



Exploring the management policy of distant water fisheries in China: Evolution, challenges and prospects

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ABSTRACT

China's distant water fisheries management policy has made significant contributions to the development of distant water fisheries since 1985. Analyzing the evolution of China's distant water fisheries management policy is conducive to solving China's frequent IUU problems and promoting further development of sustainable fisheries. This paper first summarizes how China's distant water fisheries management policy has evolved, which can be divided into four stages: the start-up period (1985–1990), the rapid development period (1991–1997), the sustainable development period (1998–2007), and the optimization and adjustment period (2008–present). Then the characteristics of current distant water fisheries management are summarized, including how management has adapted to international rules, emphasize sustainable fisheries, diversification and facilitation of management methods. China's distant water fisheries management policy still faces severe challenges in terms of technology, marine rights, management system, industrial structure, and employee capabilities. Finally, this paper highlights the importance of attaching importance to science and technology, re-evaluating distant water fisheries subsidies based on environmental policies and IUU activities, establishing a polycentric governance mechanism with stakeholders at the core, improving the supervision system, and establishing overseas distant water fisheries bases to strengthen international cooperation.

1. Introduction

China has been the world's largest fishing country since 1990, which is mainly due to overexploitation of offshore fishery resources (Xue, 2006; Yang et al., 2016). In recent years, the depletion of offshore fishery resources and the deterioration of the marine environment caused by overfishing have severely restricted the development of China's fisheries (Zhao and Shen, 2016; Ding et al., 2020; Kang et al., 2018). Therefore, the development of distant water fisheries and aquaculture has become an important way to reduce the pressure of overfishing in China (Liu et al., 2014). In addition, as a strategic industry, distant water fisheries are of great significance for meeting the domestic demand for high-quality aquatic products, ensuring food security, increasing fishermen's income, and promoting the development of the fishery economy (Mallory, 2013; Zhang et al., 2019; Yue et al., 2016).

About 90 % of the world's fish stocks have been over exploited or are fully developed, but there is still potentials for distant water fisheries resources, especially small pelagic fish, cephalopods and Antarctic krill

(FAO, 2016; Ministry of Agriculture and Rural Affairs of the People's Republic of China, 2012). Although the industrial fishing of Antarctic krill is controversial, the Chinese government regards the harvesting of Antarctic krill as one of its important strategies for distant water fisheries (Schiermeier, 2010; Tang and Shi, 2010; Nicol and Foster, 2016). Accurate resource assessment, effective catch control and sound fishery management are essential for sustainable fisheries (Nicol et al., 2012). In 2019, China had 170 distant water fisheries enterprises, operating 2654 distant water fishing vessels, and the output of distant water fisheries was 2.257 million tons. The scale and total output of the fishing fleet were among the highest in the world. China has become an important distant water fishing nation (DWFN) (Chesnokova and McWhinnie, 2019). In 2017, among the seven principal tuna species¹ in the world, the fraction of the stocks at biologically sustainable levels was 66.6 percent, which has increased by ten percent compared with 2015. It proves that fisheries management is effective (FAO, 2020). If China's distant water fisheries can achieve reasonable management, it will make a significant contribution to the world's marine fisheries.

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¹ Seven principal tuna species: albacore (*Thunnus alalunga*), bigeye (*Thunnus obesus*), skipjack (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and three species of bluefin tuna (*Thunnus thynnus*, *Thunnus maccoyii* and *Thunnus orientalis*).

The protection of the marine ecological environment, the sustainable use of marine fishery resources, and the establishment of a fishery management system have become international consensus (Tickler et al., 2018; Danielsen and Agnarsson, 2018; Zou and Huntington, 2018). China's distant water fisheries management involves the development, production, processing, sales, and trade of fishery resources, and needs to consider both domestic and international fields (Ministry of Agriculture and Rural Affairs of the People's Republic of China, 2017). Since 1985, China has continuously improved its management policies for distant water fisheries, which has promoted the rapid development of them (Huang and He, 2019). However, under the background of increasingly strict management measures of regional fisheries management organizations (RFMOs) and frequent occurrence of IUU activities, the shortcomings of China's ocean-going fishery management policies are being gradually exposed (Okafor-Yarwood and Belhabib, 2020; Miller and Sumaila, 2014; Ma et al., 2018). According to Stimson Centre statistics, China accounted for nearly 60 % of the global IUU activity from 2015 to 2017². In the future, China's ocean-going fisheries management will still face huge challenges.

This paper reviews the development of China's distant water fisheries and explains the evolution of ocean-going fishery management policies. In addition, it discusses the challenges faced by China's distant water fisheries management policies in terms of technology, marine rights, management systems, industrial structure, and employee capabilities. Finally, this paper determines the prospects of China's distant water fisheries management policy in terms of attaching importance to science and technology, optimizing subsidies, stakeholder participation in decision-making, improving the supervision system, and strengthening international cooperation.

2. Evolution of China's distant water fisheries and management policy

2.1. Start-up period (1985–1990)

On March 10, 1985, China's first distant water fleet consisting of 12 production fishing vessels and a refrigerated transport vessel sailed to West Africa, which marked the official start of China distant water fisheries. Subsequently, China launched fisheries cooperation with Guinea-Bissau, Senegal, Sierra Leone and other countries. On July 23, 1985, China and the United States signed the "Sino-US Fishery Agreement" in Washington. According to the agreement, Chinese fishing vessels could fish in US waters (China Distant Water Fisheries Association, 2015). Subsequently, Shanghai, Dalian, and Yantai Marine Fisheries Company arrived in Alaska, USA, to carry out fishing operations. This signified that China's distant water fishing was fully emerging (Chen and Dai, 2019). During this period, China's distant water fisheries were dominated by exclusive economic zone (EEZ) fisheries, and the fishing method was dominated by trawling. The government's main task was to establish fishery cooperative relations with DWFNs. As of 1990, China has established cooperative relations with 21 countries or regions. In general, considering the 1982 United Nations Convention on the Law of the Sea (UNCLOS) that stipulated the principle of freedom of fishing on the high seas and the fact that China's distant water fishery was in its infancy, China has not formed a standardized and strict distant water fishery management system. China only explored the development and management of distant water fisheries under the constraints of domestic fishery laws and UNCLOS (Table 1).

² Data source: Stimson Centre, 2019. Shining a Light: The Need for Transparency across Distant Water Fishing. Available at: <https://www.stimson.org/2019/shining-light-need-transparency-across-distant-water-fishing/>

Table 1

The main events of distant water fisheries management policy in China (1985–1990).

Time	Event	Role
1985	Instructions on Relaxing Policies and Accelerating the Development of Aquaculture	Determining the direction of developing distant water fisheries
1985	<i>China-US Fishery Agreement</i>	Chinese fishing boats can go to the United States for fishing production
1986	Distant water fisheries company of China National Fisheries Corporation (CNFC) was established	Setting up Chinese distant water fisheries fleet
1987	<i>Report on further development of China's distant water fishery</i>	Guiding the development of distant water fisheries
1988	The first national conference on cooperation in distant water fisheries	Discussing ideas and measures for further development of distant water fisheries
1988	<i>Agreement on Fisheries Cooperation between the Government of the People's Republic of China and the Government of the Union of Soviet Socialist Republics</i>	Establishing fishery cooperation relationship
1990	Distant Water Fisheries Training Center of the Ministry of Agriculture was established	Training distant water fisheries practitioners

2.2. Rapid development period (1991–1997)

China's distant water fisheries have accumulated experience and formed a good foundation for development during the start-up period. Since 1991, China's distant water fishery has entered a period of rapid development, and the output of distant water fishery has increased from 323,500 tons in 1991 to 1.037 million tons in 1997 (Fig. 1). During this period, the Chinese government issued a series of policies to accelerate the development of distant water fisheries and improve their management. Specifically, the government vigorously developed distant water fisheries by encouraging technological progress, crew training, distant water subsidies, enterprise qualification reviews, and actively participating in international distant water fishery management. China joined the International Convention for the Conservation of Atlantic Tunas (ICCAT) in 1996, which was an important milestone for China to join RFMOs and participate in international distant water fisheries management actively. In general, China's distant water fisheries have achieved rapid development and the industry scale has gradually expanded. This period is a critical period for China to explore and adapt to international distant water fishery management (Table 2).

2.3. Sustainable development period (1998–2007)

Since the 1950s, fishery resources have been gradually exhausted around the world, and China began to face serious depletion of fishery resources in the 1990s. The government recognized the importance of sustainable fisheries and issued a series of policies to promote the healthy and sustainable development of China's distant water fisheries. For example, the Chinese government proposed to implement "zero growth" in the planned output of marine fishing in 1999. The Ministry of Agriculture proposed a control system for marine fishing vessels in 2003 and achieved good results (Fig. 2). In the international field, China had begun to join international fisheries organizations more widely, participate in international ocean fisheries management and respond to the world's sustainable fishery issues more actively. In addition, China issued the "Master Plan for the Development of China's Distant Water Fisheries (2001–2010)" in 2001 to stabilize EEZ fisheries and prioritize the development of high seas fisheries, which meant that the focus of China's distant water fisheries began to shift to the high seas. During this period, the management of high seas fisheries mainly included: 1) Catch control - through a fishing license system, a summer moratorium of

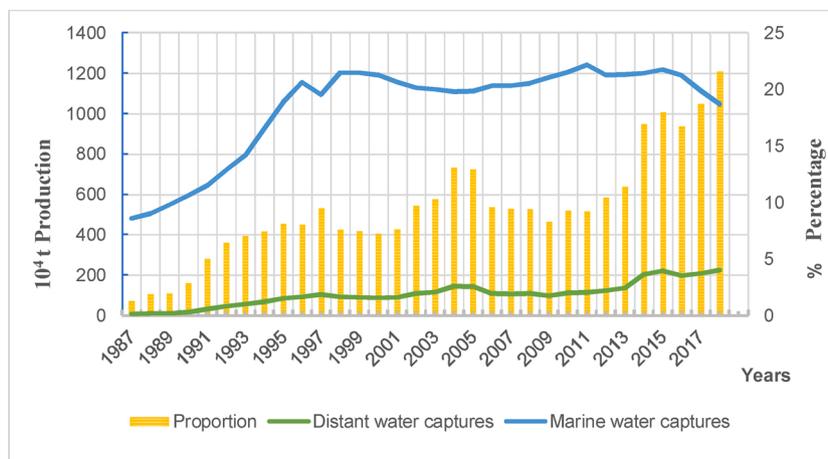


Fig. 1. Distant water fisheries production in mainland China during the 1987–2018 period. Source: China Fishery Statistical Yearbook.

Table 2

The main events of distant water fisheries management policy in China (1991–1997).

Time	Event	Role
1991	Notice on Strengthening Overseas Training of Distant Water Fisheries Crew	Strengthening crew training abroad
1991	The distant water fisheries implement the enterprise qualification review system	Implementing the preferential policies granted by the state to distant water fisheries
1994	Outline of China's Agricultural Development in the 1990s	Actively develop distant water fisheries and attach importance to the processing and comprehensive utilization of aquatic products
1994	Distant Water Fisheries Development Research Center of the Ministry of Agriculture was established	Guiding the development of distant water fisheries
1995	Notice on Strengthening the Import Management of Self-catching Aquatic Products and Fishing Raw Materials for Distant Water Fisheries Enterprises	Strengthening the supervision and management of duty-free aquatic products
1995	Agreement on Fisheries Cooperation between the People's Republic of China and the Government of the Republic of the Marshall Islands	Establishing fishery cooperation relationship
1995	Summary of Sino-Russian Talks on Chinese Fishing Boats Fishing in the High Seas of Okhotsk	Chinese fishing boat officially entered Russia's EEZ
1996	China joined The International Convention for the Conservation of Atlantic Tunas	China becomes a member of the International Commission for the Conservation of Atlantic Tunas (ICCAT)
1997	Notice of the Ministry of Agriculture on Further Accelerating the Development of Fisheries	Accelerating international fishery trade and technical cooperation

marine fishing, fishing gear and fish law control system, a total allowable catch (TAC) system, single ship catch control systems and other relevant systems, overfishing could be relatively contained (Shen and Heino, 2014). 2) Fishery science database – establish fishery archives for DWFNs so that international organizations and countries could monitor and report distant water fishing vessels and fishery resources, thereby promoting the sustainable development of distant water fisheries (Xue, 2006; Yang et al., 2016). 3) Observer system - by dispatching a certain percentage of observers to fishing vessels, it was possible to monitor the standard operations of distant water fishing vessels effectively (Shen and Huang, 2020). 4) IUU fishing - the RFMOs and countries were engaged in combating IUU activities by formulating IUU laws. Domestically, the

Chinese government promulgated the "Regulations for the Management of Ocean Fisheries" in 2003 (Shen and Huang, 2020). The government has put forward clear and detailed requirements on the application and approval of distant water fisheries projects, enterprise qualification and project confirmation, as well as ship and crew management and supervision. It was worth noting that the document stipulated that distant water fisheries vessels and crew must pass the technical inspection or qualification examination to obtain relevant qualification certificates. This management measure played a key role in promoting the development of China's distant water fisheries and reducing the risks of distant water safety. In general, during this period, the management of international distant water fisheries became stricter and China began to form a domestically regulated distant water fisheries management system (Table 3).

2.4. Optimization and adjustment period (2008–present)

With the expansion of fishing scale in the high seas as well as the increase of international political conflicts, ocean fishing conflicts³ between China and other countries occur frequently. On the one hand, under the background of continuous conflicts between China and Russia, Japan, South Korea and other fishery resources during this period, the Chinese government issued a series of documents and formulated measures to strengthen the safety of distant water fisheries production. On the other hand, China's distant water fisheries enterprises have the characteristics of large number, small scale⁴, weak ability to resist risks, and insufficient management level, which makes it difficult for the distant water fisheries industry to transform and upgrade. In order to adapt to the development situation of international distant water fisheries, strengthen the sustainable utilization of fishery resources and improve the supervision and management of distant water fisheries, the government began to implement the newly revised *Regulations on the Management of Distant Water Fisheries* in April 2020. This document has four main characteristics: 1) integrates with international management rules, 2) strengthens foreign-related safety management, 3) increases

³ For example, on November 14, 2008, the fishing boat "Tianyu 8" owned by Tianjin Distant Water Fishery Company was hijacked by Somali pirates while fishing along the coast of Kenya. On March 28, 2016, the fishing boat "Yuyan 010" affiliated to Yantai Distant Water Fishery Company was suspected of illegal fishing in the waters of Argentina and was sunk by the Argentine Coast Guard.

⁴ By 2020, there are 2239 distant water fishery enterprises in China, of which 68.6% have registered capital less than 5 million yuan (About \$754,000 at the exchange rate of 1: 6.287 between the US dollar and the yuan). Data source: <https://www.tianyancha.com/?jsid=SEM-BAIDU-PZ0824-SY-000001>

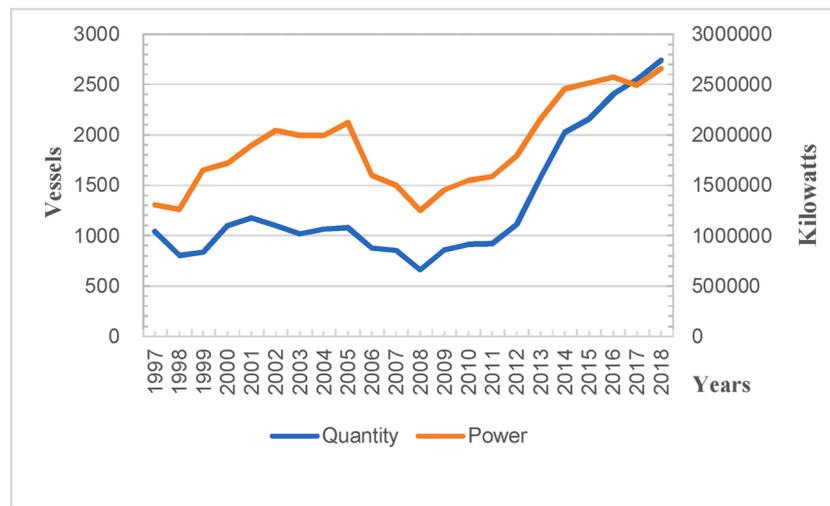


Fig. 2. Distant water vessels in mainland China during the 1997–2018 period. Source: China Fishery Statistical Yearbook

Table 3
The main events of distant water fisheries management policy in China (1998–2007).

Time	Event	Role
1998	<i>China-Yemen Intergovernmental Fishery Cooperation Agreement</i>	Establishing fishery cooperation relationship
1998	<i>Regulations on the Management of Qualifications of Distant Water Fisheries Enterprises</i>	Strengthening management of distant water fisheries enterprises
1998	<i>China joined Agreement for the Establishment of the Indian Ocean Tuna Commission</i>	China becomes a member of the Indian Ocean Tuna Commission (IOTC)
2000	<i>Temporary Administrative Measures for the Non-Taxation of the Returning of Self-caught Aquatic Products by Distant Water Fisheries Enterprises</i>	Self-catching aquatic products are exempt from customs duties
2001	<i>Interim Provisions on the Management of Foreign Exchange Revenue and Expenditure of Distant Water Fisheries Enterprises</i>	Standardizing the foreign exchange management of distant water fisheries
2001	<i>Master Plan for the Development of China's Ocean Fisheries (2001–2010)</i>	Clarifying the guiding ideology, development priorities, development goals and safeguards for the development of distant water fisheries from 2001 to 2010
2003	<i>Regulations on Management of Distant Water Fisheries</i>	Detailed and rigorous elaboration of distant water fisheries management
2006	<i>China joined The Convention for The Conservation of Antarctic Marine Living Resources</i>	China becomes a member of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)
2007	<i>Notice on Strengthening the Supervision and Administration of Fishing Vessels Working Overseas</i>	Strengthening the supervision and management of fishing vessels

the penalties for violations, and 4) simplifies management procedures. At present, the government has taken effective monitoring measures, such as production status reports, standardized fishing logs, monitoring of fishing vessel positions, dispatch of national observers, issuance of legal fishing certificates, performance assessment systems, and "black-list" systems for distant water fisheries.

In addition to strengthening production safety, another important goal of China's distant water fisheries management during this period is to accelerate the transformation and upgrading of distant water fisheries. The government formulates measures from four main aspects: controlling the scale of distant water fishing vessels rationally, optimizing the layout of the distant water fisheries industry, accelerating the

construction of the distant water fisheries industrial chain, and enhancing the level of distant water fisheries equipment and technology. In 2017, the government proposed a fishing boat input and output control system and a total fishery resource management system. The short-term goals of the systems are to cut down 20,000 marine fishing motor vessels by 2020 and control the total output of marine fishing below 10 million tons. In general, the management of China's distant water fisheries exhibited different evolutionary characteristics during the four periods, and the management system has been gradually improved (Fig. 3; Table 4).

3. Challenges of the development and management policy of China's distant water fisheries

3.1. Restriction of equipment and technology

In general, the distant water fleet is composed of large-scale processing mother ships, fishing sub-ships, bunkering ships, and transport ships with high automation and strong endurance (Liu et al., 2020). This kind of fleet with refrigeration, processing, supply and other functions poses extremely high requirements on the equipment and technology. Moreover, the competitive fishing and fishing-aid equipment can improve production efficiency effectively and reduce production safety risks. As of the end of 2019, the number of large marine fishing vessels longer than 24 m in China only accounted for 5% of the total domestic marine fishing vessels. Due to the high cost of fishing boats, Chinese fishermen are more willing to use old boats to increase the time and frequency of sea trips. Therefore, it is a slow process for Chinese fishing boats to replace old fishing boats, and the distant water fisheries still mainly use old fishing boats (Liu, 2010). These fishing boats have low production efficiency with insufficient mechanization and automation⁵, and China's distant water fisheries management become more difficult due to the obsolescence and poor security of the boats. To make matters worse, China's unsystematic management measures for distant water fishing vessels have led to a long-term negative state of fishing vessel inspection, which has caused the occurrence of illegal fishing incidents.

In addition, China has insufficient capacity in the research and development of auxiliary equipment and processing vessels, resulting in great dependency on imported equipment. The low starting point of

⁵ For example, most of the distant water fishing boats represented by the "8154" trawlers were built in the 1990s, with poor navigation, communication and insufficient endurance.

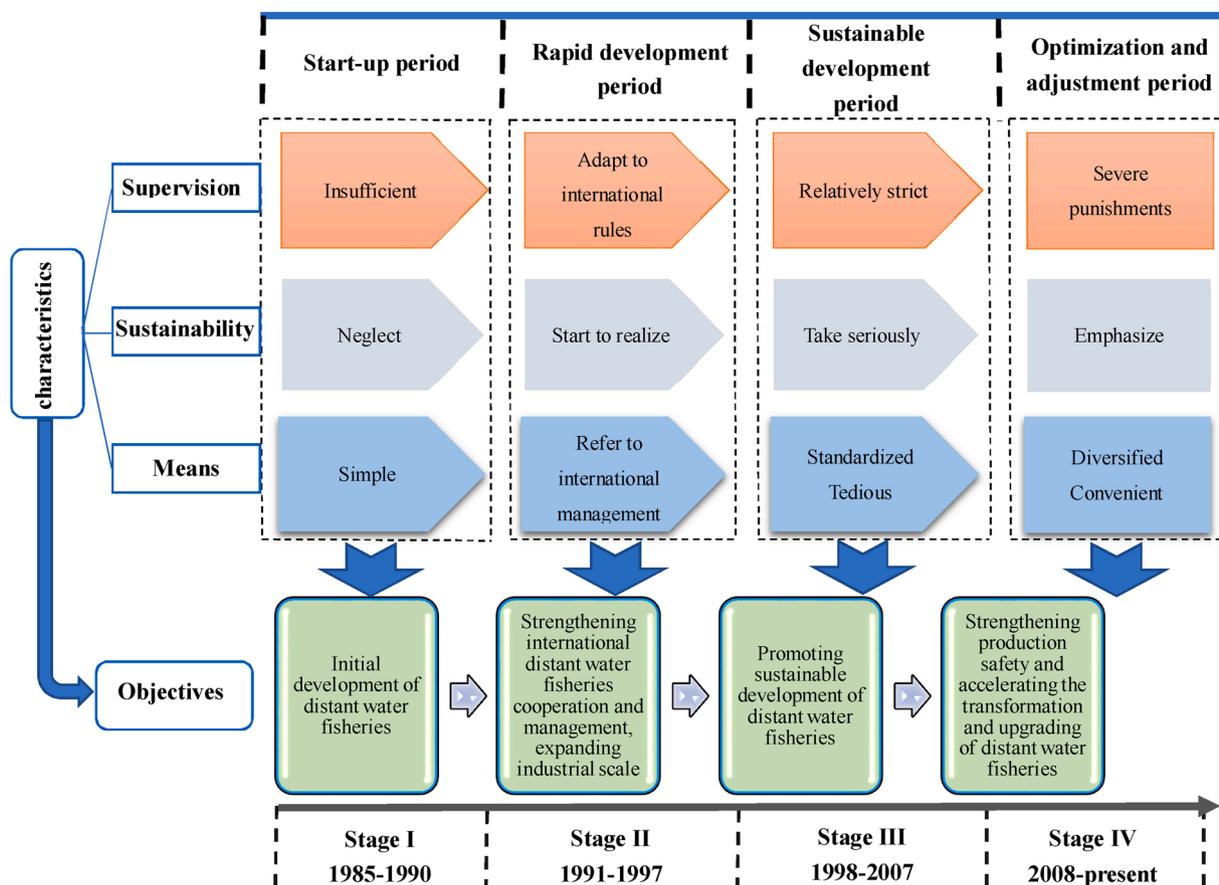


Fig. 3. Evolution of China's distant water fisheries management policy.

distant water fishing equipment, low investment in R&D and transformation, and strict technical barriers in developed countries have severely restricted the development of China's distant water fisheries. In 2008, the Ministry of Science and Technology of China implemented the key project of "Distant Water Fishery Fishing Equipment" in order to break the monopoly of advanced fishing boat manufacturing technologies in the United States and Japan. In 2012, China's self-developed tuna seine fishing vessel "Jinhui No. 8" set a milestone for the manufacture of Chinese distant water fishing vessels. In recent years, the quality of Chinese distant water fisheries equipment has been significantly improved, and a number of specialized and standardized distant water fishing vessels have been updated. However, China's distant water fisheries, which started late, still have a large gap with the marine powers in terms of ship technology level and standardization.

3.2. Maritime conflicts of interest between countries

With the gradual decline of global fishery resources, the protection of the marine ecological environment and the sustainable use of resources have become important international issues. At present, the global high seas are included in regional fisheries management, and the management requirements are becoming increasingly strict with the awareness of marine protection enhancing in coastal countries. Consequently, international fishery cooperation among various countries becomes more difficult considering both the interests of cooperative countries and sustainable development of fishery resources (Bjørndal et al., 2000; Lin

et al., 2014). On the one hand, under the EEZ system, coastal countries continue to strengthen the fishing restrictions and supervision of foreign fishing vessels, even mobilize naval and marine police for military conflict⁶ to protect their fishery resources and maintain marine sovereignty (Goldstein, 2013). On the other hand, in the context of political conflicts, there are frequent occurrences of frictions between the Chinese distant water fleet and other national fleets. All these have seriously exacerbated the risks and management difficulties of distant water fisheries production. In addition, as countries and regional organizations continue to strengthen the protection and management of fishery resources on the high seas, the amount of fishery resources that can be harvested is decreasing. As a result, fishermen started to fish in the waters of other countries' jurisdictions or on the high seas illegally driven by interests, which further intensifies the risks and management difficulties of distant water fisheries (Guggisberg, 2019). Therefore, cracking down on IUU activities has become the focus of the international community. In general, in the face of conflicts of maritime interests among countries, China is facing huge challenges in the formulation of corresponding laws and regulations as well as in the participation of global fisheries governance.

3.3. Imperfect distant water fisheries management system

China has currently promulgated special legislation on foreign-related cases, enterprise qualifications, fishing vessel supervision and management, project management, work safety management, and

⁶ For example, on March 2016, Chinese fishing boat "Luyan 010" was sunk by the Argentine maritime police. In the same year, another Chinese fishing boat was attacked by an Indonesian armed boat.

Table 4
The main events of distant water fisheries management policy in China (2008-present).

Time	Event	Role
2008	<i>Emergency Notice on Enhancing the Safety of the Operation of Distant Water Fishing Vessels in Somalia and Nearby Waters</i>	Discussing the solution to the hijacking incident of Tianyu 8 fishing boat
2010	Antarctic Marine Bioresource Development and Utilization Project Exploration and Capture Summary Meeting	Achieving productive exploration and capture of Antarctic krill
2011	<i>Notice on Strengthening Work Safety in Distant Water Fisheries</i>	Vigorously carry out enterprise safety production standardization construction
2012	China Distant Water Fisheries Association was established	Strengthening management of distant water fisheries
2012	<i>Opinions on Promoting the Sustainable and Healthy Development of Distant Water Fisheries</i>	Formulating new goals and measures for the development of distant water fisheries
2012	<i>Notice on Strengthening the Management of Renewal and Construction of Distant Water Fishing Vessels</i>	Strengthening the management of renewal and construction of distant water fishing vessels
2013	<i>Notice on Carrying Out the Standardization Work of Distant Water Fishing Vessel Type</i>	Formulating work plan for the standardization of distant water fishing vessels.
2013	<i>Notice on Further Strengthening the Management of Safe Production in Distant Water Fisheries</i>	Distant water fishing vessels maintain a safe distance of at least 3 nautical miles at the border of the EEZ of the country
2013	China joined <i>The Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean</i>	China becomes a member of the South Pacific Regional Fisheries Management Organization (SPRFMO)
2014	<i>Management Measures for Position Monitoring of Distant Water Fishing Vessels</i>	Strengthening the position information reporting system
2015	<i>Convention on the Conservation and Management of Fishery Resources in the High Seas of the North Pacific entered into force</i>	China becomes a member of the North Pacific Ocean Commission (NPOFC)
2016	<i>Notice on the Establishment of Overseas Examination Mechanism for Distant Water Fishing Crew</i>	Promote the standardization of fishery crew management
2016	<i>Implementation Rules for the Management of Observers of Distant Water Fisheries</i>	Fulfilling the management requirements of relevant international fisheries conventions
2017	<i>Measures for the Inspection and Management of Distant Water Fisheries Ships</i>	Guaranteeing the inspection quality of ocean fishing vessels
2017	<i>"13th Five-Year Plan" for the Development of Distant Water Fisheries</i>	Guiding the development of distant water fisheries
2018	<i>Notice on Strengthening the Safety Management of Distant Water Fisheries and Strictly Preventing Foreign-Related Violations</i>	Strengthening the safety management of distant water fisheries
2020	<i>Regulations on the Management of Distant Water Fisheries (2020)</i>	Improving the management of distant water fisheries

observer systems in distant water fisheries (Huang and He, 2019). On the one hand, the laws and regulations for the management of distant water fisheries gradually established on the basis of the *Fisheries Law of the People's Republic of China* were formulated earlier and were not revised in a timely manner, resulting in a mismatch with international standards. China's claims on the South China Sea issue did not follow UNCLOS, and some of the bases proposed by China were not recognized internationally. In addition, China did not agree with the UNCLOS and requires that the interpretation of freedom of navigation in EEZs should exclude military-related activities (Mallory and Panel, 2012). On the other hand, there are still insufficient supervision and inconsistencies of regulations among different domestic regions in China. For example, the *Fishery Law of the People's Republic of China* has been revised four times since its implementation in 1986. Among all the revised versions, the

2000 revised version required that fishing operations in the waters under the jurisdiction of other countries must abide by the relevant treaties, agreements and laws of the relevant countries that China has concluded. Due to insufficient government supervision, the frequent occurrence of violations by Chinese distant water fishing vessels not only caused unreasonable fishing on the high sea's resources but also seriously damaged China's international image. The revised version in 2013 required distant water fisheries to adopt a central and local hierarchical management model. The Ministry of Agriculture was responsible for the planning, organization, and management of national distant water fisheries, and the provincial fishery administration was responsible for the planning, organization, and supervision of distant water fisheries in the province (Cao et al., 2017). The fishermen's cross-regional fishery approval process is cumbersome and the law enforcement standards in different regions are inconsistent, which increases the production costs of enterprises and law enforcement costs of the government. The *Fisheries Fishing License Management Regulations* revised in 2019 requires fishing vessels to implement classified, graded and zoned control. The control indicators for small domestic marine fishing vessels are determined by the governments of provinces, autonomous regions, and municipalities, based on the fishery resources and environmental carrying capacity of the region. Inconsistent management standards in various regions can easily cause conflicts in the process of enforcing laws and regulations by local governments.

In addition, there are many loopholes in China's ocean fishery management measures. For example, under the input and output control system, fishermen can use the "input substitution" method to obtain fishing advantages, that is, to replace controlled inputs with uncontrolled inputs to increase fishing capacity. In recent years, China has set up a system that blacklists seafarers, enterprises, and management personnel who have violated laws and regulations and revoked their qualification certificates. This innovative system has cracked down effectively on illegal activities of distant water fisheries. However, there are still many problems already in China's distant water fisheries management system waiting to be improved.

3.4. Unreasonable distant water fisheries structure

China's distant water fisheries are dominated by primitive fishing or resource-consuming industries. Fishing methods include trawl, purse seine, gillnet, fishing tackle and other types of operations, among which trawl plays a major role in China's distant water fisheries, resulting in destruction of seabed ecological environment and decline of fishery resources (Xue and Fang, 2017). In 2019, trawl fishing accounted for more than half of the total output of distant water fisheries. In terms of industrial scale, with many distant water fishermen and large quantities of fishing vessels, China's production capacity of distant water fisheries ranked first (Chesnokova and McWhinnie, 2019). However, the high production capacity is mainly due to the high quantity rather than quality for the following reasons. Firstly, China's distant water fishing boats are small and numerous, with a low level of scale⁷ and organization (Xue, 2006; Yang et al., 2016). Secondly, distant water fisheries enterprises focus on low-value-added products and low-margin single-fishing, and there are few high-value-added industries such as deep processing of fish products. Lastly, excess of fishermen and enterprises engaged in fishing have greatly increased the difficulty of the management and structure transformation of distant water fisheries.

In addition, China's distant water fisheries have an irrational fishing

⁷ In 2019, Small marine fishing vessels (power less than 44.1 kW and length less than 12m) accounted for 64.2%; medium-sized marine fishing vessels accounted for 33.7%; large-scale marine fishing vessels (power greater than or equal to 44,1 million) accounted for 2.1%. Classification standard: China Fisheries Fishing License Management Regulations. Data source: China Fishery Statistical Yearbook.

structure of fish species. In 2018, the global tunas catch reached about 7.9 million tons, reaching the highest value in history. The main catch species of Chinese distant water fisheries are tunas, squids and Pacific jack mackerel (*Trachurus symmetricus*). The proportion of tunas fishing is declining, while squids and Pacific jack mackerel (*Trachurus symmetricus*) are rising (Fig. 4). In the aspect of distant water fishing, China needs to improve the international competitiveness of tuna fishery, optimize the production layout of squid fishery and control the scale of pelagic fish catches (Chen et al., 2008; Boerder et al., 2019). In particular, China should strengthen the investigation and evaluation of pelagic fish resources, such as saury, Pacific jack mackerel (*Trachurus symmetricus*) and Chub mackerel (*Pneumatophorus japonicus*), so as to improve the medium and long-term prediction technology of fish resources. Besides, with the increasing demand for taste, nutrition and health of aquatic products, the management of China's distant water fisheries should actively guide the industry to optimize the layout, allocate the quota of fish species rationally, and promote the integration of "production, processing and sales"(Li et al., 2009). Under the background of the accelerated transformation and upgrading of distant water fisheries by the government, China's distant water fisheries management will face huge challenges in the future.

3.5. Insufficient quality and ability of employees

China's distant water fisheries has developed rapidly and attracted a large number of practitioners. Due to the great demand for manual labor in distant water fisheries, the majority of the practitioners come from rural China, with low levels of culture and skills. Distant water fisheries are characterized by high risks and long operating hours, and the practitioners need to master the relevant regulations and language exchanges of different countries in order to be able to carry out legal fishing and safe production in accordance with international conventions and rules. However, employees with low qualities often lack safety knowledge and awareness, and they are easily to violate the laws and resulting in violence (Bi, 2008). After China implemented the system of holding a certificate for distant water fisheries, violations of the law have been reduced. However, problems, such as undocumented employment and insufficient professional capacity of crew members, have become the difficulties in the management of distant water fisheries in recent years. First of all, the government only educates and trains distant water fisheries managers and production personnel through one single examination, and has not established any long-term training mechanism. Secondly, colleges and vocational colleges have insufficient training capacity for high-level distant water fisheries

talents, and the training scale cannot match the current industry needs. In addition, the government and fisheries associations have not established any professional consulting or educational service institutions in domestic and overseas distant water fisheries bases. Therefore, it is difficult to improve the quality of seafarers and the ability of enterprises to handle emergency events (Guo, 2013). In general, improving the quality and capabilities of Chinese distant water fisheries practitioners is still an important direction for China's distant water fisheries management in the future.

4. Prospects of the development and management policy of China's distant water fisheries

4.1. Attaching importance to science and technology

After more than 30 years of development, China's distant water fisheries has initially formed a scientific and technological support system in the fields of fishing technology, fishery exploration, fishery equipment, and fishery forecasting (Chen et al., 2019). The government actively promotes the innovation of distant water fisheries science and technology as an important part of distant water fisheries management, which has effectively promoted the rapid development of distant water fisheries. For example, the distant water squid fishing boat "Ningtai 76" affiliated to Zhejiang Shunze Distant Water Fishery Company installed the energy-saving and environmentally friendly sixth-generation LED aggregating fish lamps developed by Baineng Photoelectric Company in 2017, which saves about 40 % fuel consumption and avoids the light damage of traditional fish lamps. This technology effectively improves the crew's working environment and reduces fishing costs.

China has great potential for developing distant water fisheries science and technology. In the future, China should focus on strengthening distant water technology management from the following aspects:

- Accelerate the research and application of new equipment, new materials, and new energy to accelerate the upgrading of old fishing vessels and equipment, eventually realize the localization of key equipment for fishing vessels.
- Encourage the development of the deep processing industry of aquatic products, support the construction of modern cold chain logistics facilities and promote the realization of a highly informatized logistics system.
- Strengthen the technology of ocean fishery resource exploration and fishery forecasting to improve the efficiency of distant water fisheries operations.

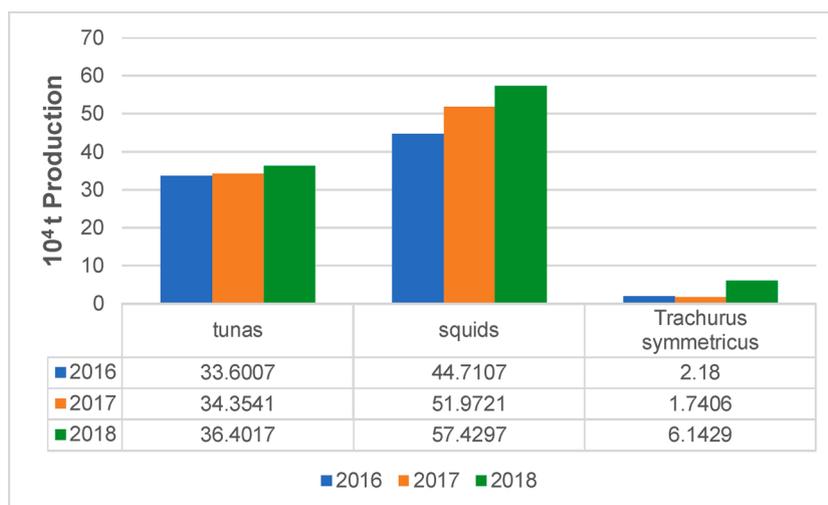


Fig. 4. China's distant water fisheries main catch species production during the 2016–2018 period. Source: China Fishery Statistical Yearbook

- Support the construction of distant water fisheries technology centers, scientific research universities and resource assessment institutions, and train distant water fisheries professionals.
- Promote the construction of polar fishery scientific research vessels and teams, and actively explore polar fishery resources, such as Antarctic krill.

In general, future emphasis on science and technology in distant water fisheries can not only achieve technological breakthrough in distant water fisheries to improve the production efficiency of distant water fisheries, but also promote the industrial cluster, extend the industrial chain and enhance the added value of products to achieve the rapid development of distant water fisheries and related industries.

4.2. Optimizing distant water fisheries subsidies

In the 1980s, China realized that its coastal marine resources had been severely damaged, and distant water fishery was one of the necessary ways to ensure future food security. Then China began to provide tax-exempt status, fuel subsidies, insurance support, and diplomatic cover to promote the expansion of distant water fisheries (Carolin, 2015). The goal of China's distant water fisheries subsidies is to explore global marine resources effectively and establish a competitive advantage in the marine economy in the high seas to ensure the supply of domestic aquatic products and the livelihood of fishermen (He, 2015). As an important means of China's distant water fisheries management, fishery subsidies have promoted the rapid development of China's distant water fisheries, but it has also caused domestic overcapacity and deteriorated the environment of fishery resources. The Chinese government has various forms of subsidies for the distant water fisheries, such as fuel subsidies, ship construction, tax exemption, etc., of which the most important and the largest amount is fuel subsidies (Mallory, 2016). Due to the lack of regulatory capacity of the central government, the lack of risk assessment and the excessive pursuit of regional production by local governments, the number of Chinese distant water fishing vessels has increased rapidly. From 2012 to 2014, the number of distant water fishing vessels increased from 1793 to 2512, the power of distant water fishing vessels increased by 94.0 %, while the output of distant water fisheries increased by only 65.7 % (Fig. 2). The fishing boats that should have been eliminated depend on the government's huge oil price subsidies to survive, which leads to overcapacity in the distant water fisheries industry and increases the financial burden on the government.

West Africa is currently an important fishing area for China's distant water fisheries. In recent years, China has provided economic assistance to West African countries, which is regarded as the capacity enhancing subsidy for access to foreign fisheries and reduces the host countries' attack on the IUU activities of the Chinese distant water fleet (Belhabib et al., 2015). In addition, China's lack of a transparent fisheries agreement has caused serious underestimation of official statistics of China's distant water fisheries output, which conceals the pressure from the expansion of China's distant water fleet to other countries' EEZs on the host country's fishery resources and environment (Pauly et al., 2014).

In general, the government should re-evaluate the existing distant water fisheries subsidy policy, stop the vicious subsidies that are harmful to resources and the environment, and attach importance to sustainable fisheries in other developing countries. On the one hand, the government should consider the fishery management policies such as the blacklist system, and stop financial support and the payment of related subsidies to individuals and enterprises that violate the regulations. On the other hand, the government should strengthen the subsidies for the protection of fishery resources to promote the sustainable development of national and global distant water fisheries.

4.3. Encouraging stakeholders to participate in decision-making

Stakeholders of China's distant water fisheries mainly include fishermen, enterprises, industry organizations and governments (Yu and Yin, 2019). The main work of fishermen and fishing enterprises is to obtain a reasonable number of aquatic products in legal fishing activities. The main work of non-fishing enterprises such as fishing boat construction and product processing is to provide support for fishing practitioners in production and sales. The main work of the industry organization is to organize and coordinate distant water fisheries production, formulate industry specifications, promote market development, and provide consulting services. The main work of the government is to formulate policies, coordinate international affairs, and strengthen maritime supervision and maritime law enforcement. As a distant water fishery involving complex systems in different countries, a polycentric governance mechanism should be established with stakeholders as the core to encourage different stakeholders to actively participate in decision-making.

In the polycentric governance mechanism, fishermen and fishing companies, as the practitioners of fishery activities, should provide industry organizations and governments with the true status of production supply and market demand, and reflect the difficulties encountered in production and sales. Industry organizations assist the government in collecting and analyzing distant water fisheries data, guide the healthy development of the industry, provide feedback to the government on the development status of distant water fisheries, and provide suggestions to help the government to formulate more reasonable policies. As the core of collaborative governance, the government solicits and evaluates the demands of other stakeholders, and revises relevant regulations promptly or formulates new policies to promote the healthy and sustainable development of distant water fisheries.

4.4. Improving distant water fisheries supervision system

China is currently implementing monitoring measures, such as fishing vessel position monitoring system, certificate of origin catches, national observer system, and standardized fishing log. With the fisheries department as the main body, a coordination supervision and management mechanism integrated with the departments of foreign affairs, public security, transportation, customs, and maritime police has been initially established. As far as position monitoring is concerned, the initial construction of the position monitoring system for Chinese distant water fishing vessels is to supervise distant water fishing vessels. Now it is playing an active role in protecting the marine ecological environment, combating IUU activities, and ensuring production safety. At present, the Chinese distant water fishing vessel position monitoring system supports Inmarsat-C, Argos, Triton Advanced, Watch Dog, Oceana 800, Fleetone and other equipment. The future development of Beidou satellite communications and 5 G technology will greatly enhance China's distant water fisheries supervision capabilities (Chen et al., 2019).

Although China has formed a preliminary distant water fisheries supervision system, illegal distant water fisheries activities and violent international conflicts still occurred frequently in recent years (Xue and Fang, 2017). In the future, the Chinese government shall improve the distant water fisheries supervision system from the following aspects:

- Strengthen the law enforcement of distant water fisheries, implement the "blacklist" system strictly, and crack down on IUU activities firmly.
- Implement a remote video monitoring system for distant water fishing vessels to improve the position monitoring capabilities of distant water fishing vessels, and promote electronic fishing logs to realize information-based ocean fishery supervision and management.

- Increase the coverage ratio of observers for distant water fishing vessels to gradually meet the needs of international compliance.
- Establish an early warning system for distant water fisheries risks and strengthen the safety of distant water fisheries production.

4.5. Strengthening international cooperation in distant water fisheries

Strengthening international cooperation is an important way to promote the development of global distant water fisheries (Zhang, 2019). International cooperation can accomplish the effective use of the fishery resources, markets, science and technology of different countries to promote the development of distant water fisheries in the region (Long, 2009; Liao and Huang, 2016). China has always advocated win-win cooperation and participated in global fisheries governance actively. At present, China has joined seven RFMOs which basically cover the global distant water fisheries operation areas and has signed fishery cooperation agreements or memorandum of understanding with eight countries. In the future, the establishment of cooperative relations between China and more countries will drive China's distant water fisheries to achieve fast and high-quality development.

The construction of overseas distant water fisheries bases is an important area of international distant water fisheries cooperation, which not only provides domestic enterprises with convenient services, such as fishing boat replenishment, fishing boat maintenance, and refrigeration processing, but also strengthens technical exchanges and cooperation between enterprises in different countries (Liu and Yu, 2017). The government should promote the construction of overseas distant water fisheries bases actively, and carry out long-term friendly and mutual beneficial cooperation with the countries in the Atlantic, Pacific and Indian Oceans in the fields of tuna fishery, squid fishing, pelagic fisheries and polar fisheries.

In general, joining regional fisheries management organizations and carrying out international cooperation in distant water fisheries can improve the technical level effectively, expand overseas markets, and promote the development of distant water fisheries. In addition, countries also need to adhere to their international obligations and crack down on IUU behavior resolutely to ensure the production safety and promote the sustainable development of global distant water fisheries.

5. Conclusion

After more than 30 years of development, China's distant water fisheries has begun to scale up and the management level of distant water fisheries has been improved significantly. Meanwhile, China's rapid expansion of distant water fisheries and frequent IUU activities put pressure on global sustainable fisheries. As an important means for the government and fisheries organizations to guide and regulate the development of distant water fisheries, fishery management is of great significance for promoting the long-term rapid and sustainable development of distant water fisheries. China's distant water fisheries management gradually adapts to international rules, innovates management methods, and strengthens supervision during the development of distant water fisheries. However, China's distant water fisheries management policy still faces the huge challenges of inadequate distant water fisheries equipment and technology level, continuous conflicts of international marine interests, imperfect distant water fisheries management system, unreasonable production structure, and insufficient quality and ability of employees.

During the optimization and adjustment period, China's management of distant water fisheries should seize the opportunities for developing distant water fisheries and formulate reasonable management policies by focusing on the following aspects: 1) Strengthen the construction of scientific research institutions and increase the investment in science and technology to improve the technology level of distant water fisheries. 2) Re-evaluate the subsidies for distant water fisheries based on environmental policies and IUU activities to eliminate

backward production capacity and ease environmental pressure. 3) Establish a polycentric governance mechanism to encourage different stakeholders to participate actively in decision-making. 4) Focus on building overseas distant water fisheries bases to promote international cooperation and participate in international management to promote the development of global distant water fisheries.

CRediT authorship contribution statement

Jinkai Yu: Conceptualization, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Project administration, Supervision. **Qingchao Han:** Data curation, Writing - original draft, Writing - review & editing, Methodology.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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