Estimation of Consumer Value on Import Management of Seafood Obtained from IUU Fishing: Using Choice Experiment Method*

Ji-Eun An

Fisheries Policy Research Division, Korea Maritime Institute, South Korea

Se-Hyun Park

Department of International Trade, Kangwon National University, South Korea

Heon-Dong Lee[†]

Division of Marine & Fisheries Business and Economics, Pukyong National University, South Korea

Abstract

Purpose – This study empirically analyzes the consumer value of risk management associated with illegal, unreported, and unregulated (IUU) fishing of fishery products imported to Korea. The global regulatory paradigm for IUU fishing has shifted from production-centered to market-centered. As a result, changes in the international fisheries trade environment emphasizing "transparency" and "legality" of the production process are accelerating. Therefore, changes in the management systems of fishery products entering the country are also needed. Accordingly, this study estimated the consumer value for risk management of IUU fishing, targeting major fish species imported to Korea, and derived the feasibility of introducing related policies.

Design/methodology – This study used the choice experiment as an analysis model to estimate consumers' willingness to pay for the "possibility to check for IUU fishing." The choice experiment assumes that the value of a good or service is composed of separable attributes and that the sum of the part-worth of these individual attributes becomes the total value. In this study, respondents were presented with profiles comprising three attributes (country of origin, price, and possibility of checking IUU fishing) and the levels of frozen poulp squid, the subject of the analysis. The participants were asked to select their preferred profile. The marginal willingness to pay for each attribute was derived from the results of the respondents' choices using conditional logit model estimates.

Findings – There is a marked difference in utility based on the preference of the country of origin of fishery products among consumers. In addition, the utility of fishery products that have undergone IUU fishing verification was observed to be higher, with the utility marked to be higher for lower prices.

Originality/value – Estimating the policy value of the risk management in IUU fishing of imported fisheries products in this study is a novel attempt that has never been conducted before. Several studies have been conducted to assess the risk of IUU fishing associated with the import of fishery products internationally. However, such studies are yet to be conducted in Korea. Instead, policies and studies have focused on issues related to complying with trading partners' legal and transparent standards for exporting fishery products. This study should be the beginning of more in-depth empirical and theoretical explorations to establish order in the domestic seafood market and respond to changes in international regulations on IUU fishing.

Keywords: Choice Experiment Method, Consumer Value, Imported Seafood Management, IUU Fishing, Market-related Measure
JEL Classifications: F18, F53, Q17, Q37, Q56

[†] **Corresponding author:** hdlee@pknu.ac.kr

1. Introduction

Seafood obtained from illegal, unreported, and unregulated fishing (hereafter referred IUU fishing) accounts for about 25% of the total global seafood catch (The PEW Charitable Trusts, 2018). Economic losses from IUU fishing range from $ 26–50 billion (Sumaila et al., 2020), indicating that international efforts to eliminate IUU fishing[1] over the past 20 years aimed to ensure the sustainability of the fisheries industry and fairness in global fisheries trade need to be relatively more effective. Given the context of the international fishery trade, Korea[2], a significant seafood-consuming and -importing country, has no choice but to be exposed to the threat of IUU seafood products. Moreover, with various changes in domestic and international conditions, seafood imports to the Korean market are expected to continue to increase. Therefore, there is an ever-increasing need to establish measures to prevent the distortion of legal markets and damage to the fishery industry caused by the entry of illegally produced seafood products.

The international community has strengthened "market-related measures" to eliminate IUU fishing, requiring market states to implement "precautionary management," ensuring a safe and legal supply of seafood products, and establishing order in fisheries and consumer markets. "Market-related measures" are trade measures under the "International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (hereafter referred to as IPOA-IUU)" of the Food and Agriculture Organization (FAO) for combating IUU fishing. Furthermore, these measures can represent non-tariff barriers that strengthen the distribution and import of fishery products and their trade by adopting catch logs and certification systems. These measures can eradicate IUU fishing by blocking entry into the seafood supply chain after confirming whether the fishery product is related to IUU fishing during production or transportation. Therefore, these measures represent "precautionary management" based on the principles[3] stipulated in the international fisheries regulations.

Market-related measures to combat IUU seafood emphasize the responsibility of exporting and importing countries to ensure smooth implementation and derive maximum effects. Furthermore, to formulate an appropriate and safe structure for the supply of fishery

---

[1] IUU fishing is a complex global practice that disrupts fisheries management and encourages overfishing in waters worldwide. It destroys fisheries resources and marine habitats, compromises sustainability, and threatens food and national security. In response, the international community announced the IUU-IPOA, an international agreement regulating IUU fishing in 2001 and implemented the IUU fishing regulations based on international standards, such as fisheries surveillance and control and monitoring of fishing gear and fishing method (Aylesworth, 2021).

[2] As of 2021, the seafood imports of Korea amounted to approximately 6.18 billion won, ranking fifth in the world. The per capita consumption of fisheries products in 2019 was 69.8 kg, ranking first worldwide (FAO, 2020; Korea Rural Economic Institute, 2019).

[3] The precautionary principle (preventive approach), based on environment-related international laws, refers to the "principle of when a state makes a decision in relation to activities that may have adverse effects on the environment, it shall act with due care and deep insight with regard to the environment, even if the scientific result is not conclusive." In the fisheries industry, traces of this concept can be observed in paragraph 2, Article of the 1995 United Nations Fish Stock Agreement. Specifically, the precautionary principle in the fisheries sector is fulfilling the obligation of the international community to take resource conservation and management measures despite scientific uncertainties, and the scope of its application includes the entire cycle of the fisheries product, such as catching, processing, and distribution (Marr, 2000).

products, market states must fulfill their precautionary management obligations as players in the global fisheries trade market. In particular, the recent inclusion of provisions related to IUU fishing regulations and the requirement for market-related measures in multilateral trade agreements, such as the CPTPP and USMCA, will strengthen the role and responsibility of market states in international fisheries trade.

Major seafood importers such as the United States (US), Japan, and the European Union (EU) have pre-emptively introduced a precautionary management system with an enhanced traceability method to secure the safety and legality of fishery products. They comply with the international obligations to implement market measures by legislating traceability obligations for imported seafood products to block their distribution and entry of IUU seafood products into their territories.

Specifically, the EU established the IUU regulations in 2008 and thus pre-emptively introduced the catch documentation scheme (hereafter referred to as CDS), applied to all fishery products entering the region. In 2020, the entire process related to the entry and distribution of all fishery products in the EU was managed and controlled by the primary country-of-origin labeling, preventing illegal catch entry, distortion of the domestic consumption market, and consumer rights infringement. The US established the Seafood Import Monitoring Program in 2018 based on Section 1857 of the Magnuson-Stevens Fisheries Conservation and Management Act[4], a fundamental law on fisheries requiring mandatory registration of catch certification for 13 seafood[5] imported and distributed in the US. Japan is the most recent country wherein relevant legal systems have been established. In December 2020, the Ensuring Proper Domestic Distribution and Impact for Specified Aquatic Animals and Plants Act was enacted. Based on this Act, the submission of catch certificates for the four types of fisheries products[6] imported into Japan has been a legal requirement since December 2022.

In addition to measures eliminating IUU fishing, a traceability system to strengthen the hygiene and safety of fishery products has recently been introduced, implying that "precautionary management" is becoming increasingly important to guarantee the supply of safe and legal fishery products.

Although the necessity and importance of implementing market-related measures to eradicate IUU fishing continue to grow internationally, countries that still need to implement such measures are highly likely to be subject to regulation by the international community. A possible explanation for this is that the negative image of an "un-cooperating country" that does not participate in the efforts of the international community to eradicate IUU fishing can be strengthened. Consequently, the possibility of emerging as the final destination for IUU seafood products increases, which may disrupt the domestic market and adversely impact the export market of seafood products; thus, preemptive countermeasures are required.

Therefore, this study indirectly estimates the policy effect of import management of IUU

---

[4] This provision prohibits the importation and trade of seafood caught, held, transported, or sold violating the laws or regulations of a foreign country or violating the binding safeguards of a treaty or RFMO to which the US is a party, either between different countries or in foreign trade.

[5] The 13 seafood products include abalone, Atlantic cod, Atlantic blue crab, dolphinfish, grouper, king crab, Pacific cod, red snapper, sea cucumber, shark, shrimp, swordfish, and tunas, i.e., albacore, bigeye, skipjack, yellowfin, and bluefin tuna.

[6] Squid, Pacific saury, mackerel, and sardine.

seafood and assesses consumer value of fisheries products on three attributes, namely "country of origin," "possibility to check for IUU fishing," and "price." Thus, this study aims to provide baseline data for setting the policy direction for the systematic management of the imports of IUU seafood. To this end, this study reviews the analysis methodology in Section 2 and explains the questionnaire design and implementation in Section 3. Chapter 4 presents the survey analysis results. Finally, section 5 concludes the manuscript.

2. Literature Review

Theoretical and policy research on implementing market-related measures for IUU seafood products is conducted actively by leading consumer and importer countries such as the US and the EU, international organizations (FAO and OECD), and environment-related international NGOs, including WWF and PEW. In particular, major seafood-importing countries, such as the US, EU, and Japan, include the concept of "legality" in their seafood management elements to control IUU fishing and seafood products derived from IUU fishing, which have been displayed as a chronic problem in the fisheries industry. In addition, several studies have been published on the need for strengthening management policies, institutionalization, and implementation plans to block the inflow of IUU marine products.

Recently, the US has emerged as the country conducting most active research on the import management of IUU seafood within the international community. In 2009, the US developed a method for estimating the IUU seafood intake by considering various possibilities (Agnew et al., 2009). Based on the results of this study, a model was developed to estimate the share of IUU seafood imported to the US in 2014 (Pramod et al., 2014). In 2021, the US International Trade Commission calculated the status of imports in IUU catches in the US and other major importing countries and the scale of economic damage to commercial fisheries caused by importing IUU catches (Unites States International Trade Commission, 2021). According to a study, as of 2019, IUU seafood imports in the US accounted for 11% of all imported seafood accounting for a total of $2.4 billion. In addition, the study revealed that removing IUU seafood from the distribution chain in the US chain can increase the price of all imported seafood, decrease total imports, and increase the profits of the domestic commercial fishery industry by approximately $60 million.

From 2008 to the present, the EU introduced the CDS for regulating IUU fishing and IUU marine products and is actively researching on the implementation of related laws and systems and future improvement plans. Elvestad and Kvalvik (2015) investigated and analyzed the current IUU-related regulations in the EU. In addition, measures to improve compliance, strengthen regulatory compliance monitoring, introduce electronic CDS, strengthen information transparency, interlock trade measures, and reinforce cooperation among flag, coastal, port, and market states. Leroy et al. (2016) analyzed the hierarchical structure of trade measures related to IUU fisheries and market-related actions related to trade in fishery products within the World Trade Organization (WTO), drawing the current status and limitations of measures implemented for regulating IUU fisheries within the EU.

The FAO is leading the development of the IPOA-IUU and the continuous development of related systems while continuing policy support and basic research activities at the national level to strengthen transparency in the global seafood supply chain. The FAO provided

voluntary guidelines for CDS in 2017 (FAO, 2017) and published a research report on CDS support systems at the national level (Hosch and Blaha, 2017).

Research into imported seafood products and IUU fishing management in Korea began in the 2000s. However, related studies undertaken in Korea have had limitations in that the two subjects, i.e., imported seafood and IUU fishing or IUU seafood products, have not been linked. Therefore, it is regrettable that there is no comprehensive research result on "IUU imported seafood management," whereas it is evident that the need and urgency of future research in this field is high.

Park (2018) represents the only study conducted in Korea on the status of IUU fishing and trade measures adopted for regulating IUU seafood. This study analyzes the control system for regulating IUU seafood imports in the US and reviews the compatibility between this system and WTO agreements to draw domestic implications. This study examined the current status of legislation related to IUU seafood imports in the main trading partners of Korea, including the US, highlighting the need for domestic laws and regulations at the international level to achieve a balance with these countries.

Prior research on the methodology used in this study employed the conditional value evaluation method (CVM) of the stated preference or the highest, confirming that minimum adjustment and conjoint analysis methods were employed in many cases. It was observed that selection experiment-type conjoint analysis based on consumer surveys, which are the targets of related policies, was mainly used to analyze the policy effects of primary industries such as agriculture and forestry, livestock, and fisheries (Lee and Joo, 2009; Lee et al., 2006; Kwak et al., 2006). A likely explanation for this could be that conjoint analysis can estimate the economic value of utility for various attributes and evaluate the value of each such attribute compared to that in CVM, which is the most commonly applied among stated preference methods.

3. Analysis Methodology

3.1. Overview of Analysis

Several discussions are needed to assess the consumer value of "precautionary management" of imported IUU fishing seafood. First, when consumers purchase seafood in Korea, they wish know beforehand whether it is derived from illegal fishing. In addition, as such information is often not provided, assessing consumer value using a market approach is limited. In the future, when the catch certification system is applied to imported seafood products, for example, if an "IUU-free" label is attached, consumers can check whether the seafood is derived from IUU fishing. However, this is currently difficult for consumers to know. Thus, a survey using a non-market approach that assumes a hypothetical purchase situation for consumers purchasing seafood products is needed. Consumers tend to consider whether a seafood product is caught via IUU fishing while buying the product. In other words, the questionnaire needs to be designed such that information on whether the seafood product is caught via IUU fishing can be considered in the purchase decision.

Second, it is necessary to review the "precautionary management" of the imports of IUU seafood in detail, and ascertain in which form these can be used to assess consumer value. In

this study, "precautionary management" is defined as a system that protects the domestic seafood market from the risk of IUU fishing by blocking seafood imports derived from IUU fishing. The key is for market states to introduce a catch certification system and adopt trade-restrictive measures so that only seafood recognized as legal can cross borders. It was assumed that if such precautionary management is applied, consumers can check whether imported seafood has been caught via illegal fishing. In other words, checking for illegal fishing, as opposed to legally caught seafood, was considered an essential attribute influencing consumers' decisions to purchase fishery products.

Third, there is the question of which product item among the seafood imported into the country will be the subject of assessment of the consumer value of the "precautionary management" of the imports of IUU seafood. An essential factor to consider in selecting product items is that they need to account for a relatively large portion of seafood imports in Korea and have a high probability of being derived from IUU fishing. In addition, such items must be produced in Korea and show differentiated preferences based on the country of origin, price, and involvement in IUU fishing. Based on the import status of fishery products in Chapter 3, Korea has recorded substantial imports from China, Russia, Vietnam, and Norway. In terms of importing by item, excluding the category of "other fish," which does not specify the fish species, shrimp, pollock, salmon, poulp squid, and snow crab account for a large portion of imports. Meanwhile, among the top 10 exporters of seafood to Korea, countries placed on the list of potential or confirmed IUU fishing countries by the US and the EU include China, Russia, Vietnam, Thailand, Taiwan, Mexico, and Ecuador.

As a result of this comprehensive review, this study selected poulp squid as the subject of analysis among imported seafood products. Shrimp, which accounts for the most significant portion of imports in terms of value, is imported from several countries. However, most of it is produced through aquaculture and thus has little relevance to IUU fishing. In addition to production from distant-water fishing by Korean vessels, pollack is imported mainly from Russia and the US. However, as there is no substantial difference in the quality and price of frozen pollack sold in the market and consumer awareness of the country of origin remains low, it was excluded from the analysis. Salmon was excluded because most salmon is imported from Norway. However, poulp squid is imported from China and Vietnam, and the possibility remains that the poulp squid is derived from IUU fishing. It is also caught every year in Korea. Therefore, consumer awareness of domestic and imported products is relatively high. Thus, poulp squid was selected as the subject of analysis because it was relatively easy to design and implement a survey on poulp squid to assess the consumer value of the "precautionary management" of the imports of IUU seafood (Table 1).

The results obtained for the consumer value assessment of the "precautionary management" of the imports of IUU seafood must be interpreted relatively more broadly to represent the effects of "precautionary management" considering all seafood imports. However, considering that it is impossible to conduct a survey that assesses numerous seafood products likely to be caught from IUU fishing and imported into the country, the results of the consumer value assessment in this study cover only a case of "poulp squid," requiring limited interpretation.

Table 1. Review for Selection of Consumer Value Measurement Items

(Unit: million USD, %)

Item	Imported value in 2021	Imported country	Review	Remark
Shrimp	732 (11.9)	Vietnam, Thailand, China, Ecuador	· Both domestic and imported products are produced via aquaculture. · Challenging to consider it as seafood obtained from IUU fishing.	Exclude
Pollock	501 (8.1)	Russia, the United States	· Low consumer awareness of the difference in price between pollock caught from distant-water fishing by Korean vessels and imported pollock.	Exclude
Salmon	371 (6.0)	Norway, Chile	· Minimal level of domestic production. · Mostly imported from Norway, produced from aquaculture.	Exclude
Poulp Squid	283 (4.6)	China, Vietnam	· Domestic and imported products are sold at various price levels in the market. There is a difference in consumer preference. · Possibility that imports may have been derived from IUU fishing.	Select

Note: When looking at the ranking by the share (by value) of imports of seafood products, in addition to the above items, snow crab, webfoot poulp squid, Bluefin tuna, mackerel, cod, and croaker can also be considered. However, these items were excluded because they do not account for a large portion of total seafood imports, as consumer awareness is low due to low domestic production, and certain items are not related to IUU fishing.

Source: compiled by the author.

3.2. Analysis Model

A choice experiment was used as an analysis model to assess consumers' willingness to pay for the possibility of checking IUU fishing. The choice experiment was based on the random utility theory. It assumes that the value of a good or service is composed of separable attributes and that the sum of the part-worth of these individual attributes becomes the total value.[7] Thus, profiles comprising various attributes and levels were presented to the respondents, followed by selecting the most preferred profile. Therefore, the choice experiment is a method wherein respondents directly choose their most preferred alternative. Furthermore, respondents do not have to express the monetary value of an object, as in the CVM. Thus, starting point bias can be minimized (Jung and Bae, 2018).

The utility function that consumer i gains from alternative j belonging to the choice set can be expressed as Equation (1):

---

[7] The choice experiment method is developed from the conjoint analysis method used widely in marketing. The difference between conjoint analysis and choice experiment methods is that the former analysis usually ranks preferences or ratings for various attributes, whereas the latter allows subjects to choose an alternative consisting of several attributes and levels (Kim Si-hyeon, 2016).

$$U_{ij} = V_{ij} + \epsilon_{ij} \tag{1}$$

Here, V_{ij} refers to the deterministic component of alternative j of respondent i which is observable, and ϵ_{ij} refers to the error component that cannot be explained by V_{ij}. If for all alternatives included in the choice set C_i is $U_{ij} > U_{ik}(k \in C_i, k \neq j)$, then respondent i chooses alternative j. Here, the probability of selection is defined as follows:

$$Pr_i(j|C_i) = Pr\{V_{ij} + \epsilon_{ij} > V_{ik} + \epsilon_{ik}\} = Pr\{V_{ij} \uparrow -V_{ik} > \epsilon_{ik} - \epsilon_{ij}\} \tag{2}$$

The error term in Equation (2) is assumed to follow a Type Ⅰ extreme value distribution (McFadden, 1974). The probability of respondent i selecting alternative j is expressed by the conditional logit model below (Choi et al., 2019):

$$Pr_i(j|C_i) = \frac{\exp(V_{ij})}{\sum_{k \in C_i} \exp(V_{ik})} \tag{3}$$

In this study, the respondents were presented with three alternatives to a questionnaire designed as a choice experiment. They were asked to choose one option in consideration of the trade-off between attributes of "country of origin," "possibility to check for illegal fishing," and "price." The choice result for the respondent i's selection of alternative j is defined by the indicator function $A_{ij} = 1(\cdot)$. Here, A_{ij} has a value of 1 when the j-order alternative is chosen by i order respondent and a value of 0 when not chosen. The log-likelihood function is expressed below. Maximum likelihood estimation was used to estimate the conditional logit model, as follows:

$$\ln L = \sum_{i=1}^{N} \sum_{i=1}^{3} \{A_{ij} \ln Pr_i(j|C)\} \tag{4}$$

However, the specific functional form of the definite part V_{ij} of the indirect utility function is assumed linear, as shown in Equation (5) below. Here, β_m represents the coefficient of estimation for the attribute, and X_{ijm} represents the attribute presented in the questionnaire, which corresponds to "country of origin (Korea, Vietnam, China)," "possibility to check for illegal fishing," and "price" in this study:

$$V_{ij} = \sum_{m=1}^{M} \beta_m X_{ijm} \tag{5}$$

Among the coefficient values estimated from Equation (5), the marginal willingness-to-pay (MWTP) can be derived for each attribute using the trade-off between individual and price attributes. MWTP is the standardized value of the change in consumers' marginal utility, expressed in monetary units. For convenience, suppose the price attribute is defined as X_{price}, and the remaining attributes are defined as X_{other}. In this case, it can be calculated using the estimate of the conditional logit model as follows:

$$\text{MWTP} = -\frac{dV/dX_{other}}{dV/dX_{price}} = -\frac{\beta_{other}}{\beta_{price}} \tag{6}$$

4. Empirical Analysis and Results

4.1. Survey Design and Implementation

Consumers' willingness to pay for the "precautionary management" of the imports of IUU seafood was estimated based on the results obtained in a public survey. Survey design for the choice experiment needed to be performed by setting the attributes and levels of the subject of the analysis and the profile of each attribute (Lee and Joo, 2009). A likely explanation for this is that in the case of fishery products, in particular, the price consumers are willing to pay differs depending on various attributes. Accordingly, this study assumes a situation in which consumers purchase frozen poulp squid[8] at a hypermarket or online shopping mall. Three attributes were set for the poulp squid, namely "country of origin," "possibility to check for illegal fishing (IUU)," and "price." Additional attributes, such as the shape of the packaging and the size of the poulp squid, could have been considered. However, the survey was restricted to only the key attributes considering that respondents may find it challenging to respond when the survey becomes overly complex.

Country of origin was divided into three levels, such as local regions/ Korea, Vietnam, and China[9], and "possibility of checking illegal fishing" was divided into two groups, such as "verified that it is not derived from illegal fishing" and "not verified." In addition, the price of frozen poulp squid was divided into three levels, namely 7,000 won, 12,000 won, and 17,000 won per 500 g package unit, by referencing the local and imported poulp squid prices currently sold in hypermarkets and online shopping malls.

As described above, 18 combinations (3 × 2 × 3) were created when the selection alternatives were constituted by considering the attributes and levels of frozen pulp squid. It was possible to use all 18 combinations in the survey because there were few alternative selection combinations compared to prior studies conducted domestically and overseas that applied choice experiments. An orthogonal plan was created, followed by the extraction of selection alternatives to enable a fractional factorial design using SPSS (Ver 27.0). Superior and rather unrealistic options were excluded from among the 18 combinations. Below are presented the various questionnaires used in this study (Tables 2 and 3; Fig. 1). Respondents were asked to choose one of the selection options, A, B, or C, for the three categories "country of origin," "whether illegal fishing is involved," and "price."

The survey used an online method with a structured questionnaire (Fig. 1) administered to 812 ordinary citizens from August 9–26, 2022. The survey consisted of four parts to determine whether consumers were aware of the need for a management policy for IUU seafood imports, which was the ultimate purpose of this study, and the level of its value. Part 1 identifies the essential awareness of IUU fishing and seafood products. Part 2 deals with ascertaining consumer satisfaction levels and the required improvements in the existing

---

[8] Poulp squid that consumers can purchase in the market can be classified into three types, such as live, fresh/ chilled, and frozen. The market price of the poulp squid based on each type shows a significant difference. Therefore, this study limited the survey subject to "frozen poulp squid" to enable a better understanding of questions in the consumer survey, ease of responding to questions, and the point that most imported poulp squid are distributed in a frozen form.

[9] As of 2021, the import status of frozen poulp squid by country in terms of value shows that China accounts for 66% of total imports and Vietnam accounts for 23%. In addition to the two countries, Korea also imports from Indonesia, Malaysia, and Thailand, but the proportion of these imports is negligible.

management policy for importing seafood. Part 3 enquires about the need for and preferred management policy for importing IUU seafood. Finally, Part 4 asks questions related to the choice experiment to estimate the value of related policies.

Table 2. Attributes and Levels of Frozen Poulp Squid

Attributes	Levels
Country of origin	① Local/Korea ② Vietnam ③ China*
Possibility to check for IUU fishing	① Verified as non-IUU seafood ② Not verified (possibility of the illegal fishery exists)*
Price (won/500g package)	① 7,000 won ② 12,000 won ③ 17,000 won

Note: * represents the reference level of each attribute.
Source: compiled by the author.

Fig. 1. Example of the actual questionnaire used

Among the frozen poulp squid products A, B, and C presented below, choose the one you are willing to purchase.

Frozen poulp squid 500g	Division	A	B	C
	Country of origin	China	Korea	Vietnam
	Whether or not illegal fishing is involved	Not Verified	Verified	Verified
	Price	7,000 won	12,000 won	12,000 won
	Choice	☐	☐	☐

Source: compiled by the author.

The statistical characteristics of the 812 respondents who answered the survey were as follows. A high percentage of respondents were in their 40s, 50s, and 60s or older, accounting for more than 20% of the sample. Furthermore, a sizable proportion of respondents lived in the Incheon/ Gyeonggi and Seoul areas (31.7 and 20.7%, respectively). Regarding occupation, relatively high proportions of respondents were office-going or production/ technical workers at 49.9 and 14.2%, respectively. College graduates accounted for 68.6% of the sample. Regarding average monthly income, the income ranges of 5–6 million and ≥7 million won were high at 25.1 and 22.0%, respectively. Regarding family members, the proportion of families with 3–4 or more members was high, accounting for more than 30%.

Table 3. Survey Design Overview

Division	Description
Purpose	· Awareness of IUU fishing
	· Issues in current management policy on imported seafood products
	· Need for management policy on IUU seafood imports and direction of policy introduction
	· Assessment of consumer's willingness to pay extra for management of IUU seafood imports
Subject	· Males and females residing in Korea aged between 20 to 69 years * Seoul (20.7%), Incheon/Gyeonggi (31.7%), Chungcheong (10.8%), Jeolla (9.4%), Gyeongbuk (10.2%), Gyeongnam (13.8%), Gangwon/Jeju (3.4)
Sample size	· The public, 812 persons (total sample extracted in terms of proportional allocation by region/ gender/ age of the population)
Survey method	· Online panel survey via e-mail
Survey tool	· Structured questionnaire
Survey period	· August 9–26, 2022
Sampling error	· 95% confidence level, ±3.44%

Source: compiled by the author.

4.2. Empirical Results

Based on the results of the choice experiment survey conducted in Chapter 3, the results of the estimation of the consumer choice model described in Chapter 2 are as follows. The estimation results of the conditional logit model are shown in Table 4. The null hypothesis $(H_{0,})$, where all estimation coefficients are zero, was tested with the likelihood ratio test, and the results showed that X^2 rejected the null hypothesis at the 1% significance level. Therefore, the estimation model was deemed acceptable. In addition, all attribute variables were statistically significant at the 1% level, which empirically shows that "country of origin," "possibility to check for illegal fishing," and "price" are essential factors in the selection and consumption of frozen poulp squid.

The estimation coefficient for each attribute level can be interpreted through a relative comparison with the reference level, whose utility is fixed at zero. For example, in the case of "country of origin," a relative comparison is made with "China." For the "possibility to check for illegal fishing," a relative comparison is made with "not verified." As the model coefficients were all estimated as positive (+) values, consumers rated the utility of other levels higher than the reference level. For the "country of origin" attribute, the utility of Vietnamese products was higher than that of Chinese products, and the utility of local/ Korean products was much higher than that of Vietnamese products, which coincides with the general intuition regarding preferences for the country of origin. Similarly, as for the "possibility to check for illegal fishing," utility was higher for "verified" than for "not verified." The coefficient of price is estimated to be negative (−), showing that the lower the selling price of poulp squid, the greater its utility to consumers.

Table 4. Estimation Results of Conditional Logit Model

Attribute	Level	Estimate	Standard error	*t*-value	*p*-value
Country of origin	Local/Korea	3.38406	0.11016	30.720	0.000
	Vietnam	0.92796	0.09488	9.780	0.000
	China	0.00000	-	-	-
Possibility to check	Verified	1.35035	0.07712	17.510	0.000
for illegal fishing	Not Verified	0.00000	-	-	-
Price	-	−0.00019	0.00001	−18.130	0.000
Observation		12,180			
Log-likelihood		−2,772.364			
Pseudo *R2*		0.2278			
Likelihood ratio test χ^2 (Prob)		1,635.94 ($p<0.0000$)			

Note: * represents the reference level for the individual attribute.
Source: compiled by the author.

Based on the above estimation results, the MWTP for each attribute of frozen poulp squid was derived (Table 5). For example, among the country-of-origin attributes, the MWTP for domestic products was 17,363 won (500 g), and the MWTP for Vietnamese products was 4,761 won. This result implies that consumers are willing to pay an additional 17,363 won for domestic and 4,761 won for Vietnamese poulp squids compared to Chinese frozen poulp squids, currently sold for approximately 7,000 won. However, considering that certain locally produced frozen poulp squids are sold for more than 17,000 won per 500 g, this is challenging to view as an excessive estimate. Therefore, these results faithfully reflect consumers' high preferences for Korea in terms of the "country of origin." For the "possibility of checking for illegal fishing," a proxy variable for the "precautionary management," the main finding of this study is that consumers are willing to pay 6,928 won more for poulp squid verified to be produced legally than for that unverified.

Table 5. Estimation of Marginal Willingness-to-Pay (MWTP)

Attribute	Level	MWTP	95% confidence interval
Country of origin	Korea/local	17,363	[16,255, 18,471]
	Vietnam	4,761	[3,807, 5,715]
Possibility to check for illegal fishing	Verified	6,928	[6,153, 7,704]

Source: compiled by the author.

5. Conclusions

Based on the above estimation results, the following implications can be suggested: first, from the viewpoint of "precautionary management" of IUU seafood imports, implying that the management of the country of origin is essential. As a result of the empirical analysis, it was observed that consumers consider the "country of origin" relatively more important than the "possibility to check for illegal fishing" when purchasing seafood. This result is consistent with the perception survey findings that consumers perceive country of origin as the third

most important factor after quality/ freshness and taste/ savor when purchasing seafood.[10] Above all, the percentage of responses that consumers check the country of origin when purchasing seafood was very high at 62.9% for "always check" and 34.9% for "sometimes check," respectively (refer to Table 6). More women than men, those in brackets of higher age, higher educational level, higher household income, and higher interest in the fisheries industry and fishing village show higher proportions to check "country of origin." In the future, the country of origin needs to be considered in policies governing the consumer-oriented management of seafood imports, along with a catch certification system for the "precautionary management" of imported IUU seafood products and strengthening the role and responsibility of market states.

Table 6. Likelihood of Checking the Country of Origin When Purchasing Seafood

Unit: %

	Division	Always check	Sometimes check	Do not check	Total
	Total	62.9	34.9	2.2	
Gender	Male	60.6	37.2	2.2	
	Female	65.3	32.5	2.2	
Age	20s	50.0	46.4	3.6	
	30s	62.8	34.3	2.9	
	40s	67.5	30.2	2.4	
	50s	61.0	38.4	0.6	
	60s and older	69.6	28.4	2.0	
Educational attainment	Up to high school completion	61.8	35.3	2.9	
	Bachelor's degree	62.3	35.4	2.3	100.0
	Master's degree or higher	69.4	30.6	0.0	
Household income	Up to 2.9 million won	55.7	3.4	0.9	
	3–3.9 million won	60.8	36.7	2.5	
	4–4.9 million won	64.7	32.8	2.6	
	5–6.9 million won	66.7	31.4	2.0	
	7 million won or higher	73.2	24.6	2.2	
Interest in the fisheries industry and fishing village	Not interested	45.7	49.4	4.9	
	So-so	49.0	47.6	3.5	
	Interested	75.1	24.0	0.9	

Source: compiled by the author.

Second, the need for the "precautionary management" of IUU seafood imports is proven through an empirical analysis in a consumer survey. In this study, the marginal willingness

---

[10] Findings of the consumer survey show that "country of origin" was considered more important than factors such as sales price, health/nutrition facts, convenience in preparation/cooking/eating, and food certification.

to pay for the "possibility to check for illegal fishing," applied as a proxy variable for the "precautionary management" of IUU seafood imports, was estimated to be 6,928 won. Considering that the current market sales price of frozen poulp squid is approximately 7, 000–17,000 won, this amount can indicate a willingness to pay similar to the lowest price of poulp squid offered in the market. Although it is low compared to the consumers' value for "country of origin," it is difficult to view this level as insignificant. As the "precautionary management" of IUU seafood imports is discussed actively, the findings of this empirical analysis will prove to be meaningful as a research case that provides the basis for policy implementation for the first time.

Third, in terms of imported fishery products, consumer preferences show clear differentiation based on the country when exporting relevant fishery products. Therefore, monitoring imports from non-preferred countries needs to be strengthened.[11] For example, in the case of empirical analysis of an item of "poulp squid," it was observed that there is a clear difference in preference for Chinese and Vietnamese products. It is necessary to prepare a legal basis for monitoring the production process of imported fishery products, designate an agency dedicated to their monitoring, and prepare a base for conducting risk assessments and strengthening investigations on the state of IUU seafood imports.

References

Agnew, D.J., J. Pearce, P. Ganapathiraju, T. Peatman, R. Watson, J.R. Beddington, T.J. Pitcher (2009), Estimating the Worldwide Extent of Illegal Fishing, PLoS One, 4(2), e4570.

Aylesworth, S. (2021). On the Hook: How the United States Enables Illegal, Unreported, and Unregulated Fishing, Natural Resources Defense Council (NRCD).

Choi, J.-S., D.-H. Jang, J.-G. Kim, G. Cho and C.-H. Song (2019). "Study on Preference for Watermelon using Discrete Choice Experiment Method," Korean Journal of Food Marketing Economics, 36-3, 29–47.

Elvestad, C. and I. Kvalvik (2015). Implementing the EU-IUU Regulation: Enhancing Flag State Performance Through Trade Measures, Ocean Development & International Law, 46-3, 241–255.

FAO (2020). The State of World Fisheries and Aquaculture, Rome, Italy: FAO.

FAO (2017). Voluntary Guidelines for Catch Documentation Schemes, Rome, Italy: FAO.

Hosch, G. and F. Blaha (2017). Seafood Traceability for Fisheries Compliance: Country-Level Support for Catch Documentation Schemes (FAO Fisheries and Aquaculture Technical Paper, 619), Rome, Italy: FAO.

Jung H.-Y. and J.-H. Bae (2018). "Analysis of Consumer Preference on Mid to Long Term Power Sources by Using a Choice Experiment," Environmental and Resource Economics Review, 27-4, 695–723.

Kim Si-Hyeon (2016). Estimation of Welfare Change by Gwangju-Cheon (Stream) Restoration Projects Using Choice Experiment Method (Doctoral Dissertation), Seoul: Seoul National University.

Korea Rural Economic Institute (2019). 2019 Food Balance Sheet, Seoul: Korea Rural Economic

---

[11]As a result of a consumer perception survey on imported seafood, among the countries that export seafood to Korea, the consumers' negative perception of China was the highest at 78.8% (So-so 16.7% and positive 4.4%), followed by Japan with a negative perception recorded at 71.3% (so-so 17.9% and positive 10.8%) and Vietnam at 33.3% (normal 49.9% and positive 16.9%).

Institute (KREI).

Kwak, S.-J., S.-H. Yoo and J.-I. Chang (2006). "Valuing the Han-river Estuary: Using Conjoint Analysis," The Korean Journal of Economic Studies, 54-4, 141–161.

Lee, H.-D. and M.-B. Joo (2009). "Measuring the Willingness to Pay for Cold Chain System Attributes of Fresh Fish: Focusing on the Mackerel," The Journal of Fisheries Business Administration, 40-2, 27–48.

Lee, J.-H., B.-O. Lee and Y.-K. Shin (2006). "A Study on the Evaluation of Beef Safety: A Choice-Based Conjoint Analysis," Korean Journal of Agricultural Management and Policy, 33-2, 351–366.

Leroy, A., F. Galletti and C. Chaboud (2016). The EU Restrictive Trade Measures Against IUU Fishing, Marine Policy, 64, 82–90.

Marr, S. (2000). "The Southern Bluefin Tuna Cases: The Precautionary Approach Conservation and Management of Fish Resources," European Journal of International Law, 11-4, 815–831.

McFadden, D. (1974). "The Measurement of Urban Travel Demand," Journal of Public Economics, 3-4, 303–328.

Park M.G. (2018). "The Problems of US Import Prohibition of the IUU Fishing Products and its Implication," Ocean Policy Research, 33-2, 1–24.

Pramod, G., K. Nakamura, T.J. Pitcher and L. Delagran (2014). Estimates of Illegal and Unreported Fish in Seafood Imports to the USA, Marine Policy, 48, 102–113.

Sumaila, U.R., D. Zeller, L. Hood, M.L. Palomares, Y. Li and D. Pauly (2020). "Illicit trade in marine fish catch and its effects on ecosystems and people worldwide," Science Advances, 6-9, eaaz3801.

United States International Trade Commission (2021). Seafood Obtained via Illegal, Unreported, and Unregulated Fishing: U.S. Imports and Economic Impact on U.S. Commercial Fisheries.

The PEW Charitable Trusts (2018). The Port State Measures Agreement: From Intention to Implementation. Available from https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2018/04/the-port-state-measures-agreement-from-intention-to-implementation.

Act on Ensuring the Proper Domestic Distribution and Importation of Specified Aquatic Animals and Plants (2023). (特定水産動植物等の国内流通の適正化等に関する法律)