A study on the influence of consumption habits of Shanghai residents on seafood consumption intention under the influence of nuclear sewage—Analysis based on linear regression model

Siyi Jiang[1,a,*], Zile Zeng[1,b], Qing Zhang[1,c]

[1]Business School, University of Shanghai for Science and Technology, Shanghai, China
[a]1452112965@qq.com, [b]2358821194@qq.com, [c]zhqing81@usst.edu.cn
*Corresponding author

Abstract: *With the increasing awareness of global ecological environment protection, the health and safety of Marine ecosystem has become the focus of international attention. However, on August 24, 2023, Japan decided to discharge water contaminated by the Fukushima nuclear disaster into the sea, which poses a threat to the Marine ecological environment and food safety of neighbouring countries. In this context, this study takes Shanghai as a case study to study the impact of Shanghai residents' seafood consumption habits on their willingness to consume seafood products from the perspective of consumers, which makes up for the lack of studies on the impact of direct victims in existing literature. In terms of methodology, this study uses statistical tools such as linear regression model to deeply analyze various factors affecting consumers' willingness to consume seafood, aiming at providing scientific basis and policy recommendations for the healthy development of China's seafood market.*

Keywords: *Nuclear wastewater discharge; Willingness to consume; Linear regression model; Seafood; Consumption habit*

1. Research Background

The ecological environment is a matter of great concern to our government and people. On August 24, 2023, Japan releases contaminated water from the Fukushima nuclear disaster into the ocean. This event may have multiple negative impacts on Marine ecosystems, seafood quality and safety, and international trade. The radioactive substances in it will affect the population structure and ecological balance of Marine organisms, and then seriously affect our ecological environment and threaten the health of our people. For neighboring countries and regions, it may also trigger international attention and trade disputes, increasing the testing supervision and trade barriers for seafood imported from Japan, thus posing a challenge to seafood imports of various countries.

As an international metropolis, Shanghai is an important seafood consuming city in China, and the demand for seafood is very strong. The impact of nuclear sewage on Shanghai seafood market is very complex, it not only directly affects the quality and safety of seafood, but also may lead to a series of indirect effects such as consumer trust crisis, market demand decline and trade problems. To this end, the government and other relevant parties need to work together and take corresponding measures to ensure the health and stability of the seafood market.

2. Research Significance

Due to the short time since the "Japanese nuclear sewage discharged into the sea" incident, there are relatively few references. Through a questionnaire survey, the report deeply understood the seafood consumption habits of Shanghai residents after the discharge of nuclear sewage, so as to explore the changes in consumers' purchase intentions for seafood after the discharge of nuclear sewage, and put forward suggestions to the government and the market on this basis, providing a theoretical basis for the development of the seafood market, and helping to cultivate the food health and safety concept of Shanghai citizens. This is not only a useful supplement to the research of seafood and other related fields, but also has certain research value for food health and related fields.

3. Conduct of Investigations

We collected data by sending out questionnaires in a combination of online and offline in Shanghai. First, to ensure the validity and analyzability of the questionnaire, we conducted a pre-survey before issuing the questionnaire. This pre-survey took the form of offline visits, a total of 200 questionnaires were issued, and 189 valid questionnaires were finally recovered after sorting and screening. After the preliminary survey, we processed the data, modified and improved the problems found, formed the final questionnaire, and distributed it online and offline. In the end, a total of 1050 questionnaires were issued, and 869 valid questionnaires were recovered, with an effective rate of 82.7%. On this basis, the questionnaire data were processed, and reliability and validity tests were used to ensure their consistency and validity. Further analysis was then carried out.

4. Analysis of Influencing Factors of Seafood Consumption Intention Based on Linear Regression Model

According to the results of the questionnaire, most consumers pay much attention to the three factors of price, origin and nutritional value when purchasing seafood. Therefore, we conducted an in-depth linear regression analysis of the impact of these three factors on seafood consumption intention：

4.1. Correlation Study

Correlation is a statistical analysis method to study the correlation between two or more random variables of the same status. In order to study the influence of factors that consumers pay more attention to in their seafood consumption habits on their willingness to consume seafood, the following assumptions are made:

H_0: There is no correlation between this factor and seafood consumption intention

H_1: There is a correlation between this factor and seafood consumption intention

After correlation analysis, the following table is obtained: The results are shown in Table 1 below:

Table 1: Correlation analysis and linear comparison table

DV　　　　　　　　　　　　　　　　　IV	Value	Price	Origin	Nutritional Value
Seafood Consumption Intention	PCCs	0.327	0.356	0.356
	P	0.000	0.000	0.000

When the P value is less than 0.05, the null hypothesis is rejected. According to Table 1, the P value of the three variables is all less than 0.05, which proves that there is a significant correlation between the independent variable and the willingness to participate in seafood consumption. Then we will establish a linear regression model to verify the hypothesis.

4.2. The Establishment of The Model

In order to further explore the degree of influence of seafood consumption habits on seafood consumption intention, we establish a linear regression equation here:

$$Y = \alpha + b_1X_1 + b_2X_2 + b_3X_3 + \varepsilon \tag{1}$$

Wherein, in order to satisfy the random disturbance term of the classical hypothesis, α is the constant term, X_1, X_2 and X_3 are the degree of attention to price, origin and nutritional value respectively, b_1, b_2 and b_3 are regression coefficients, and Y is the willingness to consume seafood.

4.3. The Verification of The Model

4.3.1. Residual Independence

Table 2: Residual independent DW table

R	R^2	Adj R-squared	DW
0.408a	0.166	0.164	2.052

DW statistics were used to test the residual independence of the regression model. The value of DW

ranges from 0 to 4. The closer the DW value is to 2, the more irrelevant the residual terms are. The closer to 0, the stronger the positive correlation; The closer you get to 4, the stronger the negative correlation.

According to Table 2, the calculated DW value is 2.052, which falls in the interval without serial correlation, indicating that the residual is independent.

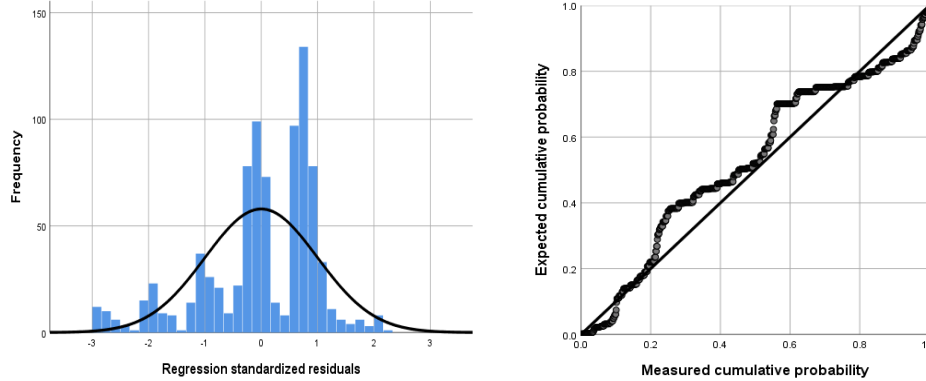### 4.3.2. Normal Distribution

Figure 1: The standardized residuals approximately follow a normal distribution.

Figure 2: Normal P-P plot for regression of standardized residuals.

It can be seen from Figure 1 and Figure 2 that the standardized residuals approximately follow the normal distribution, and the scatter points basically spread around the diagonal of the first quadrant, thus judging that the residuals basically follow the normal distribution.
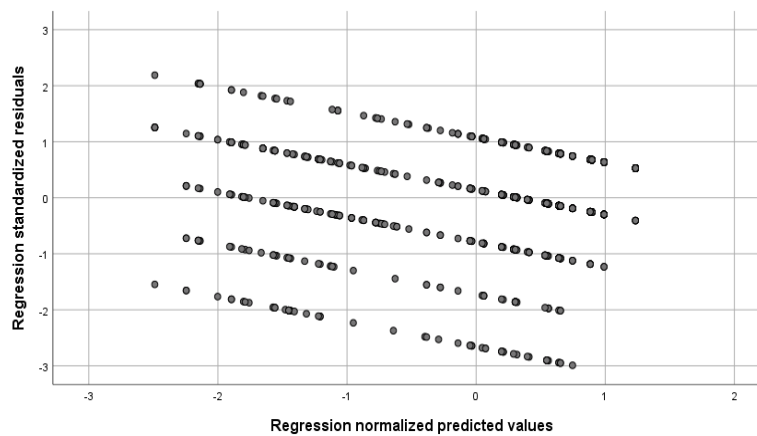
4.3.3. Homogeneity of Variance

Figure 3: Linear regression scatter plot.

It can be seen from the Figure 3 above that the dispersion fluctuation range of the standardized residuals is basically stable and does not change with the change of the standardized predicted value, so it can be considered that the residuals are basically homogeneity of variance.

4.4. Result Analysis

4.4.1. Regression Equation Calculation

As can be obtained from the multicollinearity table coefficients above, the linear regression equation of this model is:

$$Y = 2.212 + 0.116X_1 + 0.167X_2 + 0.161X_3$$
$$(3.165) \quad (4.177) \quad (4.211) \tag{2}$$

This equation indicates that seafood consumption intention $=2.212+0.116\times$price$+0.167\times$origin $+0.161\times$nutritional value. In other words, when the price factor increases by 1 point, the residents'

willingness to consume seafood increases by 0.116 points on average.When other factors remain unchanged, the residents' willingness to consume seafood increases by 0.167 points on average when the origin factor increases by 1 point. When the nutritional value factor increased by 1 point, the residents' willingness to consume seafood increased by 0.161 points on average.

4.4.2. Model Result analysis

According to the linear regression results of the model, we can conclude that from the perspective of seafood itself, the origin, selling price and original nutritional value of seafood all have significant effects on consumers' willingness to consume seafood. Among them, because the discharge of nuclear sewage in Japan is a regional pollution, the influence of origin factors is the highest, followed by nutritional value and price.

From the perspective of origin factors, based on the above data analysis results, after the discharge of nuclear sewage in Japan, consumers pay the most attention to the origin when choosing seafood products, and it also has the greatest impact on consumers' willingness to consume seafood. Therefore, we speculate that consumers who pay more attention to the origin factor will subconsciously reduce their willingness to consume seafood products from Japan and its surrounding waters, and choose other products that they think are safe as substitutes.

In terms of nutritional value, after the discharge of nuclear sewage, the food quality of seafood products produced from the polluted sea area is reduced, and the nutritional value is damaged to a certain extent. According to the results of the linear regression model, when other factors remain unchanged, the degree of attention to nutritional value is positively correlated with the intention to consume seafood. Therefore, we speculate that the more consumers pay attention to the nutritional value of seafood products when buying seafood, the more likely they are to preferentially choose products that are less affected or not contaminated for the time being. The higher the nutritional value of seafood products, the stronger the willingness of consumers to consume.

In terms of price factors, consumers who pay more attention to the price of seafood products after the discharge of nuclear sewage are more likely to change their willingness to consume seafood. We speculate that this is because the nuclear sewage incident has stimulated the seafood market, and the price of seafood products has fluctuated, and the price of those contaminated seafood has decreased, and the price of safe seafood has increased. Combined with the information investigated in the questionnaire, we can infer that more consumers tend to pay a higher price for seafood products that have passed strict inspection.

5. Relevant Measures

Based on the above conclusions, we try to put forward some suggestions and measures aimed at the factors of origin, price and nutritional value that consumers are most concerned about to improve the seafood market environment affected by nuclear sewage.

First of all, the government and relevant departments of the ecological environment have formulated strict information disclosure regulations, requiring seafood suppliers and sellers to provide complete and accurate product sources, test results and other information, including but not limited to the fishing ground, breeding environment, whether the seafood has been tested for nuclear pollution and other key information. [1]

In addition, before the seafood is put on the market, the radiation exposure of seafood and the indicators that may be affected by nuclear contamination are strictly tested, and the test results are disclosed to the market, so as to achieve full transparent and full coverage from the source to the table, so as to solve consumers' concerns about whether the seafood is contaminated. Secondly, enterprises can increase scientific research efforts in the research and development of seafood substitutes. Through biosynthesis, gene editing, cell agriculture and other new technologies, seafood substitutes with similar taste, nutritional value and edible properties can be developed to explore new food resources, develop "artificial seafood" or use other resources, such as vegetable protein, as substitute raw materials for seafood. To meet consumer demand for the nutritional value of seafood.

What's more, suppliers can widely apply the Internet, intelligent equipment, big data, satellite remote sensing, artificial intelligence and other information technologies in aquaculture, combined with accurate identification, intelligent analysis and automatic control and other technologies to establish accurate feeding, breeding and digital management, disease monitoring and early warning and feces automatic

cleaning systems, improve the quality of seafood products and detection transparency.[2]

6. Conclusions

This paper focuses on the social hot spot of Japan's nuclear sewage discharge into the sea, and studies consumers' choice of consumption behavior (i.e. consumption intention) in seafood consumption habits by starting with three factors of seafood origin, price and nutritional value, and uses the most classic linear regression model to explore the degree of influence of consumption habits on consumption intention. After this incident, many consumers have concerns about seafood food safety. Through analyzing consumers' consumption choice and purchase intention, corresponding policy suggestions are put forward, such as developing seafood substitutes, strengthening safety supervision of seafood products and improving information transparency. Nuclear sewage discharge into the sea not only has a huge impact on the seafood market, but also will continue to affect the ecological environment and human health. The government needs to pay great attention to and take effective measures to minimize the adverse impact of this incident on people and the ecological environment.

References

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