New impacts and countermeasures of nuclear waste water discharge from Japan on China's aquatic products trade

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Abstract. On April 13, 2021, the Japanese government officially decided to release Fukushima Daiichi Nuclear Power Plant into the sea, which is harmful to the marine environment. Japan is adjacent to the East China Sea. The East China Sea is China's main marine ecological aquaculture area. The discharge of nuclear waste water in Japan will inevitably have an impact on the status of China's aquatic product industry and aquatic product trade. Based on the current situation of China's aquatic products industry and the competitiveness of China's aquatic products in foreign trade, this paper predicts the impact of Japan's nuclear waste water discharge on China's aquatic products trade. Therefore, China should actively use technological innovation, regulatory upgrading, optimization of fisheries technology and other policies in advance to deal with the impact of this nuclear waste water discharge.

1 INTRODUCTION

In 2011, Japan was hit by a magnitude 7.0 earthquake and a massive tsunami that melted down three nuclear reactors at the Fukushima Daiichi Nuclear Power Plant. In the wake of the Fukushima accident, the reactor core continued to emit enormous decay heat, which had to be cooled by injecting water that turned into nuclear waste. In addition, about 1.25 million tons of nuclear waste water had accumulated in storage tanks near the reactors as a result of the sea facing and low lying Fukushima nuclear power plant, where groundwater continued to pool and flow into the reactors, 2021 said. On April 13, 2021, the Government of the People's Republic of China announced that it was releasing nuclear waste water into the sea after removing most of the radioactive elements.

Once the polluted water containing radioactive material is discharged into the open sea, the polluted sea area is first of all the sea off the Pacific coast of Japan, China is adjacent to Japan in the East China Sea, and the further proliferation of the nuclear waste water will certainly affect the sea area of China, it will have a negative impact on marine aquaculture and marine fishing in our country. The quality and structure of aquatic products may change to a certain extent, which will further affect China's aquatic products trade. In order to cope with the impact of Japan's nuclear waste water discharge on China's aquatic products import and export trade, this paper analyses the current situation of China's aquatic products industry and import and export trade, the similarity between China and other major competitors in Japan's aquatic products market is further studied, and the impact of Japan's nuclear waste water discharge on China's aquatic products trade is expected,

put forward the countermeasure strategy and the corresponding countermeasure suggestion.

2 Current situation of aquatic products industry in China

2.1. The gross output value of China's fishery economy shows a gradual upward trend

From 2008 to 2019, the total value of China's aquatic products is shown in Figure 1. From the general trend, the total value of China's fishery economy shows an annual growth trend, with an average annual growth rate of 8.18%.

Fig.1. 2010-2019 industrial output value of five fisheries

China's total fishery output value is mainly composed of the five industrial output values in Figure 1. Among them, the proportion of fresh water aquaculture

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in the output value of the five fishery industries has always been in the first place, the proportion of fresh water industry output value in the last ten years is about 51% , compared with the proportion of sea water industry output value fluctuates about 44% . The discharge of nuclear waste water will pollute the marine environment of Japan and its surrounding sea area, and will have a great impact on the quality and safety of sea water products. In view of the current situation of marine aquaculture and marine fishing in China, as shown in Figure 2, the production of marine aquaculture in China showed a steady growth trend from 2008 to 2019, with an average annual growth rate of 4%, of which the growth rate was as high as 6% in 2012 and 2013. In contrast, the country's marine harvest has declined rapidly since 2016, with an average annual decline rate of 6.6 per cent between 2016 and 2019. This indicates that China's marine fishing is being transformed to marine aquaculture, and the sea area needed for marine aquaculture will be affected by Japan's nuclear waste water discharge, which will certainly threaten the quality and safety of China's marine aquaculture.

Fig.2. Annual production of mariculture and marine fishing in China from 2010-2019

2.2 The main fishing area in China is the East China Sea, and there are differences among the species

The Bohai Sea, the Yellow Sea and the South China Sea, the East China Sea is China's four major sea areas. The East China Sea is the adjacent sea area between China and Japan. China's marine fishing output in the past ten years is shown in Figure 3. China's marine fishing is mainly in the East China Sea and the South China Sea. In 2019, the East China Sea accounted for 41 per cent of all marine catches, while the Bohai Sea accounted for only 6 per cent of total production.

There are different kinds of main aquatic products in the four sea areas of China. The East China Sea is the most productive sea area, and the Zhoushan fishery in the East China Sea is the first time that China has successfully farmed hairtail. The South China Sea is the largest and deepest offshore area in China. The water here is pure and warm all the year round. It is suitable for all kinds of marine life to grow. The South China Sea seafood product diversity level is high, the product

growth cycle is short, and abounds in each kind of tropical aquatic product, like tuna, squid and so on. The sea water in the Bohai Sea is cold all the year round. It is suitable for the growth of abalone, sea urchins and sea cucumbers. The sea floor of the Yellow Sea is smooth. There is a concentration of plankton in the sea, and at the same time there is a large amount of aquatic plants. Therefore, seafood such as shrimp, crab and shell are abundant.

Fig.3. proportion of marine fishing output in China's four major sea areas from 2010 to 2019

Fig.4. 2010-2019 China's annual total distant-water fishing output

China is a big country of ocean fishing industry. The ocean fishing seafood not only has high nutritional value, but also can promote the consumer's consumption upgrade. China's ocean fishing species mainly include tuna, squid and horse mackerel. Tuna accounted for 19.5 per cent and squid for 20 per cent of total pelagic catches in 2019. In terms of species, China's squid fishing industry is the most important. At present, China's squid fishing area has been extended to the high seas fishing grounds in the southwest Atlantic Ocean, in 2018, China's squid production accounted for one fifth of the world's total.

As shown in Figure 4, the total annual output of China's distant-water fishing has shown a trend of first rising and then basically stable in the past 10 years, and remained basically unchanged after breaking through 2 million tons for the first time in 2014. In 2019, the annual output of distant-water fishing reached 2.170,200 tons, down 3.87% from the previous year. The Pacific

Rim is the main distant-water fishing ground in China, and nearly 2/3 of the ocean fishing comes from the Pacific Rim. Therefore, Japan's nuclear sewage discharge on China's marine fishing industry is bound to cause a certain degree of impact.

3 Current situations of China's aquatic products import and export trade

3.1. Current situation of aquatic products import and export trade in China

From 2013 to 2020, Japan, the United States and the Republic of Korea are the main export countries of China's aquatic products^[1]. Among them, Japan ranks first in China's aquatic products export target market, accounting for about 16% of China's total aquatic products export volume in recent years. Affected by trade disputes between China and the United States, the proportion of China's exports to the United States has gradually decreased, and the export volume to South Korea and Thailand has increased. China's imports of aquatic products, Russia has always maintained China's first source of imports of aquatic products market, while in recent years, China's imports of developing countries such as Vietnam and Ecuador gradually expanded the proportion. In contrast, Japan in the export of aquatic products, China has been in the top export of Japanese aquatic products for years, the proportion of neighbouring countries such as Vietnam, Thailand gradually increased; the proportion of the United States has declined. At the same time, in the past eight years, we mainly import aquatic products from the United States, Chile and China. China's share fluctuates at about 10%, and the proportion of imports to Chile has an upward trend. To sum up, China's aquatic products trade development and Japan has a very close relationship, and Japan's dependence on China's aquatic products trade is higher.

3.2. The trade deficit of aquatic products between China and Japan has been maintained all the year round, and the product structure is basically stable

From the two countries' import and export trade volume, according to the relevant data of UN COMTRADE, China's aquatic products trade with Japan has maintained a large trade deficit for a long time in recent ten years. Considering the impact of the new crown disease in 2020 on the overall trade, the trade volume in 2020 dropped by more than 34% compared with the previous year. China's exports to Japan rose 27% in 2011 from a year earlier, to \$1.9 billion, after the Fukushima nuclear disaster. Since then, China's aquatic exports to Japan have fluctuated around \$2 billion, reaching a recent peak of \$2.1 billion in 2018.

From the specific types of aquatic products, the structure of China's export commodities to Japan has been basically stable in recent years. The most important

export products are 0307 kinds of products, at the same time, the main exports are 0301,0303,0304,0306 these four categories. As can be seen from Figure 7, the proportion of category 0307 gradually increases, while that of category 0306 slowly decreases, which indicates that the proportion of China's live Mollusca is gradually more than that of crustaceans, the proportion of the remaining categories remained small fluctuations.

Fig.5 2010-2020 trade volume of aquatic products between China and Japan

Fig.6. Proportion of major aquatic products in China from 2013 to 2020

3.3. Study on similarity of China's aquatic products export in Japanese market

In order to analyse the export structure similarity of certain products exported to the third market or the world market, this paper chooses the export similarity index. The formula is:

$$S_p(ij, w) = \left[\sum \min\left(\frac{X_{jw}^k}{X_{jw}}, \frac{X_{iw}^k}{X_{iw}}\right) \right] \times 100 \quad (1)$$

S_p represents the similarity of product exports, i and j represent each of the two countries being compared, and w represents the third or world market. k is for export and x is for export. The range of movement of the index is [0,100]. The bigger S_p is, the more similar the structure of the two countries' exports^[2].

The selected data in this calculation are trade-related data of 8 sub-categories and 4-DIGIT codes from Chapter 03 of HS2002 code in UN COMTRADE database. In addition, China's main competitors in the table are based on the data in Figure 5, thus selecting the main five countries that Japan imports aquatic products. According to the formula, the data is shown in Table 1. The low similarity of Chinese exports to Russia, Chile and Norway in the Japanese market means that there is less overlap between the two countries' exports and less competition for Japanese exports. By contrast, China's export similarity index with the United States and Vietnam is more than 40, suggesting that China's aquatic product mix is more similar to those of the two countries, and that competition to export aquatic products to Japan is more intense. Specific analysis of product varieties shows that: in the crab trade, China and the United States have fierce competition; in the tuna, salmon trade, China and Norway, Chile has greater competition; in the shrimp trade, china and Vietnam compete more. The discharge of nuclear sewage from Japan will probably affect the pattern of the world aquatic products trade, especially the countries in the surrounding sea area.

Table.1. Product similarity between China and major competitors

COUNTRY	USA	RUS	CHI	NOR	VIE
2013	46	36.7	46.1	30.9	42.4
2014	49.6	41.4	46.5	36.4	39.4
2015	51.8	58.4	43.6	41.4	39.1
2016	50.7	43.8	40.8	31.1	41
2017	45.3	42.7	36.8	39	38.8
2018	41.6	38.9	33.8	34	42.6
2019	43.3	38	35.4	35.3	44.1
2020	41.8	37	34.4	34.8	40.9

4 The impact of nuclear waste water discharge in Japan on China's aquatic products trade

4.1. Affecting the quality and safety of marine fishery-related products in China

Japan is China's close neighbour. Whether the nuclear waste water discharged by Japan is discharged offshore or in the open ocean, radioactive nuclear elements will be diffused in the North Pacific sea area along with the ocean current, the sea areas under our jurisdiction will inevitably be affected by the trans-boundary contamination of radioactive materials. First of all, the pelagic fishery in China will have a direct negative impact. The Pacific Rim is the natural fishing ground for

most of our country's distant-water fishing vessels. In the last five or six years, our country's total distant-water catch has been maintained at about 2 million tons, and almost two-thirds of them have been caught in the Pacific Rim. Obviously, the entire Pacific Ocean's security is closely linked with our country fishery. Secondly, most of China's sea area is closely connected with the Sea of Japan, especially the East China Sea. The East China Sea is the main producing area of China's seafood industry, and its marine environment plays a decisive role in the quality and safety of China's aquatic products.

4.2. Impact on the commodity structure of China's aquatic products export trade

China is one of the leading aquaculture countries in the world. In recent years, most of the commercial fish raised in China are contributed by freshwater aquaculture. In 2019, China's freshwater fish production is about 4.6 times that of marine fish. Among the marine fishes, hairtail, squid, salmon and tuna are the main species for pelagic fishing. Except for the tuna, our country has already started the artificial cultivation stage and has achieved results. After the pollution of the sea area, the domestic consumers may have panic about the quality and safety of the sea products, which will lead to the substitution of the aquatic products. For example, the East China Sea and the South China Sea will be seriously affected, and the hairtail, yellow croaker and other fish in these waters may become unsalable, while the sea cucumber and shellfish produced in such inland waters as Bohai Sea will be substituted. At the same time, more consumers will also focus on the choice of aquatic products in freshwater products, such as grass carp, eel and other species. In the long run, it will have an impact on China's overall consumption structure of aquatic products and further promote the development of China's freshwater fisheries.

4.3. Further promote the export trade of aquatic products in China

If Japan officially discharges nuclear waste water, the pollution could quickly affect the surrounding and adjacent waters as ocean currents move. If discharged from the Fukushima nuclear power plant on the east coast, nuclear waste water will first spread to the other side of the Pacific Ocean near the United States waters. Based on the analysis of export similarity, China and the United States have a high degree of similarity in the export of aquatic products in the Japanese market. China can catch up with this demand gap when Japan's demand for aquatic products in the United States decreases, to further promote China's aquatic products export trade in overseas markets and enhance the competitive advantage of China's aquatic products. From the specific species analysis, because China and the United States in the crab export competition, and China's Yellow Sea and other waters rich in crabs, so China can further promote the export trade of crabs.

5 Conclusions and recommendations

This paper studies the current situation of China's aquatic products industry and its import and export trade, and analyses the export similarity between China and the main competitive countries in the Japanese aquatic products market, china's aquatic products trade presents the overall good trend. China and the United States, Vietnam in the Japanese aquatic products market export competition is more intense than other countries. Considering the geographical and trade relations between China and Japan, the nuclear waste water incident will affect the quality and safety of aquatic products and the commodity structure in China on the one hand. On the other hand, because the pollution level is lower than that of the United States and other major competitive countries, to a certain extent to promote China's aquatic products export trade. Based on the above analysis, this paper puts forward the following policy recommendations:

5.1. Improve China's quality inspection system and strengthen the supervision of aquatic products industry

In the face of the world's resistance to Japanese aquatic products again, China is faced with the opportunity to export a large number of aquatic products, so we must encourage relevant enterprises to expand overseas markets. China should establish a special department to manage and test radiation products, and actively enhance our ability to monitor radiation. At the same time, the relevant departments of China should collect the relevant technical standards and laws and regulations of foreign countries in a timely manner, revise or reformulate the national standards for the identification and testing of radioactive products as soon as possible, and enhance the ability to deal with radioactive radiation in aquatic products as a whole, improving the quality inspection system of import and export food in China^[3]. China's government must strengthen the supervision and management of the aquatic products industry, start from guaranteeing the quality and safety of the domestic market, refine the safety standards of aquatic products, and then optimize the reputation of aquatic products in our overseas market.

5.2. Make up for the lack of structure of aquatic products by technological upgrading

In terms of product composition and structure, China will be able to further replace the shortage of seafood caused by Japan's nuclear pollution. In artificial salmon farming, since 2018, China has officially started the culture era, making full use of the 'Cold water mass' in the Yellow Sea area for cultivation and development. However, in recent years, China has not yet achieved complete artificial breeding of Tuna. Japan, by contrast, has a large natural breeding area for *Thunnus maccoyii*, and there are no natural areas for tuna off our coast. In terms of technology, China's current tuna culture is

basically still in a blank. If China can gradually cultivate the high-end seafood market through quality improvement and technological upgrading, and cater to the preferences of the high-end market to a certain extent, then it may gain a foothold in the high-end seafood market, china's marine products to further promote the world market, improve the competitiveness of China's aquatic products^[4].

5.3. Make up for the lack of structure of aquatic products by technological upgrading

The high-quality development of marine fishery cannot be separated from the support of professional fishery labour force. For domestic mariculture, it is necessary to upgrade the professional skills of the relevant labour force groups from aspects of the control of the mariculture environment, the science of mariculture procedures, and the safe export of mariculture products, to increase the research and development of top marine aquaculture technology, forming an autonomous and controllable marine aquaculture industry chain. As far as distant-water fishing is concerned, less distant-water fishing under the principle of maintaining the sustainable development of marine ecology has caused certain unemployment pressure to distant-water fishing labour force, and attention should be paid to the employment status of distant-water fishing industry practitioners. At the same time, for the distant-water fishing teams, research and development of high-tech fishing equipment will be used to reduce their fishing costs, and through advanced technical means to accurately select distant-water fishing areas, for example, the application of Beidou Navigation System and sonar systems in deep-sea fishing operations will further enhance the technical level and international competitiveness of China's deep-sea fishing operations.

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