



Characteristics of Small-Scale Coastal Fisheries in China and Suggested Improvements in Management Strategies: A Case Study From Shengsi County in Zhejiang Province

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Specialty section:

This article was submitted to
Marine Affairs and Policy,
a section of the journal
Frontiers in Marine Science

Received: 08 November 2021

Accepted: 12 May 2022

Published: 15 June 2022

Citation:

Xiong M, Wu Z, Tang Y, Su S and
Shen H (2022) Characteristics of
Small-Scale Coastal Fisheries in China
and Suggested Improvements in
Management Strategies: A Case
Study From Shengsi County in
Zhejiang Province.
Front. Mar. Sci. 9:811382.
doi: 10.3389/fmars.2022.811382

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Small-scale fisheries (SSFs) in China have made incalculable contributions to the supply of aquatic products, employment, and social stability. Despite their importance, aspects such as the complexity, dynamicity, and vulnerability of SSFs are yet to receive sufficient attention either from the Chinese government or from society. Here we help to address the lack of recognition of SSFs by examining their characteristics and possible management solutions. We selected Shengsi County, a community with traditional fishing activities, in Zhejiang Province as a case study to review and examine the SSFs' characteristics and policies. We aimed to explore the improvement strategies for Chinese SSF management by using data from the open-access government databases, a series of questionnaire surveys and semi-structured interviews, and a collection of national and local SSF-related legislative and policy documents. Here we summarized the physical characteristics of the small-scale fishing vessels and the socioeconomic aspects of SSFs in Shengsi County. Our findings indicate that unprecedented new institutional arrangements for SSFs have been developed in recent years at the national level, and some relevant policies of SSFs also exist at the local level. However, there are still gaps: The concept of SSFs and the goal of their management have not been developed either at the national or local levels; monitoring systems have not yet been established for collecting SSF-related data; fishers engaged in SSFs are still not well organized; cooperation and coordination between different government departments with management authority over SSFs are insufficient; the local government's response to the central government's initiatives was slow. Our findings show that the Chinese government could improve SSF management by adopting on an ongoing basis the following suggestions: (1) better define SSFs and set management goals according to their characteristics; (2) develop a monitoring system for SSFs' data and information collection and promote multidisciplinary research on SSFs;

(3) establish SSFs' cooperatives as soon as possible; and (4) develop coordination and cooperation mechanisms among government departments. This research can provide a reference for the Chinese government to understand SSFs better and contribute to the implementation and improvement of SSFs' differentiated management in China.

Keywords: small scale fishery, characteristics, management strategies, China, Shengsi County

1 INTRODUCTION

It is widely acknowledged that small-scale fisheries (SSFs) are critically important in food security, poverty alleviation, equitable development, and fishery sustainability (Kieran et al. 2012; Jentoft, 2014; FAO, 2015; Chuenpagdee, 2018; FAO, 2021). Small-scale fisheries contribute to about half of the global fish catches, with as much as two-thirds destined for direct human consumption (FAO, 2015). In the global sector of capture fisheries, more than 90% of fishers are engaged in the SSFs (FAO, 2015). The Food and Agriculture Organization (FAO) of the United Nations has recognized the importance of SSFs in the 1995 *Code of Conduct for Responsible Fisheries* (FAO, 1995). Over the past 25 years, countries have raised awareness of the key role SSFs have played in the national economy (Boopendranath, 2012; TBTI, 2016; TBTI, 2018a; TBTI, 2018b; TBTI, 2018c; TBTI, 2018d; FAO, 2021).

The Voluntary Guidelines for Ensuring Sustainable small-scale fisheries in the Context of Security and Poverty Alleviation (abbreviated as SSF-Guidelines) is considered a milestone in strengthening the management of SSFs, which not only includes ensuring food security, eliminating poverty but also emphasizing the significant contribution of SSFs to realizing sustainable development goals. In the *2030 Agenda for Sustainable Development* launched by the United Nations, the ocean sub-targets SDG14, Protecting and Sustainable Utilization of Oceans and Marine Resources to Promote Sustainable Development, proposes to provide more chances for SSFs to obtain marine resources and market opportunities (UN, 2015). FAO declared 2022 the *International Year of Artisanal Fisheries and Aquaculture*, aiming to draw the world's attention to the critical role of small-scale fishers, fish farmers, and fish workers that could play in food security and nutrition, poverty eradication, and on the urgency of improving their management, with a view to increasing understanding, awareness and action to support them (FAO, 2021).

Although a series of actions have been taken, there are still many challenges in protecting and strengthening the role of SSFs. First and foremost, there is controversy over how to define SSFs, which impedes SSF management in the first place (FAO, 2008; Purcell and Pomeroy, 2015; Rousseau et al., 2019; Smith and Basurto, 2019). SSFs are frequently referred to as distinct from large-scale or industrial fisheries (Thomson, 1980; Halim et al., 2018; Smith and Basurto, 2019). The metrics used to differentiate SSFs from large-scale fisheries or industrial fisheries vary across countries and areas due to their unique resources, political, economic, and cultural situations (FAO, 2008; Purcell and Pomeroy, 2015; Rousseau et al., 2019). Despite the fact that an

SSF could be a complicated system, some countries and areas use only a single indicator such as overall length or main engine power of fishing vessel to distinguish SSFs from large-scale or industrial fisheries (FAO, 2008; TBTI, 2018a; TBTI, 2018b; TBTI, 2018c; TBTI, 2018d; Smith and Basurto, 2019). Some scholars have cast doubt on such an approach. Smith and Basurto (2019), for example, advises scientists and practitioners to employ numerous indicators in terms of multiple dimensions to characterize and identify SSF under varied scenarios, which is consistent with the 2014 SSF-Guidelines' recommendation to define SSFs on a case-by-case basis (Jentoft and Chuenpagdee, 2009; Jentoft, 2014; Chuenpagdee, 2018). Moreover, SSF's conflicts with large-scale fisheries as well as other related industries have become more severe in recent decades under the combined influence of factors in terms of social, economic, and environmental dimensions, such as globalization, population growth, marketization, climate change, and resource reduction (Gómez et al., 2006; Tzanatos et al., 2006; Said et al., 2017; FAO, 2020; Said et al., 2020; Arthur, 2020). Furthermore, in many parts of the world, small-scale fishing communities continue to face unequal power relations (Israel, 2001; TBTI, 2016; TBTI, 2018a; TBTI, 2018b; TBTI, 2018c; TBTI, 2018d; Berkes, 2021). In this context, it is crucial to clarify the goals of management of SSFs for the government as soon as possible to protect and promote SSFs' role in food security, poverty alleviation, equitable development, and sustainable fisheries (Andrew et al., 2007; FAO, 2021).

Small-scale fisheries have a long history in China and are one of the country's oldest, most traditional, and primary types of fisheries (Xu, 1992). As is the case in many other countries, SSFs have not been defined in China's official documentation (Zhao and Jia, 2020). Nonetheless, it is usually accepted that in China, SSFs include fishing with small-scale vessels and fishing without a vessel. According to China's *Provisions on the Administration of Fishing Licenses 2019* (hereafter referred to as PAFL, 2019) fishing vessels with an overall length of less than 12 m are classified as small-scale¹, and the remaining are classified as medium or large-scale (PRC, 2013; PRC, 2019). In 2020, there were over 140,000 registered small-scale marine motorized fishing vessels accounting for 67.25 percent of total marine motorized fishing vessels in China (Fisheries Administration Bureau, 2021). Additionally, there are many non-motorized fishing vessels with a maximum length of under 12 meters. Thus, SSFs are vast in China in terms of fishing fleet size.

¹Prior to 2017, China's small-scale fishing vessels were defined as fishing vessels with a main engine power of less than 44.1 kw and an overall length smaller than 12 m.

In comparison to medium and large-scale vessel fisheries, SSFs rely on older, less competitive, and less risk-resistant fishing equipment, and demonstrate a greater sensitivity to resource, social, and economic changes (Chen and Tang, 2014). However, China's SSFs have received insufficient attention with people's lack of knowledge of them contributing to their marginalization (Yang et al., 2011; Ma and Tang, 2019). Management measures customized to SSFs remain scarce; since the 1980s, when China began to strengthen its sustainable fisheries management, a "one-size-fits-all" strategy has been widely used to manage its marine fisheries sector (Su et al., 2020).

This situation has changed greatly since 2017 when China began a new phase of fisheries reform. For the first time since the introduction of the double-control system² in the early 1990s, the Chinese central government decentralized to provincial governments the authority to develop double-control indicators for small-scale fishing fleets in 2017 (MOA, 2017). Moreover, new rules have been added to the fishing licensing system, including the requirement that fisheries employing small-scale vessels be approved for operation in Class A fishing zone³, that no family may own more than two small-scale fishing vessels, and that fishing without vessels must apply for a fishing license (PAFL, 2019). These institutional reforms heralded the dawn of a new era in China's SSFs management. To move forward, China must put more effort into closing the gaps in SSFs knowledge and management.

Here, we use a case study from Shengsi, Zhoushan, Zhejiang to investigate the characteristics of Chinese SSFs, explore the flaws in their management, and discuss how to address the flaws. This paper aims to help China's fisheries institutional reform efforts concerning SSFs, and contribute to a better understanding of Chinese SSFs on a local and global scale. The study's findings can also be used to inform SSF management reforms in other countries confronting comparable challenges.

2 MATERIALS AND METHODS

2.1 Study Area

Shengsi County is affiliated with Zhoushan City, Zhejiang Province. It is located in the heart of China's most productive fishing ground, at the confluence of the Yangtze and Qiantang rivers, as well as the confluence of Taiwan's warm current and the Yellow River's cold-water mass. Due to its unique geographical location, the waters of Shengsi are home to a

²The double control system is an input control method aimed at reducing or limiting the total fishing capacity of a fishing fleet through controlling overall vessel number and horsepower of fishing fleet (i.e., control indicators).

³According to Article 23 of the Regulations on Provisions on the Administration of Fishing Licenses 2019, the marine fishing zone is divided into four categories: A, B, C, D. Class A includes the sea area of the Yellow Sea, Bohai Sea, East China Sea, South China Sea, and other sea areas on the land side of the outer boundary of closed fishing zone for bottom trawling by motorboat; Class B are Chinese and surrounding countries jointly managed fishing areas, which including Nansha sea area, Huangyan Island sea area and other specific fishery resources fishing grounds and aquatic germplasm conservation zone; Class C including the Bohai Sea, Yellow Sea, East China Sea, South China Sea and other sea areas under China's jurisdiction except Class A and Class B fishing zones. Class D fishing area is high seas.

diverse array of fish, shrimp, and crab species many which are economically significant (Su et al., 2018).

The county is comprised of more than 400 islands, all of which are located within China's Class A fishing area, with Shengshan Island⁴ serving as China's easternmost inhabited island (Duan and Zhu, 2016). Today, the majority of China's island counties are connected to the mainland by sea bridges and are highly commercialized. Their socio-economic development is mostly driven by aquaculture and tourism, with the fishing industry gradually declining in importance. In comparison, Shengsi County has maintained a largely intact fishing industry.

Due to its distance from the mainland, inconvenient transportation, low level of commercialization, and the high proportion of the indigenous⁵ population, Shengsi's local populations are heavily reliant on fisheries, with many traditional fishing methods still in use today (Su, 2018). In 2005, the State Oceanic Administration approved the establishment of the Shengsi Ma'an Islands National Marine Special Reserve (Figure 1), where many islands and the fishing grounds of SSFs are located.

We believe that Shengsi's management of SSFs is superior to that of the rest of China in terms of research value, owing to the local government's recent initiatives to tighten SSF management, including the approval of several city and county-level rules and the exploration of a system for distributing fishing rights.

2.2 Methodology

The study employed a mixed approach to explore the characteristics and management deficiencies of the SSFs in Shengsi County. This entailed the following: (1) examined the physical characteristics of the fishing fleet *via* statistical analysis, (2) investigated the socioeconomic characteristics of the SSFs through questionnaire surveys, and (3) identified management deficiencies through semi-structured interviews and policy documents analysis. The following sections detail the methodologies and data sources used.

2.2.1 Description of Fleet Characteristics

The vessel ownership certificates and fishing vessel inspection certificates obtained from the open database of the General Office of the Zhejiang Provincial Government were utilized to gather the raw data necessary to explore the physical characteristics of Shengsi's SSFs. The raw data were required from the Zhejiang Bureau of Statistics, and we created an own MSC Access database from the raw data and then ran queries. In the first instance, we used the search conditions "main engine power less than 44.1 kW" and "overall length less than 12 m". A total of 667 results (fishing vessels) were found. In the second instance, we used the search condition "overall length less than 12 m" and a total of 694 fishing vessels were located. Note that although the standard of "main engine power less than 44.1 kW" for defining a small-scale fishing vessel had been removed from the legislation as of 2019, it was still widely utilized as a *de facto* norm by local law enforcement officers and fishers at the time we conducted this

⁴Shengshan is an island town in Shengsi County.

⁵Persons born in Shengsi who speak the local dialect.

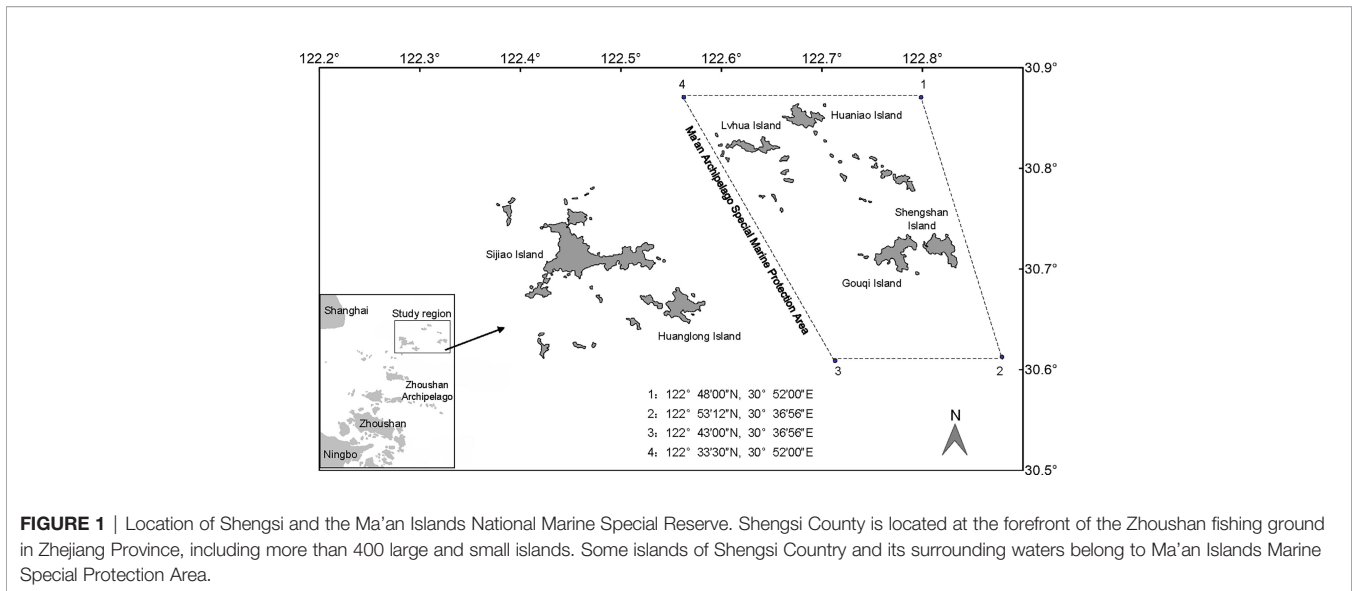


FIGURE 1 | Location of Shengsi and the Ma'an Islands National Marine Special Reserve. Shengsi County is located at the forefront of the Zhoushan fishing ground in Zhejiang Province, including more than 400 large and small islands. Some islands of Shengsi County and its surrounding waters belong to Ma'an Islands Marine Special Protection Area.

study. As a result of this, and the fact that the results of the two screenings were not substantively different, we decided to use the initial screening results for subsequent analyses.

To characterize the physical characteristics of the fisheries using small-scale fishing vessels, we counted and classified the selected sample ($n=667$) against six indicators, including the overall length (m), operation type, tonnage (t), engine horsepower (kW), distance from the shore (n mile), trip duration (h). The corresponding results are presented in section 3.1.1.

2.2.2 Questionnaire Surveys

To explore the socio-economic features of the SSFs, we used questionnaire surveys (FAO, 1998) and the Convenience Sampling method were undertaken (Battaglia, 2008; Jones et al., 2015; Ruiz et al., 2021). The questionnaire contained 25 questions divided into four sections, including general information, fishing conduct, cost and benefit, and organization (see the **Appendix** for details). In November 2020 and June 2021, we visited the wharfs and fishing villages on Shengsi County's key islands, including Huanglong, Gouqi, and Shengshan Island. The questionnaire surveys were conducted following the ethic-related regulations in China.

We invited owners and relatives of small-scale fishing vessels we met at the wharves to participate in our paper-based questionnaires⁶. We briefed them about the aim of the surveys, the questions that would be asked, and the expected time it would take to complete the questionnaire (i.e., 10–15 minutes). They were reassured that the surveys would be anonymous, that no information about them other than what they provided would be recorded, and that they may choose not to answer any of the questions or decline to participate in the surveys. 113 people agreed to our request and participated in the questionnaires. Because of their limited literacy skills, several participants ($n=23$)

requested that our study team fill out the questionnaire on their behalf using their spoken responses. The remaining participants ($n=90$) completed the surveys on their own but were accompanied by members of the study team to assist with textual interpretation as needed. Finally, we obtained 113 completed questionnaires, 97 of which were valid and used in subsequent analysis (Section 3.1.2).

2.2.3 Policy Documents Analysis and Semi-Structured Interviews

We reviewed policy documents and conducted semi-structured interviews to identify the flaws in the management of SSFs in Shengsi. Firstly, we combed through all policy and regulatory documents relating to fisheries management in Shengsi, including those issued by the government at national, provincial, city, and county levels; the documents were listed on official websites of the relevant government departments. Secondly, we read the documents and identified key sections that contained information about SSFs; nine documents were found (**Table 1A** and **1B**). We then analyzed the nine documents to identify the key deficiencies concerning SSFs management based on our knowledge and in conjunction with the physical, economic, and social aspects of Shengsi SSFs.

Subsequently, we conducted semi-structured interviews with key stakeholders to supplement and improve our findings of document analysis. Specifically, we developed 14 questions based on the findings. Afterward, we used the snowball sampling method (Naderifar et al., 2017) to identify key informants, and then assigned them different questions based on their identities (see **Table 3** for the questions and their corresponding respondents).

A total of 18 stakeholders participated in a face-to-face interview conducted in November 2021. They were six fisheries managers (coded as FM1–6) from the Bureau of Marine and Fisheries of Shengsi County, four law enforcers (coded as LE1–4) from the law enforcement agency of Shengsi County, three fish sellers (coded as FS1–3), three fish processors (coded as FP1–3), and two fishers (coded as F1–2). The six fisheries managers

⁶To ensure that the sample was representative and not influenced by our subjectivity, we invited as many fishers and their relatives running small-scale fishing vessels we met at the wharves as possible.

TABLE 1A | Summary of legislative documents relating to current legal system and relevant sections that apply to SSF management in Shengsi County.

Documents (the latest version)	Contents relevant to Shengsi small-scale fishery management
Provisions on the Administration of Fishing Licenses (2019) PRC (2019)	<p>Article 9. The quota system of fishing vessels and gears of small fishing vessels below 12meters shall be controlled by the provincial governments.</p> <p>Article 13. To apply for the fishing license of small marine fishing vessels, it is necessary to have the household registration of coastal counties (cities).</p> <p>Article 14. Small fishing vessels shall not be traded beyond the place of registration.</p> <p>Article 19. One family could get two small fishing vessels license at most.</p> <p>Article 25. The small vessels fishing area should be in class A fishing zone, the large and medium-sized fishing vessels are not allowed to enter in this district.</p> <p>Article 32. The fishery administrative department of the local people's government above the county level shall give priority to local professional fishers and fishery enterprises when approving and issuing fishing licenses; Article 50. Small-scale fishing vessel is exempted from the fishing log.</p>
Regulations of Zhejiang Province on Fisheries Management (revised for the fourth time in 2020) (Zhejiang, 2020). Measures of Zhejiang Province on Fishing License (revised in 2015) (Zhoushan, 2017)	<p>Article 24. Encourage small fishing vessels to install safety rescue information system terminal equipment. Article 25. The people's governments at or above the county level shall support local fishery producers to establish non-commercial fishery mutual aid organizations.</p> <p>Article 26, Annexes II. Fishing area and a time limit of small fishing vessels are stipulated: vessels with engine power less than 44.1 kW shall operate in fishing zone A and C except for purse seine. while vessels using trawl, purse seine, net, gill net, cage pot, fishing tackle, miscellaneous fishing gear, trap, and rake shall operate in fishing zone A of this county during the non-closed fishing season.</p>
Interim Measures for the Management of Shellfish Fishing in Zhoushan National Marine Special Reserve (2017) (Zhoushan, 2017)	<p>Article 7. The license of shellfish algae in the conservation area shall be subject to the total control system. Local livelihood fishers shall be given priority. The fishery administrative department of the county where the conservation area is located shall examine and approve the issuance of shellfish fishing licenses within the total limit and give priorities to local traditional fishers.</p> <p>Article 10. Traditional fisher should provide certificates by towns/villages where the conservation is located.</p>
Regulations on the Administration of Zhoushan National Marine Special Reserve (2016) (Zhoushan, 2016)	<p>Article 23. The total amount control of fishing vessels and fishers enter the protection zone. Government should give priority to local traditional fishers entering and conducting fishing activities.</p> <p>Article 24. The governments of the county where the protection zone is located shall guide the fishers to the transformation from fishing. Encourage fishers to use eco-friendly fishing mode.</p> <p>Article 25. Given priority fishing rights for local traditional fishers to using shellfish resources.</p>

TABLE 1B | Summary of policy documents relating to current legal system and relevant sections that apply to SSF management in Shengsi County.

Documents (the latest version)	Contents relevant to Shengsi small-scale fishery management
Notice of the Ministry of Agriculture on Further Strengthening the Management of Domestic Fishing Vessels and Implementing the Total Management of Marine Fishery Resources (2017) (MOA, 2017)	Villages/towns government or the fishery primary-level management organizations are responsible for small fishing vessel's management.
Implementation Plan for transferring fishers from marine fishery and fishing industry (2016) (Zhoushan, 2016).	Prioritize compression and reduction the quantity of old and wooden fishing vessels.
Management documents of small fishing vessels in villages and towns of Zhejiang Province (2012) (Zhejiang, 2012)	<p>Controlled and reduce the total amount of small fishing vessels gradually.</p> <p>Not allowable to build new small fishing vessels.</p> <p>Small fishing vessels implement the summer fishing moratorium policy, which lasts from May 1st to September 16th every year. Those who disobey the fishing moratorium system shall not be registered.</p> <p>Townships and their cooperatives should strengthen the safety management of small fishing vessels; villages and towns governments should build a supervision platform for small fishing vessels monitor system.</p>
Guidance of Shengsi County People's Government on the Transformation of Livelihood Fisheries in Shengsi County (2015) (Shengsi, 2015)	<p>Zone access condition: define the available area in Ocean Park and the fishing of Shengsi County in traditional operation mode as the catching area of the coastal fishery, and define the catching area range of each vessel.</p> <p>Gear access condition: keep the traditional and resource-friendly fishing gears to Shengsi County, such as lift net, drift net, fishing and basket, and pot.</p> <p>Number access condition: limit the number of people enter into the fishing ground, strengthen the train of fishers.</p> <p>limit the harvesting size, strictly abide by the national fishing gear catchable-size standard, and limitations on ratio of caught juveniles.</p> <p>The total allowable catch: in accordance with the local resource conditions develop the annual fishing capacity and guide the fishing activities.</p>

recruited for the interviews were recommended and introduced by our contact at the Bureau of Marine and Fisheries of Shengsi Country and had served in Shengsi Marine Fisheries Bureau for more than five years. The remaining 12 interviewees were recommended by and regarded as key informants of Shengsi

SSFs by the fisheries managers interviewed (a total of 12 were nominated by the six fisheries managers, and all 12 accepted our invitation to participate in the interviews).

Key information provided by interviewees was written down and verified for accuracy on the spot by the interviewees. All

interviews were audio-recorded at the same time. Notably, while no ethics clearance is necessary in China for these types of surveys, all 18 participants were informed of the interview’s content and estimated duration in advance. They were assured that their comments would be treated confidentially and that they would not be identified individually in any report or publication.

3 RESULTS

3.1 SSFs’ Characteristics in Shengsi

3.1.1 Physical Characteristics of Small-Scale Fishing Vessels

The majority (73.7%) of the vessels were wooden and most of the vessels operated with gillnets 53.7% (Figure 2). Although the

overall length of an individual fishing vessel varied from 5.00 to 11.99 m, the majority exceeded 11 m (Figure 3). Vessel’s gross tonnage varied from 1.00t to 22.00t and the majority were clustered under 17.00 t, with the most frequent occurrence in the range of 3-3.99 t, followed by 5-5.99 t, and then less than 1.00 t, only two vessels above 17 t (Figure 4). The vessel’s main engine power spanned from 2.20kW to 35.40kW, and the highest frequency was in the interval of 5-9.99kW, followed by 15-19.99kW and 25-29.99kW (Figure 5).

There are 470 vessels out of 677 in total with approved navigation area information in their vessel certificates. Navigation area types included sheltered areas not exceeding 5 n miles, coastal areas not exceeding 5 n miles, coastal navigation areas, and sheltered navigation areas (not exceeding 10 nautical miles offshore) (China, 2019). According to the regulations on navigation safety of vessels, the voyage time of small-scale fishing

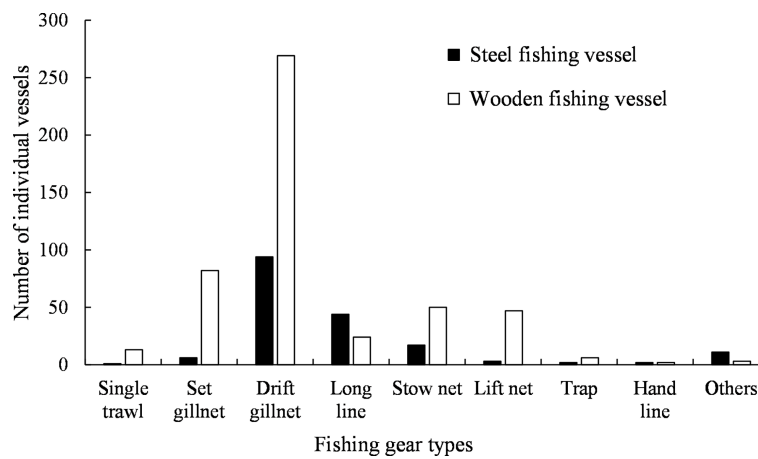


FIGURE 2 | Vessel construction material and gear types of small-scale fisheries in Shengsi County, where black bar represents steel fishing vessels, white bar represents wooden fishing vessels.

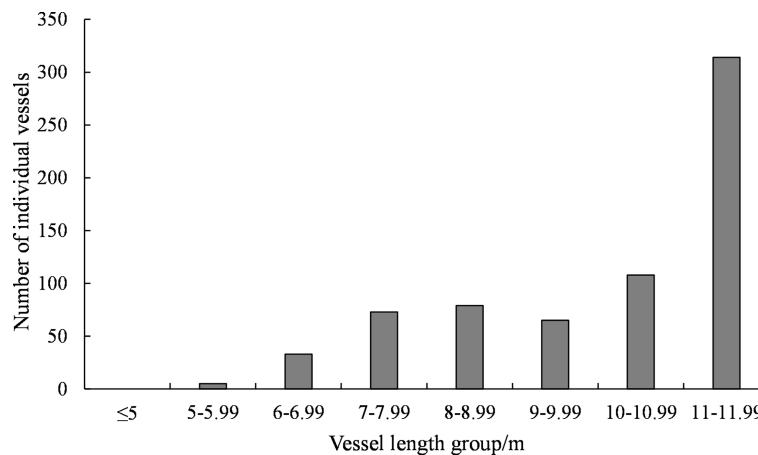


FIGURE 3 | Number of vessels per length category (in meters) for small-scale fisheries in Shengsi Country.

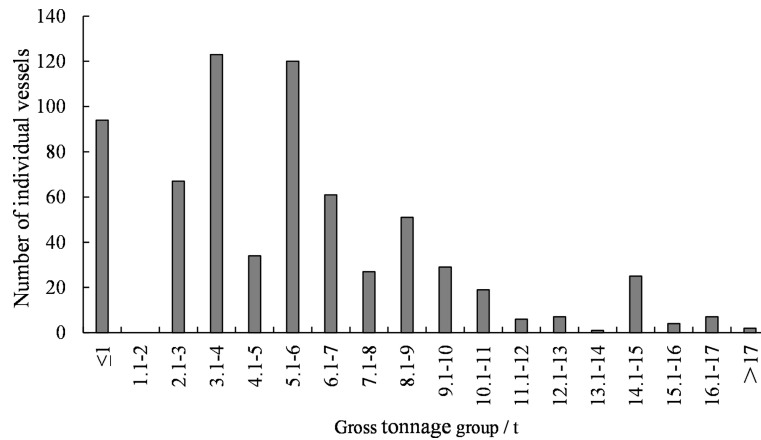


FIGURE 4 | Number of vessels per gross tonnage category (in tons) for small-scale fisheries in Shengsi Country.

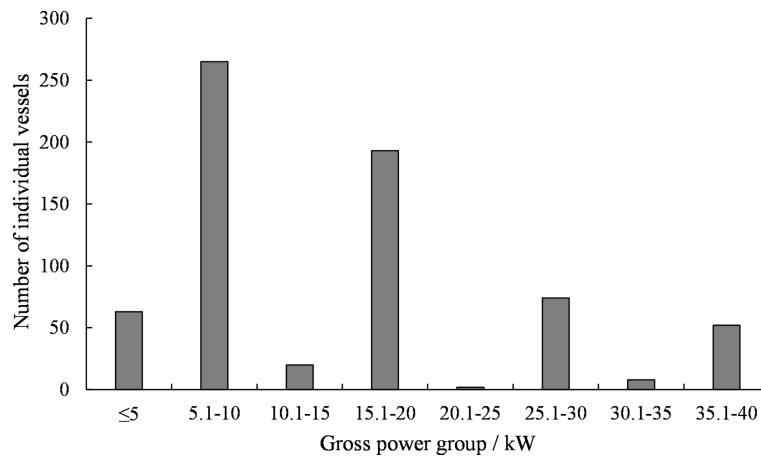


FIGURE 5 | Number of vessels per gross power category (in kW) for small-scale fisheries in Shengsi Country.

vessels in these approved navigation areas shall not exceed 4 hours.

3.1.2 Socio-Economic Characteristics of SSFs in Shengsi

Table 2 summarized the main findings of the questionnaire surveys. Of all the respondents ($n=97$), 88 were fishing vessel owners, and they were all males. Most respondents indicated that they engaged in fishing on a family basis, and each family owned only one small-scale fishing vessel. They relied on their own experience and traditional knowledge to fish. In most cases (accounting for 71% of the total), the fishing vessel owner was the only person in the family that directly engaged in fishing operation; their partners were mainly responsible for pre- and post-fishing work, including selling the catch.

Fishers' annual fishing hours varied by the type of fishing gear they used. Those who engaged in handline fishing operated throughout the year, while those who used stow nets, gillnets,

and cages fished from March to April and September to December. On average, each household spent six months each year engaged in the fishing operation. These findings are consistent with the fishing closure's regulations.

According to the surveys, each family's annual income ranged between 60,000 and 120,000 Chinese yuan (about 9,500 - 19,000 USD). It appeared that fisheries that using stow nets earned more money than those using other types of fishing gear and that the income was heavily influenced by resource conditions. The main expenses in the fisheries were vessel and net maintenance, as well as fuel usage. Few responses showed employment relationships. In terms of how respondents deal with their catches, it was found that the majority of the catch was sold to fishmongers, traded at the dock, and the remainder were retailed in the market. Furthermore, all of the respondents who identified as vessel owners were indigenous people who lived in fishing villages in Shengsi County. Their family had been fishing for generations and had no cultivated land, but their children's household

TABLE 2 | A summary of the general characteristics of SSFs in Shengsi.

Indicator Category	Indicator investigated: Results observed by the statistical analysis and the questionnaire surveys
Physical characteristics	Vessel materials: Wooden Length (m): 5.00-11.99 engine horsepower(kW): 2.20-35.40 Tonnage (t): 1.00-22.00 Distance from fishing ground to the shore (n mile): 0-10 Duration of one Trip (h): 0-4
Socioeconomic characteristics	Commonly used fishing gear (list by frequency of use): Gillnet, stow net, lift net, trap, and tackle. Fishing days per year (days):90-120 Operation pattern: Fish by family Employment relationship: Rare Family annual income per year (\$): 9,510-19,020 (exchange rate:1CNY≈0.1584USD) Catch use: For sale The average age of fishing vessel owners: 51 Gender of fishing vessel owners: All male Household registration of fishing family: Local Fishers own cultivated land: None Vessel-owners directly involved in fishing: 71%

registration had been moved away from Shengsi County in most cases.

3.2 Management of SSFs in Shengsi Country

3.2.1 Recent Improvements in the Policy Documents

Since 2017, China has simplified the standards used for defining small-scale fishing vessels and developed customized management regulations for them in various respects. These regulations, according to the PAFL, 2019 include the following: (1) each provincial government shall be responsible for setting and issuing vessel and net control indicators for small-scale fishing fleets within their provinces, and the indicators cannot be traded across provinces; (2) to minimize competition that is damaging to SSFs, the fishing grounds of small-scale fishing vessels shall be approved in the Country's Class A fishing area, while medium and large -scale fishing vessels shall not be permitted to operate in the region; (3) a family can own up to two small-scale fishing vessels and non-coastal residents are prohibited from getting marine fisheries license; and, (4) give preference to local professional fishers when issuing fishing licenses to protect the legitimate rights and interests of local practitioners following the implementation of total capacity control. Further, both the PAFL 2019 and the Ministry of Agriculture's *Notice on Strengthening Control of Domestic Fishing Vessels and Implementing Total Management of Marine Fishery Resources* require fishers to join fishery organizations in order to improve the current state of loose fisheries management. All of these improvements demonstrate that China's central government has recognized the importance of customized management of SSFs.

At the provincial level, Zhejiang Province's fisheries legislative documents demand the installation of terminal equipment (i.e., vessel monitoring system, VMS) for the safe rescue information

system on small fishing vessels and dynamic monitoring of small-scale fishing vessels. In addition, the legislation encourages the establishment of fisheries mutual guarantee organizations. At the municipal level, the two Zhoushan City legal documents on special marine reserves indicate that SSFs are allowed to operate moderately in the reserves, and appropriate arrangements have been made to ensure the priority access of subsistence fishers to the resources. Furthermore, Shengsi County's subsistence fisheries-related documents have provided a framework for the protection and management of subsistence fisheries.

3.2.2 Shortcomings in the Management Practice

The PAFL 2019's new rules on small-scale fishing vessel management and the licensing requirements for fishing without a vessel are unprecedented developments since the People's Republic of China was founded in 1949. These initiatives demonstrate the Chinese central government's apparent desire to improve SSFs' management. According to the interviewees, the above-mentioned newly revised and added regulations in PAFL 2019 had been notified and implemented in Shengsi (also see Q1-7 in **Table 3**). However, we found that Shengsi SSF management continues to have some significant weaknesses, consisting of the following aspects:

3.2.2.1 Missing Legal Definitions and Tailored Management Systems for SSFs

We found that none of China's fisheries-related legal documents, from national to county-level, explain what an SSF is and what SSF management entails. The above-mentioned new PAFL 2019 rules are dispersed over several sections of the documents, not to mention that the rules were designed for small-scale fishing vessels rather than SSFs.

In terms of interviewees' perceptions of "what are SSFs", six of them stated that fisheries using fishing vessels under 12 m or with main engine power less than 44.1 kW had long been considered SSFs in China in management; the remaining respondents (n=12) stated that they were unsure about the specific definition of SSFs. What's worth noting is that all the 18 interviewees agreed that using merely vessel length and/or main engine power cannot adequately identify SSFs; they indicated that SSFs shared some common characteristics, such as using vessels less than 12 m, being operated by a small group of people (usually less than three), going on short fishing trips, and close to shore. Additionally, all the interviewees (n=18) agreed that SSFs should be managed separately from commercial fisheries. The fisheries managers and law enforcers interviewed further confirmed that a specific management system for SSFs in Shengsi was not yet established.

3.2.2.2 Missing Requirements on the Collection and Use of SSF-Related Data

Through document analysis, we found that there was no national mandate requiring fisheries with small-scale vessels or without vessels to provide catch logs, nor were there any additional national or local legal requirements on collecting and utilizing SSF-related data in management. According to the interviewees, the government had not yet adopted any approaches to

TABLE 3 | Questions developed based on the findings of document analysis for the semi-structured interviews and their corresponding respondents.

Findings of document analysis	Questions	Respondents
Starting from 2017, vessel and gear limits of a province's small-scale fishing fleet are set by the provincial government instead of the national government.	Q1. Are the current vessel and gear limits of the small-scale fishing fleet in Zhejiang Province set by the provincial government?	FM1-6
Starting from 2019, the vessel and gear quota of small-scale fishing vessels cannot be traded across provinces.	Q2. Is it permissible for interprovincial trade of the vessel and gear quota of small-scale fishing vessels?	FM1-6; LE1-4; F1-2
Starting from 2019, large and medium-scale fishing vessels are no longer allowed to operate in Class A fishing grounds.	Q3. Is it permissible for large and medium-sized fishing vessels to operate in Class A fishing areas without obtaining special approval?	FM1-6; LE1-4; F1-2
Starting from 2019, a family can own up to two small-scale fishing vessels.	Q4. Is it permissible for a family to own more than two small-scale fishing vessels in Shengsi?	FM1-6, LE1-4, F1-2
Starting from 2019, non-coastal residents are prohibited from getting marine fisheries licenses.	Q5. Is it permissible for non-coastal residents to obtain marine fishing licenses in Shengsi?	FM1-6, LE1-4, F1-2
Starting from 2019, fisheries agencies are required to give preference to local professional fishers when issuing fishing licenses.	Q6. Are Shengsi's fisheries agency required to prioritize local professional fishers when issuing fishing licenses?	FM1-6; F1-2
Starting from 2019, fishers wishing to obtain a marine fishing license must provide a reference letter of the fishing organization to which he/she belongs.	Q7. Do fishers being asked to provide a reference letter of a fishers' organization when applying for a marine fishing license? Q8. Are there any specialized fishers' organizations for SSFs?	FM1-6; F1-2 FM1-6; FS1-3; FP1-3; F1-2
The <i>Regulations of Zhejiang Province on Fisheries Management</i> has included an article encouraging fishers to install terminal devices on their small-scale fishing vessels since 2020. SSFs have no legal definition.	Q9. Is the terminal equipment used to collect fisheries-related data, such as landings and number of fishing trips, to support fisheries decision-making? Q10. What do you think SSFs are? Q11. Do you think SSFs should be managed separately from other types of fisheries, such as commercial fisheries?	FM1-6; F1-2 All interviewees All interviewees
There are no legal requirements for the collection and use of SSF-related data in management.	Q12. Has the government taken measures to collect SSF-related data such as landings in Shengsi? Q13. In addition to fisheries agencies, what agencies are involved in the management of SSFs in Shengsi? Q14. Are there collaborative mechanisms between fisheries agencies and the other agencies in Shengsi? If so, how effective is the collaboration?	All interviewees All interviewees All interviewees

monitoring SSFs in Shengsi County, and the VMS terminal devices installed on some small-scale fishing vessels were not used to collect fisheries production data such as landings to aid decision-making but were solely used to monitor vessel location to help assure safe navigation.

3.2.2.3 Missing Countywide Specialized Fishers' Organization for SSFs

When applying for fishing licenses, the PAFL 2019 requires fishers to provide a reference letter signed by the fishers' organization to which they belong, implying that fishers must join an organization. The goal of developing such a rule was to strengthen fisheries communities' organizational level and to empower the fishing fleet. However, the majority of SSFs in Shengsi were still run on a household basis, and no organization dedicated to SSFs existed at the time the interviews were conducted. According to the interviewees, a fisher would provide a reference letter signed by the village committee or neighborhood committee when seeking a fishing license, and these committees, however, were broad grass-roots autonomous groups comprised of residents. That is, they were not specialized fishers' organizations and did not contribute to the sector's organizational development.

3.2.2.4 Insufficient Cross-Departmental Coordination for SSF Governance

Interviewees widely recognized that although the fisheries agency was primarily responsible for SSF management, there were other

departments involved, including those in charge of marine, financial, civil, human, and social affairs, public security, border defense, health, education, and housing development. Our document analysis, however, revealed that no cross-departmental coordination mechanism had yet been developed between the fisheries agency and these departments. The importance of coordination across departments for successful SSF management was emphasized by the 10 interviewees (i.e., FM1-6 and LF1-4). They noted that such coordination appeared to be challenging because the administrative functions of the departments somewhat overlapped and their administrative objectives were diverse and occasionally conflicting. Another finding, according to one interviewee (FM2), was that while the fisheries and marine agencies, the two most important authorities dealing with SSFs, were internal divisions of the same department at the county and city levels⁷, they were two separate departments at the province level⁸. This inconsistency in organizational structure hampered departmental coordination even further.

3.2.2.5 Local Governments' Policy Lagging Behind the National Agenda

The PAFL 2019 with new rules concerning SSFs has been enforced for three years. However, the policy documents

⁷At City and county levels: Bureau of Marine and Fisheries of Zhoushan City; Bureau of Marine and Fisheries of Shengsi County.

⁸At provincial level: Department of natural resources of Zhejiang Province; Department of Agriculture and Rural Affairs of Zhejiang Province.

governing SSFs in Zhejiang Province, Zhoushan City, and Shengsi County were largely enacted before 2019 and were not updated to reflect the changed or newly added provisions of PAFL 2019. The gap between national and local legal documents indicates, to some extent, that the SSFs management in Shengsi was lagging behind the national agenda⁹.

4 DISCUSSION: HOW TO IMPROVE SSFS MANAGEMENT IN CHINA?

We found that the management of the SSFs in Shengsi still has a lot of space for improvement based on the results of the policy analysis and the opinions of stakeholders. While modifications made to national fisheries legal texts have the potential to improve SSF management, these documents continue to have shortcomings. There is still no precise definition of SSFs, and there is no legal requirement for data collection and usage in SSF management. Meanwhile, there are flaws in the organizational structure and division of responsibilities. Additionally, local governments' response to the change of national-level policy has been slow. The Ministry of Agriculture and Rural Affairs issued *China's 14th Five-Year Plan for Fisheries Development 2021-2025* in January 2022, stating that the next stage of China's marine fisheries management will focus on "optimizing the structure of the fishing industry" instead of the previous "strict control (over total fishing capacity)." This shift in focus mirrors China's fisheries management's movement toward distinction, refinement, and science, which presents new opportunities for improving SSF management. In this regard, we propose to focus efforts in the following areas to strengthen SSF management in China. **Figure 6** presents a schematic to illustrate the strategy we proposed to improve SSF management, including the different spheres of management and their interactions.

4.1 Defining SSFs Based on Their Characteristics and Clarifying Management Objectives

Defining SSFs is an important base for the precise governance of SSFs (Jentoft, 2014; Chuenpagdee, 2018; Halim et al., 2018; Smith and Basurto, 2019). China is a country whose fisheries management relies on a largely homogenous and top-down system (Zhao and Jia, 2020). However, 'China has a vast coastline, a large number of fishing vessels, and a complex structure of the fishery industry' (Huang and Tang, 2019), universally defining SSFs throughout the nation can be hard due to the very diverse characteristics of SSFs in different regions of the country. In this case, according to the available data sources of SSFs and the existing regulations, we propose that China could develop a set of basic indicators for identifying SSFs at the national level, and then allow the local government to add customized socio-economic indicators and determine the

specific values of the basic and customized indicators to define the SSFs under its jurisdiction according to the local situation. The basic indicators could include the type and size (including fishing without vessels) of a fishing vessel, the spatial scope and type of fishing, and the number of fishing vessels owned by the owner.

Quantitative characteristics are generally straightforward to ascertain, whereas qualitative characteristics are highly variable and difficult to ascertain due to their high degree of integration with political, economic, cultural, and other aspects (FAO, 2005; Johnson, 2006; Jentoft, 2014; Su, 2018; Robotham et al., 2019; Smith and Basurto, 2019). We propose to use a combination of the quantitative and qualitative features of the fisheries to determine SSFs. Quantitative indicators include the type and size of a fishing vessel and the area of the fishing ground; qualitative indicators include the type and size of fishing gear, fishery output units, income levels, and catch utilization patterns. Additionally, the household registration system, cultivated land ownership *via*, and whether the vessel owners are directly participating in fishing could be used as qualitative markers to distinguish SSFs from other fisheries.

It is critical to define management objectives in order to ensure successful governance (Guyader et al., 2013; García-Flórez et al., 2014; Halim et al., 2018). We propose developing a set of SSF-specific management objectives. Such objectives could include safeguarding SSF practitioners who rely on fisheries for their living when fishing capacity is reduced, prioritizing SSFs practitioners when allocating fishing opportunities, and maintaining SSFs fishing grounds.

4.2 Strengthening Data Collection in SSFs

The data serve as the foundation for science-based fisheries management (Costello et al., 2012., EDF, 2013., Su et al., 2021). Data scarcity is a global, long-term issue that impedes the management and protection of SSFs worldwide (Thorpe and McGoodwin, 1996; Zeller et al., 2007; Guyader et al., 2013; García-Flórez et al., 2014; Zeller et al., 2014; Chuenpagdee and Jentoft, 2018). Due to the distinct characteristics of SSFs and industrial fisheries, data gathering in SSFs is significantly more difficult than that of industrial fisheries (FAO and World Fish Center, 2008; Kieran et al., 2012; Nguyen et al., 2017; FAO, 2017; EDF, 2018). Lack of data gathering of SSFs in China is the primary cause of the data and knowledge gap in its SSFs, which makes the implementation of science-based fisheries decision-making even more difficult.

Here, we offer the following approaches for improving data gathering of SSFs in China based on the findings of this study. To begin, in terms of fishing operation data, rather than requiring individual fishers to complete fishing logs, we propose developing an organization-based fishing operation reporting system. To do this, the government must foster the formation of small-scale fisher's organizations and then allow the organizations to act as a conduit between the vast number of SSF fishers and the local government. In detail, SSF members would be expected to submit data to the organizations to which they belong. After each fishing trip, the

⁹This issue makes assessing the impact of legislative changes at the national level on local SSFs impossible and futile at this time, despite the fact that such a topic deserves to be addressed.

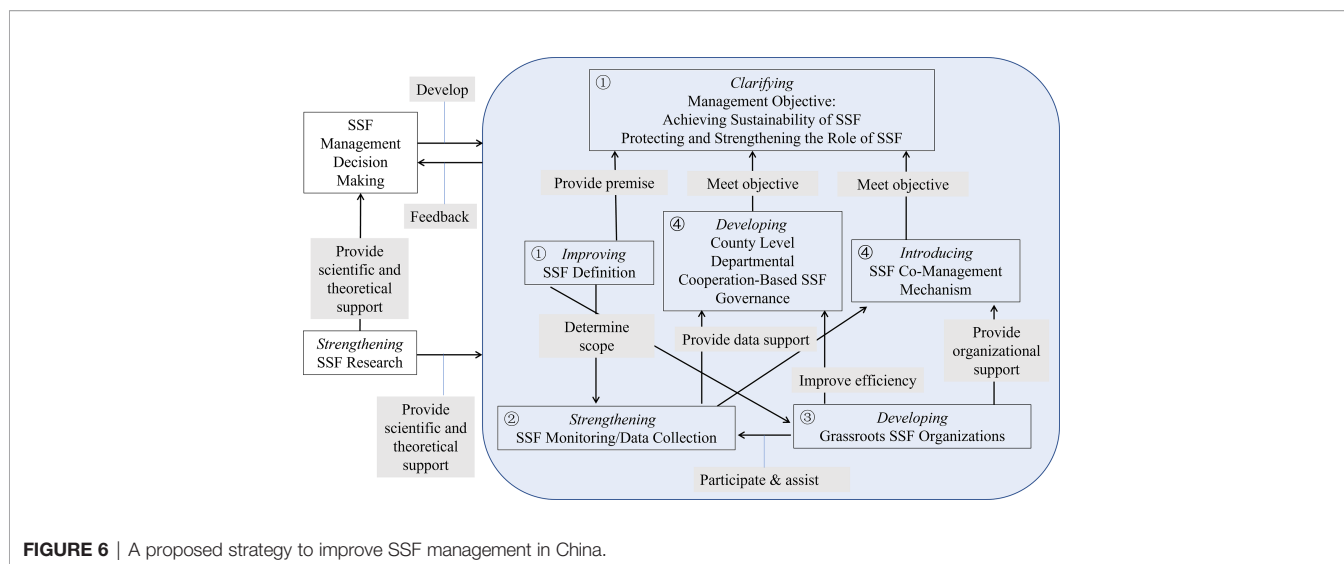


FIGURE 6 | A proposed strategy to improve SSF management in China.

species of catch, the quantity caught, the operation location, and the date of the trip can be reported. Monthly, quarterly, and annual reports can be made on the physical characteristics of fishing vessels and gear, as well as on employment, income, cost, landings and their composition.

The small-scale fishers' organizations may be responsible for developing, maintaining, and updating SSF databases. The government and the organizations might collaborate to develop a simple-to-use mobile fishing log APP or to assist fishers in installing video monitoring equipment on eligible fishing vessels if finance allows (Fréon et al., 2014; Fujita R et al., 2018; Aura et al., 2019).

4.3 Accelerating the Construction of GrassRoots SSF Fishers' Organizations and Introducing a Co-Management Mechanism

Organizations are crucial to improving the management of SSFs (Castilla and Fernandez, 1998; Pomeroy et al., 2001; Linke and Bruckmeier, 2015; Jentoft and Chuenpagdee, 2015; Chambers and Carothers, 2017; Berkes, 2021). To promote China's SSF management, we propose that the government assists SSF fishers in coastal communities who share common interests in organizing, and then provides institutional and financial support to the organizations. To ensure that an organization's members are cohesive and capable of sharing and acquiring common information, experience, production, and technology, the established organizations could be categorized according to population size, fishing type, and employment type (e.g., fishing, processing, and sale). We recommend that the organizations be accountable for organizing the fishing gear, labor, and capital in an integrated fashion. This technique will benefit not only in terms of decreasing individual operation costs but also in terms of sensible resource allocation and use. Additionally, it will help

save management costs, increases the effectiveness of policy execution, and strengthens fishers' sense of belonging and their social responsibility and value.

In fact, several countries, like Japan, South Korea, the United States, and Chile, have substantial experience operating SSFs on an organizational level (Castilla and Fernandez, 1998; Defeo and Castilla, 2005; Song, 2015; Defeo et al., 2014; Delaney, 2015; Lee and Rahimi Midani, 2015; Su, 2018; Tsurita et al., 2018; Alyne, 2018). Furthermore, the benefit of the co-management approach used in SSFs in facilitating collaboration between stakeholders, including Producer Organizations (Pos), the government, and markets, in France has been recognized (Pascual-Fernandez J, 2020; Jentoft, 2005; Jentoft, 2007). Among the stakeholders, the Pos serves a vital role in SSF management by formulating regional fisheries management plans and allocating quotas to the organizations' members (Pascual-Fernandez J, 2020). These practices suggest that the co-management model is highly worth investigating.

4.4 Establishing a Departmental Cooperation-Based Governance Model for SSFs

Collaboration across many government departments is necessary to ensure that SSFs management meets its output targets (Léopold et al., 2013; Purcell and Pomeroy, 2015; Chuenpagdee, 2018). We urge the agencies with responsibilities for managing SSFs to address the issue of insufficient inter-departmental coordination as soon as possible. We recommend that county governments build an inter-departmental collaboration mechanism and information exchange platform for SSF management. The mechanism and the platform should be developed to handle existing challenges such as functional overlap among departments. We underline here that interdepartmental collaboration should anticipate

management issues and develop plans to mitigate opposition and implementation costs, ultimately resulting in the formation of a departmental cooperation-based governance model. Furthermore, mechanisms for addressing concerns across administrative levels and regions are needed.

4.5 Strengthen Research on Small-Scale Fisheries

At the moment, research on China's SSFs is insufficient. Most of the earlier research on this subject conducted by Chinese scholars concentrated on the conceptual analysis of SSFs or providing an introduction to SSFs administration in other countries. Inadequate scientific studies have contributed to China's knowledge gap regarding SSFs and have hampered science-based decision-making when regulating SSFs. As a result, we call for increased data collection and research on SSFs. The research should be multidisciplinary, covering aspects including fisheries, resources, environment, society, economy, humanities, and politics.

5 CONCLUSIONS

The critical role and management of SSFs have garnered broad international attention. In China, this issue is gaining unprecedented attention. In 2020, there were more than 140,000 small-scale registered marine motorized fishing vessels, (Zhao and Jia, 2020). China's domestic marine fishing output will account for 87% of total domestic fishery output in 2020 (Fisheries Administration Bureau, 2021); fishers who engaged in fishing for not less than six months with their net income from fisheries accounted for 50% of the total household income accounted for 54% of all people engaged in fishing (Fisheries Administration Bureau, 2021). The catch of SSFs consisted of more than 100 fish stocks from at least 32 types of fishing gears and methods (Zhao and Jia, 2020). China's coastline is extensive, and its fishing industry is vast with a very complex structure. The SSFs in different parts of the Country's coastal areas varies significantly. Through a case study of SSFs in Shengsi County, we analyzed the characteristics and management policies of SSFs in a specific locality and puts forward suggestions for improving the management of SSFs in China.

In terms of SSF management, the PAFL 2019 indicates that the standard for defining small-scale fishing vessels has been simplified the overall length of the vessel is now the sole indicator, and the main engine power is no longer employed. Also, China has built new institutional arrangements at the national level for the management of SSFs. These arrangements address the development and assignment of the small fishing vessel and net indicators, the distribution of fishing grounds, and the application of fishing licenses. Along with legislative changes at the national level, Zhejiang Province has strengthened vessel location monitoring, mutual assistance, and dynamic supervision of small-scale fishing vessel fisheries. Zhoushan City allows SSFs to operate on a modest level within the special marine protected area and prioritizes fishing chances for subsistence fishers. Additionally, Shengsi County has

established a policy framework to promote and protect subsistence fisheries. Despite the fact that there are initiatives in place, the management of SSFs in Shengsi continues to have serious flaws, including the following: (1) neither the concept of SSFs nor its management objectives are clearly defined in national nor local legal documents; (2) small-scale fishing vessels and fishing without vessel are not required to submit fishing logs, and there are no other relevant legal requirements for the collection and use of SSFs data in management; (3) small-scale fishers' organizations have not been established, and (4) coordination between government departments on SSF management is insufficient. Furthermore, our document analysis revealed that there were regulatory gaps in SSF management requirements between national and local legal documents. This reflects the local governments' slowness in responding to national policy.

By and large, given the critical role of SSFs in ensuring the sustainability of China's fisheries and the socio-economic development of coastal fishing communities, we urge that the Chinese government work to advance SSF management on an ongoing basis. We propose that the government incorporates a standard into legal documents that allow defining SSFs on a case-by-case basis. Meanwhile, the government should clarify SSF's management objectives, strengthen data collection and multidisciplinary research on SSFs, promote science-based decision-making, and establish an interdepartmental coordination and cooperation mechanism for SSF management.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**. Further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

Questionnaire surveys and interviews in this study were conducted in compliance with Chinese laws and with the consent of the respondents. All participants were aware of the use of the data obtained from the surveys and were over 18 years old.

AUTHOR CONTRIBUTIONS

MX: Conceptualization, data collection and resources analysis, investigation, writing-original draft, writing-reviewing and editing, restructure of the manuscript and its revision to address the reviewers' comments. ZW: Conceptualization, data collection and analysis, investigation. YT (corresponding author): Conceptualization, supervision, provision of study resources, reviewing and modification, restructure of the manuscript and its revision to address the reviewers'

comments, funding acquisition. SS: restructure of the manuscript and its revision to address the reviewers' comments. HS: Writing-reviewing.

FUNDING

This study was supported by the fund of the Ministry of Agriculture and Rural Affairs: The Construction of fisheries resources use right system and its relationship with other fisheries management systems.

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ACKNOWLEDGMENTS

We thank all the participants for sharing their time, knowledge and experience. We are grateful two anonymous reviewers for constructive comments.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2022.811382/full#supplementary-material>

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