowable catch of fisheries resources should be determined and fishing quotas system should be gradually implemented. There is a need to establish a sound system for surveying and evaluating fishery resources; develop a system for allocating fishing quotas and a system for supervising and managing them; allocate quota indicators in a fair, just and open manner; and explore effective mechanisms and ways of quota transfer.

There is also a need to promote alternative livelihoods for fishers. In accordance with the state's plan to control the number of vessels and nets and to reduce the number of vessels, China will accelerate the restructuring of the fisheries industry and motivate fishers to transfer to the aquaculture industry, the aquatic products processing and distribution industry, recreational fishery and so forth. Professional skills training will also be provided for fishers (Yang Jing, Liu Yulong and Li Xin, 2019).

Finally, efforts must be made to strengthen resource protection and ecological restoration. Affected by many factors, China's fishery resources are declining day by day. Therefore, it is necessary to restore fishery resources and aquatic ecological environments. The construction of aquatic conservation systems, such as aquatic nature reserves and aquatic germplasm resource reserves, creates a good foundation for fish production, breeding and feeding, and is conducive to restoring the ecological functions of key fishing grounds (Guo Yugang *et al.*, 2014).

Traditional fishing methods are gradually being withdrawn from large waterbody areas and the development of ecologically enhanced fisheries for resource conservation, in collective and other situations, may be the future direction for developing environmentally friendly fisheries in large waterbody areas in China.

4.2.2 Development planning for enhanced fishery

Enhanced fishery refers to the artificial release of larvae (or adults or eggs) of aquatic organisms such as fish, shrimp, shellfish and algae into natural waters to increase the population size and optimize the community structure of fishery resources in the waters, so as to increase fishery resources and maintain ecological balance (Li Muzi, Zeng Ya and Ren Tongjun, 2021).

The terms fishery resource enhancement, marine ranching and enhanced fishery are basically the same at home and abroad, and their common objectives are to increase biomass, restore resources and repair marine ecosystems (Tang Qisheng, 2019). From the perspective of inland fisheries, the development of enhanced fisheries in China has mainly taken the form of releasing larvae (summerlings and large fish fingerlings, of which the mortality rate of summerlings is high, while the survival rate of large fish fingerlings is above 85 percent).

Relevant planning documents: In 1950, the First National Fishery Conference was held in Beijing, and the state subsequently promulgated a series of relevant fishery regulations and

instructions. In 1957, the Ministry of Fisheries promulgated the Provisional Regulations on the Protection of Aquatic Resources Reproduction (Draft), and in 1958, the Ministry of Fisheries issued the Notice on the Collection of Parent Fish for Spawning and Hatching and Releasing during the Autumn and Winter Fishing Periods, implementing the policy of "taking fish from the local area and releasing them in the local area", and carrying out artificial hatching of carp and crucian carp in large numbers.

In 1964, the State Council approved the trial implementation of the Regulations on the Protection of Aquatic Resources and Reproduction (Draft) and carried out activities to increase the number of aquatic organisms, mainly green carp, grass carp, silver carp and bighead carp, and conducted corresponding research on fishery resources. In 1986, the Fisheries Law stipulated that the state should encourage and support relevant departments to take measures to increase fishery resources.

In 2006, the State Council issued the Outline of Action for the Conservation of Aquatic Life Resources in China, considering stock enhancement as one of the important measures for the conservation of living aquatic resources.

In 2009, the Management Regulations on Aquatic Stock Enhancement encouraged social funds to support the conservation of living aquatic resources and enhance stocks; in the same year, the General Office of the Ministry of Agriculture issued the Notice on the Preparation of Stock Enhancement Planning for Aquatic Life Resources, which promoted the overall enhancement of aquatic stocks.

In 2010, the Master Plan for National Aquatic Stock Enhancement (2011–2015) and the Technical Regulations for Aquatic Stock Enhancement were issued. They defined the guiding ideology, objectives and tasks, suitable species, suitable waters, regional layout and protection measures for aquatic stock enhancement, and promotion of the scientific, standardized and orderly development of aquatic stock enhancement in China.

From 2015 to 2019, the former MoA implemented the relevant requirements of the Outline of Action for the Conservation of Aquatic Life Resources in China and vigorously carried out activities on aquatic stock enhancement, resulting in good ecological, economic and social benefits. In 2016, the Ministry of Agriculture and Rural Affairs issued the Guidance on Aquatic Stock Enhancement During the 13th Five-Year Plan, which further emphasized the importance of stock enhancement and proposed the initial construction of aquatic stock enhancement systems with "distinctive regional characteristics, clear target positioning, scientific and reasonable layout, perfect assessment system, standardized and effective management, significant comprehensive benefits".

In 2020, the Yangtze River Office issued the Notice on Further Standardization of Aquatic Stock Enhancement in the Yangtze River Basin to coordinate the planning and layout of stock enhancement, guarantee the quality of seedlings, regulate release behaviour, conduct scientific monitoring and assessment, and supervise strict law enforcement and continuous improvement of the systemic, scientific and effective nature of stock enhancement.

In 2022, the Ministry of Agriculture and Rural Affairs issued the Guidance on Aquatic Stock Enhancement During the 14th Five-Year Plan, which further emphasized the importance of stock enhancement and proposed to gradually build the aquatic stock enhancement system with "distinct regional characteristics, clear target positioning, scientific and reasonable layout, as well as standardized and orderly management". Table 4.10 reviews stock enhancement planning documents.

TABLE 4.10. Planning documents on stock enhancement

Year	Planning documents
1957	Provisional Regulations on the Protection of Aquatic Resources Reproduction
1964	Regulations on the Protection of Aquatic Resources and Reproduction
2009	Management Regulations on Aquatic Stock Enhancement Notice on the Preparation of Stock Enhancement Planning for Aquatic Life Resource
2010	Master Plan for National Aquatic Stock Enhancement (2011–2015)
	Technical Regulations for Aquatic Stock Enhancement
2015	Notice on Stock Enhancement in 2015
2016	Guidance on Aquatic Stock Enhancement During the 13th Five-Year Plan Notice on Further Standardization of Aquatic Stock Enhancement
2017	Notice on Stock Enhancement in 2017
2018	Notice on Stock Enhancement in 2018
2019	Notice on Stock Enhancement in 2019
2020	Notice on Further Standardization of Aquatic Stock Enhancement in the Yangtze River Basin
2022	Guidance on Aquatic Stock Enhancement During the 14th Five-Year Plan

Source: FFRC using data generated for this review.

Problems faced by stock enhancement fisheries: After years of development, enhanced fisheries have succeeded in restoring fishery stock resources, improving waterbody ecologies, protecting biodiversity and endangered species, increasing fishery benefits and fishers' incomes, and enhancing national awareness of environmental resource protection. However, the following issues have been concomitant problems (Le Jiahua and Zhang Cheng, 2013; Luo Gang *et al.*, 2016):

- *Insufficient professional institutions for stock enhancement:* At present, there are not enough experimental stations for stock enhancement in China; many provinces and municipalities are managed by fishery departments, but no special stock enhancement stations are set up for key lakes and rivers. The same applies to breeding experimental stations which is not conducive to the implementation of stock enhancement and assessment of the effects.
- *Lack of means to assess the effects/impacts of stock enhancement:* During the development of fisheries enhancement, there has been a lack of comprehensive and in-depth research on the biodiversity and ecosystems of waterbodies. China has not yet found a standard method to evaluate the effect of aquatic stock enhancement due to the difficulty in distinguishing the released fish from the naturally reproducing fish, *inter alia* caused by the low and highly variable return rate of the marked released fish and the imperfect evaluation means.
- *The development orientation is not clear:* The current division of labour between national and provincial stock enhancement institutions and municipal and county aquatic technology departments in the production of fish, shrimp and shellfish fry, the housing of temporary facilities for fry and the intermediate cultivation and release of fry is unclear. In terms of fry breeding, national, provincial, municipal and county levels undertake and produce fry, but the identity of the main implementation body is unclear.
- *Insufficient mobilization efforts for stock enhancement activities:* Compared with other countries, China's stock enhancement activities started late and mobilization of the early stage of aquatic stock enhancement was inadequate. In particular, it was difficult to stimulate the enthusiasm and initiative of fishers and fishery cooperative organizations and the connections among industry, the academia and research were not close.

Development proposals

Accelerating the enhancement of the fishing industry is conducive to improving the sustainable development of the fishery economy, promoting the regeneration of fishery biological resources, adjusting the structure of the fishing industry, addressing labour problems in fishing areas, ensuring sustainable income for fishers and boosting the economic growth of fisheries. In order to better develop enhancement of the fishery sector, the following four approaches should be adopted initially:

Formulate reasonable stock enhancement planning

Planning for stock enhancement fishery is not only the basis for development, organization and resource management, but also the basis for the government to formulate fishery development policies. Before the implementation of stock enhancement, field surveys should be carried out to fully grasp the characteristics of the ecosystem of the waterbodies involved and the condition of wild populations, and to clarify in advance the expected effect of the implementation of stock enhancement. In view of the differences in morphology and physiology of different released species, other modes of management can be adopted and strict technical operating procedures for stock enhancement should be formulated, including quality control of released species, transportation tools and methods, markers and marking methods, and stock enhancement methods.

Improve the legal protection system

The generation of benefits from stock enhancement is a relatively long process, so the stability and continuity of the development of stock enhancement fisheries cannot be guaranteed without help from the legal system. Establishing and improving a legal guarantee system for stock enhancement fisheries could help them to achieve expected goals and effects. At the same time, the laws and regulations of stock enhancement should include performance assessment of fisheries management and introduction of incentive policies for fisheries personnel to address the problem of inadequate legal and regulatory controls on stock enhancement activities..

Strengthen supervision and management functions

As stock enhancement fishery is extensive and difficult to manage, it is necessary to strengthen the government's supervision and management role in the implementation process and gradually improve the management and coordination mechanism for the development of stock enhancement fisheries. Fishery administration departments should strengthen the supervision and management of stock enhancement activities. Staff should select waterbodies for stock enhancement as well applying scientific methods rigorously, and strictly abiding by the operation specifications of stock enhancement. While reducing the loss of seed resources, they should correctly guide stock enhancement practices and firmly promote and implement the concept of protecting aquatic organisms.

Build a scientific assessment system

The effect of stock enhancement is the core issue of resource enhancement and the starting point for planning and implementation of resource enhancement. This requires establishing an independent and distinct operational and evaluation system from that of the aquaculture industry. It also involves integrating evaluation of economic, social and ecological benefits, and conducting scientific and systematic analysis of regional stock protection, and improvement of fry quality. The benefits of investment and output will help stock enhancement fisheries to develop in a healthy and vigorous manner.

4.2.3 Recreational fisheries development planning

Recreational fisheries optimize the allocation of fishery resources to achieve integration of the various services they provide. China's recreational fisheries involve, *inter alia*, tourism-oriented recreational fisheries, leisure fishing, ornamental fish culture and ornamental fish adjuncts (aquariums, fish medications), fishing tackle and bait supply, and so forth. In recent years, the rapid development of recreational fishery has become important for the integrated development of the fisheries industry and green development. It has played an important role in promoting the rural revitalization strategy, driving employment and income for farmers and fishers, and meeting the aspirations of urban and rural residents.

Relevant planning documents: The State Council promulgated the Instruction on Relaxing Policies and Accelerating the Development of Aquatic Industry, and the Fisheries Law of the People's Republic of China which was implemented in 1986. Subsequently, fishery administrative departments and educational and scientific research institutions began to pay attention to the development of recreational fisheries.

In 1996, the 9th Five-Year Plan on National Economic and Social Development issued by the Central Committee of the Communist Party of China and the State Council proposed that the agriculture sector should encourage rural collectives and farmers to actively develop the use of non-agricultural land and resources and bring the development of recreational fisheries into the scope of industrial restructuring adjustment. This was the first declaration of policy incentives for the development of recreational fisheries.

In 2001, the 10th Five-Year Plan for National Agricultural and Rural Economic Development (2001–2005) proposed that "where conditions exist, actively develop technology- and capital-intensive factory farming and develop recreational fisheries". It was the first formal introduction of recreational fisheries. In May 2003, the State Council issued the Outline of the National Ocean Economic Development Plan, which explicitly "combines the enhancement of fishery resources with recreational fisheries, and actively develops different types of recreational fisheries".

In March 2006, the MoA issued the Opinions on Implementing the Central Government's Strategic Plan for Promoting New Socialist Countryside Construction, which also encouraged the development of the aquatic product processing industry and recreational fishery. In June of the same year, the MoA released the 11th Five-Year Plan for National Agricultural and Rural Economic Development, which explicitly guided and promoted the development of urban recreational fisheries in areas where suitable conditions existed.

In June 2011, the MoA issued the 12th Five-Year Plan for National Fisheries Development, which for the first time included recreational fisheries in the fisheries development plan and clearly listed it as one of the five major industries of modern fisheries in China. In 2012, the MoA launched the creation of recreational fishery demonstration bases. In December of the same year, the Guidance on Promoting the Sustainable and Healthy Development of Recreational Fisheries was issued, which for the first time made a special deployment for recreational fisheries. In the same month, the State Council issued the Notice on the 12th Five-Year Plan for the Service Industry Development, which called for the active development of recreational agriculture, ecological agriculture, recreational fishery, rural tourism and other services to increase the income of farmers and fishers.

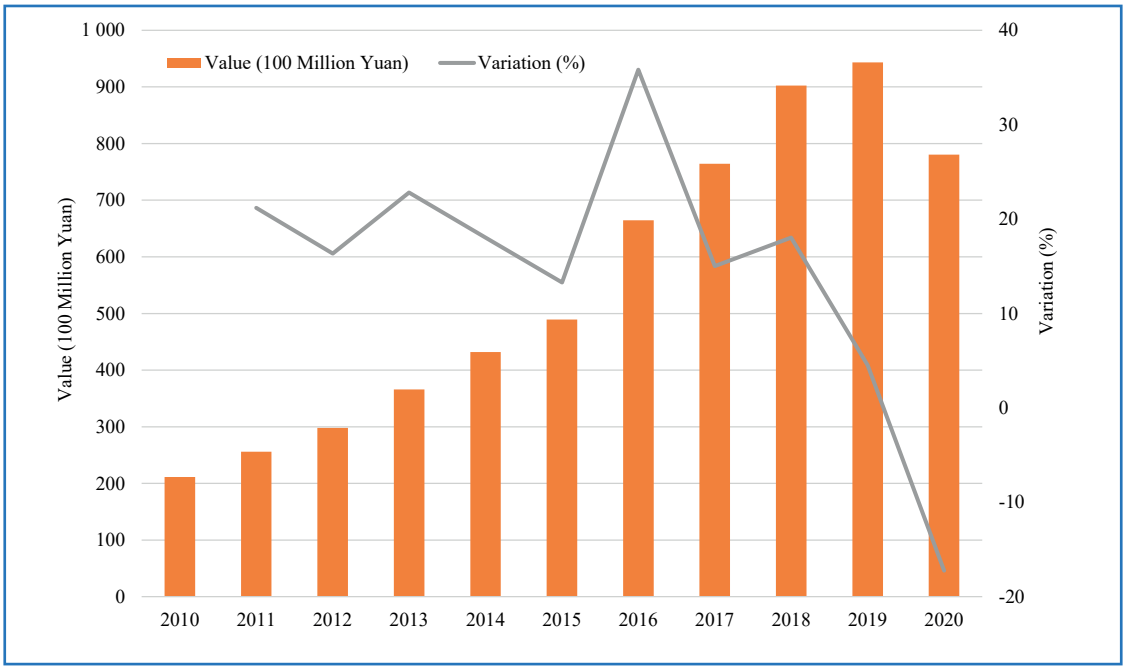
In May 2016, Guidance on Accelerating the Mode Transformation and Structure Adjustment of Fisheries proclaimed the need "to develop and improve the management methods and standards for leisure fisheries and carry out in-depth activities to create leisure fisheries demonstration bases". In October of the same year, the MoA held a national recreational

fishery field meeting in Xiamen, Fujian, which was the first national meeting on the theme of recreational fishery. It was held to further promote the development and standardization of recreational fishery management.

In 2017, the MoA organized and implemented the "four-one" project for brand cultivation of recreational fisheries. Structured and quantitative monitoring was carried out nationwide for the first time. Based on this, in 2018, the Ministry of Agriculture and Rural Affairs, the National General Fisheries Technology Promotion Station and the China Fisheries Society jointly released the China Recreational Fisheries Industry Development Report, which comprehensively summarized the history, current situation, problems and development ideas of China's recreational fishery development. Table 4.11 summarizes recreational fishery development over time.

As shown in Figure 4.3, the output value of China's recreational fisheries increased rapidly, and decreased in 2020 mainly due to the impact of the COVID-19 pandemic.

FIGURE 4.3. National recreational fishery output value and growth rate, 2011–2020



Source: National Fisheries Technology Extension Center & China Society of Fishery. 2021. *China recreational fishing development monitoring report.*

TABLE 4.11. Planning related to recreational fishery development

Year	Development planning
1996	The 9th Five-Year Plan on the National Economic and Social Development
2001	The 10th Five-Year Plan for National Agricultural and Rural Economic Development (2001–2005)
2003	Outline of the National Ocean Economic Development Plan
2006	Opinions on Implementing the Central Government's Strategic Plan for Promoting New Socialist Countryside Construction
	The 11th Five-Year Plan for National Agricultural and Rural Economic Development
2011	The 12th Five-Year Plan for National Fisheries Development
2012	Guidance on Promoting the Sustainable and Healthy Development of Recreational Fisheries
	Notice on the 12th Five-Year Plan for the Service Industry Development
2013	Guidance on Promoting the Sustainable and Healthy Development of Marine Fisheries
2016	Guidance on Accelerating the Mode Transformation and Structure Adjustment of Fisheries
2017	Notice on the Brand Cultivation of Recreational Fisheries
	Notice on Monitoring the Development of Recreational Fisheries
2022	The 14th Five-Year Plan for National Fisheries Development

Source: FFRC using data generated for this review.

Industry development: The development of recreational fishery depends on regional resource conditions. It is also directly influenced by the level of regional economic development, national consumption capacity and the policy environment for industrial development. With regard to the four aspects of economic, social, industrial and policy environment, China's recreational fishery is enjoying a period of major development opportunity, with a superior development environment and broad market space.

The economic level directly determines the ability to develop recreational fishery resources as well as the capacity to address the national demand for leisure tourism and consumption. In terms of economic growth, China's economic growth rate has remained at a high level, and the GDP is experiencing a positive growth trend, reflecting the resilience and good expectations of the economy. In addition, China's transportation and health systems, as well as other infrastructure, continue to grow and improve, providing convenient conditions for business entities to operate and residents to travel. With the continuous improvement of living standards, the proportion of developmental- and enjoyment-oriented consumption continues to increase.

Recreational fishery is a crossover industry based on fisheries, combining fisheries and tourism. With the growing demand of China's urban and rural residents for high-quality and safe aquatic products and aesthetic waterbody environments, China's fisheries are accelerating the transformation needed and upgrading to high-quality development. Thus the recreational fishery industry is being consolidated. At the same time, as fishery conservation continues to advance, the multifunctional development and utilization of industries such as large waterbody environmentally friendly fisheries and integrated rice and fishery farming will provide more powerful industrial support for the development of recreational fisheries.

Problems and recommendations: In recent years, China's recreational fishery has increasingly expanded its functions, constantly innovated its model and is showing a good development trend, but there are still some constraints and shortcomings.

The recreational fishery sector is not streamlined and coordination among the regional economies, fisheries industries, resources and environmental development is not adequate. There is poor linkage and even competition between the fishing industry and recreational services such as fishing, sightseeing, boating and catering.

Management and service levels need to be improved. The management mainstays are fishers and small farmers, but the development and management capacity of recreational fishery is insufficient, and the quality and level of tourism reception services is not high. Otherwise, externally, there are still problems related to inadequate planning and guidance, unregulated industry management and inadequate policy support.

In order to guide the development direction of recreational fisheries and promote their healthy and rapid development, there is a need to focus on the following points:

1. Based on regional economic and social development as well as tourism market demand, fisheries foundational and structural adjustment needs warrant attention. Scientific development planning should be formulated to guide convergence of capital, technology, talent and other resource factors for recreational fishery and related sectors such as tourism, transportation, culture and sports.
2. Strengthen standardized management. Improve the recreational fishery management system and standard system, develop standards for recreational fishery access, infrastructure construction, business services, hygiene and food safety in line with the actual development of the industry, and enhance the standardization and standardized development level of the industry. Practise self-regulation of social organizations such as industry associations and inculcate moderation among business entities.
3. Fully exploit the advantages of fisheries, culture and natural resource; promote the expansion of recreational fishery into multifunctional activities; cultivate a variety of recreational fishery development modes, such as recreational fishery parks and special fishing towns.
4. Improve the quality of service. Expedite the construction of public infrastructure in recreational fishery bases, fishing villages, wharves and other sites, improve the conditions of service facilities and enhance the convenience and comfort of tourists' trips. Strengthen the training of personnel, improve overall quality and service levels.
5. Establish the brand effect. Based on their own competitive advantages, localities polish their fishery cultures, constantly develop brand building and promotion of recreational fishery, and hold various cultural festivals related to recreational fishery.

4.3 OVERVIEW OF FISHERIES LAWS AND REGULATIONS

4.3.1 Relevant national regulations

Since the early 1950s, the State Council and the state fishery authorities have promulgated various fishery regulations and related circulars and instructions. The Fisheries Law of the People's Republic of China in 1986 marked the formation of China's fisheries management system and China's fisheries entered the era of comprehensive management. New China has formulated and promulgated nearly 1 000 national and local fisheries laws, regulations and rules, covering all aspects of fisheries production and fishing.

In addition to the laws and regulations on fisheries, there are other laws and regulations related to fisheries. For example, the Law of the People's Republic of China on the Protection of Wildlife and the Law of the People's Republic of China on the Prevention of Water Pollution are both related to fisheries. Parts of the Civil Law and Criminal Law related to fisheries are also sources of fisheries regulations as are other administrative regulations related to fisheries, such as the Regulations of the People's Republic of China on Nature Reserves. Then there are other departmental regulations in this context such as the Provisions on Administrative Punishment Procedures in Agriculture. All are important sources of juridical information regarding the fisheries sector (Table 4.12).

TABLE 4.12. Laws and regulations related to the protection of freshwater fisheries

Legal scope	Name	Grade	Date of issue	Themes
Basic laws for fisheries	Fisheries Law of the People's Republic of China	National	1986 (5th amendment in 2018)	The core fisheries law, the general framework for fisheries protection.
	Implementing Rules of Fisheries Law of the People's Republic of China	National	1987 (amended in 2020)	Specific supplements to the Fisheries Law.
Fisheries production and management	Management Measures for Aquatic Seeds	National	2001	Protection and rational use of aquatic germplasm resources, improvement of seed quality, etc.
	Code of Practice for Production of Original and Good Aquatic Seeds	National	2001	Strengthening the production management of aquatic seed farms and improving the quality and production of original seeds.
	Regulations on Administration of Fishing Licenses	National	2018 (amended in 2022)	Fishery management measures, indicating relevant fishing production requirements.
Conservation and rational use of fishery resources	Regulations of the People's Republic of China on the Protection of Aquatic Resources Reproduction	National	1979	Protection of aquatic resources.
	Measures for Collection and Use of Fishery Resources Reproduction and Protection Fees	National	1988	Enhance and protect fishery resources, and promote the sustainable, stable and healthy development of fisheries.
	Notice on Implementation of Spring Fishing Closure System in the Yangtze River Basin	Yangtze River Basin	2002	Conservation and rational use of aquatic resources of the Yangtze River.
	Outline of Action for the Conservation of Aquatic Life Resources in China	National	2006	Protection and rational use of aquatic biological resources, implementation of sustainable development strategies.
Aquatic wildlife protection	Regulations of the People's Republic of China on the Protection of Aquatic Wildlife	National	1993 (second amendment in 2013)	Protect aquatic wildlife.
	Regulations of the People's Republic of China on the Utilization of Aquatic Wildlife	National	1999	Protect, develop and reasonably utilize aquatic wildlife resources.
	Yangtze River Protection Law	National	2020	Strengthen the protection of resources in the Yangtze River Basin.
	Notice on Cracking Down on Illegal and Criminal Activities Destroying Wildlife Resources	National	2021	Further strengthen the work of combating illegal crimes against wildlife resources.
	Regulations on Protection of Aquatic Life in the Yangtze River	National	2022	Strengthen the protection and management of aquatic life in the Yangtze River.

Source: FFRC using data generated for this review.

4.3.2 Local regulatory documents

Local regulations are normative documents formulated and promulgated by:

- The People's Congresses and their standing committees of provinces, autonomous regions, municipalities directly under the central government.
- Cities where the provincial capitals are located.
- Cities that are the capitals of autonomous regions and larger cities approved by the State Council according to local needs and without contradicting the Constitution, laws and administrative regulations.

Local regulations on fisheries are an important basis for each locality to implement national laws and administrative regulations on fisheries, for example:

- The Measures for Implementation of the Fisheries Law of the People's Republic of China in Shandong Province.
- The Measures for Implementation of Fisheries Management in Guangdong Province.
- The Regulations on Management of Inland Fisheries in Shandong Province.
- The Regulations on Protection of Aquatic Resources Propagation in Heilongjiang Province.
- The Regulations on Protection of Aquaculture in Shanghai.
- The Regulations on Management of Fishing Vessels in Liaoning Province.

Other examples are given in Table 4.13.

TABLE 4.13. Relevant local documents on fisheries protection

Region	Documents	Year	Main content
Jiangsu	Regulations on Management of Fisheries in Jiangsu Province	2002	Protection, enhancement, development and utilization of fishery resources.
	Regulations on Management of Taihu Lake Basin	2011	Protection of water resources and prevention of water pollution in Taihu Lake Basin to improve the ecological environment.
	Notice on Implementation Plan for Comprehensively Promoting the Fishing Ban and Retreating Fishing in Yangtze River Basin in Jiangsu Province	2020	Comprehensively promote the fishing ban and recreational fishing in the Yangtze River Basin in Jiangsu Province.
	Regulations on Lake Protection in Jiangsu Province	2021	Strengthen the protection and rational use of lake resources, etc.
	Regulations on Protection of Hongze Lake in Jiangsu Province	2022	Strengthen the protection of Hongze Lake and promote the scientific use of resources, etc.
Anhui	Implementation Plan for Strengthening the Protection of Fishery Resources in Chaohu Lake	2020	Promote the ecological protection of Yangtze River, accelerate the restoration of fishery resources of Chaohu Lake, improve the ecological environment of Chaohu Lake, etc.
Hubei	Regulations on Lake Protection in Hubei Province	2012	Strengthen lake protection, protect and improve the ecological environment of lakes, and promote sustainable economic and social development.
Hunan	Regulations on Protection of Dongting Lake in Hunan Province	2021	Protect and improve the ecological environment of Dongting Lake, ensure sustainable economic and social development, etc.
Xizang	Measures for Implementation of the Fisheries Law of the People's Republic of China in Tibet Autonomous Region	2006	Strengthen the protection, proliferation and utilization of fishery resources, and promote the development of fishery production.
	Measures for Protection of Wild Fish in Lhasa City	2012	Promote the sustainable development of wild fish resources in Lhasa.
Jiangxi	Regulations on Protection of Poyang Lake in Jiangxi Province	2003	Protect wetland resources of Poyang Lake, maintain ecological functions and biodiversity of wetlands, etc.
Inner Mongolia	Regulations on Hulun Lake National Nature Reserve in Inner Mongolia Autonomous Region	2016	Strengthen the protection and management of Hulun Lake National Nature Reserve.

Source: FFRC using data generated for this review.

4.4 OVERVIEW OF INTERNATIONAL TREATIES ON FISHERIES

4.4.1 International conventions and agreements relevant to inland fisheries and their management

With the strengthening of international cooperation in the twenty-first century, exchanges between different countries have gradually increased, and cooperation on the conservation of endangered aquatic organisms and the conservation and utilization of fishery resources is increasing (Table 4.14).

TABLE 4.14. International conventions and agreements relevant to inland fisheries

Name	Theme	Countries	Date
International conventions			
Ramsar Convention on Wetlands	Protection of wetland resources. Since all inland fish, and fisheries, depend on wetlands, all implementation of the Ramsar Convention concerning inland wetlands is highly relevant to, and contributes to, the maintenance of inland fisheries		1971
Convention on International Trade of Endangered Species of Wild Flora and Fauna (CITES)	Regulate, not completely ban, international trade in wild species. Some species of inland fish are endangered by international trade, including some species in the ornamental trade. There are more threats through trade in endangered inland fish species at the national level, but this is not covered by CITES.		1973
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	The CMS mandate covers the conservation of all taxa of species which are regarded as migratory, under a geopolitical definition of "migratory" species which habitually cross national boundaries on a regular and predictable basis.		1979
UN Convention on Biological Diversity (CBD)	Conservation of biodiversity, sustainable use of biological resources, and fair and equitable sharing of benefits arising from the use of genetic resources.		1992
United Nations Framework Convention on Climate Change	Stabilization of greenhouse gas concentrations in the atmosphere that are dangerous influences on the global climate system. The Intergovernmental Panel on Climate Change has repeatedly reported in its assessment reports that various inland wetland ecosystems are particularly vulnerable to, and are being affected by, climate change. The importance of the role of such wetlands in mitigating and adapting to climate change has received far less attention than that of forests. Many of the impacts of climate change will be, and are being, felt through alterations to the global water cycle, and thus undoubtedly an issue for inland fisheries.		1994
UN Convention on the Law of the Non-navigational Uses of International Watercourses	Adopted by the UN General Assembly in 1997 and entered into force in 2014. The Convention's main focus is on water itself, however, the Convention text contains several articles relating to environmental protection, including the general obligation to protect and preserve the ecosystems of international watercourses		1997
Nagoya Protocol on Access and Benefit Sharing	Access and Benefit Sharing is relevant to inland capture fisheries largely with respect to wild relatives as genetic resources for species of potential use in aquaculture.		2010
The Aichi Biodiversity Targets	Range of targets up to 2020 that are relevant to ecosystems and habitats that support inland fisheries and aquatic biodiversity. Will be superseded by the Kunming-Montreal Global Biodiversity Framework (GBF) which is in process.		2010
The 2030 Agenda for Sustainable Development and Sustainable Development Goals (SDGs)	The explicit role of inland fisheries is poorly represented in the 17 goals of the SDGs, although many of the goals are relevant to water and ecosystems all have relevant		2015
Non-binding agreements			
FAO Code of Conduct for Responsible Fisheries	Overarching guide to responsible fisheries. Countries engaged in fishing, breeding, processing, shipping and marketing, international trade and fisheries scientific research activities, should assume their responsibility for the requirements of the guidelines.		1995
FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication	The principles in the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) address policies, strategies and legal frameworks concerning small-scale fisheries, but also other matters affecting lives and livelihood in fishing communities. They have a clear human rights-based approach, and they put people, rather than fish, in focus.		2014
FAO Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests	Relevant to the rights to access inland fisheries resources, and protection of those resources from impacts generated by other activities.		2019
Agreements between China and other countries			
Name	**Theme**	**Countries**	**Date**
Protocol between the Government of the People's Republic of China and the Government of the Russian Federation on Cooperation in the Conservation, Adjustment and Enhancement of Fishery Resources in the Border Waters of the Heilongjiang and Ussuri Rivers	Rational use of fishery resources of the Heilongjiang and Ussuri rivers.	China, Russian Federation	1994
Lancang–Mekong River Fisheries Resources Conservation Cooperation Framework Agreement	Intercommunication of information, joint law enforcement, and stocking	China–Lao PDR	2015
Five-Year Action Plan for Lancang–Mekong Cooperation (2018–2022)	Promoting the economic and social development of countries along the Mekong coast	China, Myanmar, Lao PDR, Thailand, Cambodia, Viet Nam	2018
Joint Statement on Strengthening Cooperation on Sustainable Development in Lancang–Mekong Countries	Strengthening good relations and practical cooperation among six countries	China, Myanmar, Lao PDR, Thailand, Cambodia, Viet Nam	2021

Source: FFRC using data generated for this review.

4.4.2 Regional cooperation in the Lancang–Mekong

The Lancang River originates in the northeastern part of the Tanggula Mountains in Qinghai Province, China, and flows through China, TAR and Yunnan Province. It is known as the Mekong River after leaving China's borders and is the largest international river in Southeast Asia. The Lancang River runs through the Hengduan Mountains and has a complex and diverse geomorphological system, and the different types of landforms, as well as the height of the terrain, the size of the slope and the direction of the mountains and rivers, directly affect the redistribution of water and heat conditions (Yang Fan, 2012).

The Lancang–Mekong River is one of three rivers with the highest freshwater biodiversity in the world. It is estimated to have at least 890 species of freshwater fishes, second only to the Amazon River (Liu Mingdian *et al.*, 2011). The publications *Fishes of Yunnan Province*, *Zoology of China* and *Fishes and fish resources in Xizang, China* describe 11 species of fishes recorded in the source of the Lancang River, 22 species in the upstream, 44 species in the midstream, 142 species in the downstream and 9 species in the affiliated Erhai Lake (Chu Xinluo and Chen Yinrui, 1990). Altogether, more than 200 species, among which 13 species are listed as protected in the *China red data book of endangered animals – fish*, including the national protected fishes *Gyrinocheilus aymonieri*, *Zacco taliensis*, *Pangasius sanitwongsei* and *Anguilla marmorata*.

The Lancang–Mekong River Basin supports one of the most important inland fisheries rivers in the world and its fish resources are extensively exploited in the Lower Mekong Basin (FAO, 2018). Coupled with the negative impacts of large-scale hydropower development, invasion of exotic species and environmental pollution of the waters, the entire basin has shown a significant decline in both fish species and population sizes. Due to the transboundary migratory habits of fish, the effectiveness of conservation measures by a single country is extremely limited, therefore, exploring resource conservation measures at the watershed scale is an important tool for transboundary river diversity conservation.

Establishment of the Lancang–Mekong cooperation mechanism: In November 2014, Premier Li Keqiang proposed the establishment of the Lancang–Mekong cooperation mechanism at the 17th China–ASEAN Leaders' Meeting. Cooperation has been reached in the fields of planning and construction of aquatic habitats, joint resource surveys, ecological restoration of waters, research on breeding techniques, development of conservation policies and measures, joint training, monitoring of resources and the environment, stock enhancement, information sharing and joint law enforcement. In March 2016, further exchanges were held with the fisheries departments of Viet Nam, Lao PDR and Cambodia to reach a consensus on cooperation on joint fisheries law enforcement, cross-border training and protection of rare and endangered aquatic organisms unique to the Mekong River. In 2017, China and Cambodia signed the Memorandum on Cooperation on the Conservation of Aquatic Biological Resources of the Lancang–Mekong River. On 10 January 2018, the Second Leaders' Meeting on Lancang–Mekong Cooperation was held in Phnom Penh, Cambodia, which formulated the Five-Year Plan of Action on Lancang–Mekong Cooperation (2018–2022), specifying related aquatic biological resource cooperation. On 24 August 2020, the Third Leaders' Meeting of the Lancang–Mekong Cooperation was held via videoconference to propose further deepening of cooperation, and on 4 July 2022, the Seventh Foreign Ministers' Meeting of the Lancang–Mekong Cooperation was held to adopt the Five-Year Plan of Action on Lancang–Mekong Cooperation (2023–2027).

The Lancang–Mekong cooperation mechanism will be further improved and on the basis of the comprehensive fishing ban on the Lancang River in China, further studies will be conducted on a fishing ban in transboundary waters to ensure the uniformity of basin-wide measures, which will be more meaningful for the protection of fish resources.

Joint stock enhancement and law enforcement activities: In June 2015, the agricultural department of Xishuangbanna Prefecture signed a framework agreement with Lao PDR Luang Namtha Province on cooperation in the conservation of fishery resources on the Lancang–Mekong River. This included information sharing, joint law enforcement and stock enhancement (indigenous fishes such as *Hemibagrus wyckioides*, *Hypsibarbus vernayi*, *Hampala macrolepidota* and *Gyrinocheilus aymonieri*) between China and Lao PDR. Since the signing of the agreement, Xishuangbanna Prefecture and the Department of Natural Resources and Environment of Luang Namtha Province have jointly held a fish release festival every year, presenting a total of 275 000 indigenous fish fry to each other for stock enhancement. The data from the evaluation of the effect of the stock enhancement show that the catches of Lao people in the Mekong River Basin have increased by 30 percent to 40 percent since the conservation of the cross-border fishery resources of the Lancang–Mekong River was carried out by China and Lao PDR.

On 26 October 2021, the Yangtze River Basin Fisheries Administration and Supervision Office of the Ministry of Agriculture and Rural Affairs, together with the Freshwater Fisheries Research Center of the Chinese Academy of Fisheries Sciences, the Department of Agriculture and Rural Affairs of Yunnan Province, the People's Government of Xishuangbanna Prefecture and the Department of Natural Resources and Environment of Luang Namtha Province, Lao PDR, jointly conducted the 2021 Lancang River-Mekong River China–Lao PDR Synchronous Stock Enhancement and Joint Law Enforcement Activities.

The event was the seventh consecutive year that China and Lao PDR had jointly conducted fisheries law enforcement and aquatic stock enhancement activities in the waters of the Lancang–Mekong River, with a total of 254 000 fish fry released and 20 sets of electric fishing devices and nearly 100 nets seized in the border waters and subsequently destroyed. Over the years, China and Lao PDR have deepened their law enforcement cooperation and the ecological protection of the waters of the Lancang–Mekong River, especially the protection of aquatic biological resources, has become an important task of cooperation between the two countries and has achieved positive results.

International exchange cooperation and training: In November 2018, the Lancang–Mekong River Basin Biological Resources Conservation Sub-Forum of the Yangtze River Biological Resources Conservation Forum was held in Wuhan, China. From 2020 to 2022, personnel from the Freshwater Fisheries Research Center of the Chinese Academy of Fisheries Sciences went to the Lancang River to investigate the feasibility of a comprehensive fishing ban and take the lead in making a greater contribution to fish conservation in the Lancang River Basin.

5. Conclusion

China's has been the world's largest producer of fish from inland fisheries since 1989. The country´s reported production from inland capture fisheries (1 457 500 tonnes in 2020) constitutes 12.7 percent of global inland capture fishery production.

Sustainable inland capture fishery production is of great significance to the regulation of aquatic biodiversity, appropriate utilization of water resources and human health with Fisheries resources are renewable, but their utilization must be commensurate with their regenerative capacity in order to be sustainable. Inland capture fisheries in China are facing a range of pressures such as overfishing, water pollution, hydraulic engineering for agriculture, cities, industry, and navigation. These all result in changes to fish habitats and have led to a downward trend in inland fishery resources. With the emergence of China's ecological society and the requirements of modern fishery development in recent years, inland capture fishery output has gradually decreased, and development goals relating to economic and food provision, biodiversity and ecological integrity are being adjusted.

China has generated statistics on inland capture output since 1950. The implementation of the comprehensive fishing ban in the Yangtze River Basin in 2020 resulted in significant decrease in inland capture fishery landings in 2020, but national production was still reported to have reached 1.5 million tonnes. A challenge to the widespread implementation of China's fishing ban system has been difficulties in compiling reliable statistics on inland fisheries, which urgently need to be based on a more scientifically reliable approach. As inland capture fisheries are still of great significance to food security and nutrition, aquatic ecosystems and biodiversity, it is necessary to improve the understanding of the inland fishery resources of China and strengthen the collection and collation of inland fishery data at the provincial level in China.

More importantly, as inland fishery output is the product of the aquatic ecosystem, it is necessary to improve the understanding of the current situation and develop a strategy for the sustainable development and management of the inland fisheries of the country.

A better understanding is an essential basis for appropriate fishery management measures to make inland fisheries consistent with ecosystem protection and contribute to the achievement of conservation and sustainable use of the considerable inland living aquatic resources of China.

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