

Societal Perceptions of Aquaculture: China's Aquatic Food Market and Strategic Insights for Europe

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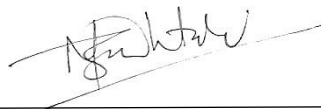
Declaration

I hereby declare that this thesis has been submitted following the requirements for the Degree of Doctor of Philosophy of the Institute of Aquaculture and is my original work, except where otherwise stated. The content has not been submitted for any other degree or qualification.

I have received formal ethical approval for the primary research conducted as part of this thesis, and all research was carried out following the ethical guidelines of the General University Ethics Panel, University of Stirling. Furthermore, no generative artificial intelligence software was used in the preparation of this thesis, including the generation of data or writing of the final text.

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A handwritten signature in black ink, appearing to read 'Mausam Budhathoki', is written over a horizontal line.

Mausam Budhathoki (MSc, MPH, BHN)

December 2024

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Abstract

Since the late 1990s, European aquaculture has struggled to grow, leading to a heavy reliance on imported farmed aquatic food from low- and middle-income countries. Concerns about the environmental and social impact of these imports, along with safety issues, have drawn negative media attention that has hurt public trust in the industry. Although Europe has introduced rigorous certifications and stricter regulations to address these concerns, gaining full public confidence remains a challenge. Meanwhile, there is a growing demand for European aquaculture products—particularly in emerging economies of Asia, where aquatic food is a dietary staple—which presents a promising opportunity for future growth.

This thesis aims to provide strategic recommendations for European aquaculture to improve its societal acceptance and market positioning of its products, particularly in China. A multidisciplinary research approach was employed, combining a systematic scoping review and media analysis to explore societal perceptions, secondary data analysis to examine trade flows, key informant interviews to assess demand, text mining to evaluate consumer e-commerce satisfaction with salmon purchases, and sensory evaluation with willingness-to-pay studies to assess salmon's competitiveness. Findings revealed that media and scientific literature often oversimplify sustainability issues, leading to fragmented stakeholder understanding. Price, quality, safety, and country of origin play crucial roles in shaping consumption patterns, with Chinese consumers preferring imported salmon due to perceived higher standards. While European aquaculture benefits from its association with stringent safety and sustainability standards, there remains a considerable gap in sustainability awareness within the Chinese aquatic food market.

The thesis recommends a twofold strategy: domestically, European aquaculture must prioritize societal acceptance by addressing sustainability concerns and increasing transparency. Internationally, in markets like China, European aquaculture producers should emphasize the quality, safety, and sustainability of their products to differentiate them from local alternatives. By adopting these strategies, European aquaculture can enhance its global leadership and competitiveness, with China's critical influence on global aquatic food demand.

Keywords: European aquaculture; Sustainability; Perception; Chinese aquatic food market; Consumer preferences

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Chapter 1 General Introduction and Methodology

1.1 Problem Statement and Research Overview

Aquatic food plays a critical role in the global food system by providing nutritious food, supporting economic livelihoods, promoting environmental sustainability, and enhancing resilience to climate change. Recently, the Blue Food Assessment has positioned aquatic food at the forefront of discussions on food security and sustainability (*The Blue Food Assessment*, 2024). It emphasised how aquatic food functions as vital sources of essential nutrients, healthy substitutes for terrestrial animal-source foods, providers of nutrients with minimal environmental impact, and pillars of cultural, dietary, economic, and livelihood aspects (Crona et al., 2023).

Aquatic food production encompasses two primary methods: aquaculture and wild capture fisheries. Aquaculture involves the farming of aquatic organisms such as fish, molluscs (including shellfish like mussels and oysters), crustaceans (such as shrimp and crayfish), and aquatic plants (algae) in controlled environments, ranging from freshwater ponds and tanks to ocean enclosures. In contrast, wild capture fisheries involve the harvesting of fish and other aquatic organisms directly from their natural environments, such as oceans, rivers, and lakes. As the global demand for aquatic food has surged, aquaculture has increasingly dominated the supply, expanding by 6.6 % between 2020 and 2022, and producing approximately 116 million tonnes of aquatic food (Food and Agriculture Organization, 2024). The growth in aquatic food consumption has been driven primarily by the rapid expansion of aquaculture, particularly since production from wild capture fisheries has been stagnant since the late 1980s (Little et al., 2016a).

In Europe, wild capture fisheries produced the majority of aquatic food in 2022, totalling 13.9 million tonnes, compared to 3 million tonnes from aquaculture (Food and Agriculture Organization, 2024). While aquaculture experienced rapid growth during the 1980s and 1990s, its continued increase in the European region has not been as productive compared to the Asian region (Figure 1). For instance, European aquaculture production has increased by 24 % since 1994 but has only grown by 6 % between 2007 and 2022. This slower progress is likely due to the perception that aquaculture lacks a compelling value proposition compared to alternative protein sources, such as chicken, which have seen more consistent growth over the same period due to affordability, versatility, and familiarity (Bostock et al., 2010a). In addition, the decline in demand for certain aquaculture products, such as mussels, highlights the influence of shifting consumer preferences rather than solely misperceptions

about aquaculture practices. Limited public understanding of aquaculture, negative media portrayals, and environmental concerns—including water pollution, habitat destruction, and the use of antibiotics and chemicals—also remain significant barriers to consumer acceptance (Bacher, 2015). Addressing these challenges requires targeted efforts to position aquaculture products as sustainable, high-value alternatives that align with the evolving preferences of health-conscious and environmentally aware consumers.

Despite these challenges, the European aquaculture industry has made significant progress in improving sustainability and reducing its environmental footprint through advancements in technology, stricter regulations, and adherence to certification standards. Furthermore, innovation programs and strategic guidelines are actively supporting the development of sustainable and efficient aquaculture practices, helping to stimulate the growth and capacity of aquatic food production in the region (European Commission, 2021).

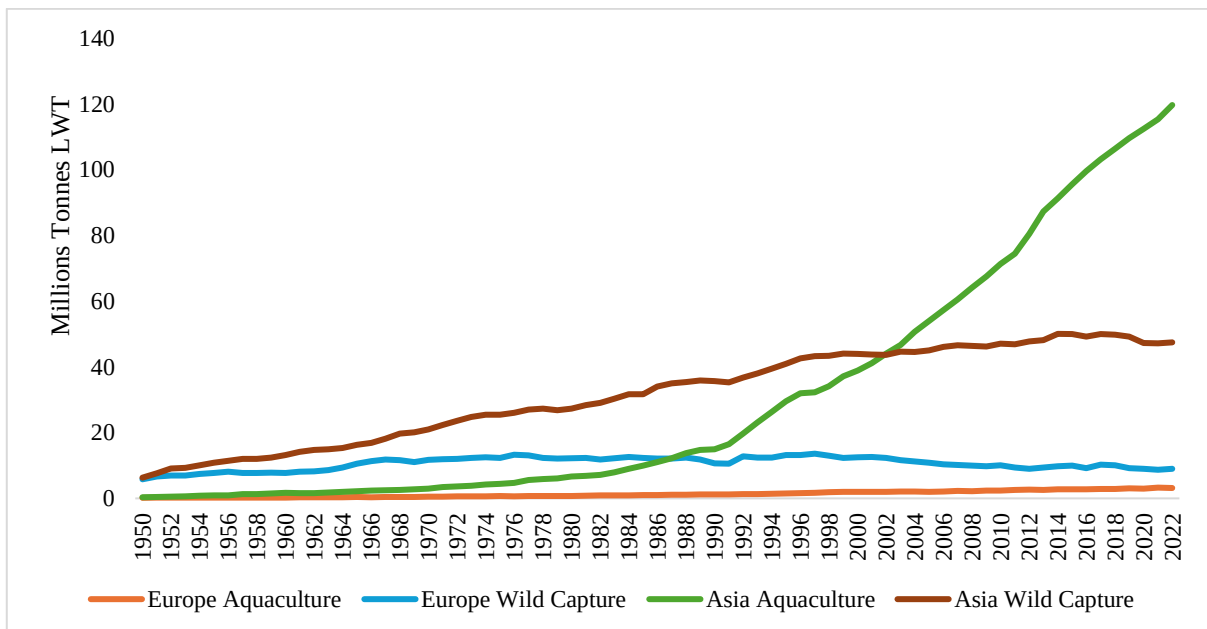


Figure 1. Production in million tonnes live weight for European and Asian aquaculture and wild capture fisheries, 1950-2022. Data source: FAO FishstatJ, 2024.

This thesis is part of the EATFISH project, a multidisciplinary initiative under the EU's Marie Skłodowska-Curie Actions. The project aims to promote sustainable and profitable aquaculture in Europe by aligning innovations with market and societal expectations. Within this broader initiative, this thesis specifically investigates the societal perceptions and market demand for European aquaculture products in China. This focus stems from significant research gaps: limited understanding of Chinese consumer preferences for European aquatic food, insufficient knowledge of sensory and willingness-to-pay dynamics in this market, and the growing importance of China as an importer of high-value aquatic food products. This

thesis also emphasizes the need for effective positioning of European aquaculture products in emerging markets through data-driven strategies.

Aquatic food, encompassing both plants and animals, is gaining increased attention for its nutritional benefits and its environmental impact (Gentry et al., 2020; Troell et al., 2014). While insights into global aquatic production capacity and transition pathways may vary, there is a consensus on the essential role of aquaculture within the food production system. Aquaculture is a complex domain, with production dynamics, value chains, and socioeconomic-cultural effects differing significantly across various production systems, geographic regions, and social contexts and circumstances, meanwhile, the rise of certification programmes highlights the sector's evolving commitment to sustainability (Saha, 2022). Programs, such as the Aquaculture Stewardship Council (ASC) and various national schemes such as Danish organic Ø label and Naturland set rigorous environmental and socio-cultural standards, helping to build consumer trust in buying farmed aquatic food, particularly among European consumers (Alfnes et al., 2018). By providing assurance that aquaculture products meet high sustainability benchmarks, these certifications play a crucial role in addressing consumer concerns and promoting sustainable aquaculture, defined in this thesis as 'aquaculture practices that meet present food needs without compromising environmental integrity or the ability of future generations to meet their own needs' (Boyd et al., 2020). This includes reduced ecological impact, ethical sourcing, traceability, and socio-economic responsibility. However, achieving broader social acceptance remains a complex challenge. Ocean NGOs have significantly influenced public perceptions, often portraying aquaculture as inherently harmful to ocean health, which has reinforced negative consumer attitudes toward the sector (Tlustý et al., 2019). This narrative has perpetuated misconceptions about the environmental impacts of aquaculture, overshadowing its potential to contribute to global food security and sustainable seafood production. The gap between public perception and the reality of modern, sustainable aquaculture practices not only hampers consumer trust but also constrains investment and innovation in the sector. Public and political support, essential for implementing new technologies and practices, remains limited, highlighting the need for more effective communication strategies to reframe aquaculture as a critical component of sustainable aquatic food systems.

Despite stagnant growth, the biological and technological advancements in the European salmon farming sector have been important in driving growth and innovation across the aquaculture industry both in Europe but also globally (Asche & Bjørndal, 2011). Particularly, innovations in genetics have led to the development of more resilient and faster-

growing salmon strains, enhancing productivity. Advanced feed formulations have improved the nutritional profiles of farmed salmon while reducing reliance on wild-caught fish for feed, thus supporting sustainability efforts (Afewerki et al., 2023). Enhanced disease management techniques, including the use of vaccines and integrated pest management, have significantly reduced mortality rates and the need for antibiotics, promoting healthier salmon populations (Bondad-Reantaso et al., 2023). Further, the adoption of digital technologies and data analytics in European aquaculture operations has revolutionized the industry. Real-time monitoring and management of water quality, feed distribution, and fish health through sensors and automated systems have optimized operational efficiency and minimized environmental impacts (Rowan, 2023). Further, in the European Union, the traceability of aquatic food has been ensured by implementing stringent regulations (Hofherr et al., 2016), which is supported by the European Market Observatory for Fisheries and Aquaculture Products (European Commission. Directorate General for Maritime Affairs and Fisheries & EUMOFA., 2022; Paolacci et al., 2021), providing consumers with verifiable information about the origin and journey of their aquatic food, thus building trust and encouraging consumption of their farmed aquatic products among international consumers.

Simultaneously, European-farmed aquatic products have gained traction in global aquatic food markets, driven by their reputation for quality, sustainability, and traceability. This export-oriented growth has been particularly pronounced in emerging economies where rising incomes and urbanization are fuelling demand for nutritious food sources. In recent years, countries in Asia, particularly East and Southeast Asia, have become significant importers of European aquaculture products, contributing to the sector's global expansion. The high standards maintained by European aquaculture producers, reinforced by rigorous safety and environmental processes, ensure that their products meet the international safety and environmental criteria increasingly demanded by consumers worldwide. However, this aspect has never been understood concerning the demand for European aquatic food products in emerging markets.

Thus, understanding and responding to the complex perceptions of aquaculture—whether shaped by genuine public concerns or amplified by interest group positions magnified through media narratives—is becoming increasingly urgent. As global demand for aquatic food continues to rise and wild fish stocks face overexploitation, it is essential to recognize that different stakeholders, including consumers, industry actors, policymakers, and advocacy groups, hold diverse and often conflicting views about aquaculture practices. This calls for a deeper exploration of these perspectives to develop targeted strategies that build

trust and acceptance across all stakeholder groups. Demonstrating these benefits with evidence-based strategies is crucial not only for fostering acceptance of aquaculture but also for paving the way for its expansion and integration into the broader food system. This shift is crucial not only for the future of the aquaculture sector in Europe but also for global food security and the sustainability of marine resources. Additionally, understanding the demand for European aquatic food products in emerging markets is essential to gain insights into consumer preferences and develop effective marketing strategies. This is important for European aquaculture because it can help expand market reach, enhance competitiveness, and generate additional earnings, thereby boosting aquaculture growth in the region and driving sustainable development by aligning production with consumer needs and expectations in these rapidly growing markets.

1.2 Objectives of the Thesis

In light of stagnant European aquaculture production and the urgent need to understand societal perceptions for fostering growth and development, this thesis seeks to develop strategic recommendations for European aquaculture by understanding societal perceptions in a broader context and examining the demand for its products in China. The six broad objectives of the thesis are as follows:

1. To understand societal perceptions of aquaculture and assess differences across international contexts.
2. To analyse consumption behaviour in Asia.
3. To examine the demand for high-value aquatic food in China.
4. To investigate farmed salmon import trends and consumer e-commerce satisfaction in China.
5. To assess sensory perception and willingness to pay for farmed salmon in China.
6. To develop strategic recommendations for European aquaculture based on insights from the above five objectives, helping to enhance market positioning and growth opportunities.

1.3 Methodology

The thesis utilizes a mixed-method approach to accomplish its objectives, integrating a variety of methodologies drawn from multiple academic disciplines. This combination allows for a comprehensive analysis that is based on both quantitative and qualitative techniques, ensuring a more nuanced and in-depth understanding of the research problem.

By utilizing diverse approaches, the study can address complex research questions from different perspectives, enhancing the validity and robustness of the findings. For instance, perception studies help understand societal attitudes, while integrated social science frameworks assess broader societal impacts. Sensory science techniques are applied to evaluate sensory perceptions, and economic principles are used to analyse willingness to pay. Additionally, consumer science investigates purchasing behaviours, and trade analysis explores the dynamics of international aquatic food markets. Collaboration with EU and Chinese academic institutions ensured comprehensive data collection and cross-contextual insights. Data collected in China were supported by translation assistance from Chinese academic project partners and students, who also provided valuable insights into the local context. Their support was instrumental in ensuring the accuracy and relevance of the data, which was crucial to the completion of the PhD thesis. Research tasks requiring English were directly undertaken by the PhD student.

Below, a brief description of the study areas and the rationale for their selection is provided. This is followed by an overview of the projects and timeline of the doctoral research, as well as a concise description of the methods and units of study that constitute the core of this thesis. Given that each subsequent chapter contains its own Materials & Methods section, only a brief overview is presented here.

1.3.1 Background of the Study Area

Three case studies were conducted in China, the world's largest producer and consumer of aquatic food, as well as an emerging market importing high volumes of aquatic food products. This is supported by its vast population base of over 1.4 billion people. In 2022, China accounted for 36 % of the world's aquatic food production, emphasizing its critical role in the global aquatic food supply chain (Food and Agriculture Organization, 2024). More than 90 % of consumers in China eat aquatic food more than once a month, with about 35 % consuming it twice or more per week and about 32 % eating it 3–4 times per month (Xu et al., 2024), reflecting a cultural shift towards greater aquatic food consumption. This trend is further supported by rising annual per capita consumption of aquatic food, which increased from 3.1 kg in 1985 to 11.4 kg in 2016 (National Bureau of Statistics, 2020). This increase can be disaggregated by urban and rural consumers, for instance, first-tier cities like Shanghai particularly consume aquatic food of about 27.2 kg per capita per year in 2019 (Meng et al., 2021). Newton et al. (2021) further highlight that these changing consumption habits are driven by different product forms and purchasing locations. In particular, urban

consumers are increasingly opting for frozen or canned seafood from supermarkets or online platforms, moving away from traditional "wet" markets. This shift, especially among younger and wealthier populations, underscores the evolving nature of China's aquatic food market. These trends not only highlight the growing domestic demand for aquatic food but also China's critical influence on global aquatic food markets. Given this dynamic landscape, it is essential for European aquaculture to closely study and understand the evolving Chinese aquatic food market to remain competitive.

Aquatic food is a staple in the Chinese diet, with deep-rooted cultural preferences for fresh and diverse aquatic products. This massive consumer base drives demand for a wide range of aquatic species, influencing global supply chains and pricing. Understanding China's aquatic food market dynamics, consumer preferences, and import trends offers valuable insights for the European aquaculture sector looking to expand its market reach, enhance competitiveness, and adapt to global trends. As Europe seeks to strengthen its aquaculture industry, analysing China's market strategies, consumption patterns, and the impact of its population's aquatic food habits can help European aquatic businesses better navigate global challenges and tap into emerging opportunities in the aquatic food industry.

1.3.2 Project Background and Timeline of the Doctoral Research

The PhD research is embedded within Work Package 3 ("The Fish Market") of the EATFISH project (Figure 2). WP3 aligns market development with technological advances. The project involves leading academic and private sector partners across Europe, including Wageningen University, Ifremer, CSIC, Nofima, CCMAR, and others. The candidate, enrolled at the Institute of Aquaculture, University of Stirling, actively participated in all EATFISH project workshops, training, and secondments (Table 1). Secondments were completed at Aarhus University in Denmark and the University of Western Brittany in France to build research collaborations on societal perceptions of aquaculture in France, Spain, Denmark, and Turkey (Table 2). After the secondments, an initial draft of the study of the perception was submitted as an EU deliverable in March 2023. In the second year, two research visits were conducted in collaboration with Shanghai Ocean University, China. Research activities included market observation, trade show interviews, secondary data analyses, consumer taste testing sessions, and choice experiments.

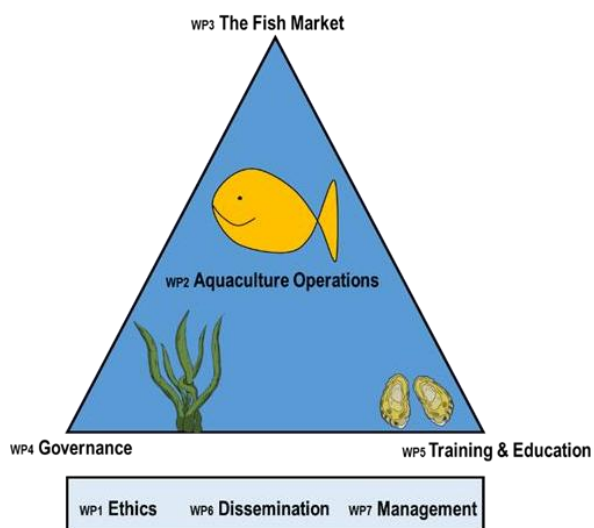


Figure 1. EATFISH programme and work packages.

Table 1 Training and meetings attended by the PhD student in the EATFISH programme.

S.N.	Date	Place	Institution	Training and meetings	Activities
1	28 March 2022 – 5 April 2022	Valencia, Spain	The Spanish National Research Council (CSIC)	Network and workshop meeting 1	Lecture on Open science, Research and Time management, Action Learning, Instituto de Acuicultura Torre de la Sal (IATS) and farm visit
2	12 September 2022 – 16 September 2022	Faro, Portugal	University of Algrave Campus de Gambelas	Network and workshop meeting 2	Summer school on Entrepreneurship, midterm evaluation of the EATFISH project
3	24 April 2023 – 28 April 2023	Szarvas, Hungary	Research Centre for Fisheries and Aquaculture, Hungarian University of Agriculture and Life Sciences,	Network and workshop meeting 3	Market workshop, project evaluation, carp farm visit
4	18 September 2023 – 22 September 2023	Vienna, Austria	Messe Wien Exhibition Congress Center	Network and workshop meeting 4	Marketing review presentations, European Aquaculture Society conference, project evaluation
5	4 March 2024 – 8 March 2024	Cork, Ireland	University College Cork	Network and Workshop 5	Governance workshop, Bantry Marine research station visit

Table 2. Overview of the PhD research projects and timeline.

S.N.	Country and time in the field	Project partners	Objective of the field	Data for chapter
1	Denmark, January – February 2023	MAPP center, Aarhus University, Aarhus	To build research collaboration for understanding societal perceptions of aquaculture in Denmark and Turkey	Chapter 2
2	France, February – March 2023	University of Western Brittany, Brest	To build research collaboration for understanding societal perceptions of aquaculture in France and Spain	Chapter 2
3	China, August – September 2023	Shanghai Ocean University, Shanghai	To collect data for understanding the demand for high-value imported aquatic food products	Chapter 4
4	China, October – November 2023	Shanghai Ocean University, Shanghai	To collect data for understanding sensory perception and willingness to pay for salmon	Chapter 5

1.3.3 Brief Overview of Methods and Materials

This thesis employs a range of methodologies across several chapters to address specific objectives related to societal perceptions, consumption behaviour, and market trends. An overview of the research studies conducted during the PhD programme period is illustrated in Figure 3. In **Chapter 2**, a systematic scoping review and newspaper content analysis were conducted to understand societal perceptions of aquaculture in a broader context. In the systematic scoping review, 151 relevant documents, while in newspaper articles ($n = 100$) from the United Kingdom, Denmark, France, Spain, Turkey, and China; elsewhere all articles identified were included (Poland, 79; Hungary, 29; India, 70) were analysed to capture societal perceptions. **Chapter 3** utilized a systematic scoping review to identify 113 relevant documents to understand factors influencing aquatic food consumption behaviour in Asia. **Chapter 4** examined the demand for high-value imported aquatic food in China using trade flow analysis and semi-structured key informant interviews within a social science framework. In this chapter, Chinese customs data were collected and analysed to understand the import trends of aquatic food in China. Further, 30 semi-structured interviews were conducted at the 17th Shanghai International Fisheries and Seafood Exhibition, Shanghai and Qingdao China Fisheries and Seafood Expo, Shandong, China. **Chapter 5** analysed salmon import trends in China and consumer satisfaction with farmed salmon e-commerce. Salmon import data from the China Customs as well as salmon production statistics from *FishstatJ* software was collected and analysed. Further, 10,064 consumer comments were analysed to understand salmon e-commerce satisfaction. Finally, **Chapter**

6 explores Chinese consumers' preferences for farmed salmon involving blind-informed taste testing, and discrete choice experiments to assess their willingness to pay. The study was conducted at the sensory lab, College of Food Science, Shanghai Ocean University. An overview of the methods for each chapter can be found in Table 3. These methodologies are more explicitly detailed in the subsequent chapters.

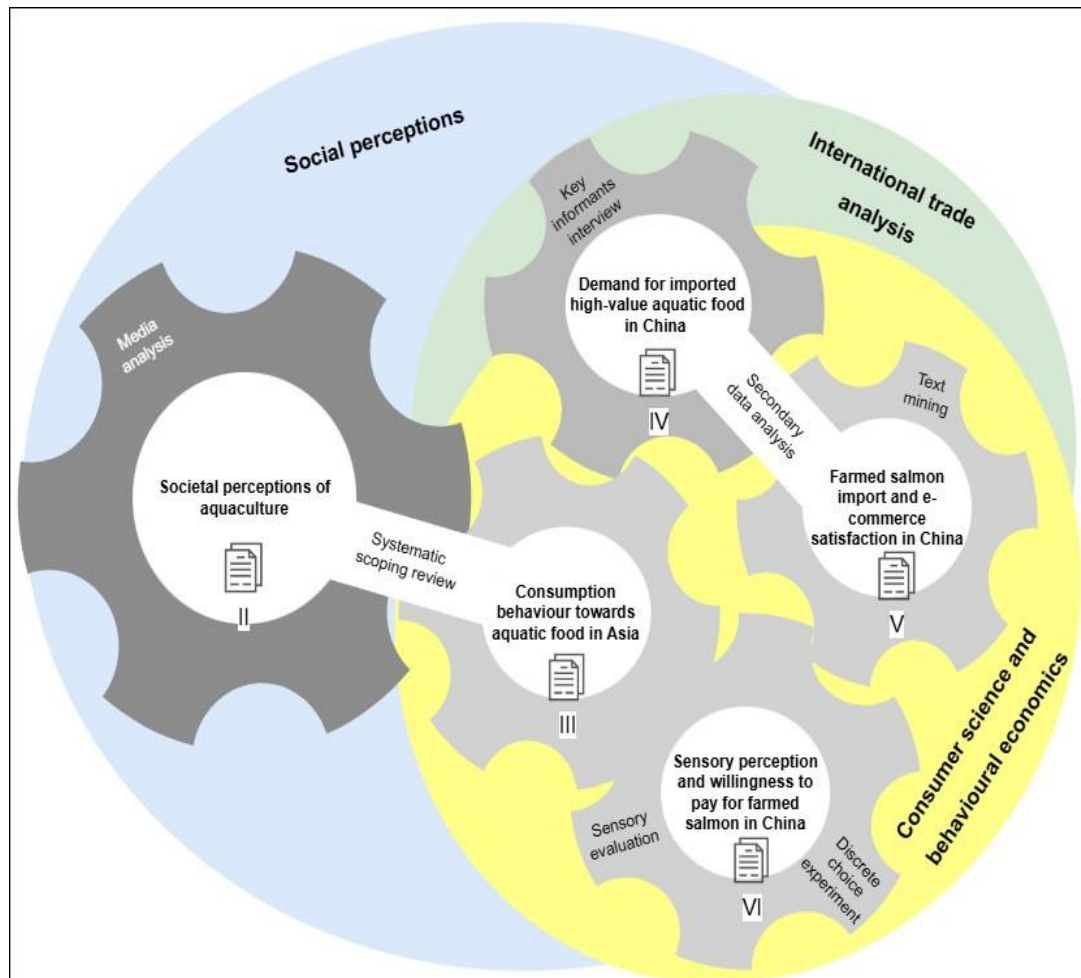


Figure 3. A brief overview of the research studies conducted during the PhD.

Table 3. Overview of the methods for each chapter.

S.N.	Chapter	Geographic focus	Methodologies	Objectives	Specific methods
1	Chapter 2	Global	Systematic review & Media analysis	To understand societal perceptions of aquaculture and assess differences across international contexts	Scoping literature review with thematic clustering method & newspaper article content analysis
2	Chapter 3	Asia	Systematic review	To understand factors influencing aquatic food consumption behaviour in Asia	Scoping literature review with thematic clustering method
3	Chapter 4	China	Trade analysis & Social science framework	To understand the demand for high-value imported aquatic food in China	Import trend analysis & semi-structured key informant interviews
4	Chapter 5	China	Trade analysis & Consumer Science	To understand the salmon import trends in China and consumers' satisfaction towards farmed salmon e-commerce	Import trend analysis & consumer satisfaction comments/reviews
5	Chapter 6	China	Sensory science and economic principles	To understand Chinese consumers' preferences towards farmed salmon	Blind-Informed tasting sessions & choice experiments

Chapter 2 Societal Perceptions of Aquaculture

Abstract

Aquaculture has been recognised as a potential food industry to contribute to multiple United Nations Sustainable Development Goals; its further growth and development depend on understanding, and responding to, societal perceptions in a broader context. However, to date, no comprehensive reviews have been conducted to understand whether scientific and newspaper publications portray societal perceptions of aquaculture – in terms of sustainability – in positive, negative, or neutral terms. To fill this gap, this study synthesises articles on societal perceptions of aquaculture to understand whether scientific and newspaper articles mention multiple sustainable dimensions before portraying aquaculture as positive, negative, or neutral. A scoping review identified 151 academic studies for inclusion in our five research clusters of scientific publications: (1) social acceptability, (2) growth and development, (3) media coverage, (4) sustainable aquaculture, and (5) consumer perception. Coverage of aquaculture varied but newspaper articles (n = 100) were sampled from the United Kingdom, Denmark, France, Spain, Turkey, and China; elsewhere all articles identified were included (Poland, 79; Hungary, 29; India, 70). The findings suggest that scientific and newspaper articles tend to present one or more aspects of aquaculture sustainability in a simplified form before framing perceptions as positive, negative, or neutral. Key stakeholder groups include fish farming enterprises (fish farmers, aquaculture associations), civil society stakeholders (environmental NGOs, activists, community groups, media), governmental officials, scientists, and business leaders both within aquaculture value chains (retailers/wholesalers, technology industry) and outside of them (fisheries, tourism). Also, other stakeholders including the public can be disaggregated as indigenous groups and consumers. The stakeholder groups perceived aquaculture differently and depending on the circumstances and context, their perception ranged from positive to negative. Many factors influenced their perceptions, including aquaculture's impact on multiple sustainability dimensions, knowledge, transparency, personal interests, types, and location of aquaculture practices, regulations, experience, food-related and dietary lifestyles, as well as sociodemographic characteristics such as age, gender, education, and income. Thus, aquaculture practitioners focus on context-specific multifaceted strategies – prioritizing transparency, communication, and accountability – and provide essential knowledge to ensure that societal perceptions of aquaculture are based on accurate, empirical information.

Keywords: Public perceptions; Newspapers; Sustainable aquaculture; Social acceptance

2.1 Introduction

Aquaculture is increasingly recognised as a critical food sector for achieving multiple United Nations Sustainable Development Goals (SDGs) by 2030, including SDG1: ‘No Poverty’, SDG2: ‘Zero Hunger’, SDG3: ‘Promoting Health and Wellbeing’, SDG12: ‘Responsible Consumption and Production’, SDG13: ‘Climate Change’, and SDG14: ‘Life Below Water’ (Schatte Olivier et al., 2020; Troell et al., 2023; United Nations, Department of Economic and Social Affairs, 2022; Zeller et al., 2018). There is substantial evidence that aquaculture offers significant socioeconomic benefits for coastal and rural communities (Bostock et al., 2010b; Fonseca et al., 2017; Little et al., 2016a; Rimmer et al., 2021). Furthermore, aquaculture products are rich in both macro- and micronutrients, contributing to food and nutrition security for many vulnerable populations (Belton et al., 2018; Beveridge et al., 2013; Garlock et al., 2022). The growing use of genomic tools in selective breeding is enhancing already low feed conversion ratios compared to terrestrial livestock (Fry et al., 2018), and a range of strategies—ranging from therapeutics to improved management practices—are supporting resilience against diseases, thereby enhancing the sustainability of production (Pounds et al., 2022).

There is a growing public interest in creating national laws to help traditional aquaculture move towards more sustainable practices that focus on responsibility, resilience, and conservation aquaculture principles and strategies (Brugère et al., 2019; Naylor et al., 2023; Schatte Olivier et al., 2020; FAO, 2022). In this context, responsible and resilient aquaculture prioritizes environmental sustainability, social responsibility, and economic viability (Bunting, 2013), while “conservation aquaculture” aims to mitigate environmental impacts through the preservation of biodiversity (Froehlich, Gentry, & Halpern, 2017) (asc- aqua.org, 2023). Additionally, the newly proposed concept of “restorative aquaculture” seeks to provide direct ecological benefits to the environment (Alleway et al., 2023). To date, the principles of responsible and resilient aquaculture have been validated through third-party certification, gaining traction in markets and promoting opportunities for responsible consumption (Amundsen & Osmundsen, 2020).

Aquaculture production has seen remarkable growth in Asia over the past few decades, now representing over 90 % of global farmed aquatic food output (FAO, 2022b). In contrast, production is minimal in Europe (< 3 %), the Americas (< 4 %), Africa (< 2 %), and Oceania (< 0.2 %). Costa-Pierce & Chopin (2021) refer to the emergence of new aquaculture geographies—areas outside Asia where aquaculture is not traditionally practised—but indicate that growth in these geographies has been slow or even declining (Little et al.,

2016a). Development levels in aquaculture vary considerably among regions. For example, the production of Atlantic salmon in Europe has risen by over 33 %, and sea bass by 29 %, whereas mussel production has declined by 5 % from 2011 to 2021. Nonetheless, the increasing dependence of high-income European countries on imports of farmed aquatic food from low- and medium-income nations, along with concerns regarding the environmental, social, and safety standards of these products, has resulted in significant negative media coverage (Bacher, 2015; Krøvel et al., 2019). Initiatives aimed at boosting local production have faced challenges primarily due to stringent governance and regulatory environments, which are viewed as the main obstacles rather than technological limitations or economic issues (Bostock et al., 2010b; Gentry et al., 2017; Hishamunda et al., 2014). Additionally, researchers argue that a deeper understanding of societal perceptions regarding aquaculture is essential for its growth and advancement (Bacher, 2015; Chu et al., 2010; Little et al., 2018; Mazur & Curtis, 2006; Tiller et al., 2013). Therefore, studies that explore societal perceptions of different aquaculture practices and products within a broader context are crucial for promoting the continued evolution of aquaculture towards greater sustainability and enhancing public acceptance of the sector.

This review distinguishes itself from prior studies (Bacher, 2015; Cavallo et al., 2022; Schlag, 2010) by (1) employing rigorous methodology (2) encompassing a wide range of production-consumption contexts geographically, and (3) concentrating on the relationship between perceptions and contemporary sustainability dimensions. The study aims to synthesize and analyse both scientific and newspaper articles to assess whether they address multiple aspects of sustainability before depicting aquaculture in a positive, negative, or neutral light. A thorough examination of scientific articles was conducted to explore various sustainability dimensions mentioned, without categorizing them by sentiment. In contrast, sentiment analysis was applied to newspaper articles to classify their portrayal of aquaculture. Additionally, the study aims to identify key stakeholders, their roles, and the factors that shape their perceptions of aquaculture. The research is structured into two complementary phases: 1) a systematic scoping review to understand societal perceptions of aquaculture through scientific literature, and 2) a media analysis examining how aquaculture is portrayed in mainstream newspapers. Findings from the systematic scoping review were used to inform the design of the media analysis. By employing both methods, this study aims to create a more comprehensive and triangulated understanding of prevailing perceptions, addressing a key limitation found in previous aquaculture perception studies (Froehlich, Gentry, Rust, et al., 2017; Joyce & Satterfield, 2010; Rector et al., 2023; Wood & Filgueira, 2022).

2.2 Methods and Materials

2.2.1 Systematic Scoping Review

A systematic scoping review was conducted to identify and synthesise relevant scientific articles. Similarly to a systematic review, it follows a predefined protocol that outlines the review process in detail (Armstrong et al., 2011; Munn et al., 2018). However, unlike a systematic review, its goal is to provide a comprehensive understanding of a broader research field. This study adhered strictly to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-ScR) Extension for Scoping Reviews (Tricco et al., 2018). Research questions guiding the systematic scoping literature review were as follows:

1. How were stakeholders' perceptions documented in aquaculture literature and who were the relevant stakeholders?
2. What perceptions did different types of stakeholders have towards aquaculture?
3. What are the factors that influence their perceptions towards aquaculture?

a) Data Collection

Three scientific databases – Web of Science, Scopus, and Google Scholar – were used to search for research articles published between 1 January 2015 and 15 January 2023. The authors collaboratively discussed broad search terms to capture a wide range of literature related to aquaculture perceptions. For example, one of the search strings used in the Scopus database was:

*(ALL (aquaculture OR farm * fish OR aquafarm* OR mariculture OR polyculture)) AND (TITLE – ABS– KEY (perception * OR belief * OR attitude * OR imag* OR opinion *)).*

This string was adapted to suit the syntax of each database. The reference sections of the identified academic papers were also examined for additional potential articles.

The inclusion criteria encompassed all types of records, including reviews, books, reports, conference papers, and original articles; publications released between 1 January 2015 and 15 January 2023; articles in the English language; those available as full text; and articles relevant to the study's purpose. Exclusion criteria included records where the search terms were used in a context unrelated to the research question (e.g., aquaculture management and

conservation, economic and demand analyses, technological aspects of aquaculture, or perceptions of wild fisheries), and articles that did not focus on societal perceptions of aquaculture, which is central to the study.

b) Data Preparation and Analysis

Articles meeting the inclusion criteria were imported into the Zotero software for citation management (Ivey & Crum, 2018). A thesaurus file was initially created to ensure consistency in spelling and synonyms within the text data (e.g., replacing “farmed fish” with “aquaculture”). To identify the research clusters, thematic clustering was performed using the visualisation of similarities (VOS) software (version 1.6.20) (van Eck & Waltman, 2010a). The association strength of co-occurring terms in the title and abstract fields was analysed to define the thematic research clusters. A co-word map was generated with a minimum threshold of eight-word occurrences using the VOS mapping technique, allowing thematic research clusters to be visualised (Van Eck & Waltman, 2011). Irrelevant terms, such as country and city names, were excluded from the analysis. The counting method was set to binary and the scales for network and overlay visualization were both set to 1.00. Each article was then assigned to the thematic research cluster that it aligned with most closely, a process that involved reviewing the title and abstract and reading the full text to confirm its relevance to the clusters. This task was conducted independently by three reviewers, with a fourth reviewer being consulted to resolve any disagreements through discussion. Finally, each article was summarised based on details such as the author(s) and year of publication, research design, topic focus, stakeholder involvement, and aquaculture/sustainability attributes addressed.

2.2.2 Media Analysis

National, regional, and local mainstream newspapers from the United Kingdom, Denmark, France, Spain, Poland, Hungary, Turkey, China, and India were examined for articles related to societal perceptions of aquaculture. These countries were selected based on factors such as aquaculture production levels (compared to wild-caught fisheries), aquatic food trade deficits, per capita consumption of aquatic foods, geographical location, and their current or potential future roles in global aquaculture. For instance, China is the largest producer of aquaculture, with one of the highest per capita consumptions and no trade deficit in aquatic foods. In contrast, Hungary has the lowest aquaculture production, low per capita consumption, and a trade deficit in aquatic foods. The inclusion of both Asian countries

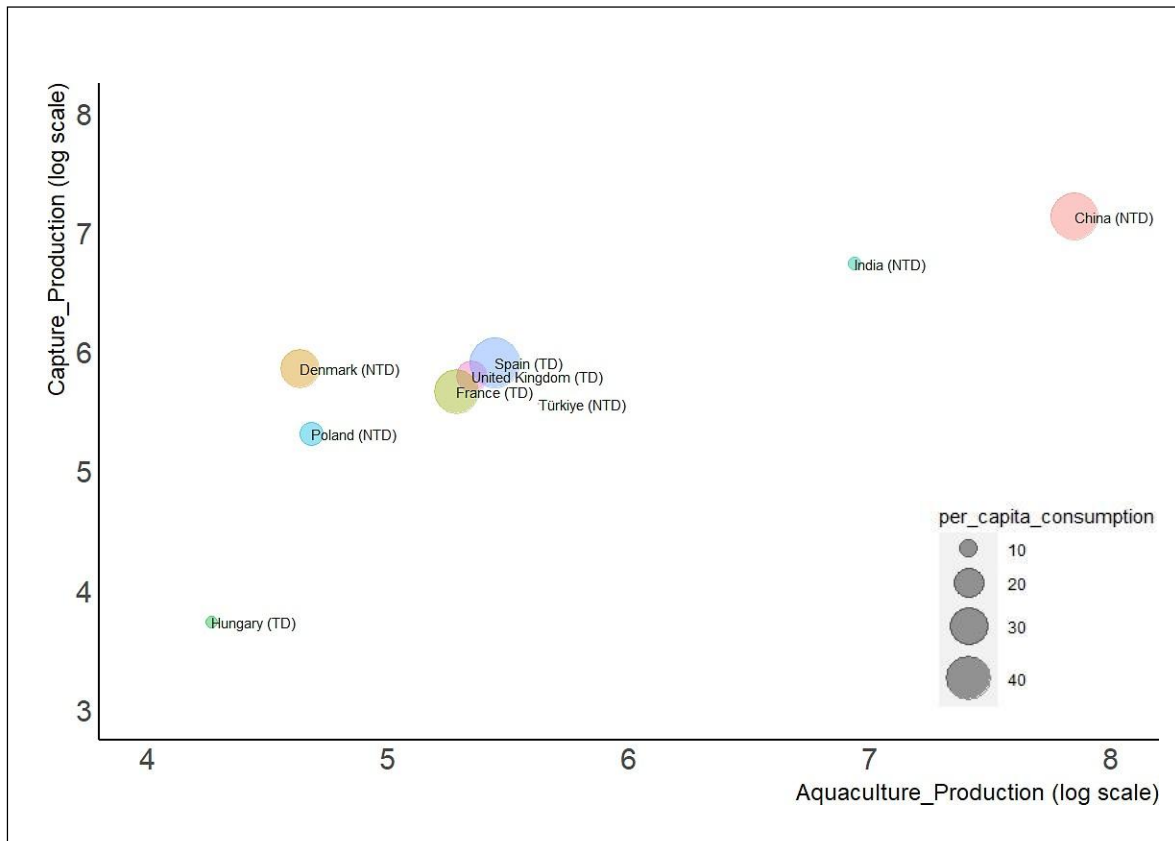
(China and India) and European (United Kingdom, France, Spain, Denmark, Poland, Turkey, and Hungary) provided a wider geographical and cultural scope for analysis, offering deeper insights and a more nuanced understanding of cross-cultural dynamics that shape societal perceptions of aquaculture across a large portion of the global population. To harmonize data collection across diverse contexts, a structured content analysis framework was modified and adapted from (Weitzman & Bailey, 2019) (Appendix A). This framework outlined coding variables such as media genre, stakeholder types and roles, aquaculture type, sentiment/tone, topics covered, and sustainability attributes. A shared Excel template was used to record all article data in a consistent format. To ensure uniform interpretation, the PhD student provided a detailed coding guide and presented sample article analyses to all collaborators. These examples served as reference points to align interpretations, reduce ambiguity, and support inter-coding consistency across countries. Figure 4 presents a comparative analysis between these nations.

Table 4 outlines the search keywords, databases/online archives used, and the number of newspaper articles analysed for each country. The search terms and the databases were adjusted for each country to better locate relevant articles, as a standard database was not consistently effective. Despite the adjustments, efforts were made to locate as many relevant newspaper articles as possible in each country.

The inclusion criteria for articles were content focused on societal perception of aquaculture, article types (news wire, feature, editorial), publication period (1 January 2015 to 15 January 2023), and official languages of selected countries (see Table 4). A random quota sampling technique was used to select 100 articles in countries where more articles were available. Due to disparities in article volume across countries, a quota sampling approach was adopted. A maximum of 100 articles per country were selected to balance representation and feasibility. Each article was subjected to content and stakeholder analysis, incorporating a “summative content analysis” approach, which quantifies certain words while also assessing the contextual meaning (Hsieh & Shannon, 2005). This approach blends quantitative and qualitative techniques to investigate both the content and the portrayal of specific themes in the articles (Weber, 1990). The inclusion of both state-influenced and independent media sources also enabled comparative reflections on media freedom. For instance, portrayals in China (with a more state-aligned media) may reflect official narratives, while in countries with a freer press (e.g., Denmark), a more critical or diversified portrayal was observed. An Excel worksheet was created to summarize each newspaper article, detailing the headline, publication date, publisher, country, stakeholders mentioned, sustainability attributes, key findings, sentiment/tone, and types of aquacultures discussed. Articles were categorized by

topics and themes; thus, the total topic count may exceed the number of articles analysed, as some articles covered multiple themes (e.g., addressing both environmental and social benefits of aquaculture).

It is acknowledged that media content both reflects and shapes public perceptions; this dual role is explored further in the discussion.



^aData on per capita consumption of aquatic food (kg/year/capita) and production (tonnes, live weight) were sourced from the Food and Agriculture Organization (2020). Both the x-axis and y-axis are displayed using a logarithmic scale for improved visualisation. TD represents the Aquatic Food Trade Deficit, while NTD indicates No Aquatic Food Trade Deficit.

Figure 4. Comparative analysis of the countries selected for the media analysis of newspapers. ^a

Table 4. Search terms, databases used, and the number of newspaper articles reviewed for each country. ^a

	United Kingdom (English)	Denmark (Danish)	France (French)	Spain (Spanish)	Poland (Polish)	Hungary (Hungarian)	Turkey (Turkish)	China (Chinese)	India (Hindi/English)
Keywords	Aquaculture Farm fish Aquafarming Mariculture Polyculture	Akvakulture, fiskeopdræt	Aquaculture, Pisciculture, Conchyliculture Saumon elevage	Acuicultura, Piscicultura,	Akwakultura a, Hodowla ryb, Gospodarka rybacka, Polikultura	Haltenyésztés, Akvakultúra, Tógazdaság	Su Ürünleri Yetiştiriciliği, Akuakültür, Su Ürünleri Çiftliği	水产养殖, 鱼养殖, 虾养殖, 蟹养殖, 贝养殖, 藻养殖, 海水养殖, 淡水养殖	मत्स्य पालन, एकाकल्चर, मछली पालन
	Perception, Belief, Attitude, Image, Opinion	Opfattelse, Synes, Tænke	Opinion, Perception, Croyance	Opinion, Percepción, Creencias	Opinia, Postrzeganie, Percepcja, Zdanie, Punkt widzenia	Vélekedés, Hozzáállás, Vélemény, Megítélés	Algı, Görüş, Fikir	观念, 信仰态度, 形象意见, 观点看法	अनुभूति, रवैया, छतव, राय
Databases	Nexis	Infomedia	Europress	Hemeroteca nacional	AGRO, SIGŻ, newspaper websites	Arcanaum	Sabah, Türkiye, Sözcü, Milliyet, Hürriyet	Chinese National Knowledge Infrastructure	ProQuest
Results	2072	1455	424	445	79	29	1147	146	130
Analysed	100	100	100	100	79	29	100	100	70

^a the language listed under each country represents the official language used in that country.

2.3 Results

2.3.1 Systematic Scoping Review

The initial search across Web of Science, Scopus, and Google Scholar identified 12,504 potential records. After applying the eligibility criteria, 11,648 records were excluded based on their titles, and 655 were removed after reviewing the abstracts. A further assessment of the full text of 201 articles led to the inclusion of 151 articles in the systematic scoping review. Figure 5 illustrates the article selection process following the *PRISMA – ScR* guidelines.

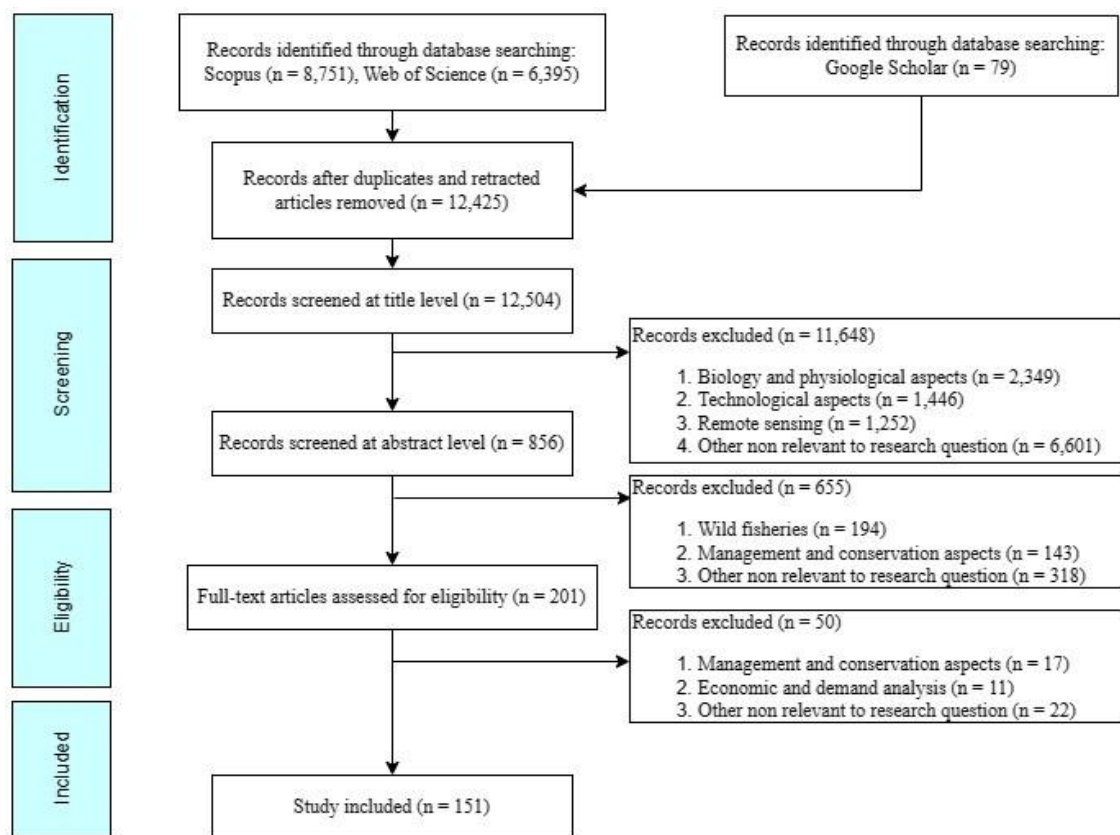


Figure 2. PRISMA-ScR flow diagram illustrating the systematic scoping review process.

a) Overview of Thematic Research Clusters

Thematic clustering of the selected scientific articles revealed five key thematic research clusters: (1) Social acceptability, (2) Growth and development, (3) Media coverage, (4) Sustainable aquaculture, and (5) Consumer perceptions. Figure 6 displays the co-word map highlighting co-occurring terms within the scientific literature. The first thematic research

Asia contributed only 6.6 % of the studies aimed at understanding societal perceptions related to aquaculture.

The predominant focus of these studies was on user perceptions, which constituted 42.3% of the total. This category primarily includes individuals who interact with or consume aquaculture products. Notably, the research on user perceptions is mainly found in thematic research cluster 5, labelled 'Consumer Perceptions,' with most articles conducted in Europe. More than half of the research articles (53 %) dealt with aquaculture in a general sense, while the remaining articles focused on specific types of aquacultures: finfish (9.9 %), marine (9.3 %), and shellfish (7.3 %). Additionally, over one-third of the publications examined stakeholder perceptions concerning sustainability aspects of aquaculture, covering two or more dimensions. Other areas of focus included general perceptions (46.3 %), risks and benefits (7.9 %), and access arrangements (2.6 %).

Table 5. Descriptive analysis of the thematic research clusters and the percentage of the total sample.

%(n)	Categories	Social acceptability N = 30	Growth and development N = 24	Media coverage N = 35	Sustainability aspects N = 23	Consumer perceptions N = 39	Total
Primary article location	Asia	-	-	2.8(1)	30.4(7)	5.1(2)	6.6(10)
	Africa	-	4.2 (1)	-	8.7(2)	-	2(3)
	Australia	3.3(1)	-	14.3(5)	8.7(2)	-	5.3(8)
	Europe	40(12)	62.5(15)	37.1(13)	30.4(7)	71.8(28)	49.7(75)
	North America	43.3(13)	20.8(5)	34.2(12)	4.3(1)	17.9(7)	25.2(38)
	South America	6.6(2)	-	8.6(3)	4.3(1)	-	3.9(6)
	Global	6.6(2)	16.6(4)	8.6(3)	13.0(3)	7.7(3)	9.9(15)
Primary article focuses	Growth and development	13.3(4)	33.3(8)		26.1(6)	-	11.9(18)
	Multiple sustainability aspects	6.6(2)	12.5(3)	5.7(2)	21.7(5)	-	7.9(12)
	Policy and regulation	3.3(1)	12.5(3)	-	4.3(1)	-	3.3(5)
	Profitability	-	-	-	8.7(2)	-	1.3(2)
	Conflict of interests	-	16.6(4)	42.8(15)	4.3(1)	-	13.2(20)
	Social acceptability	6.6(2)	8.3(2)	2.8(1)	8.7(2)	-	4.6(7)
	Risk perception	3.3(1)	4.2(1)	2.8(1)	-	-	2(3)
	User perception	46.6(14)	8.3(2)	14.3(5)	17.4(4)	100(39)	42.3(64)
	User impacts	10(3)	4.2(1)	5.7(2)	4.3(1)		4.6(7)
	Public perception	10(3)	-	2.8(1)	4.3(1)		3.3(5)
	Transparency and communication	-		22.8(8)			5.3(8)

Types of Aquacultures analysed	Aquaculture in general	53.3(16)	58.3(14)	42.8(15)	39.1(9)	66.6(26)	53(80)
	Aquaculture products, in general					10.3(4)	2.6(4)
	Finfish aquaculture		8.3(2)	31.4(11)		5.1(2)	9.9(15)
	Marine aquaculture	23.3(7)	8.3(2)	8.6(3)	8.7(2)		9.3(14)
	Integrated multitrophic aquaculture	3.3(1)	8.3(2)		13.0(3)	7.7(3)	5.9(9)
	Shellfish aquaculture	20(6)		5.7(2)	13.0(3)		7.3(11)
	Organic aquaculture				13.0(3)	7.7(3)	3.9(6)
	Offshore aquaculture		12.5(3)				2(3)
	Others (cage, inland, etc.)		4.2(1)	11.4(4)	13.0(3)	2.5(1)	5.9(9)
Aquaculture/sustainability attributes	Economic and environment	6.6(2)		2.8(1)	4.3(1)	5.1(2)	3.9(6)
	Social and environment	3.3(1)	4.2(1)		8.7(2)		2.6(4)
	Socioeconomic		12.5(3)		17.4(4)		4.6(7)
	Social, economic, and environment	23,3(7)	25(6)	22.8(8)	4.3(1)	2.5(1)	15.2(23)
	Multiple dimensions (social, economic, health, quality, environment, etc.)	16.6(5)	20.8(5)	25.7(9)	21.7(5)	2.5(1)	16.5(25)
	Risks and benefits	10(3)	8.3(2)	14.3(5)	8.7(2)		7.9(12)
	Access arrangement	3.3(1)	8.3(2)			2.5(1)	2.6(4)
	Perception in general	36.6(11)	20.8(5)	34.3(12)	34.8(8)	87.2(34)	46.3(70)

c) Thematic Research Clustering

Thematic Research Cluster 1: Social Acceptability

This thematic research cluster examined the social acceptability of aquaculture, focusing primarily on the public as the key stakeholder group. The findings revealed that public perceptions of aquaculture were varied—positive, neutral, or negative—depending on specific aquaculture activities, geographical location, knowledge about aquaculture, and perceived socioeconomic benefits versus environmental risks.

Perceptions of different aquaculture practices varied by country. For instance, a survey indicated that people in Italy and Israel viewed integrated multi-trophic aquaculture (IMTA) more favourably than conventional aquaculture. In contrast, in Norway, where IMTA systems are not yet commercially widespread, there was uncertainty regarding its environmental benefits (Alexander et al., 2018). This discrepancy suggests a gap between the views of decision-makers, who may be more optimistic about IMTA's potential, and the general public's understanding, which could be influenced by limited exposure or media portrayals. Such perceptions may be shaped not only by the actual presence of IMTA systems but also by broader narratives around sustainability, highlighting the importance of addressing both stakeholder beliefs and public understanding when developing and promoting new aquaculture technologies. IMTA involves the simultaneous cultivation of fed species like finfish, alongside inorganic and organic extractive species such as seaweeds and filter feeders. Despite considerable research interest, IMTA remains largely theoretical and has not gained traction among commercial stakeholders, largely due to regulatory hurdles (Chopin et al., 2012). Across various regions, the public generally held a more positive view of farming mussels and seaweed (Agúndez et al., 2022; Hudson et al., 2015; National Institute for Marine Research and Development, 2021; Thomas et al., 2017). In Atlantic Canada, attitudes were more mixed; while some recognized that bivalve farming could mitigate pollution, there were concerns about potential impacts on the ocean floor and overall coastal ecology (Wood & Filgueira, 2022).

A review of European aquaculture highlighted that many aquaculture operations occur in public spaces and interact with diverse resource users and local communities. Thus, their social acceptability is closely linked to their operational locations (Cavallo et al., 2022). In Spain, some public groups believe that areas closer to the coast are ideal for aquaculture development (Agúndez et al., 2022). However, broader concerns arise about conflicts with other economic and recreational uses near the coast, as well as the potential negative impacts on aesthetics (Alexander et al., 2018; Dalton et al., 2017; Dalton & Jin, 2018; Jodice et al.,

2015; Murray & D'Anna, 2015; Ruiz-Chico et al., 2020). In contrast, attitudes in Northern Norway was more neutral regarding aquaculture's impacts on fishing and both commercial and recreational uses (Bjørkan & Eilertsen, 2020).

Stakeholder knowledge about aquaculture also appears to influence its social acceptability. Individuals with a deeper understanding of aquaculture are generally more supportive of its development (Kim et al., 2020; Rickard et al., 2020; Sinner et al., 2020; Whitmore et al., 2022). For instance, research by Whitmore and colleagues (2022) found that men with college degrees and non-white individuals in the United States reported higher subjective knowledge of aquaculture, correlating with greater support for it. In contrast, women with lower education levels and white individuals indicated the least familiarity with aquaculture. While many studies do not distinguish between familiarity and knowledge, Flaherty et al. (2019) used specific questions, such as asking about local aquaculture species, to measure actual knowledge rather than self-reported familiarity.

The results indicate that public perceptions of aquaculture sustainability play a crucial role in determining its social acceptability. However, the literature linking negative or mixed perceptions to specific environmental impacts often lacks quantifiable evidence (Armbrecht & Skallerud, 2019; Bjørkan & Eilertsen, 2020; D'Anna & Murray, 2015; Hynes et al., 2018). Generally, the public in Europe and North America perceives aquaculture as a threat to the marine environment, citing concerns such as eutrophication, impacts on wild fish stocks, heavy metal contamination, and pollution. Further, environmental sustainability is critical for enhancing public confidence in aquaculture products (Fernández et al., 2023; Flaherty et al., 2019; Hynes et al., 2017; Jodice & Norman, 2020; Outeiro et al., 2018). Research has shown that levels of heavy metal contamination are typically much higher in wild fish stocks than in farmed fish (Fallah et al., 2011; Habib et al., 2024; Rodríguez-Hernández et al., 2017). Wild fish, particularly those higher up the food chain, accumulate heavy metals like mercury through bioaccumulation in the marine environment. In contrast, farmed fish are subject to strict regulations and monitoring, significantly reducing the risk of such contamination. Consequently, demonstrating environmental sustainability is critical for enhancing public confidence in aquaculture products.

Conversely, aquaculture is also associated with local job creation and economic support. In some regions, such as the United States, Ireland, and Norway, attitudes towards the socioeconomic benefits of aquaculture are more influential in shaping support or opposition than environmental concerns (Dalton et al., 2017; Dalton & Jin, 2018; Hudson et al., 2015; Hynes et al., 2018; Jodice et al., 2015; Knapp & Rubino, 2016). The trade-offs between socioeconomic and environmental impacts are rarely addressed explicitly in the literature,

missing an opportunity to explore their interconnectedness.

Another aspect of social acceptability identified in two studies is that lower fish prices are seen as a positive aspect of aquaculture for consumers (Ruiz-Chico et al., 2020; Ruiz-Chico et al., 2020). However, food safety issues—such as disease transfer, lower quality, and inferior taste—are regarded as negative factors by others (Alexander et al., 2018; Ruiz-Chico et al., 2020). Sinner et al. found that cultural factors, including community identity and culture, were the only significant predictors of social license scores determining public acceptance of aquaculture in New Zealand, while environmental, economic, and social impacts were not significant (Sinner et al., 2020). In contrast, economic benefits to coastal communities were not deemed critical to the social acceptability of aquaculture in Europe (Cavallo et al., 2022).

Thematic Research Cluster 2: Growth and Development

This cluster was closely associated with thematic research cluster 1 (Societal Acceptability; see Figure 6) but specifically concentrated on the perspectives of key stakeholders within the sector. These stakeholders included government officials, representatives from civil society (such as environmental NGOs, activists, and community organizations), fish farming enterprises (including fish farmers and industry associations), business leaders both within aquaculture value chains (like retailers and technology providers) and in related sectors (such as fisheries and tourism), as well as scientists (including researchers, students, and legal experts) regarding the growth and development of aquaculture.

The results indicate that government officials, fish farming enterprises, scientists, and business leaders—particularly in the retail and technology sectors—generally held neutral to positive views on aquaculture's growth. In contrast, civil society representatives, especially environmental NGOs, activists, and certain community groups, along with business leaders with competing interests (particularly from fisheries and tourism), expressed more neutral to negative opinions (Corner et al., 2020; Ertör & Ortega-Cerdà, 2017; Kongsvik et al., 2018; Memery & Birch, 2016). The public exhibited less polarized views, showing a spectrum of perceptions from positive to negative (Billing, 2018; Black & Hughes, 2017).

Aquaculture's growth and development are crucial topics in discussions about food security and sustainability. Stakeholders supportive of aquaculture, such as fish farming enterprises, government officials, and scientists, believe that expanding aquaculture enhances food production and bolsters national food security, particularly by reducing reliance on imported aquatic foods in Europe (Baporikar, 2019; Krause & Mikkelsen, 2017; Schupp et al., 2021). They also assert that the growth of aquaculture could reinforce related industries along the

value chain and create new business opportunities. Additional perceived advantages include a reduced strain on wild fish stocks, contingent upon aquaculture transitioning from wild-caught fish to alternative feed sources and improving water quality (notably in shellfish aquaculture or Integrated Multi-Trophic Aquaculture, IMTA). Conversely, civil society stakeholders—especially environmental NGOs, activists, and certain community groups—argued that expanding aquaculture could lead to disease outbreaks and compromise the genetic diversity of wild fish populations, contribute to chemical pollution, and detract from the coastal landscape's visual appeal. They also noted that marine aquaculture could increase traffic congestion at sea and in ports, along with various environmental risks such as accidents and oil spills. Their overall stance was that the potential environmental hazards of expanding aquaculture outweigh the perceived benefits (Bacher, 2015; Bailey & Eggereide, 2020; Krause & Mikkelsen, 2017; Siddiki & Goel, 2015; Young et al., 2019).

Fish farming enterprises, business leaders, and scientists believe that innovative aquaculture techniques—such as IMTA, increased use of plant-based feed, organic practices, polyculture, and combining offshore wind farms with aquaculture—could enhance the public perception of aquaculture (Alexander et al., 2016; Billing et al., 2022; Perdikaris et al., 2016; Salas-Leiton et al., 2021; Watson et al., 2022). Meanwhile, they recognized that negative public perceptions of aquaculture, along with regulatory and financial barriers and a lack of understanding of these innovations among policymakers, pose significant challenges to their implementation. Note that the potential cost-effectiveness and broader economic advantages of adopting such practices have not been thoroughly examined in the existing literature.

Thematic Research Cluster 3: Media Coverage

The thematic research cluster investigates how aquaculture is represented in the media and the conflicts of interest among key stakeholder groups. Approximately one-third of the analysed publications concentrated on finfish aquaculture, highlighting the public controversies surrounding this sector.

Overall, global media coverage of aquaculture tends to be favourable (Feucht & Zander, 2017; Olsen & Osmundsen, 2017; Weitzman & Bailey, 2019). However, the literature reveals that mainstream media in developed nations is generally more critical of aquaculture compared to that in developing countries (Condie et al., 2022b; Froehlich et al., 2017). The primary stakeholders represented in the mainstream media are fish farmers and government officials, while civil society stakeholders, including environmental NGOs, activists, and community groups, receive more attention than scientists and experts. The voices of non-

producers within the seafood supply chain, such as retailers, processors, and suppliers, are notably less prominent (Feucht & Zander, 2017; Weitzman & Bailey, 2019). Civil society groups (environmental NGOs, activists, and community groups) typically express critical viewpoints about the sector.

Additionally, research indicates that responses from aquaculture enterprises or government agencies featured in media coverage tend to be defensive regarding criticisms raised by civil society stakeholders (Condie et al., 2022b; Weitzman & Bailey, 2019). In contrast, media outlets often seek 'expert' opinions from academics and specialists in both the private and public sectors. Govaerts (2021) discovered that positive news coverage in French newspapers stemmed from engagement with the fish farming industry and government, predominantly focusing on economic, scientific, and technological aspects. Conversely, negatively framed articles involved a larger representation of civil society stakeholders, with a primary focus on health, safety, governance, and ecological issues.

Overall, discussions about environmental impacts dominate newspaper coverage more than other subjects such as social, cultural, or economic factors (Condie et al., 2022b; Cullen-Knox et al., 2021; Kraly et al., 2022; Olsen & Osmundsen, 2017; Rickard & Feldpausch-Parker, 2016; Van Holt et al., 2018). Nonetheless, some studies indicate that many articles present a mix of benefits and risks (Froehlich, Gentry, Rust, et al., 2017; Weitzman & Bailey, 2019). For example, Rickard et al. (2018) found that many articles praised the environmental advantages of shellfish and seaweed farming, presenting them as sustainable practices without negative environmental effects. The most frequently mentioned environmental concerns included threats to wild fish populations, disease and parasites, fish escapes, and the use of antibiotics and pesticides (Feucht & Zander, 2017, 2017; Govaerts, 2021; Olsen & Osmundsen, 2017; Osmundsen & Olsen, 2017; Papacek et al., 2018; Van Holt et al., 2018; Weitzman & Bailey, 2019).

Consistent findings show that the rapid growth of finfish farming in Western countries, particularly during the late 20th century and early 2000s, has led to increased social conflicts and public concerns (Bachmann-Vargas et al., 2021; Condie et al., 2022a; Cullen-Knox et al., 2019; Ertör, 2021; Froehlich et al., 2017; Osmundsen & Olsen, 2017). Civil society narratives regarding the salmon industry in New Zealand highlight public health worries about the product being "potentially unhealthy and unclean," environmental concerns being "damaging the local environment", and concerns about local governance and democracy being "threatening local democracy and public resources" (Fløysand et al., 2016). Issues regarding community impact, indigenous rights, space usage, transparency, and public consultation are also significant topics of discussion. The increased visibility of civil society

stakeholders in media narratives reflects a shift in public engagement with aquaculture discourse (Condie et al., 2022b, 2022a; Fløysand et al., 2016; Lebel et al., 2019). In contrast, an analysis of 273,319 tweets from 2006 to 2021 by Glutting (2022) found that most tweets from stakeholder groups (academic/researcher, fish industry/worker, environmental NGOs/conservation, government officials, Indigenous and media) generally had a positive sentiment and trend over time. Notably, communications were especially favourable among academics/researchers and the fish farming industry/worker groups, suggesting the presence of an 'echo chamber effect' (Cinelli et al., 2021).

Thematic Research Cluster 4: Sustainable Aquaculture

The thematic research cluster focused on sustainable aquaculture, specifically examining the economic and social perceptions surrounding the industry. It investigates how fish farming enterprises and stakeholders in the value chain perceive sustainable aquaculture, emphasizing their roles as key groups in this area.

Many stakeholders view aquaculture as a viable practice for addressing climate change and food security issues globally. However, to ensure sustainability, effective monitoring and control mechanisms are necessary to adhere to environmental standards (Little et al., 2016a; Oyebola & Olatunde, 2019). Developed economies increasingly recognize the importance of sustainable and responsible aquaculture, yet civil society often feels that government efforts to mitigate environmental challenges are insufficient.

The aquaculture sector aims to prevent rising production costs and reputational harm, leading to a growing interest in certifications from organizations like the Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP). These third-party organizations believe that international certification standards are essential for enhancing consumer trust, legitimizing the industry, and ensuring compliance with sustainability requirements (Bacher, 2015; Little et al., 2016a; Mather & Fanning, 2019; Xuan et al., 2021).

Conceptualised and non-conventional aquaculture practices such as Integrated Multi-Trophic Aquaculture (IMTA), aquaponics, and organic methods, are generally perceived as more sustainable than traditional approaches, even though they are often practised on a limited scale and lack substantial evidence of sustainable performance. For example, Australian researchers view the expansion of seaweed farming as aligned with the United Nations Sustainable Development Goals, offering benefits like local ecosystem support, food provision, and economic opportunities (Spillias et al., 2022). Similarly, many European fish farmers and scientists engaged in European projects believe that IMTA can enhance economic and ecological sustainability, along with food security (Alexander et al., 2016;

Kleitou et al., 2018). A systematic review by Gambelli et al. (2019) indicated that organic aquaculture can improve living conditions for fish farmers in developing regions, although profitability can vary due to high feed costs and lower yields. Additionally, while stakeholders view IMTA as compatible with organic principles, they often do not see recirculation aquaculture systems in the same light, despite their limited application on a larger scale for commercially significant species like salmon (Lembo et al., 2018). Conversely, polyculture—common in Asia but less so in Europe—is viewed as more sustainable. A recent pilot study revealed that integrating shrimp, tilapia, and seaweed in polyculture led to increased economic benefits and reduced costs for Vietnamese farmers (Tran et al., 2020).

Overall, fish farming enterprises express satisfaction with the productivity of sustainable aquaculture methods (Fleming et al., 2015; Ray et al., 2021; Ton Nu Hai & Speelman, 2020; Tran et al., 2020; Xuan et al., 2021). Nonetheless, some farmers have opted out of aquaculture due to inherent risks (Kinney, 2017; Richardson & Suvedi, 2018). Key motivators for adopting aquaculture include dwindling wild fish stocks, the potential for higher earnings, benefits of working from home, increased household food availability, and rising demand driven by urban purchasing power (Bello et al., 2021; Kinney, 2017; Richardson & Suvedi, 2018; Ton Nu Hai & Speelman, 2020; Tran et al., 2020). Barriers to adoption involve issues like access to quality feed and seedlings, inadequate financial returns, lack of knowledge and technology, regulatory hurdles, disease outbreaks, and negative social perceptions (Apriliani et al., 2021; Hambrey & Evans, 2016; Kinney, 2017; Kleitou et al., 2018; Lindland et al., 2019; Richardson & Suvedi, 2018; Xuan et al., 2021). Various sociodemographic factors, such as age, gender, occupation, fishing experience, education, and household size, also play significant roles in the adoption and expansion of aquaculture (Bello et al., 2021; Francisco et al., 2017; Ray et al., 2021; Richardson & Suvedi, 2018; Xuan et al., 2021).

Thematic Research Cluster 5: Consumer Perceptions

This thematic research cluster examined consumers' perceptions of aquaculture and the factors that influence consumers' perceptions. The results indicated that most consumers tend to have a negative outlook on aquaculture compared to wild fisheries (Altintzoglou et al., 2022; Budhathoki et al., 2021; Carlucci et al., 2015; Güney, 2019; Hoerterer et al., 2022; Krešić et al., 2020, 2022; Lang & Rodrigues, 2021; Polymeros et al., 2015; Pulcini et al., 2020; Rickertsen et al., 2017; Tomic et al., 2016). Generally, consumers view wild fish products as more natural, healthier, nutritious, safer, and tastier, with higher quality and firmer texture, whereas they perceive aquaculture products as cheaper, lower quality, and

more widely available (Bronnmann & Asche, 2017a; Güney, 2019; Pulcini et al., 2020; Wongprawmas et al., 2022). Nonetheless, some studies found that many consumers struggle to distinguish between aquaculture and wild fish products at the point of sale, or that aquaculture products may offer superior sensory attributes (taste and overall liking) compared to wild fish (Budhathoki et al., 2021; Claret et al., 2016).

Recent research suggests a shift toward more positive consumer perceptions of aquaculture (Carrassón et al., 2021; Loncaric et al., 2021; Nguyen et al., 2023; Runge et al., 2021; Stancu et al., 2022). A study by Nguyen et al. (2023) found that consumers in the United States are beginning to perceive aquaculture products as safer, tastier, higher quality, and more fairly traded compared to wild-caught fish. Positive views were particularly pronounced for products sourced from traditional aquaculture practices (Krešić et al., 2020; Risius et al., 2017; Runge et al., 2021; van Osch et al., 2019), such as IMTA (van Osch et al., 2017; Yip et al., 2017), aquaponics (Miličić et al., 2017), and organic systems (Budhathoki et al., 2022a; Ferfolja et al., 2022; Feucht & Zander, 2015; Osmond et al., 2022). However, many consumers in these studies had not sampled products from these practices, and their views were largely influenced by external information.

Consumers perceive ecolabel aquaculture products as healthier, safer, tastier, and leaner, although they are often seen as more expensive and less accessible. In addition to valuing sustainability certifications, consumers showed a preference for aquaculture products from the European region (Banovic et al., 2019a, 2019b; Budhathoki et al., 2021; Cantillo et al., 2023; Rickertsen et al., 2017; Risius et al., 2017). Psychographic segmentation was employed in two studies to better understand aquatic food consumers (Reinders et al., 2016; Stancu et al., 2022). The findings revealed that European consumers could be categorized based on behaviour, with two specific groups particularly inclined to favour aquaculture products: ‘Foodies,’ who place a high value on food choices, demonstrate responsibility, and seek innovative products, and ‘Involved Innovators,’ who possess knowledge about and engage with seafood, especially innovative types (Reinders et al., 2016; Stancu et al., 2022). Additionally, research by Cantillo et al. (2023) showed greater acceptance of aquaculture products among consumers who favoured salmon, preferred European-origin products and shopped at supermarkets, while acceptance was lower among those who frequently consumed seabream and bought food from non-supermarket retail outlets.

Sociodemographic factors such as age, gender, education, household size, and income also play a role in shaping consumers' perceptions of aquaculture products. For instance, the study by Cantillo et al. (2023) found that Spanish women with two or more children and households with lower income levels were more likely to accept aquaculture products.

2.3.2 Summative Content Analysis of Newspaper Articles

Table 6 outlines the characteristics of newspaper articles from different countries. The analysis revealed differences in the focus of these articles, the stakeholder groups represented, the types of aquacultures covered, the sustainability factors discussed, and the overall tone or sentiment.

In the United Kingdom, articles primarily highlighted civil society stakeholders, particularly in discussions about risk perceptions. There is increasing anxiety regarding the negative environmental effects of finfish aquaculture, including issues like sea lice infections, fish escaping into the wild, and general pollution. The sentiment in these articles is largely negative, largely due to concerns over animal welfare and environmental damage, and efforts to conserve iconic wild fish populations, which hold significant cultural and recreational value, particularly for sport fishing. Conversely, some articles convey positive sentiments by emphasizing the socioeconomic benefits and technological advancements within finfish aquaculture. For example, Scotland is recognized for producing high-quality salmon, contributing to reduced seafood trade deficits, stimulating the local economy, and promoting gender equality.

In Denmark, newspaper articles primarily feature fish farming businesses, government officials, and industry leaders, focusing on policy and regulation as well as the growth of sustainable aquaculture practices. Approximately 48 % of the articles have a positive tone, often discussing new sustainable initiatives like documentation and labelling. However, civil society stakeholders, especially environmental NGOs, contribute to a more negative political discourse surrounding environmental issues, which appear in about 38 % of the articles.

In France, newspaper articles tend to focus on growth, development, and risk perceptions, with both civil society stakeholders and fish farming enterprises represented equally. Most articles discuss aquaculture generally, with a significant emphasis on shellfish production, which leads the industry in France. There is a strong push to promote domestic aquaculture over imports, resulting in a generally positive tone. Nonetheless, concerns about quality, health, food safety, and negative environmental impacts are also prevalent.

In Spain, fish farming enterprises and the public are the most prominently represented groups. The articles mainly convey a positive sentiment, highlighting the benefits of incorporating aquatic foods into diets and the democratization of access to these resources through aquaculture. There is a strong focus on growth and development, along with associated socioeconomic advantages.

In Poland, newspaper articles predominantly reflect a positive outlook on growth and regulatory aspects of aquaculture, featuring fish farming enterprises as the main

stakeholders, followed by scientists and civil society groups. However, new legislation that removes water and environmental subsidies for common carp (*Cyprinus carpio*) has drawn significant criticism from fish farming enterprises. Civil society stakeholders have raised concerns regarding animal welfare issues related to live carp sales and are opposed to new recirculating aquaculture system (RAS) facilities.

In Hungary, newspaper articles are largely focused on fish farming enterprises, addressing the low profitability of pond aquaculture. While most articles highlight the socioeconomic benefits positively, a few address the negative environmental and social impacts of aquaculture.

In Turkey, newspaper articles are largely influenced by pro-aquaculture stakeholders, including fish farming enterprises, government officials, and industry leaders, focusing on growth and development in the sector. Most articles emphasize the positive socioeconomic effects of aquaculture, resulting in an overall positive framing.

In China, newspaper articles primarily feature government officials (63 %), followed by fish farming enterprises (51 %) and scientists (16 %), with an emphasis on aquaculture's growth and development. The articles often highlight the socioeconomic benefits of aquaculture and polyculture, reflecting China's rapid economic transformation from middle to high-income. Media coverage tends to spotlight the increasing demand for higher-quality seafood and initiatives aimed at environmental improvement through scientific innovation, enhanced aquaculture practices, and better legal frameworks.

In India, articles predominantly feature government officials, followed by civil society stakeholders. Many articles discuss various sustainability aspects, along with growth and development strategies aimed at planning and allocating special budgets by the Union Government for new projects that support small-scale aquaculture farmers. Overall, most articles convey a positive tone, focusing on enhancing export opportunities with government backing, although civil society stakeholders' express concerns regarding the negative environmental and social impacts of aquaculture.

Table 6. Characteristics of the newspaper articles.

%(n)	Categories	United Kingdom N = 100	Denmark N = 100	France N = 100	Spain N = 100	Poland N = 79	Hungary N = 29	Turkey N = 100	China N = 100	India N = 70
Stakeholder involved	Government officials	23	70	14	21	22.7(18)	24.1(7)	66	63	42.8(30)
	Business leader	8	69	19	19	7.6(6)	-	44	-	5.7(4)
	Civil society group	59	16	38	11	17.7(14)	17.2(5)	2	-	22.8(16)
	Fish farming industry	55	71	38	39	39.2(31)	62(18)	90	51	12.8(9)
	Scientists	13	15	18	15	36.7(29)	13.8(4)	9	16	15.7(11)
	Public	3	3	23	37	5(4)	-	4	-	-
Article focus	Growth and development	8	27	17	37	19(15)	13.8(4)	40	48	17.1(12)
	Multiple sustainability aspects	4	32	5	5	13.9(11)	17.5(5)	24	14	37.1(26)
	Policy and regulation	4	28	6	8	19(15)	13.8(4)	26	16	5.7(4)
	Profitability	8	5	13	9	5(4)	20.6(6)	3	13	2.8(2)
	Conflicts of interests	4	20	4	4	2.5(2)	6.9(2)	2	-	11.4(8)
	Social acceptability	4	3	8	5	8.8(7)	3.4(1)	6	4	1.4(1)
	Risk perception	44	8	17	6	15.2(12)	6.9(2)	-	-	10(7)
	User perceptions	13	4	10	-	6.3(5)	13.8(4)	-	3	8.5(6)
	User impacts	5	2	10	2	2.5(2)	10.3(3)	1	-	1.4(1)
	Public perception	2	19	9	9	2.5(2)	-	2	-	2.8(2)
	Transparency and communication	2	20	1	15	5(4)	-	-	2	1.4(1)
Sustainability attributes	Economic	25	26	31	20	36.7(29)	31(9)	78	59	27.1(19)

	Social	28	29	29	15	29.1(23)	24.1(7)	67	46	12.8(9)
	Environment	55	36	15	18	16.4(13)	17.5(5)	12	25	11.4(8)
	Quality, health, and safety	12	25	25	13	1.2(1)	3.4(1)	3	4	-
	Multiple sustainability aspects	3	21	9	21	6.3(5)	17.5(5)	13	16	24.3(17)
	Access arrangement	2	-	4	7	20.2(16)	6.9(2)	3	16	5.7(4)
	Animal welfare	12	-	6	2	12.6(10)	-	-	1	-
	Perception in general	3	23	17	12	7.6(6)	20.6(6)	1	2	31.4(22)
Types of aquacultures	Aquaculture in general	41	84	49	62	20.2(16)	44.8(13)	70	59	52.8(37)
	Aquaculture products, in general	-	1	2	-	-	-	-	-	10(7)
	Finfish aquaculture	46	4	2	7	-	-	-	-	12.8(9)
	Marine aquaculture	-	4		-	5(4)	-	1	3	20(14)
	Shellfish aquaculture	4	-	33	2	-	-	3	2	1.4(1)
	Organic aquaculture	1	-		-	-	-	1	-	-
	Offshore aquaculture	-	6	7	13	1.2(1)	-	8	4	-
	Other (cage, inland, freshwater, etc.)	3	1	6	11	73.4(58)	58.6(17)	17	13	2.8(2)
	Polyculture	1	-	-	-	-	-	-	19	-
	Seaweed	3	-	1	3	-	-	-	-	-
Sentiments/tones	Positive	33	48	54	70	48.1(38)	79(23)	95	87	58.5(41)
	Negative	45	14	29	16	35.4(28)	6.9(2)	1	4	22.8(16)
	Neutral	20	38	17	14	16.4(13)	13.8(4)	4	9	18.5(13)

2.3.3 Comparing and Contrasting Findings

Most scientific literature and newspaper articles reference one or more aspects of sustainability concerning aquaculture. However, the intricate nature of sustainability leads both scientific literature and newspaper articles to simplify sustainability as a concept. Scientific literature tends to provide a more detailed and rigorous analysis of social perceptions, while newspaper articles offer a broader overview. While scientific studies focus deeply on specific topics and issues, newspaper articles focus on current events and trends. The main objective of the scientific literature is to gauge public perceptions of aquaculture, whereas newspaper articles often aim to influence societal views by amplifying stakeholder voices. This dynamic results in a complex discourse around aquaculture, addressing and reacting to its various sustainability facets.

The findings from both analyses indicate that aquaculture is generally viewed positively for its economic advantages, while concerns about environmental risks create a negative perception. This is a common trend in food production, which significantly affects freshwater use, greenhouse gas emissions, and land utilization (Ritchie et al., 2022). Social issues also exhibit a spectrum of perceptions, varying based on context. The systematic scoping review, which identified a media coverage cluster, corroborated the newspaper media analysis. The combination of these two approaches revealed the stakeholder groups predominantly featured in the media coverage across nine countries and their perceptions of aquaculture. For instance, in Spain, a country with a strong aquatic food-eating culture, the positive sentiment in newspaper articles stems from the perceived benefits of including aquatic food in diets and how aquaculture has made this resource more accessible.

The dietary contributions of aquaculture also influence media representation. Chinese newspaper articles highlight the country's high aquaculture production and seafood demand, leading to a focus on policies and technological innovations for sustainable growth. In contrast, India, where per capita seafood consumption is low, sees discussions centred on aquaculture as an export opportunity or a potential livelihood for smallholders. Danish articles engage in discussions about various sustainability aspects of aquaculture, resulting in more balanced narratives that avoid being overly negative or positive, unlike those in other European countries. Overall, findings from both analyses suggest that perceived socio-environmental risks are a primary concern for civil society groups, particularly environmental NGOs, activists, and some community organizations, as well as for business leaders with competing interests, such as those in fisheries and tourism. Conversely, perceived socioeconomic benefits are often promoted by the commercial fish farming sector,

government officials, and certain business leaders, particularly within retail, wholesale, and technology industries, to support aquaculture.

2.4 Strategic Implications

As the aquaculture industry expands in both scale and economic value, the scrutiny of its sustainability impacts will intensify. Consequently, pro-aquaculture coalitions will need to adapt to the evolving discourses surrounding aquaculture. One approach to achieve this could be to adopt various strategies—such as involving, collaborating, defending, or monitoring—for effective communication with different stakeholder groups based on their stances regarding aquaculture (Varvasovszky, 2000). This relates to the Advocacy Spectrum of Allies theory, which categorizes stakeholders into five groups: (1) active allies, (2) passive allies, (3) neutrals, (4) passive opponents, and (5) active opponents (Powershift, n.d.). The theory emphasizes the importance of shifting the attitudes of passive supporters and neutral observers to effectively influence public opinion, rather than solely focusing on active allies or opponents. By altering the views of those with neutral or mixed opinions, aquaculture coalitions can enhance their social acceptability. Additionally, these coalitions should strive to engage more groups that could potentially support the aquaculture industry and its products. This could include stakeholders who view aquaculture practices based on organic principles, as well as those involved in the seaweed sector and IMTA, even if there is limited commercial evidence for their effectiveness, and their advocates may exaggerate their sustainability. Building coalitions may be vital for stakeholders who currently perceive established aquaculture practices as unsustainable.

The findings from this study suggest a need for closer collaboration with mainstream media, which can serve as a facilitating force, and a wider range of civil society groups, particularly those focused on transforming food systems. Chatterton (2004) argues that mainstream media can be neutral and recommends hiring communication experts for regular media briefings on relevant aquaculture topics. The study indicated varying levels of awareness and knowledge about aquaculture practices among different stakeholder groups, suggesting that targeted communications would be more effective (Botterill & Mazur, 2004). Social media platforms offer a robust means to engage with the public, especially younger consumers.

Swinburn (2019) notes that for some regions, narratives about food security, sovereignty, or malnutrition may resonate more, but whatever the narrative, it should encompass the diverse interests of various groups passionate about all facets of food production, including organic farming, animal welfare, and sustainable diets, etc... Ensuring a transparent narrative,

maintaining open communication, and establishing realistic timelines and mechanisms for addressing trade-offs will be crucial for garnering government support for the growth and expansion of aquaculture. In this context, aquaculture coalitions should enhance collaboration with stakeholders holding diverse views to promote sustainable practices. An example of such collaboration is the Global Salmon Initiative (GSI), a pre-competitive partnership aimed at driving substantial improvements across the salmon sector regarding social responsibility and environmental impact through global collaboration and shared resources (Global Salmon Initiative, 2023). This initiative has reported significant progress; according to the 2021 GSI Sustainability Report, approximately 48 % of its members' production is now ASC-certified, and antibiotic usage has been reduced by nearly half since 2013 (Global Salmon Initiative, 2021). Transparent reporting is essential for helping the public and relevant stakeholders understand the risks and commitments to sustainability. A similar approach could be beneficial for other commercially farmed species, such as tilapia, shrimp, and prawns, potentially enhancing positive perceptions of aquaculture, though challenges may arise from the greater diversity of systems and contexts compared to cage salmon farming.

Many perceptions held by environmental advocacy groups about aquaculture stem from the real challenges associated with intensive food production systems, but different organizations employ varying strategies to pursue their objectives, from confrontation and criticism to positive engagement (Allsopp et al., 2008; Casadesus-Masanell et al., 2019). Aquaculture coalitions can shape outcomes by proactively initiating evidence-based discussions about social and environmental risks with NGOs that express legitimate concerns. Initiatives like the aquaculture or seafood dialogues organized by the World Wide Fund for Nature (WWF) have facilitated discussions among industry representatives, NGOs, governments, and scientists, creating a framework for addressing negative perceptions. Furthermore, involving environmental stakeholders in the governance of aquaculture certification could be crucial in altering their viewpoints.

Additionally, many researchers argue that the perceived negative environmental impacts of aquaculture can be mitigated through collaborative research between fish farming enterprises and specialized scientific institutions (Bostock et al., 2010b; Brugère et al., 2019; Volpe et al., 2013). Tools like Life Cycle Assessment (LCA) and comprehensive frameworks such as the Ecosystem Approach to Aquaculture (EAA) can guide aquaculture towards enhanced sustainability. Increasingly, third-party standards utilize these tools to bolster the sustainability of individual farms (Hishamunda et al., 2014; Partelow et al., 2022) and numerous initiatives aim to improve governance at various levels (*Aquaculture Governance*

Indicators, n.d.).

There may also be opportunities for fish farmers to collaborate with both public and private sector initiatives (including certification, subsidy policies, and standards) in ways that explicitly promote sustainable aquaculture practices (Waite et al., 2014). For instance, business-to-business certifications like Global Good Agricultural Practices (GlobalGAP) could be more effective by concentrating on food safety and socially and environmentally responsible farming standards. However, establishing international certifications and standards to improve environmental performance may be less applicable to small-scale aquaculture practices in many countries, especially in the Global South. Sustainability labelling schemes can place undue burdens on small-scale farmers, and studies indicate that without external support from cooperatives, donor-funded projects, or governmental or NGO assistance, small-scale producers often struggle to enter markets that require sustainable certification (Belton et al., 2011; Bush et al., 2013). Additionally, it has been argued that certification schemes may lead to higher prices for eco-labelled aquaculture products (Kaczorowska et al., 2019), which could negatively impact poorer consumers' ability to access farmed aquatic foods (Green et al., 2013). Moreover, some evidence suggests that eco-labelling based on Northern norms is losing traction in emerging markets like China, which require alternative sustainability criteria (Bush et al., 2019).

The sustainability aspects of aquaculture may not resonate as clearly with the public, particularly consumers, who may not readily recognize their benefits. Research shows that most aquatic food consumers prioritize price and food safety over sustainable production practices and eco-labels (Budhathoki et al., 2022a; Grunert et al., 2014). Influencing consumer behaviour toward sustainable aquaculture products poses challenges, particularly regarding the intention-behaviour gap. White et al. (2019) propose that consumer engagement in pro-environmental behaviours can be enhanced when messaging incorporates psychosocial factors such as social influence, habit formation, self-esteem, emotions, and tangibility. Additionally, aquaculture practitioners could adopt behavioural strategies such as SHIFT (Social, Habit, Individual, Feeling and Cognition, and Tangibility) to help overcome barriers to changing consumer behaviour toward purchasing sustainable aquaculture products (White et al., 2019).

2.5 Conclusion and Limitation of the Study

The current systematic scoping review and newspaper media analysis consolidate the key findings from both scientific literature and newspaper articles that aim to understand societal perceptions of aquaculture within a broader context. Specifically, the scoping review

identified five main thematic research clusters: (1) social acceptability, (2) growth and development, (3) media coverage, (4) sustainable aquaculture, and (5) consumer perceptions. A comparison of the scoping review and newspaper analysis findings suggests that both scientific publications and newspaper articles often simplify the discussion of aquaculture's sustainability aspects.

The primary stakeholders identified include fish farming enterprises (such as fish farmers, aquaculture associations, or groups), civil society (encompassing environmental NGOs, activists, community groups, and media), governmental officials, scientists, and business leaders both within and outside aquaculture value chains (e.g., retailers/wholesalers, technology industry, fisheries, tourism). Additionally, the public, disaggregated into indigenous groups, residents, and consumers, also plays a role. These stakeholder groups hold varying perceptions of aquaculture, which fluctuate between positive and negative depending on the context. These perceptions are influenced by various factors such as the impact of aquaculture on sustainability dimensions, transparency, knowledge, personal interests, types and locations of aquaculture practices, regulations, individual experiences, dietary habits, and sociodemographic factors like age, gender, education, occupation, household size, and income. Environmental risks are generally perceived negatively by certain groups, particularly environmental NGOs, while the economic benefits are often seen in a positive light. Social and cultural perceptions of aquaculture also vary, depending on the situation.

Based on the findings related to societal perceptions of aquaculture in Europe, and informed by comparative insights from China and India, several policy directions can enhance aquaculture's competitiveness. In Europe, public concerns largely centre on environmental risks, limited familiarity with aquaculture practices, and mixed consumer perceptions of product quality. To address this, policies should prioritize transparent communication and public education to build trust in sustainable practices. Learning from China's focus on technological innovation and India's emphasis on supporting small-scale farmers, Europe can benefit from stronger stakeholder engagement, especially with civil society groups, and by promoting inclusive certification schemes. Encouraging consumer-facing campaigns and improving access to eco-labelled products may also improve public perception and market acceptance, ultimately strengthening aquaculture's social license and competitiveness across the region.

This study has some limitations. The search keywords may have restricted the inclusion of relevant articles, especially those that did not specifically focus on societal perceptions. The systematic scoping review was limited to English articles, and the newspaper analysis was

confined to the official languages of the countries the author was proficient in. Most articles related to the 'Media Coverage' thematic research cluster also analysed newspaper media, limiting the comparison between perceptions expressed on social media, in newspapers, and scientific literature. Additionally, while media analysis can offer valuable insights into how aquaculture is framed and discussed in the media, it has limitations in fully capturing societal perceptions of aquaculture (Couldry & Hepp, 2018; McQuail, 2010). Therefore, future studies could complement media analysis with other methods such as mixed methods research and content analysis of public discourse to develop a more comprehensive understanding of societal views on aquaculture.

Moreover, studies offering detailed analyses of the socio-demographic factors that shape societal perceptions of aquaculture are underrepresented, making it difficult to explain some of the findings from the primary articles. Future research might consider qualitative studies to explore the influence of sociodemographic and lifestyle factors on perceptions of aquaculture. None of the scientific articles provided longitudinal data, limiting the ability to understand how societal perceptions of aquaculture evolve. Interpreting scientific and newspaper articles can also introduce unconscious bias. Furthermore, most articles only briefly touched upon aquaculture's sustainability aspects, suggesting that stakeholders did not necessarily base their perceptions on sustainability considerations. Future research could investigate whether stakeholders prioritize specific sustainability dimensions over others or view them differently when forming their perceptions of aquaculture.

Chapter 3 Consumption Behaviour towards Aquatic Food in Asia

Abstract

Although Asia represents more than 70 % of global aquatic food consumption, there remains a lack of research specifically examining the behaviours and attitudes of Asian consumers toward aquatic foods. This study synthesizes existing research on factors influencing aquatic food consumption behaviours in Asia and explores pathways to encourage shifts toward more sustainable consumption patterns. In conducting a systematic scoping review, 113 studies were included and identified five main thematic research clusters: (1) Product attributes, availability, and accessibility (24 % of identified relevant documents); (2) Willingness to pay for aquatic foods (25 %); (3) Psychosocial factors (e.g., attitudes and subjective norms) (17 %); (4) Socio-demographic and lifestyle factors (21 %); and (5) Miscellaneous factors, including food safety and social status (13 %). Findings suggest that Asian consumers' aquatic food consumption behaviours are influenced by multiple interrelated factors, with price being especially influential. Knowledge and attitudes of quality and safety were also significant, though moderated by household characteristics. Conversely, aspects such as sustainable production methods, origin of products, and eco-labelling had a lesser impact on behaviour. Enhancing consumer understanding of quality and safety may positively impact aquatic food consumption patterns. Further interdisciplinary research is necessary to deepen insights into the complex factors influencing aquatic food consumption in Asia.

Keywords: Consumer behaviour; Seafood consumption; Quality and safety; Asia

3.1 Introduction

The EAT-Lancet Commission's guidelines for sustainable food consumption within planetary boundaries (Willett et al., 2019) initially considered aquatic food as a single commodity group (Pounds et al., 2022) overlooking critical aspects such as affordability, cultural diversity, and demographic-specific nutritional adequacy (Adesogan et al., 2020; Hirvonen et al., 2020). As a result, the complexity and significance of aquatic food concerning broader food security and sustainability have often been underestimated, limiting comprehensive perspectives on their role in diets and consumption patterns. The Blue Food Assessment has been established to bridge this gap by establishing foundational knowledge on how aquatic foods contribute to global food systems (Gephart et al., 2021; Golden et al., 2021; Naylor et al., 2021; Short et al., 2021).

Eating behaviour is influenced by a multitude of personal and socio-cultural factors that extend beyond basic hunger or nutritional needs (Cairns, 2019; Chen & Antonelli, 2020; Furst et al., 1996; Köster, 2009; Rozin, 2007; Sobal et al., 2006). According to Sobal & Bisogni (2009), food choices are frequent, multifaceted, context-dependent, and constantly evolving, making it difficult for any single theory, framework, or model to fully encompass the complexity of eating behaviour. Factors impacting aquatic food consumption specifically include availability, price, convenience, health beliefs, sensory appeal, origin, production methods, and cultural or religious influences, as well as individual socio-demographic characteristics (Belton et al., 2022; Budhathoki et al., 2021, 2022a; Cantillo et al., 2020; Carlucci et al., 2015; Govzman et al., 2021; Malcorps et al., 2021; Richter & Klöckner, 2017).

Globally, aquatic food consumption has grown from an average of 9.0 kg per capita per year in 1961 to 20.2 kg per capita per year in 2020 (FAO, 2022a), though most people still consume insufficient amounts of aquatic food daily (Agrawal et al., 2014; Jahns et al., 2014; Su et al., 2018; Vanhonacker et al., 2011). This growth, particularly among lower-income consumers, has largely been driven by aquaculture expansion (Belton et al., 2018; Garlock et al., 2022). Asia, with some of the world's highest aquatic food consumption levels (24.6 kg/capita/year), accounted for 113.1 million of the 157.7 million tonnes consumed globally in 2019. However, consumption varies widely across Asian countries (FAO, 2022a; Needham & Funge-Smith, 2014), between urban versus rural areas (Soselisa et al., 2021), across households, and even within a household level (Mamun et al., 2021). These disparities can be attributed to economic differences, technological advances, infrastructure limitations

(cold chain storage), distribution systems, and consumer preferences (Naylor et al., 2021; Belton et al., 2018; Kobayashi et al., 2015; Tveterås et al., 2012; York & Gossard, 2004; Olsen, 2004; Tonsor & Marsh, 2007). In comparison to six other global regions, Asia's urbanization level more than doubled from 17.5 % in 1950 to 49.9 % in 2018, experiencing the highest average annual urbanization rate of 1.6 % between 1990 and 2018 (United Nations et al., 2019). Consequently, aligned with 'Bennett's Law,' rising incomes in Asia, particularly in urban areas, have driven a shift toward greater dietary diversity, with increased consumption of non-grain foods like fruits, vegetables, meat, dairy, and fish rather than grains and starchy staples (Naylor et al., 2021; Reardon, Tschirley et al., 2014; Timmer et al., 1983). Additionally, Little et al. (2016a) observed that urbanisation makes self-sourcing of food less feasible for urban populations compared to those in rural areas.

Given the significant influence of preferences, choices, and habits in shaping aquatic food consumption, especially within market-driven economies, a nuanced understanding of consumption behaviour is essential for effective marketing and policy decisions. Cairns (2019) noted that marketing can substantially shift food preferences and reshape cultural values around food. Yet, studies on aquatic food consumption in Asia remain fragmented due to the region's diverse national and local food cultures. The wide variation in study approaches, from objectives to methodologies, highlights the challenge of building a cohesive understanding of aquatic food consumption behaviour across such a heterogeneous landscape, which includes over 2,500 aquatic species consumed globally (Golden et al., 2021; Tigchelaar et al., 2022). This diversity makes it particularly challenging to study aquatic food consumption in a way that accounts for the regional context in Asia.

So far, no review has been undertaken to synthesize the understanding of consumption behaviour related to aquatic foods in Asia. Existing reviews primarily focus on high-income countries, thereby neglecting studies that explore aquatic food consumption in Asian contexts. For example, Carlucci et al. (2015) conducted a systematic review of consumer purchasing behaviours towards seafood products based on a sample of international studies but did not include any research from Asia on this subject. Understanding the factors that influence consumption behaviour towards aquatic foods is crucial from a marketing perspective, especially given the diverse consumption patterns and habits present in the region. Unlike many consumers in the West, Asian consumers often favour purchasing whole or live fish, whether from wet markets, restaurants, supermarkets, or online sources. In this chapter, the aim is to bridge this gap by identifying and analysing the key findings from research on consumption behaviour toward aquatic foods among consumers in East Asia,

Southeast Asia, and South Asia through a scoping literature review. Investigating consumer behaviour regarding aquatic foods may facilitate transitions toward more sustainable food consumption in Asia and promote long-term food and nutrition security, particularly among economically disadvantaged consumers. Research has shown that incorporating aquatic foods into diets can provide more sustainable food options than those derived from terrestrial animal production and, in some instances, crops (Bogard et al., 2019; Farmery et al., 2017; Tigchelaar et al., 2022) aligning with the principles of a sustainable diet (Burlingame & Sandro, 2012; Farmery et al., 2017; Troell et al., 2019). Additionally, various studies have highlighted the importance of aquatic food consumption for food and nutrition security among vulnerable populations (Belton et al., 2018; Beveridge et al., 2013; Garlock et al., 2022). Therefore, the primary objective of this scoping review is to provide insights into consumption behaviour related to aquatic food by identifying and analysing any factors associated with such behaviours among consumers in the three regions of Asia. In this study, aquatic foods encompass the entire range of edible aquatic animals, plants, and microorganisms that are sourced from bodies of water.

3.2 Materials and Method

Systematic scoping reviews analyse emerging evidence and identify research gaps in the current literature, maintaining the same level of methodological rigour as systematic literature review (Arksey & O'Malley, 2005). Previous studies suggest that scoping reviews are particularly useful when specific questions cannot yet be addressed by a systematic review (Armstrong et al., 2011; Munn et al., 2018). Additionally, Peterson et al. (2017) highlight the advantages of scoping reviews for exploring complex and interdisciplinary topics, such as food consumption behaviour. The planning, execution, and documentation of this systematic scoping review were guided by the PRISMA-ScR framework (Tricco et al., 2018) and the study is inspired by previous systematic scoping review studies (Béné et al., 2016; Levac et al., 2010). The research question guiding the systematic scoping literature review was as follows:

What are the factors influencing the consumption behaviour toward aquatic food among consumers in East Asia, Southeast Asia, and South Asia?

3.2.1 Identifying and Selecting Potential Articles

Scientific search databases: the Web of Science, Scopus, and Google Scholar were employed to locate published records post-2010, with 83 % of potential records being published after

2015. These records were written in English and focused on the three Asian regions: East Asia, Southeast Asia, and South Asia. An initial search was performed in January 2022, covering titles or abstracts that matched the following search string: *“(aquatic OR seafood OR fish OR shellfish) AND (consum* OR eat* OR intake) AND (behav* OR intention OR choice* OR attribute OR preference OR attitud* OR habit OR buy* OR purchas* OR willing* OR perception) AND (Asia OR “South Asia” OR “Southeast Asia” OR “Northeast Asia” OR “East Asia” OR China OR Japan OR “South Korea” OR “North Korea” OR Taiwan OR “Hong Kong” OR Mongolia OR Macao OR Brunei OR Burma OR Myanmar OR Cambodia OR Timor-Leste OR Indonesia OR Laos OR Malaysia OR Philippines OR Singapore OR Thailand OR Vietnam OR India OR Bangladesh OR Nepal OR Maldives OR “Sri Lanka” OR Bhutan OR Pakistan OR Afghanistan).”*

The search string was modified to the syntax of each database.

The inclusion criteria covered various types of records, including reviews, reports, and both qualitative and quantitative studies; all records were required to be in English, accessible in full text, and conducted among consumers in East, Southeast, or South Asia. Records were excluded if they used search terms in contexts outside the research scope (e.g., analytical sensory analysis of aquatic foods, logistics, or business models related to aquatic food sales) or were irrelevant to the systematic scoping review's objective.

3.2.2 Characteristics and Assessment of Relevant Identified Articles

The relevant identified articles were imported into EndNote software for citation management (Peters, 2017). An Excel spreadsheet was then created to record key study details, including attributes such as the author, publication year, and Google citation counts (Martín-Martín et al., 2018). To assess representation, variations in per capita publications relative to per capita aquatic food consumption (kg/year) were examined, allowing for analysis of whether countries with high aquatic food consumption were adequately covered in the review. Additionally, annual publication counts were analysed to track the trend in publication growth over the study period. The evolution of publications was further stratified by country, with citation counts per article (CRPA) calculated for each country to identify which regions were most represented and whether this correlated with higher citation rates. CRPA was determined by dividing Google Scholar citations by the number of publications from each country.

3.2.3 Clustering of Identified Relevant Articles

Thematic clustering was conducted using visualisation of similarities (VOS) viewer software, which enables the visualization of scientific relationships and is well-suited for bibliometric mapping that reveals thematic research clusters (Alhammadi et al., 2021; Cheng et al., 2021; van Eck & Waltman, 2010b). The VOS clustering technique was applied to detect thematic groupings, utilizing the co-occurrence frequencies within text data (title and abstract fields) based on association strength (Eck & Waltman, 2009; Nardi et al., 2016). Initially, a thesaurus file was generated to standardize variations in spelling and synonyms (e.g., aligning "social norms" with "subjective norms"). Irrelevant terms, such as specific country and city names, were then excluded from the analysis. A co-word map was produced through the VOS mapping technique, requiring a minimum of four occurrences per word in the dataset, resulting in visually distinct clusters (van Eck & Waltman, 2011). The counting method was set to binary, with the network and overlay visualization scales set at 1.00.

3.2.4 Characterising and Analysing Thematic Research Clusters

Once each publication was linked to a thematic research cluster, descriptive statistics were performed to illustrate consumers' age ranges, the types of products analysed (e.g., fish, tuna, etc.), and the research focus across the various clusters. Additionally, the quality of evidence within each thematic research cluster was assessed by aggregating the scores from individual papers based on three criteria: (1) Size, (2) Quality, and (3) Consistency (Béné et al., 2016). Table 7 outlines the framework used to evaluate the individual scores of the studies within this three-criterion assessment system, which includes validity (2 questions), rigour (5 questions), and reliability (2 questions). Each question awarded 1 point for a "Yes" response, while "Partially" and "No" responses received 0 points.

Table 7. Framework for assessing the quality of through individual score.^a

Indicator	Criteria
Validity	1. 'Are the findings substantiated by the data and has consideration been given to limitations of the methods that may have affected the results?' 2. 'Are there issues in applying the method to some research question(s), i.e., was the methodology adequate for the research question?'

Rigour	1. 'Is the context or setting adequately described?' 2. 'Is (are) the research question(s) clear?' 3. 'Is the method used appropriately to answer the research question(s)?' 4. 'Is the method applied correctly?' 5. 'Is there evidence that the data collection was rigorously conducted to ensure confidence in the findings?'
Reliability	1. 'Is the data analysis rigorously conducted to ensure confidence in the findings?' 2. 'Is the methodology adequately described to ensure confidence in the findings?'

^a*Adapted from (Béné et al., 2016).*

Once the scores for each paper were established, they were combined to assess the quality of evidence within each identified cluster. The high quality was characterized by scores exceeding 0.75 across all three indicators: validity, rigour, and reliability. Moderate quality was indicated by having at least one score below 0.75 but above 0.5 in at least two out of the three indicators. Low quality was defined as having scores below 0.5 in at least two of the three indicators. It's important to mention that reviews and conceptual papers were not included in the quality assessment. Table 8 provides a summary of the criteria used to evaluate the size, quality, and consistency of evidence within each thematic research cluster. Table 8. Standards for assessing size, quality and consistency of evidence across each thematic research cluster. ^a

Indicators	Categories	Criteria
Size	Large Medium Small	Greater than 10 documents Greater or equal to 5 and less or equal to 10 Less than 5
Quality	High Moderate Low	Greater than 0.75 scores across all three indicators i.e., validity, rigour, and reliability Less than 0.75 at least one score, but greater than 0.5 at least two scores Less than 0.5 scores at least two scores
Consistency	Consistent Inconsistent	Studies yield the same or similar conclusions. Studies present diverse conclusions. For example, varying designs or methodologies used in different contexts can lead to differing results.

^a*Adapted from (Béné et al., 2016).*

3.3 Results

3.3.1 Descriptive Analysis of Relevant Identified Articles

Following the initial search, a total of 4,232 potential records were found across the three databases. Each article's title and abstract were then screened based on eligibility criteria for

inclusion or exclusion. At the title screening stage, 3,946 articles were filtered out, and 153 irrelevant articles were excluded during the abstract screening. This screening process was repeated by an independent reviewer, with any disagreements resolved through consensus. The full texts of 131 articles were assessed further, resulting in the inclusion of 111 articles. Additionally, two other relevant articles not captured in this process were suggested by experts. The complete selection process leading to the identification of the 113 articles is illustrated in Figure 7, and a summary with brief details about each publication, including their research focus and design, is presented in Appendix B. The findings in Figure 8 show a disparity between per capita research intensity and per capita aquatic food consumption (kg per year). For instance, while Hong Kong and Macao exhibit both high per capita aquatic food consumption and research intensity, they were not relevant to this scoping review. In contrast, despite having relatively low research intensity per capita, China contributed 29 publications pertinent to this study. Figure 9 highlights a significant increase in publications, rising from 2 in 2010 to 31 in 2021, with numbers more than doubling following the COVID-19 pandemic.

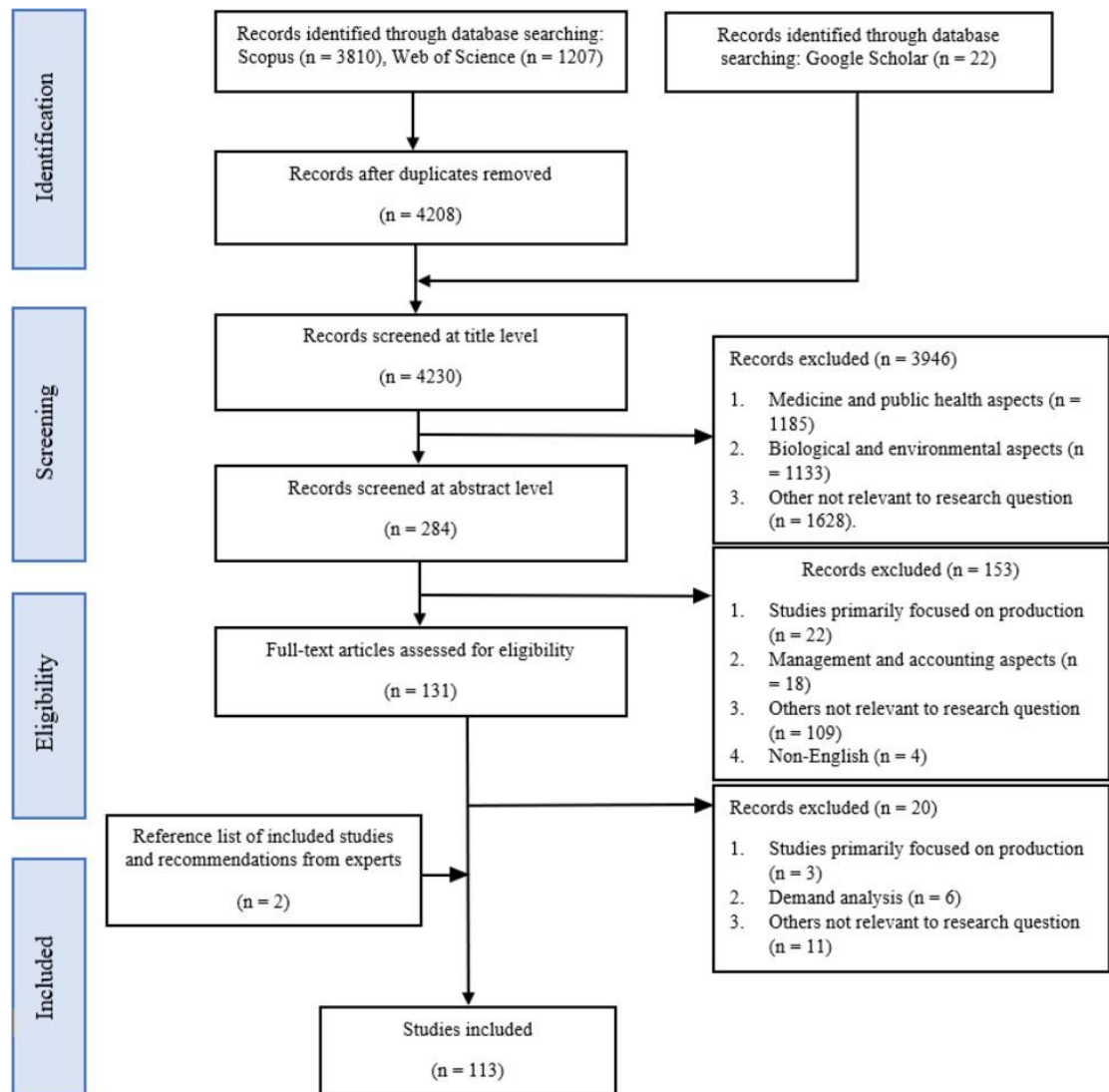
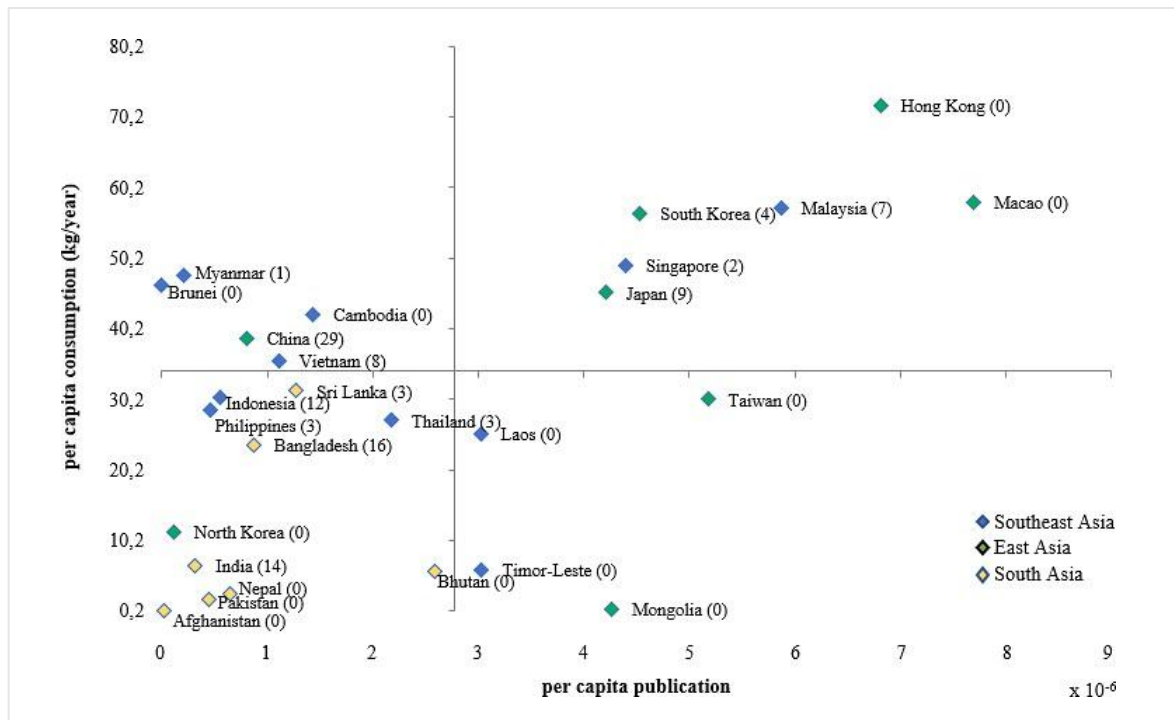
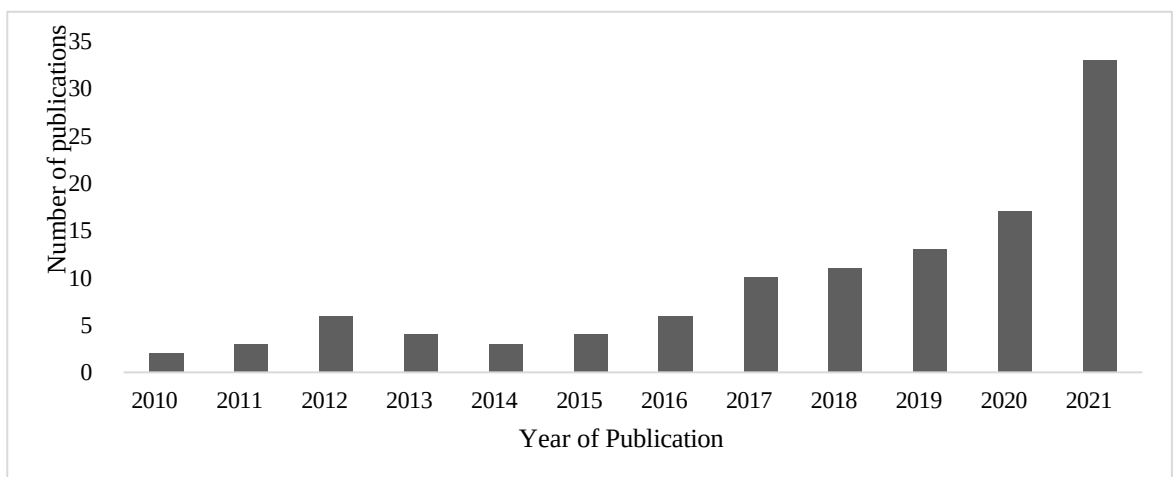


Figure 7. PRISMA–ScR flow diagram illustrating the systematic scoping review process.



^a Data regarding per capita aquatic food consumption was sourced from (De Silva & Yuan, 2020); ^b the per capita publication figure is based on the potential publications related to aquatic food consumption behaviour identified in the Scopus database; ^c the numbers in parentheses represent the quality of publications included in the systematic scoping review; ^d the Maldives, considered an outlier was excluded.

Figure 8. Differences in per capita publications (multiplied by 10⁻⁶) compared to per capita aquatic food consumption (kg per capita per year). ^{abcd}.



Publications released after 2021 were restricted and subsequently excluded.

Figure 4. Trends in the number of publications focused on factors affecting aquatic food consumption behaviour among consumers in Asia.

Additionally, the distribution of the 113 identified publications was analysed by country, along with the citations received per article (CRPA) in each country (Figure 10). The findings revealed that Japan, despite having a lower total number of publications, accounts for a significant number of highly cited articles.

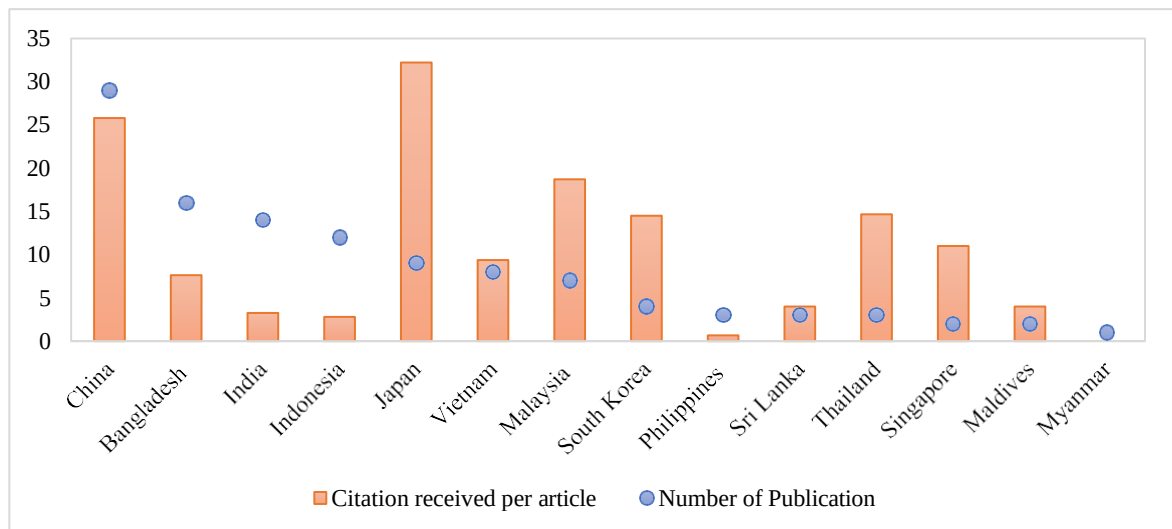


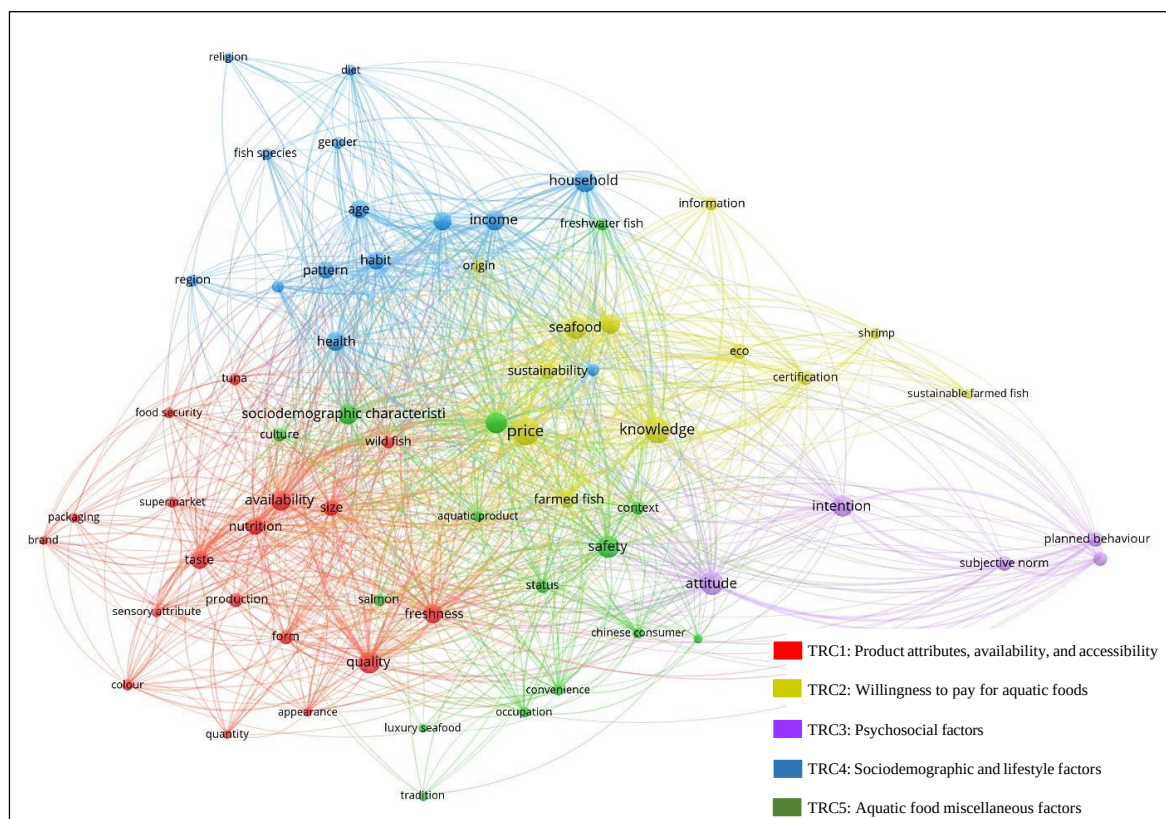
Figure 5. The number of publications and the citation impact of the identified works by country of research from 2010 to 2022.

3.3.2 Thematic Clustering of Identified Relevant Articles

To begin with, a term map was developed using 64 terms that were categorized into five thematic research clusters. Table 9 provides a concise overview of these five thematic clusters, including their definitions and associated keywords, while Figure 11 illustrates their visualization and level of saturation. The findings presented in Table 9 and Figure 11 reveal that the term map highlights “quality,” “safety,” “price,” “household,” and “attitude” as key concepts, with “price” being the most prominent. The first cluster pertains to Product attributes, encompassing both intrinsic features (such as those inherent to the aquatic food itself) and extrinsic features (like packaging and branding), along with the availability and accessibility of aquatic foods. The second cluster focuses on “Willingness to pay for aquatic food products,” where most studies utilized econometric models to assess willingness-to-pay (WTP). The third and fourth clusters relate to “Psychosocial factors,” including attitudes and subjective norms, and “Socio-demographic and lifestyle factors,” respectively. The fifth cluster labelled “Miscellaneous factors in aquatic food,” includes elements such as food safety and social status, with many of the studies primarily involving Chinese consumers.

Table 1. Defining thematic research clusters based on keywords used in aquatic food consumption literature.

Cluster-ID/Colour	Thematic Research Clusters	Definition of cluster	Keywords (Links, Total Link Strength, Occurrences)
C1/Red	Product attributes, availability, and accessibility	Product attributes are both intrinsic and extrinsic attributes as well as availability and accessibility of aquatic food products.	Quality (56, 207, 25), availability (53, 160, 20), freshness (57, 147, 18), taste (53, 136, 16), nutrition (49, 121, 15), size (50, 129, 14), form (47, 93, 11), production (36, 68, 10), wild fish (42, 79, 8), tuna (39, 63, 8), colour (25, 48, 7), food security (36, 52, 6), supermarket (36, 54, 6), sensory attributes (38, 55, 5), packaging (31, 41, 5), appearance (28, 43, 4), quantity (28, 39, 4), brand (21, 30, 4)
C2/Yellow	Willingness to pay for aquatic foods	The majority of the publications are related to Asian consumers' willingness to pay (WTP) for aquatic foods.	Price (60, 281, 41), knowledge (57, 220, 34), seafood (55, 168, 24), fish product (51, 152, 20), farmed fish (50, 107, 15), sustainability (48, 106, 14), eco (34, 72, 12), certification (42, 90, 11), origin (35, 61, 9), information (29, 52, 9), shrimp (30, 44, 7), sustainable farmed fish (22, 34, 5)
C3/Purple	Psychosocial factors	Psychosocial factors influencing aquatic food consumption behaviour.	Attitude (57, 202, 28), intention (52, 134, 22), subjective norms (34, 79, 12), planned behaviour (25, 68, 12), behavioural control (28, 63, 10)
C4/Blue	Sociodemographic and lifestyle factors	Sociodemographic and lifestyle factors influencing consumption behaviour towards aquatic foods.	Household (50, 165, 24), income (50, 167, 20), health (50, 143, 18), habit (52, 141, 17), age (43, 135, 17), education (51, 142, 16), pattern (45, 122, 15), economy (35, 60, 8), urban area (37, 63, 8), gender (34, 60, 8), fish species (33, 51, 8), region (33, 49, 8), diet (30, 52, 7), religion (21, 30, 5)
C5/Green	Aquatic food miscellaneous factors	Closely linked to other thematic research clusters, the majority of the publications are related to Chinese aquatic consumption.	Safety (50, 183, 24), city (59, 173, 23), sociodemographic characteristics (55, 136, 20), status (43, 87, 11), culture (35, 54, 9), context (34, 47, 9), freshwater fish (38, 66, 8), salmon (32, 45, 8), convenience (41, 69, 7), aquatic product (36, 58, 7), occupation (35, 60, 7), Chinese consumer (35, 50, 6), tradition (20, 24, 5), shellfish (32, 42, 4), luxury seafood (20, 24, 4)



Text data from both the title and abstract fields of the identified publications were Probabilistic similarity measures based on association strength were used to assess co-occurrence in the text data (Eck & Waltman, 2009). TRC stands for thematic research cluster analyzed.

Figure 11. Thematic research clusters map identified through keyword co-occurrence and density visualization.

3.3.3 Characteristics and Analysis of the Thematic Research Clusters

The findings in Table 10 present that most publications within the thematic research clusters focused on consumers aged between 18 and 55 years. The studies on “Willingness to Pay for Aquatic Foods” explored a range of aquatic products, while the majority of articles in the clusters “Socio-demographic and Lifestyle Factors,” “Product Attributes, Availability, and Accessibility,” and “Psychosocial Factors” primarily concentrated on fish. All thematic clusters aimed to identify the drivers and obstacles affecting fish consumption, with “Willingness to Pay for Aquatic Foods” and “Product Attributes, Availability, and Accessibility” specifically examining consumer preferences regarding fish characteristics. Additionally, the quality of the evidence varied, with moderate quality found in “Product Attributes, Availability, and Accessibility,” “Aquatic Food Miscellaneous Factors,” and “Psychosocial Factors,” and high quality in “Socio-demographic and Lifestyle Factors” and “Willingness to Pay for Aquatic Foods.” Each thematic cluster included more than 10

publications, indicating a substantial sample size. Notably, a high degree of consistency in research outcomes was observed among the three clusters: “Product Attributes, Availability and Accessibility,” “Socio-demographic and Lifestyle Factors,” and “Willingness to Pay,” while the consistency was lower in the clusters “Aquatic Food Miscellaneous Factors” and “Psychosocial Factors.”

Table 10. Descriptive analysis of the five thematic research clusters and their quality assessment.

Variables		Product attributes, availability, and accessibility	Willingness to pay for aquatic food	Psychosocial factors	Sociodemographic and lifestyle factors	Aquatic food miscellaneous factors
Consumers' age range, median (IQR)		37(21.8)	43.2 (13.4)	30 (28.25)	43.5 (23.7)	47(25.7)
Types of products analysed %(n)	Fish in general	34.6(9)	7.4(2)	47.4(9)	62.5(15)	14.3(2)
	Seafood in general	7.7(2)	26(7)	10.5(2)	12.5(3)	35.7(5)
	Aquaculture products	11.6(3)	22.2(6)		4.2(1)	
	Processed fish products	19.2(5)	3.7(1)	15.8(3)	8.3(2)	21.4(3)
	Tuna	15.4(4)	3.7(1)		4.2(1)	
	Salmon		7.4(2)			21.4(3)
	Shrimp	3.8(1)	11.1(3)	5.2(1)		
	Shellfish	7.7(2)	3.7(1)	5.2(1)		7.1(1)
	Labelling		11.1(3)	10.5(2)		
	Others		3.7(1)	5.3(1)	8.3(2)	
Research focus %(n)	Drivers and barriers to fish consumption	61.5(16)	48.2(13)	89.4(17)	75(18)	71.4(10)
	Consumer preferences for fish attributes	30.8(8)	51.8(14)	5.3(1)	12.5(3)	7.1(1)
	Drivers and barriers to seafood consumption	3.8(1)				14.3(2)

	Drivers and barriers to shellfish consumption	3.8(1)			8.3(2)	7.1(1)
	Drivers and barriers to seaweed consumption			5.3(1)		
	Fish consumption practices				4.2(1)	
Validity		0.92	0.94	0.72	0.77	0.89
Rigour		0.88	0.95	0.88	0.90	0.94
Reliability		0.67	0.76	0.68	0.70	0.64
Quality ^a		Moderate	High	Moderate	High	Moderate
Size		Large	Large	Large	Large	Large
Consistency		Consistent	Consistent	Inconsistent	Inconsistent	Consistent

^aAdapted from (Béné et al., 2016), IQR represents the Interquartile Range.

Thematic Research Cluster 1: Aquatic Food Product Attributes, Availability, and Accessibility

Numerous studies consistently show that both intrinsic (e.g., taste, flavour, texture, appearance) and extrinsic (e.g., quality, packaging, brand) attributes of aquatic food products influence consumption behaviours among Asian consumers. These findings reveal that taste remains the most influential factor in health and nutritional benefits for most Asian consumers when choosing aquatic foods. Additionally, availability and accessibility are significant contributors to consumption behaviour (Akter et al., 2019; Das et al., 2013; Devadawson et al., 2015; Sajeev et al., 2021; Sun & Che, 2012). For example, after price, availability and accessibility were ranked as the second and third most important factors in fish purchasing decisions for Indian consumers (Sajeev et al., 2021).

Overall, studies suggest that Asian consumers often prefer wild-caught aquatic foods, especially for their intrinsic qualities (Hossain, 2021; Kitano & Yamamoto, 2020; Mitra et al., 2021; Sajiki & Lu, 2022). Specifically, Mitra et al. (2021) found that Bangladeshi consumers favour wild-caught fish for its freshness, while farmed fish is preferred for its larger size. Furthermore, Kitano and Yamamoto (2020) noted that Japanese consumers perceive wild-caught fish as superior to farmed fish, often choosing it even when both types have similar attributes and conditions.

Thematic Research Cluster 2: Willingness to Pay for Aquatic Foods

The second research theme focuses on consumer preferences and perceptions of aquatic foods, along with the role of information and knowledge in shaping consumption behaviour. Most studies applied econometric models to assess willingness-to-pay (WTP) for aquatic foods (see Appendix B). Findings generally indicate that price is a key factor influencing aquatic food consumption among Asian consumers (Kim & Lee, 2018; Omar et al., 2021; Prince & Wahid, 2020; Wakamatsu & Miyata, 2017). Asian consumers are often willing to pay more for aquatic products with clear packaging labels indicating food safety certifications (Hoque, 2021; Murakami et al., 2017; Omar et al., 2021; Tan, 2017; Zheng et al., 2021), ecological production methods (eco-labels) (Ariji, 2010; Hoque et al., 2021; Hori et al., 2020; Kim & Lee, 2018; Uchida et al., 2014; Wakamatsu et al., 2017; Wakamatsu & Miyata, 2017; Xu et al., 2012; Xuan, 2021; Zhang et al., 2020a), country of origin information (Kim & Lee, 2018; Sayeed et al., 2021; Uchida et al., 2014), and traceability information (Yin et al., 2020). Additionally, research suggests that increasing consumer knowledge about certifications, labelling, and production processes could further enhance interest and WTP for aquatic foods (Hoque et al., 2021a; Hori et al., 2020; Karnad et al.,

2021; Murakami et al., 2017; Uchida et al., 2014; Wakamatsu et al., 2017; Xuan, 2021; Yin et al., 2020). For example, Yin et al. (2020) found that introducing European Union organic certification in China's shrimp market raised WTP by 84.06 %, and by providing additional information, WTP further increased by approximately 120.16 %. Other studies indicate that consumers are willing to pay more for eco-labelled farmed aquatic foods compared to both wild-caught and conventionally farmed alternatives (Hoque et al., 2021a; Uchida et al., 2014; Yin et al., 2020).

Thematic Research Cluster 3: Psychological Factors

Most studies in this research cluster, with about 63 % of the publications utilizing structural equation modelling, applied social-psychological behavioural theory to explore and predict aquatic food consumption behaviour (see Appendix B). This theory posits that the three main components of human behaviour, 1) attitude, 2) subjective norms, and 3) perceived behavioural control, jointly shape the intention to consume aquatic foods (Ajzen, 1991). Table 11 reveals that while most studies identified attitude, subjective norms, and perceived behavioural control as significant factors influencing the intention to consume aquatic foods, a few studies reported otherwise.

Among the factors, some research found attitudes to be the strongest predictor of intent to consume aquatic foods (Fiandari et al., 2019; Thong & Olsen, 2012), while others found subjective norms (Abidin et al., 2021; Chen & Wang, 2021; Ho Huy et al., 2013) and perceived behaviour control (Duy & Ai, 2019) as more influential. The underlying cause of having positive or negative attitudes toward aquatic foods tends to be complex including multiple aquatic food attributes and cues. For example, Thong and Olsen (2012) found bones and smell to negatively impact attitudes toward fish, whereas taste, texture, and appearance had positive effects. However, attitudes may differ based on product form; in Bangladesh, bones and smell were not viewed negatively for dried fish, potentially due to distinct preparation and cooking methods compared to fresh fish (Siddique, 2012).

Other studies reported that attitudes toward aquatic foods are also shaped by food safety perceptions, environmental concerns, convenience, context, and socio-demographic factors (Dai et al., 2021; Gajaria & Mantri, 2021; Novita & Rowena, 2019); however, a positive attitude does not always lead to increased fish consumption (Pethiyagoda & Olsen, 2013; Rotuauli et al., 2020). Lastly, affordability, convenience, and accessibility emerged as key factors influencing perceived behavioural control in aquatic food consumption (Duy & Ai, 2019; Fiandari et al., 2019; Thong & Olsen, 2012).

Table 11. Psychosocial factors influencing the intention to consume aquatic foods.

Psychosocial factors	Studies that found significant influence	Studies that found no significant influence
Attitude influencing intention	(Abidin et al., 2021; Chen & Wang, 2021; Fauziyah, 2020; Fiandari et al., 2019; Junaidi et al., 2020; Novita & Rowena, 2019; Siddique, 2012; Thong & Olsen, 2012)	(Ghifarini et al., 2018; Huang et al., 2020)
Subjective norms influencing intention	(Abidin et al., 2021; Chen & Wang, 2021; Ghifarini et al., 2018; Ho Huy et al., 2013; Siddique, 2012; Thong & Olsen, 2012)	(Fiandari et al., 2019; Huang et al., 2020; Junaidi et al., 2020)
Perceived behavioural control influencing intention	(Chen & Wang, 2021; Duy & Ai, 2019; Fiandari et al., 2019; Ho Huy et al., 2013; Huang et al., 2020; Li & Zhong, 2017)	(Abidin et al., 2021; Ghifarini et al., 2018; Junaidi et al., 2020; Siddique, 2012; Thong & Olsen, 2012)

Thematic Research Cluster 4: Socio-demographic and Lifestyle Factors

This cluster examined the socio-demographic and lifestyle factors that shape aquatic food consumption behaviours (Lee & Nam, 2019; Zhou et al., 2015). Findings reveal that household characteristics, including type, economic status, and size, are significant influences on aquatic food consumption behaviour (Lee & Nam, 2019; Rahman & Islam, 2020; Sajeev et al., 2021; Shashikanth & Somashekar, 2020; Supartini et al., 2018; Zhou et al., 2015). For example, Zhou et al. (2015) found a negative relationship between household size and fish consumption. Additionally, socio-demographic factor—such as age (Ahmad et al., 2016; Arthatiani et al., 2021; Devadawson et al., 2015b; Haque et al., 2019; Kashem et al., 2021; Rahman & Islam, 2020), gender (Devadawson et al., 2015b; Haque et al., 2019; Islam et al., 2018; Rahman & Islam, 2020), education (Ahmad et al., 2016; Fu et al., 2019b; Haque et al., 2019; Islam et al., 2018; Poti et al., 2021; Rahman & Islam, 2020), marital status (Ahmad et al., 2016; Arthatiani et al., 2021), occupation (Fu et al., 2019b), household size (Arthatiani et al., 2021; Islam et al., 2018; Zhou et al., 2015), income (Arthatiani et al., 2021; Danso et al., 2017; Fu et al., 2019b; Haque et al., 2019; Lee & Nam, 2019; Mugaonkar

et al., 2017; Rahman & Islam, 2020; Zhou et al., 2015), ethnicity (Ahmad et al., 2016), religion (Haque et al., 2019; Hoa & Käre, 2017), place of residence (Ahmad et al., 2016; Arthathiani et al., 2021; Kashem et al., 2021; Lee & Nam, 2019) – were found to be significantly influencing aquatic food consumption. Generally, older, higher income, educated male consumers in urban or coastal areas consume more aquatic foods in Asia. Conversely, some studies indicated no significant link between consumption and factors like age, gender, income, marital status, and religion (Supartini et al., 2018).

Lifestyle factors such as health, habits, and dietary practices also influence aquatic food consumption. Many Asian consumers prefer aquatic foods for their health benefits (Ahmad et al., 2016; Devadawson et al., 2015; Haque et al., 2019; Rahman & Islam, 2020; Sajeev et al., 2021; Supartini et al., 2018; Zhang et al., 2021a; Zhou et al., 2015). Zhou et al. (2015) found a positive association between household members' health status and home fish consumption, whereas Supartini et al. (2018) reported that perceived health benefits did not influence seafood consumption behaviour among Singaporean consumers. Furthermore, Zhang et al. (2021a) found that dietary habits, beyond health motives, significantly impact seafood purchase frequency in urban Chinese consumers. In contrast, Huang et al. (2020) observed that while habit strength indirectly affects fish consumption through intent, irregular consumption indicates limited cognitive engagement in decision-making.

Additional research has shown that habits around purchasing, species selection, and cooking practices also influence aquatic food consumption (Goh et al., 2013; Salim, 2020; Salim et al., 2020; Tezzo et al., 2021). For example, Tezzo et al. (2021) noted that rural-urban migrants in Myanmar often fry commonly available farmed fish, such as tilapia, likely because frying is a quick cooking method that enhances flavour and aligns with the availability of affordable cooking oil, making it a practical and appealing option compared to preparing smaller species like anchovies or gourami [*Trichopodus pectoralis*].

Thematic Research Cluster 5: Aquatic Food Miscellaneous Factors

The majority of the publications, closely connected to other thematic research clusters, examine the factors influencing aquatic food consumption behaviour among Chinese consumers. Due to ongoing food safety concerns in Asia, many rising middle-class consumers are increasingly prioritizing the safety of aquatic foods, leading to a growing demand for labelled, wild-caught imported marine species, particularly from Norway and North America (Fabinyi et al., 2016; Meng et al., 2021; Wang et al., 2018). Additionally, various consumption habits related to aquatic foods have been identified, influenced by numerous factors such as location, cultural background, social status, tradition, convenience, context, and sensory characteristics. Specifically, older consumers in rural areas tend to

favour domestic, live aquatic foods from local "wet" markets, while younger, wealthier consumers in urban areas prefer imported, convenient aquatic food products available in supermarkets or online (Fabinyi et al., 2016; Farradia & Sunarno, 2020; Hu & Yuan, 2015; Newton et al., 2021a). In Japan, sushi and sashimi are regarded as convenient and status-enhancing foods often enjoyed during social gatherings (Altintzoglou et al., 2016). Rising incomes have transformed the lifestyles and taste preferences of many middle-class urban residents, impacting their choices regarding the types, preparation, and purchasing locations for aquatic foods (Fabinyi, 2012; Hu & Yuan, 2015; Wang et al., 2018; Wang & Somogyi, 2020a). For example, research indicates that salmon, lobster, abalone, and sea cucumber are considered luxury seafood items in China's high-end market, typically consumed at social gatherings outside the home. Furthermore, Wang et al. (2018) found that Chinese consumers aged 30 and older, particularly those who are married, have higher income and education levels, and reside in first-tier cities, hold positive beliefs and perceptions about luxury aquatic food consumption.

3.4 Discussion and Conclusion

This chapter seeks to explore the factors that affect aquatic food consumption behaviours among Asian consumers. Through VOS clustering of 113 publications, five thematic research clusters were identified: 1. Product attributes, availability, and accessibility; 2. Willingness to pay for aquatic foods; 3. Psychosocial factors, including attitudes and subjective norms; 4. Sociodemographic and lifestyle factors; and 5. Miscellaneous factors, such as food safety and social status. The analysis revealed overlapping factors across these clusters, suggesting that consumption behaviour is complex and multifaceted. Key influences include price, knowledge, attitude, quality, safety, and household characteristics such as size, income, and type. Notably, the number of publications has more than doubled since the COVID-19 pandemic; however, most studies utilized data collected before the pandemic, with only three focusing on its impacts on aquatic food consumption behaviour (Farradia & Sunarno, 2020; Kashem et al., 2021; Prince & Saira Wahid, 2020). Factors driving increased research interest in Asian consumer preferences for aquatic foods may include the growth of aquaculture, international trade, urbanization, globalization, and advancements in innovative product development technologies. Generally, there has been a significant rise in research focused on food choices and behaviours among Asian consumers; for instance, a search in the Scopus database showed that the number of publications in 2021 was more than double that of 2015. However, disparities exist in the per capita publication rate, which reflects societal investment in the sector compared to per capita aquatic food

consumption (kg/capita/year), indicating the importance of aquatic foods in diets.

The study's findings indicate that price is the primary factor influencing aquatic food consumption among Asian consumers, particularly among lower-income groups. Previous studies also suggest that while consumers find most aquatic food products convenient and easy to prepare, the price remains a significant barrier to increased consumption (Birch et al., 2012; Christenson et al., 2017; Govzman et al., 2021). Research has shown that European consumers prioritize price over sustainability credentials, even when sustainability information is readily available and understandable (Grunert et al., 2014). Larson & Story (2009) identified that both direct and indirect costs of purchasing and preparing nutritious foods pose barriers to good nutrition for low-income consumers. Generally, more nutritious foods tend to be pricier on a per-calorie basis, leading to greater socioeconomic disparities in diet quality and health (Darmon & Drewnowski, 2015). Similarly, aquatic foods are often more expensive, and less filling compared to other meat alternatives (Torrissen & Onozaka, 2017), which may explain how household factors such as type, economic status, and size impact aquatic food consumption behaviours among Asian consumers. These results align with earlier studies on Western consumers, where increased household size and decreased income correlated with a lower likelihood of consuming aquatic foods (Bronnmann & Hoffmann, 2018; Love et al., 2022). Consequently, marketing strategies, such as nudging and pricing adjustments, could effectively influence aquatic food purchasing behaviours in the Asian consumer environment (Castro et al., 2018; Hoenink et al., 2020; van der Molen et al., 2021). Furthermore, increased investment in production research could help reduce both direct and indirect costs of aquatic foods, making them more competitive with terrestrial meat sources (e.g., chicken, pork, and beef) and ultimately boosting demand. For example, chicken, pork, and beef have benefited from centuries of investment, whereas aquaculture has room for improvement, despite already possessing many intrinsic advantages that research and development could enhance (Belton & Thilsted, 2014; Kumar & Engle, 2016; Little et al., 2016a; Little & Bunting, 2016). Currently, farmed whitefish species like tilapia and pangasius are cheaper than many meat cuts in several Asian countries (*Meat Price Index in GPB*, 2022).

The study's findings also highlight the significance of knowledge and attitudes towards aquatic foods as essential factors in explaining consumption behaviour. Generally, increased awareness of the benefits of aquatic foods for a healthy diet fosters positive attitudes towards them. Therefore, practitioners in the aquatic food sector should focus on promoting the advantages of aquatic foods relative to non-aquatic options (e.g., highlighting their health, nutritional value, taste, safety, and environmental sustainability) to influence consumer

behaviour. Moreover, quality and food safety are found to exert a greater influence on consumption behaviour than sustainability considerations. This contrasts with previous studies on Western consumers, who typically show more interest in sustainability aspects and prefer eco-labels on aquatic foods (Bronnmann & Asche, 2017b; Budhathoki et al., 2022b; Cantillo et al., 2020). Recent research has indicated that, unlike their Western consumers prioritizing sustainability, Chinese consumers prioritize messaging related to food safety and quality (Malcorps et al., 2021). Fundamentally like any food product, aquatic foods can pose health risks due to viruses, bacteria, and parasites under certain conditions, primarily arising from three sources: 1) processing and preparation, 2) faecal contamination of the aquatic environment, and 3) the natural aquatic environment (Ahmed & Institute of Medicine, 1991). However, the microbiological risks associated with aquatic foods, aside from raw molluscan shellfish, are generally lower and often stem from recontamination or cross-contamination during preparation, particularly with improper time/temperature handling (Ahmed, 2007). Additionally, concerning toxicants like mercury (Hg) in aquatic foods, recent studies have shown that farmed species such as tilapia, shrimp, and cod generally exhibit low toxicity levels ($\text{Hg} < 0.15$) (Li et al., 2022; Yang et al., 2017). Therefore, it is advisable to provide reliable information about the toxicity risks associated with aquatic foods and to educate Asian consumers on safe handling practices through various channels, including web-based applications (Seow et al., 2022). Using credible quality and safety labels can also help build trust and positive attitudes towards aquatic foods (Wang et al., 2013). Additionally, Pieniak et al. (2010) argue that integrating information beyond health benefits, such as enjoyment and pleasure, while reinforcing positive attitudes towards aquatic foods may improve adherence to dietary recommendations. Lastly, given the complex nature of consumption behaviour, a multifaceted approach is recommended for interventions aimed at increasing aquatic food consumption (McManus et al., 2011). For instance, farmed salmon has become increasingly prevalent in the Chinese diet through effective strategies such as marketing via online sales channels, developing new products tailored to consumer preferences, and implementing traceability systems (Godfrey, 2020; Market Publishers, 2020; www.seafoodnews.com, 2021).

This review does have some limitations. First, the keywords used in the literature search may have restricted the inclusion of relevant publications, particularly those where consumption was not the primary focus. Most of the studies employed questionnaires, administered either face-to-face or online, while few utilized focus-group discussions for exploratory research, and none were longitudinal (see Appendix B). This limits the ability to draw causal inferences from the findings and makes it challenging to identify factors influencing

behavioural changes among Asian consumers. Additionally, the methodological foundations concerning attitudes toward aquatic foods are complicated by the prevalent attitude-behaviour gap (Vermeir & Verbeke, 2006; Yamoah & Acquaye, 2019). Thus, a consumer who expresses a willingness to pay and has a positive attitude towards aquatic foods in surveys may behave unpredictably in real-world scenarios. A recent meta-analysis revealed a substantial hypothetical bias of approximately 21 % when measuring willingness to pay for consumer goods (Schmidt & Bijmolt, 2020). Therefore, any methods developed for determining pricing strategies for aquatic foods should account for such biases.

Moreover, the review only included publications in the English language, which may limit the overall understanding of the topic. Although VOS viewer software was employed to visualize bibliometric networks, combining it with tools like SciMAT and Citespace could enhance the insights gained and offer new opportunities for a more thorough interpretation of the scientific landscape. Additionally, the qualitative nature of interpreting such maps is complex and can lead to unintended bias. The inclusion of two cross-national comparative studies comparing aquatic food consumption behaviours between consumers in Asia and Western countries may have also impacted the findings.

Lastly, sensory tests among consumers were underrepresented in this review, with only one study incorporating sensory taste testing; however, that study exhibited poor methodological quality (see Appendix B). As a result, the findings related to thematic research cluster 1—product attributes, availability, and accessibility—were based on proxy measures of sensory perception, such as consumer agreement on the taste of aquatic foods, which may present methodological limitations (Köster, 2009). Such attitudinal evaluations tend to reflect varying degrees of satisfaction or dissatisfaction with aquatic foods (Gilbert et al., 1998).

3.4.1 Research Gaps and Future Research Directions

Interest in understanding aquatic food consumption behaviour among Asian consumers is increasing; however, existing studies often fail to examine the interplay of multiple factors influencing this behaviour. Many publications display a narrow focus, restricting their insights to specific disciplines, which limits a comprehensive understanding of the complexities involved in aquatic food consumption in real-world contexts. Currently, fields such as sociology, marketing, food science, and economics have addressed central questions in aquatic food consumption research, including the motivations, timing, and locations of consumption among Asian consumers. For instance, much of the economic research has centred on price, product attributes, and household expenditure related to aquatic food consumption. Therefore, future research should adopt a multidisciplinary approach,

employing a deductionist perspective (Köster, 2009) to enhance understanding and prediction of the various factors and their interactions that shape aquatic food consumption behaviour among Asian consumers.

Moreover, there is a pressing need for research that focuses on intrinsic product characteristics, such as sensory attributes, rather than primarily focusing on extrinsic factors like packaging and labelling. This exploration should also integrate insights from economics and psychology to achieve a more holistic understanding of the complex behaviour surrounding aquatic food consumption. Additionally, some studies suggest that aquatic food consumption may be habitual and performed routinely without conscious consideration of potential outcomes. The high levels of aquatic food consumption in certain Asian regions might simply stem from deeply ingrained habits formed through cumulative satisfactory past experiences influenced by cultural norms. However, in-depth studies analysing the habits affecting aquatic food consumption are scarce, with only one study examining changes in individuals' aquatic food practices when transitioning from rural to urban settings. In general, Asian consumers tend to exhibit positive attitudes towards aquatic foods. Nonetheless, there is potential to bridge the gap between these attitudes and actual consumption behaviour by incorporating factors such as food safety, price, quality, convenience, and knowledge about aquatic foods into decision-making processes. Additionally, attitudinal ambivalence towards aquatic foods appears to be particularly pronounced among urban consumers, affecting the link between attitudes and consumption behaviours. For instance, while many urban consumers in Asia prefer live and whole wild-caught fish, they also prioritize sustainability, convenience, and competitive pricing. The impact of ambivalence on aquatic food consumption among urban residents is an area that has been largely overlooked and could provide valuable insights for practitioners seeking to promote changes in consumption behaviours. Future research could benefit from conducting meta-analyses to gain a clearer understanding of how various specific factors influence aquatic food consumption behaviour among Asian consumers.

A notable research gap is the limited focus on sensory studies, particularly the role of taste, texture, and smell in shaping consumer preferences towards aquatic food. This lack of sensory-focused research is especially striking given the high and increasing consumption of farmed salmon in China. The demand for high-value imported aquatic foods, such as salmon, continues to grow, driven by factors including rising incomes, urbanization, aspirational dining preferences, and the perception of imported products as superior in quality and safety. These findings set the stage for the next chapter, which highlights the critical gaps in sensory studies and focuses on the cultural, economic, and social drivers

behind the increasing demand for high-value imported aquatic foods like farmed salmon in China, offering insights into their implications for sustainable aquaculture, global aquatic food trade, and consumer behaviour research.

Furthermore, a notable omission in the current body of literature is the role of informal markets—such as street vendors and unregulated wet markets—which remain a dominant source of aquatic food for a large portion of the population in many Asian countries. These informal systems play a crucial role in accessibility and affordability, particularly for low-income and rural consumers. However, such market dynamics were largely absent in the studies captured by the systematic scoping review, likely due to the underrepresentation of these contexts in the available literature. This gap highlights the need for future research to explore informal market channels, including their influence on consumption behaviour, food safety perceptions, and trust in product quality. Greater inclusion of these informal markets in academic studies would provide a more holistic understanding of aquatic food systems in Asia and improve the relevance of policy and marketing interventions.

Overall, these findings offer clear policy implications for promoting European aquaculture products in emerging Asian markets, with a particular focus on China. To enhance competitiveness, European producers and policymakers must align product development, marketing, and export strategies with Chinese consumer preferences. This includes prioritizing attributes such as food safety, quality assurance, traceability, and convenience, which are highly valued by Chinese consumers—often more than sustainability credentials alone. Tailoring products to meet sensory expectations, including taste and texture, and offering ready-to-cook or ready-to-eat formats can further appeal to urban middle-class consumers. Strategic use of certification labels and clear origin information can also help position European products as premium, trustworthy, and aspirational. At the same time, education and communication campaigns in target markets should emphasize the unique advantages of European aquaculture—such as rigorous safety standards, traceability systems, and environmental stewardship—while addressing consumer concerns around freshness and familiarity. For China, strengthening regulatory frameworks around food safety in both formal and informal markets and expanding consumer knowledge on sustainable aquaculture may create a more receptive environment for high-quality imported products. Ultimately, promoting European aquaculture in Asia will require a market-driven approach grounded in consumer insights, cross-cultural awareness, and sustained investment in innovation and outreach.

Chapter 4 Demand for High-Value Imported Aquatic Food in China

Abstract

China dominates the global aquatic food market through production, consumption, and trade. In 2022, China imported around USD 22 billion worth of aquatic foods, mostly high-value species (e.g. Atlantic salmon, lobster, abalone, and sea cucumber). The perceptions that are fuelling the demand for imported aquatic food in the Chinese aquatic food market are distinct from those of well-documented markets in Western countries but remain comparatively under-researched. Thus, this study aims to understand aquatic food imports and gain in-depth insights into the perceptions influencing the demand for high-value imported aquatic food in China. Secondary data analyses were conducted on the China Customs dataset. Further, semi-structured key informant interviews (n = 30) were conducted at Fisheries and Seafood trade shows, in Shanghai and Qingdao. Framework analysis for qualitative data was utilised to analyse collected data. The result indicated that perceptions related to quality, health and food safety coupled with cultural and social norms significantly influence the demand for imported high-value aquatic species. Consumers seem to perceive that aquatic food originating in certain countries has a higher standard in terms of food safety and quality, leading to trust in such products. Further, there are changing consumer preferences for aquatic food, which are shaping the current trade practices. The interaction between trading practices, government policies, and economic factors influences the pricing, demand, and consumer behaviour towards higher-value aquatic food. While traders prioritize traceability to ensure food safety, product quality, and clear country of origin information, their focus on sustainability remains secondary. This discrepancy, particularly evident in the Chinese aquatic food market, poses a significant challenge to achieving sustainable markets. It is recommended that traders and suppliers should prioritize further traceability to ensure food safety, product quality, and clear country of origin information. Additionally, addressing the limited focus on sustainability in the Chinese aquatic food market is crucial, which may require public information campaigns to highlight the importance of sourcing sustainable aquatic foods.

Keywords: Aquatic food trade; consumer demand; Seafood market; High-value species; China

4.1 Introduction

Global trade flow in food commodities is valued at approximately USD 2 trillion in 2023 (Emsden, 2024). Aquatic food is one of the highest-valued food commodities – export value reached USD 195 billion in 2022 and is now comparable to the total value of trade (including export and import values) for all terrestrial meats (cattle, pig, poultry and sheep) (FAO, 2024). The value of the overall international trade in aquatic foods has only been possible due to the rapid expansion of aquaculture as global capture fisheries production has been stagnant since the late 1980s (Asche et al., 2015; Budhathoki et al., 2024; Garlock et al., 2020). In 2022, about 37.6 % of global aquatic food production entered international trade (FAO, 2024), which is comparatively high compared to other food commodities, for instance, 9.8 % for meat and 6.7 % for milk and dairy products (Natale et al., 2015). Further, Tveterås et al. (2012) estimate that 78 % of aquatic food products are exposed to international trade competition. Another distinctive feature is the high diversity of aquatic products traded; currently, there are more than 600 aquatic species traded internationally in 225 states and territories of the world (FAO, 2024). However, trade was dominated by a narrower range of species groups; in 2022 these included salmon and trout (20 % share in value), shrimp and prawns (17 %), ground fish and other whitefish (9 %), tuna (9 %), cephalopods (7 %) (ibid). In recent years, the demand for high-value aquatic species – ‘any aquatic species that hold significant economic worth due to their demand, price and market appeal’, has been growing in developing countries, particularly in emerging economies of East and Southeast Asia. In these regions, increased urban middle-class incomes have led to dietary diversification, including more meat and aquatic food in their diets, ultimately changing the historical global aquatic food trade network (FAO, 2022b; Reardon, Tschirley, et al., 2014; Watson et al., 2017).

China, the largest aquatic food market, dominates global aquatic food production, consumption, and trade activities (FAO, 2024). In 2022, China produced and consumed more than one-third of all global aquatic food. It is one of the main exporters of aquatic animal products (12 % of global export value) while the second largest single importing country (12 % of the global import value) following the United States (17 %). In 2021, China imported around USD 22 billion worth of aquatic foods, mostly high-value species (e.g., Atlantic salmon, lobster, abalone, and sea cucumber) that represent a growing proportion of the aquatic food market (Abbott et al., 2021; China Fishery Yearbook, 2022; FAO, 2024). Salmon, lobster, abalone, and sea cucumber were among the most common high-value

aquatic species consumed in China (Wang & Somogyi, 2020) while other aquatic species including tuna, haddock, cod, Alaska Pollock, and Pacific salmon are almost exclusively imported for re-export (re-export share > 75 %) (Asche et al., 2022). The consumption trend of high-value aquatic species in China is driven by broader economic socio-demographic and lifestyle changes including urbanisation, rising income, and changing food preferences (Budhathoki et al., 2022). According to the FAO projection, by 2030, China is expected to account for 37 % of all global consumption of aquatic food. Chinese decisions about what to eat and how and where to acquire aquatic food are becoming increasingly crucial to understand, not only for China but also for the rest of the world – given its impact on food equity, safety, security, and the environment (Asche et al., 2015; Gephart & Pace, 2015; Sumaila et al., 2020; Zhao et al., 2024).

To date, aquaculture production has experienced significant growth in the South, Southeast, and East Asian regions, driven by positive societal attitudes and supportive governmental policies (Budhathoki et al., 2024) – producing more than 90 % of global aquaculture in 2022. However, domestic aquatic production might not necessarily address Chinese consumer preferences for specific high-value aquatic species and trade is a way to align preference with supplies. For instance, Chinese consumers' increasing preference for Atlantic salmon, is almost completely based on imports as the cost of breeding is relatively high and farming Atlantic salmon in China has faced many environmental and technical challenges (Godfrey, 2020; Research and Markets, 2020). Furthermore, ever-stricter regulations and certification schemes in high-income countries (Belton et al., 2020; European Commission, 2022) have arguably raised standards and made Western aquatic products, particularly European aquatic products, more sustainable and safer to eat, enhancing their desirability in export markets such as China.

The contentious nature of this trade is evident, as some argue that the growing export of aquatic food products to China generates additional earnings, reduces trade deficits, and drives the expansion of aquaculture in high-income countries. Proponents also claim that this trade may contribute to sustainable futures by promoting innovations in aquaculture and more efficient resource use. However, opponents of this trade contend that such seafood exports to emerging economies further exploit local natural resources, harm small-scale fisheries, and increase greenhouse gas emissions from intercontinental transportation undermining long-term sustainability and placing undue pressure on ecosystems critical for future resilience (Bostock et al., 2010a; Crona et al., 2020; Gephart & Pace, 2015; Pounds et al., 2022).

The growing demand for high-value aquatic species in China is shaped by shifting consumer

expectations and evolving retail landscapes. Products such as Atlantic salmon, lobster, abalone, and sea cucumber are not only seen as luxury foods but increasingly as symbols of a healthy and modern lifestyle, particularly among urban middle-class consumers (Budhathoki et al., 2022; Crona et al., 2020; Wang et al., 2018). Rising health consciousness, food safety concerns, and the Westernization of dietary patterns—including growing interest in sushi and sashimi—are key factors driving demand for imported aquatic foods. These products are often associated with higher standards due to foreign regulatory controls, traceability systems, and eco-labels. Consequently, attributes such as country of origin and certification have become critical in shaping purchasing decisions. The COVID-19 pandemic also accelerated the digital transformation of seafood retail in China (Guo et al., 2021; Love et al., 2021). Lockdowns and travel restrictions prompted both consumers and traders to shift to e-commerce, live-stream sales, and cold-chain logistics. These channels expanded market reach beyond Tier 1 cities and increased the visibility of product-level information. As a result, traceability and transparency are playing a more prominent role in how high-value aquatic food is marketed and trusted by Chinese consumers.

Despite these developments, few studies have provided detailed insight into the specific perceptions, market mechanisms, and supply chain factors driving this segment of China's aquatic food market. While existing literature often focuses on domestic consumption or export promotion of Chinese aquatic products, the import-side dynamics—especially for high-value species—remain poorly understood.

The perceptions that are fuelling the demand for high-value imported aquatic food in the Chinese market are distinct from those of well-documented markets in Western countries but remain comparatively under-researched (Budhathoki et al., 2022). A quick search in the Scopus database was carried out on 26 May 2024 with the following search string:

(ALL (import * OR trade) AND TITLE – ABS – KEY ("aquatic food" OR seafood OR "fish* " OR "shellfish") AND TITLE – ABS – KEY (China OR Chinese))

The search resulted in 7,736 potential documents published in the English language. Altogether 16 documents were targeted to further understand the aquatic food trade of China, the majority being overviews of the China seafood trade and export of domestic seafood products. While 21 documents were focused on understanding aquatic food consumption in China, the majority were cross-sectional surveys to understand the consumers' seafood buying intention and behaviour. Among these documents, only one document conducted an in-depth understanding of perceptions of sea cucumber consumption, and the factors influencing its import (Fabinyi et al., 2017). Further, a study by O'Malley et al. (2017)

employed a traders' survey to investigate the consumers and suppliers involved and the drivers of demand for dried gill plates from manta and devil rays. All other documents either investigated Chinese consumers' buying behaviour or discussed ways to improve the export of Chinese aquatic food products in international markets or were irrelevant. Further, none of the studies conducted in-depth, current, and practical insights into the imports of high-value aquatic food and the market landscape. Thus, there is a challenge in understanding the perceptions of the growing demand for high-value aquatic food in China.

To fill a significant gap in the literature, this paper offers a novel contribution by specifically focusing on the importation of high-value aquatic foods in China—an area that has been relatively under-explored in both academic research and industry reports. While previous studies have primarily examined general consumption trends or domestic aquatic food production and exportation, they have not provided a comprehensive understanding of the unique dynamics, logistical challenges, and market drivers that shape the demand for high-value imported aquatic foods. This study aims to bridge this gap by combining secondary data analysis with semi-structured interviews with key informants to provide in-depth insights into the perceptions influencing demand, as well as the underlying supply chain dynamics. The research design ensures a holistic understanding of how high-value aquatic foods are imported, the complexities of the trade, and the evolving consumer preferences in China. By focusing on high-value imports, this study adds a critical layer to the existing literature, offering fresh perspectives on factors such as traceability, certification, and changing market demands, and thus provides valuable contributions to both academic knowledge and practical industry applications.

4.2 Methods and Materials

4.2.1 Data Collection

Firstly, datasets from Chinese customs were collected and analysed to understand the import trends of aquatic food in China. The publicly available China trade data (China Fishery Yearbook, 2022) were extracted in Excel, where comparative analysis was performed and presented as graphs. Secondly, interviews with key informants were conducted to gain deeper insights into their perceptions of the demand for imported high-value aquatic food in China. These informants were selected based on their extensive professional experience in the aquatic food trade, ensuring that their perspectives reflected aggregated consumer demands and market trends. This approach allowed for the collection of detailed insights from individuals directly involved in aquatic food trade and distribution. While this method

was chosen due to logistical constraints and the study's focus on supply chain dynamics, the lack of direct consumer input may limit the understanding of end-user expectations and decision-making processes. Primary data were collected through semi-structured interviews conducted at the 17th Shanghai International Fisheries and Seafood Exhibition, Shanghai (August 2023) and Qingdao China Fisheries and Seafood Expo, Shandong, China (October 2023). Thirty key informant interviews were conducted that lasted 30 – 60 minutes.

The key informants primarily included importers (40% of the participants), sales professionals (26.6%), and marketers (10%), along with distributors, producers/exporters, and R&D personnel. The focus on importers and sales/marketing professionals was intentional, as these roles provided critical insights into both the supply chain operations and aggregated consumer demand trends. Their positions at the interface between international suppliers and Chinese consumers allowed for a deeper understanding of product preferences, pricing strategies, and market behaviour—factors essential to evaluating demand for imported high-value aquatic species, particularly salmon. The selection criteria for participation were based on their working experience with imported high-value aquatic food in China. Table 12 shows an overview of the participants' composition.

Table 12. Characteristics of the key informant interview, N=30.

Characteristics	Categories	
Age, years, mean $\pm$ SD		37.13 $\pm$ 6.28
Gender	Male	70 (21)
	Female	30 (9)
Position, %(n)	Importer	40(12)
	Sales	26.6(8)
	Distributor	13.3(4)
	Marketer	10(3)
	Producer and exporter	6.7(2)
	R&D	3.3(1)
Experience in the company, y, mean $\pm$ SD		7.70 $\pm$ 4.20
Experience in the field, y, mean $\pm$ SD		10.83 $\pm$ 5.34
Species specialised, %(n)	Salmon	60(18)
	Multiple	40(12)

SD represents Standard deviation, % represents a percentage, and n represents a number,

R&D represents Research and Development.

4.2.2 Key Informants' Interviews

A semi-structured interview guide (Kvale, 2010) was developed to capture the in-depth opinions of key informants. The majority of interviewees held roles as importers, sales professionals, and marketers—positions that are central to understanding both the upstream

(supply chain logistics, sourcing, trade flows) and downstream (consumer preferences, purchasing behaviour, and market adaptation) dynamics of high-value aquatic food, particularly salmon. These stakeholders act as intermediaries between international producers and domestic consumers and are well-positioned to provide aggregated insights into market demand, pricing, branding strategies, and shifting consumer trends. This targeted selection was informed by secondary trade data, which helped define the interview focus on species with high trade volumes and value. The interview guide also included probe questions, such as, “Can you give an example?” to elaborate on their responses. The guide (see Appendix C) was adapted to the subject of interest based on several previous studies (Fabinyi et al., 2017; Fabinyi and Liu, 2014; Fabinyi and Liu, 2014; Kehoe et al., 2016) and the questions focused on a range of topics related to trade, consumers’ and buyers’ preferences, pricing and market trends, and aquatic resource governance in source countries and China. The interview guide was assessed by four academics, resulting in minor changes in structure and wording. Apart from interviews, observations were also conducted, as well as informal conversations with importers, marketers, and distributors at the Shanghai seafood wholesale market and three Carrefour retail outlets in Shanghai, China. The interviews were conducted by four researchers (three from Shanghai Ocean University and the PhD student). The majority of the interviewees specialized in the salmon market (60 % of the interviews) (see Table 12). Interviews were audio recorded, or detailed notes were taken depending on interview preference. The audio-recorded interviews were transcribed by interviewers and translated into the English language following standard practice (Li & Hope, 2021; Sechrest et al., 1972; Squires, 2009). The transcripts and notes from interviews were then qualitatively analysed for themes that emerged. This method was selected for its structured yet flexible approach, making it well-suited to applied, multidisciplinary research involving diverse stakeholder perspectives. As described by Gale et al. (2013), the framework method facilitates systematic theme identification while preserving individual respondent nuances. It was particularly appropriate for this study, which aimed to capture aggregated market insights from stakeholders engaged in the imported aquatic food trade. The five stages were implemented as follows:

1. Familiarization involved repeated reading of transcripts and notes to immerse the research team in the data.
2. Identifying a thematic framework combined deductive codes from trade literature and interview guides with inductive codes emerging from the data.
3. Indexing was conducted using a coding matrix in Excel to systematically label transcript

segments.

4. Charting entailed organizing key themes into a matrix to facilitate comparison across stakeholder roles; and
5. Mapping and interpretation focused on identifying patterns and relationships among trade roles, market dynamics, and consumer demand.

This structured approach ensured a transparent and rigorous analysis, yielding both descriptive and explanatory insights from the informant interviews. The analytical process and the presentation of findings were adapted from prior research to maintain consistency and methodological rigour in qualitative trade studies (Budhathoki et al., 2021b).

To further validate the interview findings, key themes were cross-checked against observations and discussions from the China 6th Global Salmon Industry Development Summit, which convened major stakeholders from the global and domestic salmon sectors. This event provided complementary insights into China's salmon market, including rising consumer demand for premium and branded products, emerging challenges in cold-chain logistics, and supply-side concerns related to sustainability and traceability. The alignment between industry-level discourse at the summit and interviewee responses strengthened the credibility of the findings and situated them within a broader market context.

While direct consumer surveys offer first-hand data on preferences and purchasing behaviour, this study intentionally prioritized interviews with trade stakeholders—particularly importers, sales professionals, and marketers—due to their aggregated market knowledge and direct involvement in procurement, pricing, and distribution decisions. These actors observe large-scale purchasing patterns, consumer feedback, and emerging demand trends across multiple retail and wholesale channels, making them reliable proxies for understanding market-level consumer behaviour. Additionally, given the exploratory nature of the study and its focus on imported high-value aquatic food, trader interviews were more practical and informative for capturing evolving consumer trends shaped by supply chain factors. However, it is acknowledged that these insights reflect perceived consumer behaviour rather than self-reported preferences, which may introduce interpretive bias.

Participation in the study was entirely voluntary, with written (and in some cases, verbal) consent obtained from each participant before the interviews. Informants were made aware of the confidentiality measures regarding data handling, and anonymity was preserved using pseudonyms. The study received ethical approval from the University of Stirling Ethical Panel (Reference number, 12406).

4.3 Results and Discussion

4.3.1 Import Trend Analysis of High-Value Aquatic Food in China

The results from the secondary data analysis (Figure 12) suggest that high quantities of aquatic food are being imported into China from other Asian countries, the Americas and Europe. Asche et al. (2022) estimated that 74.9 % of Chinese aquatic food imports are re-exported, suggesting that domestic demand is not driving China's export orientation and associated sustainability concerns. Aquatic species such as Tuna, Cod, Haddock, Alaska Pollock, Pacific Salmon, Flatfish, Cuttlefish and Squid are mostly imported for processing and are re-exported (ibid). The advancements in freezing technology have allowed aquatic food processing to occur away from landing locations, based on comparative advantage. As a result, China has become the largest importer of various aquatic species, including frozen cod from Norway, salmon and Alaska pollock from the United States, and Pacific salmon from Russia, as well as a major exporter of processed products like frozen fillets (Anderson et al., 2017; Asche et al., 2016; Roheim & Zhang, 2018). The result from this study indicated that the COVID-19 restrictions had influenced the aquatic food trade, sharply reducing imports, especially from Europe, which reached their lowest point in 2020-2021 before sharply rebounding in 2022. The findings are consistent with a recent study that found a rapid rebound in general consumption occurred after experiencing a sharp decline, exhibiting a V-shaped recession-recovery pattern (Chen et al., 2024). In 2022, China appears to have imported higher volumes of valuable aquatic species from the Americas compared to other regions, as depicted in Figure 12. Crustaceans such as shrimp and prawns have the highest value, while various other aquatic species categories such as salmon, cephalopods, and whitefish also have significant import values and quantities (Figure 13). Ecuador is the largest contributor to crustacean imports with about 37.88 % of the import value (Figure 14); most are Shrimps and Prawns with head-on, shell-on (HOSO) shrimp that are processed into value-added products for the domestic market and re-export (Godfrey, 2024a). Other significant contributors include Russia, Vietnam, and Canada, which supply valuable species like crabs, lobsters, and cuttlefish & squid. Newton et al. (2021) point out that the increase in imported high-value aquatic food observed in China does not imply a decline in the consumption of traditional species, but rather a diversification of consumer preferences that includes both more expensive species and affordable commodity products in the diet. Notably, China imports large volumes of *Pangasius hypophthalmus* catfish from Vietnam to meet domestic demand, reflecting a preference for this affordable and versatile fish (FAO, 2023). Further, in general, frozen aquatic food products are becoming more popular in China

and the growth rate of the imported frozen aquatic food products reflects this (Fabinyi & Liu, 2016). The rise of supermarkets and e-commerce – as opposed to traditional wet aquatic food markets – are much more closely linked with the sales of frozen aquatic food in China (Fabinyi, 2018).

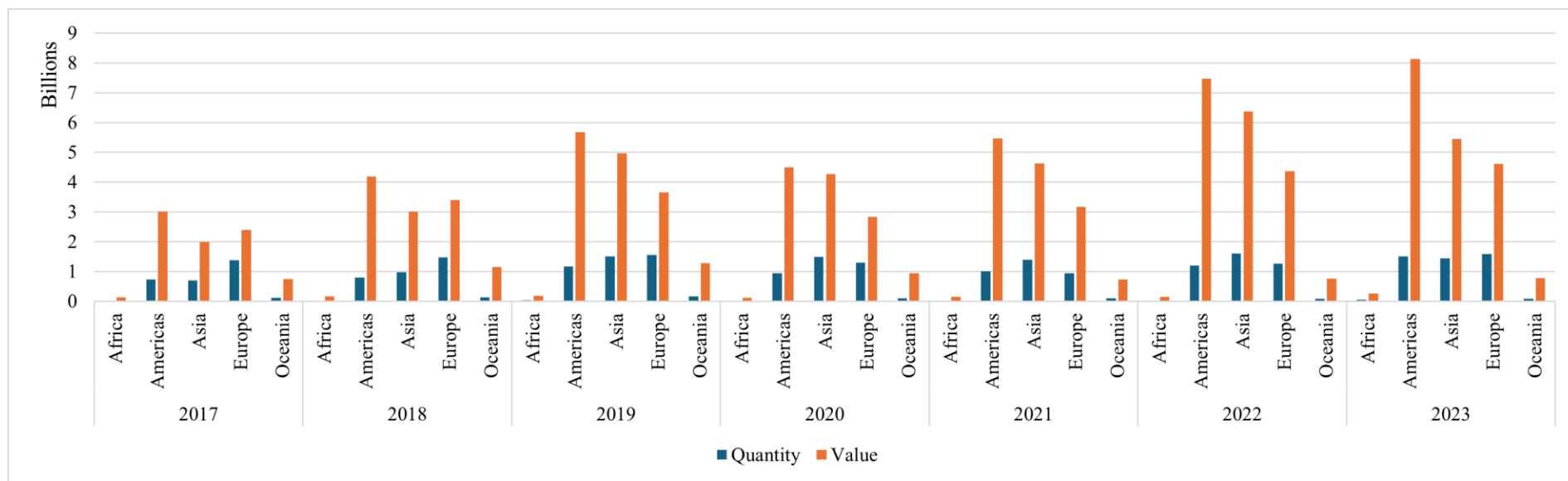


Figure 12. Quantity (in kg live weight) and value (in USD) of aquatic food imports into China by region, 2017–2023.

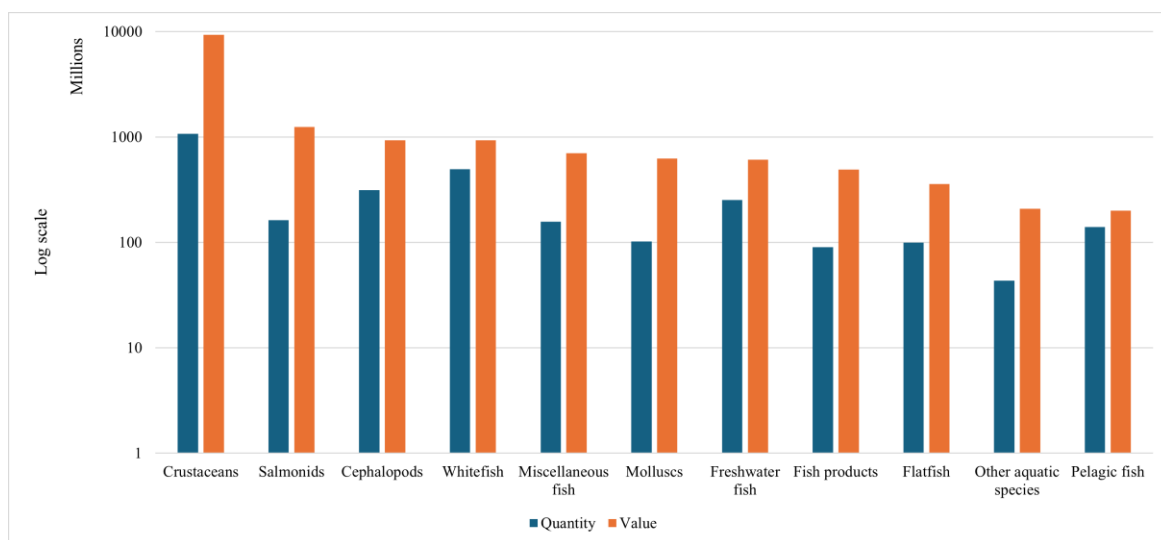
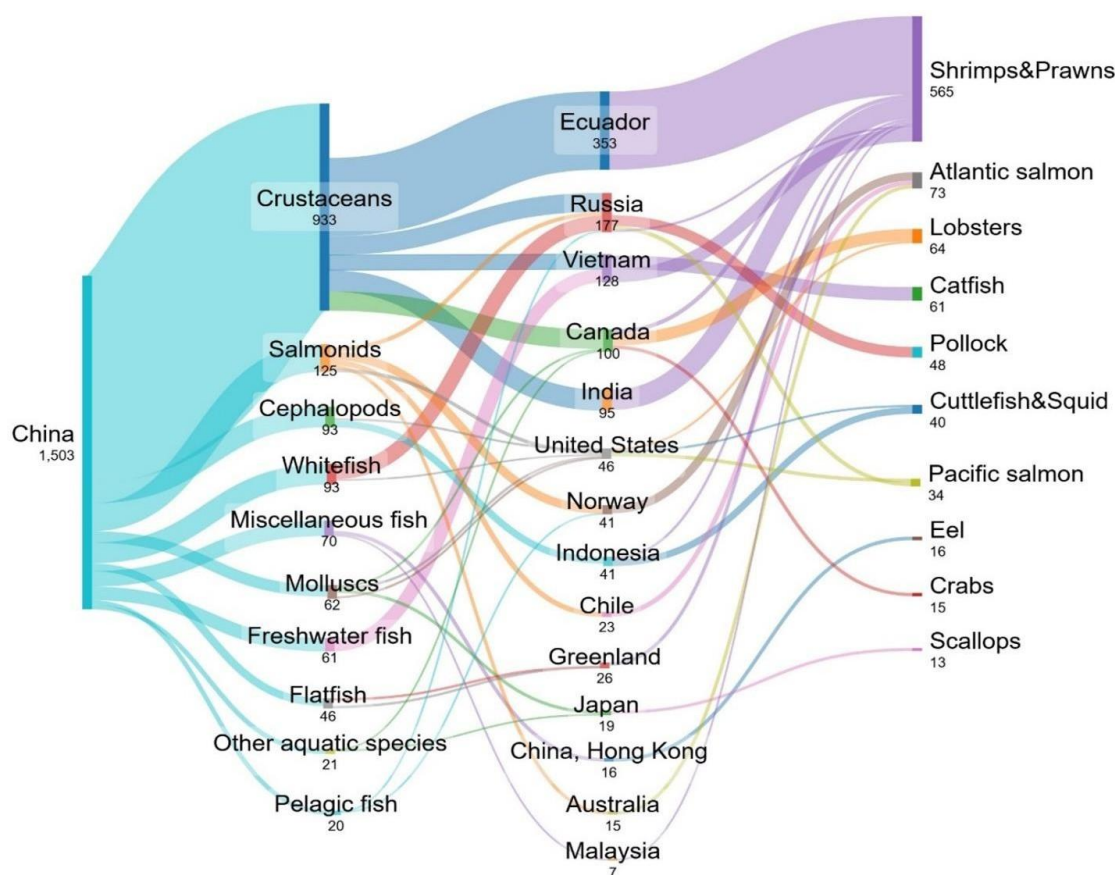


Figure 13. Import Value (in USD, log scale) and Quantity (in kg live weight, log scale) of Aquatic Species Categories Imported into China, 2022.



Unspecified aquatic species were removed from the analysis

Figure 6. Categories of imported aquatic species, their source countries, and their main species, with values in ten million USD for 2022.

4.3.2 Perceptions Fuelling the Demand for High-Value Aquatic Food

After analysing the qualitative data, seven distinct framework categories emerged that reflected the key informant's perception of the increasing demand for high-value imported aquatic foods in China. The identified framework categories are presented and discussed as follows:

a) Changing Consumption Preferences for Aquatic Food

In general, there is a significant shift in aquatic food consumption patterns across China. Informants emphasised that this shift is closely linked to urbanization and the country's rapid economic development, which has resulted in a growing demand for diverse and higher-value imported aquatic food products. Informants indicated that consumers, particularly from first and second-tier cities, have increased disposable income, greater exposure to Western foods, and higher health consciousness, which might have contributed to this trend. A recent survey found that residents across China consistently place health and nutrition as the main reasons for aquatic food consumption (Zhang et al., 2021). This is supported by informants who observed that "... high-value imported aquatic food products are healthy..." (Importer, 35, male) and that "...they are perceived as a part of a healthy lifestyle..." (Marketer, 40, male). Individuals who are more motivated towards a healthy lifestyle would give more importance to natural food (Milošević et al., 2012). Aquatic food is often considered a natural food due to its minimal processing, rich nutritional profile, and potential for sustainable sourcing. It is believed that compared to many terrestrial animal products and highly processed plant-based alternatives, aquatic food maintains more of its natural qualities, making it a valuable part of a balanced and healthful diet. For instance, aquatic foods, particularly high-value species such as Atlantic salmon, sea cucumber, and abalone, are considered nutritionally beneficial sources to human health as they contain omega-3 polyunsaturated fatty acids and other natural contents (Rimm et al., 2018; Thong & Solgaard, 2017). Further, high-value carnivorous local aquatic species like Yellow Croaker (*Larimichthys polyactis*) and Chinese Sturgeon (*Acipenser sinensis*) are facing competition from imported high-value species such as Atlantic salmon, sea cucumber, lobster, oysters, and abalone. These imported aquatic species are perceived as luxury items and are often associated with health benefits. While carp continues to be popular, the aquatic food market dynamics are shifting as consumers seek out these premium options. Thus, the food consumption model among Chinese consumers is shifting from "eating well" to "eating healthy," resulting in a higher demand for healthy aquatic foods in their diet (Xu & Hu, 2019;

Zhang, 2018). However, "healthy" does not always equate to higher-priced or higher trophic-level species. Many nutritious options, such as small pelagic fish, are both affordable and rich in essential nutrients, while higher trophic level species like tuna and salmon, though sought after for their health benefits, can be more expensive and prone to accumulating contaminants like mercury. There is literature in China on the health risks associated with consuming higher trophic species, emphasizing the importance of informed consumer choices (Geng et al., 2015; Nong et al., 2021).

Following the COVID-19 pandemic, consumers increasingly use other sales channels including e-commerce platforms such as JD.com, and Alibaba Group (Taobao) to buy their preferred aquatic foods. Chen et al. (2023) found that the preference for fresh food e-commerce shopping was accelerated by the COVID-19 lockdown with the usage rate increasing by 48 % compared to the period before the lockdown. Further, e-commerce platforms have facilitated access to a wider range of aquatic foods including high-value imported aquatic species at competitive prices (Budhathoki et al., 2024). As one distributor noted, "...due to JD.com and Alibaba, many products are very accessible, and prices are reasonable too..." (Distributor, 39, male). Liu and Chen, (2021) indicated that young consumers of urban areas are increasingly consuming convenient food reflecting their urban lifestyle: an individualised or self-centred, technology-dependent and fast-paced lifestyle. These young, urban consumers value convenient food aligned with a flexible daily schedule and relaxed lifestyle. They seek to reduce household burdens, save money and taste a variety of food. While some consumers may find the preparation of aquatic food, such as cutting or removing skin, to be time-consuming or challenging, the convenience of aquatic food often comes from the availability of ready-to-cook or pre-prepared options, such as canned, smoked, frozen, or pre-filleted ones. These products require less preparation time and skill compared to whole fish or shellfish, making them a more accessible option for busy individuals. Further, although aquatic food may not always be cheaper than other alternatives, farmed whitefish species like tilapia and pangasius are currently more affordable than many meat cuts in several Asian countries (Feedr, 2024).

b) Quality and Food Safety

Quality and food safety are important factors influencing the aquatic food consumption pattern in China (Meng et al., 2023; Wang et al., 2009). Informants perceived that consumers are seeking aquatic food products with higher quality and food safety. Chinese consumers with disposable income appear to be following the pattern of Maslow's hierarchy of needs, i.e. individuals satisfy their basic subsistence needs before then prioritizing quality and

safety, especially regarding food products (Taylor, 2014). As one informant noted, “...consumers are cautious, they check where it’s coming from and if it is safe to eat...” (Research and Development, 32, female). Consumers are increasingly cautious of potential health risks associated with contaminated aquatic food. Following Japan’s nuclear wastewater discharge into the Pacific Ocean, Chinese consumers have become more vigilant about the quality and safety of aquatic food, with some even reducing their consumption of aquatic food originating from Japan (Pu et al., 2022). Further, they perceived that consumer trust imported aquatic food products from countries other than Japan for quality and safety standards compared to domestic products. As another informant observed, “...consumers think imported aquatic food products are safer to eat and have higher quality...” (Importer 1, 45, male). Consumers perceived that imported aquatic food products undergo inspection and testing procedures both at the production source and upon entry into China (Kendall et al., 2019), which assures them of the safety and quality of these imported products. Additionally, traders interviewed for this study emphasized that most of the aquatic food products seeking access to international markets have Hazard Analysis and Critical Control Points (HACCP) certification or compliance for aquatic food products. As such certification is often regarded as a prerequisite for meeting recognised safety standards, particularly in China, which imposed stricter food safety regulations following the COVID–19 pandemic (Song et al., 2024).

c) Cultural Influence and Social Norms

Informants highlighted the significant impact of cultural factors and social norms on consumer preferences and behaviour towards aquatic food in China. Among affluent consumers, consuming imported high-value aquatic species has become a symbol of status and prosperity. These findings are in line with previous studies that found that high-value aquatic food consumption was more influenced by the symbolic value motivation dimension than the food value dimension (Fabinyi, 2012; Fabinyi and Liu, 2014; Wang et al., 2018; Wang and Somogyi, 2020). As one informant noted, “...in social gatherings and festivals, having expensive seafood has become a symbol of status and prosperity...” (Importer 1, 43, male). Beyond taste, the main attraction of high-value aquatic food for some consumers is their price, which symbolizes respect and honour for guests. In China, these costly aquatic dishes are referred to as 'face dishes' (mian cai, 面菜) because they are intended to 'give face.' Hosting a lavish aquatic food banquet serves to reinforce social ties, and in professional settings, it facilitates networking, maintaining ‘guanxi’ (关系), and building relationships

with influential individuals (Jacka et al., 2013).

Further, younger consumers are increasingly consuming imported aquatic foods as part of their modern lifestyle. Although this study did not specifically organise attitudes by key themes for different age groups, this observation highlights a notable trend among younger consumers. They perceived these foods as trendy and sophisticated, aligning with their desire to explore diverse culinary experiences. For instance, salmon is commonly enjoyed in sushi and sashimi dishes, typically at social gatherings in out-of-home dining settings, reflecting a fusion of traditional Japanese cuisine with contemporary Chinese dining preferences.

This trend is fuelled by the influence of social media platforms such as TikTok and WeChat, where influencers and aesthetically pleasing images of aquatic dishes encourage younger generations to seek out aquatic dishes dining experiences. As one marketer observed, "...social media platforms like TikTok and WeChat are popular these days...companies hire celebrities/influencers to showcase salmon...making them look super trendy and desirable..." (Marketer, 38, female). Corvo et al. (2022) pointed out that social media serves an aesthetic and emotional purpose, exemplified by "food selfies" that showcase meals and beverages being enjoyed. Sharing these food images fosters a virtual sense of togetherness, attempting to recreate the joy of communal dining. Although social media content covers a range of food types, there has been a noticeable emphasis on high-value aquatic dishes compared to terrestrial alternatives. For example, on Instagram, the hashtag #sushi has 38 million posts, significantly more than the 17 million posts for #steak as of 25 July 2024. Luxurious options like sushi and sashimi, often receive more attention on social media platforms like Instagram and TikTok due to their aesthetic presentation and associated with high-status dining experiences. This focus has contributed to the normalisation of consuming imported high-value aquatic food products, particularly among young consumers residing in urban cities, and reinforcing existing social norms surrounding aquatic food consumption.

d) Country-of-Origin and Trust

Country of origin and trust emerged as a prominent framework in exploring Chinese consumer demand for imported high-value aquatic food. Informants perceived that consumers are increasingly placing significant importance on the country of origin, associating certain countries with higher standards of food safety and quality. This perception leads to greater trust in aquatic food products originating from those countries. Specifically, aquatic food products from European countries are generally perceived as having higher standards for food safety and quality, based on their established reputation, stringent regulation measures implemented by European countries, and technological

advancements in food processing. As one informant noted, “Our clients demand salmon from Norway because they regard it to be of high quality and safe” (Importer 2, 45, male). Another informant emphasized, “European countries have strict regulations and adapt technology to make sure their seafood products are safe and high quality” (Sales, 37, male). Further, informants perceived that consumers seem to also associate certain countries with specific aquatic food products famous for their quality and authenticity. For instance, salmon from Norway, oysters from France, and lobsters from Canada are perceived as particularly desirable. While these products are perceived as particularly desirable, the lack of verification mechanisms raises concerns about the authenticity and trustworthiness of these claims. These findings are in line with previous studies that found that place of origin branding is important in highlighting high-quality seafood products (Fabinyi et al., 2017). However, the strong reputation for quality associated with certain countries can lead to a risk where aquatic food is marketed as originating from these preferred countries without independent validation. This issue is particularly challenging in China due to traceability problems (Zhang et al., 2024), which can undermine consumers' trust and complicate efforts to ensure food safety and authenticity. Some informants pointed out that as Japan has started discharging so-called “treated” and “diluted” water from the damaged Fukushima Daiichi nuclear power plant into the Pacific Ocean, there is a general food safety concern and a lack of trust in the aquatic food originating from the region. These findings are in line with findings from recent studies that indicated that the information negatively affects willingness to pay for aquatic foods caught on high seas, leading to reduced import of aquatic food products from the region (Chen et al., 2023; Liang et al., 2024). The role of social media in informing consumer interest was recently demonstrated by Chinese social media star, Wang Hai's warning of excessive sodium metabisulfite residues (a commonly used preservative in food products, including frozen shrimp to prevent microbial growth and discolouration to make them appear fresher) found on shrimp imported from Ecuador (Godfrey, 2024b). This led to several follow-up interviews with Chinese media, reduced consumer trust in Ecuadorian shrimp and a government import suspension on nine major Ecuadorian shrimp exporting companies (Global Food Mate, 2024).

e) Production Method

Informants highlighted that production methods do matter for some of the high-value imported aquatic foods such as sea cucumber, abalone, sea cucumber, and bluefin tuna. Some noted that wild-caught products offer a premium price, particularly in food service sectors where high quality and superior taste are demanded. Similarly, Zheng et al. (2021) found

that there is a strong preference for wild-caught salmon over farm-raised options. Particularly, Chinese consumers exhibit a relatively high willingness to pay a premium for wild salmon, with the additional amount ranging between USD12 and USD14 per 500 g, which is comparable to their preference for chilled products. As one importer observed, “...most don't care about how it's produced, but some do prefer wild-caught...” (Importer, 40, male). However, most informants acknowledged that both wild-caught and farmed aquatic foods are valued by consumers for different reasons. While wild-caught products are often associated with premium quality and taste, farmed options are increasingly popular across various segments of the market. As one producer and exporter noted, “...farmed are popular because it has a good quality all year round...” (Producer and exporter, 48, male). Farmed products such as farmed Atlantic salmon are valued for their consistency, availability, and affordability, making them accessible to a wider range of consumers. Additionally, some pointed out the fact that the advancements in aquaculture practices have enhanced the quality and food safety of farmed seafood, increasing its appeal to consumers. A distributor highlighted this improvement, saying, “...I think the quality and safety of farmed fish has improved...” (Distributor, 32, male). A recent survey among 3,403 Chinese consumers indicated that more than half of the younger consumers of post-2000s generations perceived that farmed and wild-caught are equal (Xu et al., 2024).

f) Traceability and Sustainability Assurance

Informants highlighted that traceability is prioritized over sustainability assurance of the high-value imported aquatic food to ensure the safety and quality of the products. Traders and producers are under pressure to establish robust traceability systems to meet Chinese consumer demands, despite the limited penetration of international sustainability standards. As one importer pointed out, “...when the origin of the salmon is uncertain, it poses a significant challenge...so ensuring traceability is essential, as it ensures safety...” (Importer 2, 43, male). However, there are concerns about the inconsistency and opacity of traceability systems, which hinder conformity regarding the product's origin and production method. A previous study found that the majority of imported seafood (about 75 %) marketed from an e-commerce platform were inconsistent in terms of Web page and label descriptions, a further 35 % of the samples were inauthentic (Xiong et al., 2020). Further, the prevalence of grey trade, *‘transporting aquatic food into mainland China through informal channels to avoid tariffs’* for much of the high-value aquatic food imported into China means that traceability is a significant challenge. By the time aquatic food reaches end users in mainland China, it has undergone numerous transactions, making it difficult to verify its origin. This

issue is exacerbated by inadequate regulations for aquatic food traceability in China, where a standardized labelling system and an official list of aquatic food names are absent (Xiong et al., 2016). These challenges, however, may favour giant e-retailers who can bypass intermediaries and use their streamlined supply chains to market the quality, traceability, and desirability of their products more effectively and at lower cost through social media platforms to reach consumers.

Research has shown that blockchain technology can play a crucial role in improving food traceability, which in turn supports building consumer trust and promotes sustainable practices (Dasaklis et al., 2022; Fiore et al., 2024; Fiore & Mongiello, 2023). Aligning trader practices with consumer expectations—especially around food safety and traceability—is essential for meeting growing demand (Aung & Chang, 2014). Moreover, incorporating consumer insights on sustainability—such as their willingness to pay for verified traceability and sustainably sourced products—could provide actionable recommendations that further enhance marketability and consumer trust in agri-food products (Fiore et al., 2024; Zhao et al., 2019).

In addition to these technological advancements, it is important to consider the relative importance of different sales channels for buying aquatic food in China. Wet markets have traditionally been a primary source of aquatic food, offering a wide variety of live and fresh options (Zhong et al., 2020). Supermarkets and retailers are also significant players, particularly in urban areas, providing a range of live, fresh, and frozen aquatic food products. However, salmon stands out as a high-value and premium product that, unlike other expensive seafood, does not need to be sold live to maintain its perceived quality and price. This unique attribute makes it especially well-suited to retail environments, where the convenience and variety of presentation formats, such as frozen and sashimi-grade options, align with consumer preferences and modern shopping habits. E-commerce has seen rapid growth in recent years, driven by consumer convenience and the increased number of online platforms, which now offer extensive selections of aquatic food, including high-value imported aquatic food (Budhathoki et al., 2024). The shift towards supermarkets and e-commerce platforms is influencing the dynamics of aquatic food sales and traceability dynamics. Major retailers and e-commerce platforms often have more stringent quality control measures and traceability systems compared to wet markets. Consequently, aquatic food sold through these modern channels may be subject to better traceability practices, although challenges remain due to the complex supply chains (Zhang et al., 2024) and grey trade activities (Fabinyi et al., 2017). Therefore, while traceability issues are pervasive, they may vary in severity across different sales channels. For instance, Xiong et al. (2016a) found

that over 60 % of fish labelled as ‘cod’ (Xue鳕) in China were mislabelled. There is speculation that concerns about price inflation may also be a factor influencing the Chinese government's decision to tolerate the practice of grey trade (Edwards et al., 2016). Following the COVID-19 pandemic, and earlier food safety crises – such as the 2008 Chinese milk scandal (Xiu & Klein, 2010), Chinese authorities have imposed stricter requirements for thorough documentation and verification processes, emphasising the importance of traceability for compliance with food safety. While food safety remains the primary driver of consumer trust, eco-labelling is beginning to gain traction, especially among younger and environmentally conscious consumers. Regarding sustainability certification, informants noted that the majority of imported high-value aquatic food products from Western countries already possess an eco-label certification. However, some participants questioned the efficacy of eco-labelling and sustainability certifications in enhancing their business in China. As one importer remarked, “...ecolabel does not boost my business...I don't think Chinese buyers pay much attention to it...” (Importer 1, 39, male). It is worth considering whether the eco-label serves as a proxy for good governance and best practices in this context (Barclay & Miller, 2018). While some informants acknowledge the potential benefits of eco-labelling for branding, they also express doubts about its immediate influence on their business. These findings are in line with a previous study by Malcorps et al. (2021) indicating that Chinese seafood trade shows had less of an emphasis on sustainability compared to that in Europe and the United States but placed a greater emphasis on food safety and quality than on environmental concerns. However, a recent survey found that young consumers are aware of environmental sustainability labels such as Best Aquaculture Practice (BAP) and that it positively influences their purchasing decisions (Xu et al., 2024). Thus, while eco-labelling may currently play a secondary role in food safety, it holds growing potential to shape purchasing behaviour as awareness of environmental sustainability continues to rise.

g) Trading and Price

The dynamics of trading and pricing significantly impact the demand for aquatic food in China. Traders' perceptions about trading practices and price fluctuations shape consumer behaviour and preferences. When prices fluctuate due to changes in trading practices, Chinese consumers react by adjusting their buying habits. Chinese consumers display significant sensitivity to fluctuations in the aquatic food market, actively seeking the best deals and maximizing value for their expenditures. In general, price is a central influencing

factor for aquatic food consumption behaviour globally, it plays an especially significant role among Asian consumers due to varying income levels and economic considerations (Budhathoki et al., 2022a). One importer mentioned that “...some (consumers) are sensitive to price...when price increases, they select for more affordable choices or purchase smaller quantities of salmon...” (Importer 2, 39, male).

Moreover, government regulations and policies highly influence market stability and product availability, further shaping consumer demand. Changes in import regulations and tariffs, often influenced by decisions made by the Chinese government, can significantly impact the availability and pricing of salmon in China. For example, the free trade agreement signed on May 1, 2024, between China and Ecuador reduced shrimp tariffs from 5 % to 2 %, with plans to eliminate the tariff within 10 years (The State Council Information Office of the People’s Republic of China, 2024). This reduction will make shrimp more affordable in China’s aquatic food market. Given that Ecuador is currently the top country from which China imports a high volume of shrimp & prawns, this agreement will have a substantial impact. A recent study by Song et al. (2024) found that despite the increasing influence of non-state actors, China as a state actor is taking a more proactive role in shaping the seafood trade. The unique economic structure, government intervention, and strategic policies make China a distinct case where state actors and business interests are closely interacting in shaping international trade outcomes. This process is complex, subject to change over time, and entangled in a broad range of other economic and social institutions. One informant mentioned that geopolitical tensions and global economic conditions can also influence trade dynamics and market stability in China. For instance, seafood trade tensions between Norway and China between 2010 and 2016 were triggered by the awarding of the Nobel Peace Prize to Liu Xiaobo. China’s state government responded with informal trade restrictions on Norwegian aquatic food, particularly salmon (Chen & Garcia, 2016; Kolstad, 2020). Adjustments in import tariffs or alterations to trade agreements between aquatic food exporting countries and China can influence the cost of products in the country, consequently affecting retail prices and affordability for domestic consumers. One salesperson remarked “...Norwegian salmon is facing competition from Chilean salmon...Chilean salmon has an advantage of lower import tariffs, making it more competitive in price and is driving market share...” Similarly, Zhang et al. (2023) found that changes in the volatility (or variability) of salmon prices and exchange rates significantly affect the quantity of farmed salmon being imported.

4.4 Strategic Implications

Given the disruption of aquatic food imports during the COVID-19 pandemic, it is recommended that traders should have strong risk management plans in place to deal with such disruptions. For instance, maintaining adaptable logistics and broadening the supply base to enable switching source nations according to market conditions (e.g., switching from Norway to the Faroe Islands or Scotland in the case of Atlantic salmon) might be useful. Our recent study found that Chinese consumers could not differentiate the origin of salmon under blind conditions (Budhathoki et al., 2024), suggesting that such logistical adjustments would not adversely affect consumer perceptions. With these strategies, importers can adjust their sourcing strategy and logistics in response to market conditions, improving their capacity to control currency and pricing risks. In the highly competitive aquatic food industry, this technique helps importers efficiently manage both price, exchange rate risks and logistics by enabling them to modify their sourcing strategy in response to market conditions even in crises. Zhang et al. (2023) argue that depending on how successfully importers manage risks and the accessibility of hedging options, the effects of pricing versus exchange rate fluctuations on trade can differ. Fixed-price contracts and financial derivatives, for example, can assist lower the risks associated with high-value aquatic food prices, and different hedging tactics can help traders lessen the impact of exchange rate swings. Thus, it is recommended to strengthen connections with foreign producers and suppliers in Norway, Chile, Scotland, Australia, the United States, Canada, and the Faroe Islands to provide a steady supply chain for high-value aquatic species such as Atlantic salmon, sea cucumbers, and lobsters. This will indeed fulfil customer demand and preserve market stability.

The demand for high-value aquatic species, along with the sustained importance of freshwater species like carp, and catfish reflects the diversification of consumer preferences. While carp, a traditional staple, continues to be widely consumed, more recently introduced species such as channel catfish (*Ictalurus punctatus*), which is produced domestically in large quantities, and Basa (*Pangasius bocourti*), which is imported in larger quantities, have also gained popularity. This trend illustrates the evolving landscape of aquatic food consumption in the country, blending traditional and exotic species. Thus, it is recommended for importers to diversify product offers to meet a wide range of consumer demand. Increasing demand for convenient frozen aquatic food products due to the growth of e-commerce and supermarkets as well as the urban lifestyle of young consumers offers a substantial opportunity for distributors, processors and traders. Previous studies have found that imported products from another side of the globe can have comparable or in some cases smaller carbon footprint than domestic products, particularly, frozen and shipped, which may

be the most energy efficient (Farmery et al., 2015; Tlustý & Lagueux, 2009). Thus, promoting frozen imported aquatic food products can meet rising consumer demand while also offering an energy-efficient and environmentally friendly option compared to live or fresh imported or domestic products. Importers and distributors can use sales channels other than traditional wet markets such as supermarkets and e-commerce platforms for the sales of premium high-value imported frozen aquatic food to boost sales and promote easy accessibility. The fact that consumers are increasingly purchasing aquatic food products from supermarkets and online retailers in addition to traditional “wet” markets and food service sectors suggests a change in the retail environment. Thus, the use of digital marketing and enhancing social media engagement can increase brand awareness and loyalty, while digital marketing can help high-value imported aquatic foods reach a large customer base (Dolan et al., 2019; Santos et al., 2022).

In the competitive aquatic food market of China, traders must ensure imported aquatic food products’ quality and safety through recognisable safety certifications that comply with stringent inspection procedures. Emphasizing the country of origin in marketing materials can increase consumer trust in products originating from certain provenance with solid reputations for food safety and quality. Despite there being less emphasis on sustainability, promoting certifications like the Aquaculture Stewardship Council (ASC) and Marine Stewardship Council (MSC) can improve brand reputation. Previous studies have demonstrated that certification schemes not only enhance consumer trust but also shape broader market perceptions, positioning certified seafood products as higher-quality and more credible options (Cantillo et al., 2021; Malcorps et al., 2021). These certifications have evolved from traditional ecolabels to comprise a broader range of issues, including environmental, and social impacts, as well as fish welfare. This comprehensive approach supports responsible aquatic food production (Rector et al., 2023). To empower consumers to make informed choices and support sustainable practices, clear and accurate labelling is essential. Public information campaigns can further enhance consumer awareness and influence behaviour towards sustainable aquatic food consumption. These campaigns are effective in motivating consumers to adopt sustainable practices voluntarily. According to Simões, (2016), education and information are critical to many public initiatives, often supported by media communication and social marketing techniques. Such campaigns increase consumer awareness of certifications and help reduce the environmental footprint of consumption habits.

A critical component of maintaining quality and safety in the aquatic food supply chain is ensuring robust traceability. Global supply chain traceability can be enhanced by reducing

the number of nodes in the supply network and increasing vertical integration (Hopkins et al., 2024). This is particularly relevant in the context of China's complex aquatic food import network, where longer supply chains with numerous nodes introduce multiple points of vulnerability. Implementing end-to-end traceability, akin to 'Farm to Fork' systems used in terrestrial agriculture, is recommended. This approach involves tracking products from their source through to the consumer, ensuring that the entire journey is transparent and verifiable. The rise of digital technologies offers sophisticated tools for traceability, making it easier for consumers to access detailed product information (Astill et al., 2019). For aquatic food products, full-chain digital traceability—comprehensive tracking of a product's path through the supply chain using advanced digital systems—becomes indispensable. This not only helps ensure that products are safe, legal, and sustainably sourced but also supports accurate labelling and consumer trust. Therefore, integrating strong traceability measures with certification and labelling efforts provides a comprehensive approach to ensuring the quality, safety, and sustainability of aquatic food products.

Finally, it is important to acknowledge the significant influence of Chinese state actors in the aquatic food trade. The Chinese government plays a central role in shaping the types of seafood imported into the country, as well as how these imports enter the domestic market. This is especially relevant given China's food safety policies and regulations, which often dictate the importation processes and quality standards for high-value aquatic food products. While discussing state actors' influence may be politically sensitive and challenging to address directly with traders, it remains a critical aspect of understanding the broader dynamics of the seafood trade. State policies and regulations regarding tariffs, certifications, and safety standards can significantly affect the availability and pricing of imported seafood. Therefore, Chinese policymakers and relevant state actors should work alongside both international and domestic stakeholders to ensure the development of transparent and effective trade policies that support food safety, sustainability, and the smooth functioning of the aquatic food import sector.

4.5 Conclusion and Limitation of the Study

China's aquatic food import patterns have undergone notable shifts in recent years, marked by temporary disruptions—such as those observed during the COVID-19 pandemic—and a subsequent rebound in trade activity. In particular, imports of high-value species like crustaceans from the Americas increased significantly in 2022, reflecting broader trends toward diversified consumption. This study highlights significant shifts in aquatic food consumption patterns in China, driven by economic growth, urbanization, and heightened

health awareness. The increasing demand for high-value imported species, such as Atlantic salmon, lobster, abalone, and sea cucumber, among affluent urban consumers reflects a move towards more diverse and health-conscious diets. Key drivers of this demand include perceptions of quality and food safety, heavily influenced by cultural and social norms. The country of origin and traceability play crucial roles in shaping consumer trust, as products from specific regions are perceived to have higher safety and quality standards. The findings also suggest that current trading practices, government policies, and economic factors strongly influence pricing, demand, and consumer behaviour toward high-value aquatic food.

However, sustainability remains a secondary concern, though interest in sustainable practices appears to be growing, particularly among younger consumers, indicating a critical opportunity to promote sustainable futures. By integrating sustainability into the supply chain, businesses and policymakers can contribute to a long-term vision of a more resilient and environmentally responsible trade system that aligns with global efforts to combat climate change and resource depletion.

The expansion of retail channels—from traditional wet markets to supermarkets and e-commerce platforms—demonstrates the evolving distribution landscape. These changes offer considerable growth opportunities for traders and distributors to access a broader consumer base by leveraging modern sales channels and prioritizing product quality, safety, and sustainability. To maintain competitiveness and meet the evolving demands of China's high-value aquatic food market, traders must adopt flexible sourcing strategies and engage in strategic marketing that emphasizes traceability, sustainability, and the potential to contribute to a sustainable future. Policymakers can further support these efforts by incentivizing sustainable sourcing practices, enhancing regulations, and ensuring that both economic growth and environmental stewardship remain central to the long-term sustainability of the aquatic food trade.

This study has several limitations that should be considered when interpreting the findings. First, the interviews focused primarily on trade stakeholders—such as importers, sales professionals, and marketers—rather than direct consumers. While these participants provided valuable insights into aggregated consumer trends and market behaviour, their perspectives may not fully capture the nuances of individual consumer preferences or decision-making processes. As such, the findings reflect perceived rather than self-reported consumer behaviour. Second, due to logistical and resource constraints, the study did not include a formal consumer survey, which could have strengthened the demand-side analysis. Third, the interviews were conducted at two major seafood expos in China, which may have

introduced a degree of selection bias toward larger or more internationally connected actors in the aquatic food trade. Fourth, while qualitative methods enabled deep exploration of stakeholder perspectives, the findings are context-specific and may not be generalizable across other species, markets, or periods. Future studies should consider incorporating mixed methods, including consumer surveys and longitudinal trade data, to triangulate findings and enhance external validity.

This chapter sheds light on the demand for high-value aquatic products imported into China, particularly within the context of global trade dynamics and rising concerns about food security and sustainability. By linking informants' insights to traceability and transparency challenges, the chapter highlights a critical gap between market priorities—such as demand for high-value aquatic products—and public sustainability objectives. The following chapters build upon these findings by narrowing the focus to China's evolving aquatic food market, with a specific emphasis on farmed salmon. Chapter 5, 'Farmed Salmon Import and E-commerce Satisfaction in China,' examines the growing role of e-commerce platforms in shaping consumer satisfaction and market access for farmed salmon imports. The chapter explores how digital marketplaces influence purchasing behaviour, satisfaction levels, and perceptions of quality and sustainability. In Chapter 6, 'Sensory Perception and Willingness to Pay for Farmed Salmon in China,' the analysis shifts toward understanding the factors driving consumer preferences for farmed salmon, including quality, price, origin, and sustainability impact willingness to pay.

Chapter 5 Farmed Salmon Import and E-commerce Satisfaction in China

Abstract

Salmon, considered a luxury aquatic product, has experienced a steady increase in imports to China. The rapid expansion of the Internet shifting consumption behaviour, and the effects of the COVID–19 pandemic have driven consumers to buy salmon products through e-commerce platforms. Given this context, understanding salmon import trends and consumer satisfaction with e-commerce for salmon is essential to supporting and growing online sales of these products. Thus, this study investigates salmon import trends in China and examines factors that influence consumer e-commerce satisfaction with buying salmon. A dataset of 10,064 out of 25,763 consumer comments was analysed, adjusting for positive and negative feedback proportions. Using the sentiment analysis tool TextBlob, 65.2 % of comments were found to be positive, 21.7 % negative, and 13.1 % neutral. Furthermore, Latent Dirichlet Allocation topic modelling identified five satisfaction-related areas: purchase decision (19.5 % of comments), eating experience (22.3 %), service quality and delivery (20.6 %), purchase history (17.5 %), and general product quality (20 %). Findings reveal that service quality and delivery are the most crucial for consumer e-commerce satisfaction for buying salmon, while purchase history has the least impact. Factors like PLUS membership, product style, and preservation method significantly influenced satisfaction, while country of origin, weight, and price did not. To improve consumer satisfaction, salmon e-commerce platforms should focus on enhancing logistics and delivery services to ensure the efficient delivery of fresh salmon.

Keywords: Salmon e-commerce; Text mining; Sentiment analysis; Online comment; China

5.1 Introduction

Salmon, whether wild or farmed, is highly valued for its nutritional benefits (Colombo & Mazal, 2020), culinary flexibility (Coates, 2006), convenience (Onozaka et al., 2014), and economic significance (Asche & Bjørndal, 2011). Farmed Atlantic salmon leads in both traditional and emerging markets due to its reliable availability, affordability and large-scale production. Currently, approximately 75 % of salmon, primarily Atlantic salmon, is produced through aquaculture (FAO, 2023) making it a popular choice among consumers in Northern Europe, North America, and parts of Asia. The FAO reported that in 2021, global salmon production reached around 4.2 million tonnes (live weight) with about 90 % designated for direct human consumption. The same year, salmon represented 4.7 % of the global aquatic food supply (MOWI, 2022) and achieved a high trade value, totalling about 61 billion USD, including imports, exports, and reexports.

China, as the world's largest consumer of aquatic food, is experiencing a significant increase in demand for farmed salmon, particularly in urban areas, driven by rising incomes and shifting dietary preferences (Budhathoki et al., 2022a; Crona et al., 2015). As discussed in Chapter 3, Thematic Cluster 5, this shift reflects broader trends in aquatic food consumption, including a growing preference for safe, high-status, and imported seafood among younger, urban, and affluent Chinese consumers. Chapter 4 further illustrates the rise of salmon as a luxury aquatic product, aligning with lifestyle shifts and evolving purchasing behaviours in urban China. Chinese consumers perceive salmon as a premium imported product, valued for its high production standards, superior health benefits, and sensory appeal compared to other seafood. Wealthier consumers view salmon as a status symbol, typically enjoyed in social settings, especially as Japanese-style sushi or sashimi in restaurants and at banquets (Fabinyi & Liu, 2014). Beyond dining out, the trend of purchasing convenient salmon products from supermarkets and e-commerce platforms has expanded, partly due to COVID-19 restrictions on dining out (Du et al., 2020; Zhang & Liao, 2024). Unlike Western consumers, who generally prefer salmon fillets, some Chinese consumers enjoy traditional soups and stews made with various salmon cuts, including heads, tails, and bones (Malcorps et al., 2021; Stevens et al., 2018). Which are available alongside fillets in supermarkets and online. Salmon species available in China include Atlantic salmon (*S. salar*), Pacific salmon (*Oncorhynchus spp.*), pink salmon (*O. gorbuscha*), Keta salmon (*O. keta*), Coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), and rainbow trout (*O. mykiss*). In China, these are sold under the trade name 三文鱼 (sān wén yú), a phonetic translation for “salmon,” rather than a

taxonomic label (Xiong et al., 2016). These species vary in taste, texture, nutritional content, and price, generally ranging from 7 to 50 USD per kg (Wang et al., 2021) with farmed Atlantic salmon being the most popular, primarily imported from Norway and Chile.

In 2023, Atlantic salmon imports from Norway, the United Kingdom, the Faeroe Islands, and Canada faced a 7 % tariff, while those from Chile, Iceland, Australia, and New Zealand were tariff-free (Hu, 2024). While China mainly produces rainbow trout, with approximately 37 thousand tonnes produced in 2022, there are efforts to produce other salmon species like Atlantic salmon. In 2021, China managed to produce about 2 thousand tonnes of Atlantic salmon (China Fishery Yearbook, 2022; FAO, 2024). However, production remains limited due to the high costs and technical challenges involved in cultivating Atlantic salmon locally (Godfrey, 2020c; Lu, 2022). Consequently, to meet the growing demand for favoured salmon varieties, China relies heavily on imported supplies.

During the COVID-19 pandemic, efficient e-commerce platforms and infrastructure were essential in facilitating the direct delivery of aquatic food from overseas to local consumers (Zhang et al., 2021). This led to a shift in consumer habits toward purchasing aquatic food products through e-commerce, and the food e-commerce market in China has since grown rapidly, with an annual growth rate exceeding 40 % (Asian Development Bank, 2023; Guo et al., 2022; Zhang & Liao, 2024). For instance, research by Zhang and Liao (2024) revealed that post-pandemic, Chinese consumers developed a greater appreciation for the nutritional benefits of aquatic foods and became more health-conscious, increasing their frequency of purchase, expanding the variety of species bought, and diversifying sales channels.

A recent survey by the Global Seafood Alliance identified e-commerce as a key channel for urban Chinese consumers seeking aquatic foods (Global Seafood Alliance, 2023). Consumers aged 25–49 years are particularly inclined to buy preferred food items through these platforms (HL Bank Singapore, 2023). Additionally, e-commerce allows consumers to share feedback on purchased seafood, covering price, quality, sensory characteristics, and logistics, which provides useful insights for future buyers who might have limited access to in-person markets like restaurants, supermarkets, or local markets (Cheung & Lee, 2012). These reviews can validate product details and influence purchasing decisions (Li et al., 2019; Mudambi & Schuff, 2010; Xiao et al., 2016). Therefore, analysing consumer comments presents a valuable opportunity for salmon producers, marketers, and distributors to gain insights into consumer salmon e-commerce satisfaction with both products and services.

Consumer satisfaction, as defined in satisfaction literature (Giese & Cote, 2000), is a cognitive or emotional response that relates to a specific focus (such as the buying or eating

experience of a product) and occurs at a particular time (post-purchase or post-consumption). Understanding the drivers of consumer satisfaction with salmon e-commerce is essential for fostering customer loyalty, maintaining a positive brand image, and meeting regulatory standards. By prioritizing key factors that impact satisfaction, e-commerce platforms can enhance the purchasing experience and strengthen their position in the competitive online market. Further, enhancing consumer satisfaction is critical to promoting salmon product sales through e-commerce, contributing to the sustainable growth of these businesses (Li et al., 2023). Previous research has identified several elements influencing satisfaction with online food purchases, including perceived price, promotions, service quality, and food quality (Choi et al., 2019; Guan et al., 2022; Hong et al., 2019; Prasetyo et al., 2021; Tan & Kim, 2021).

So far, limited studies have explored salmon preferences among Chinese consumers, and studies specifically examining satisfaction with salmon e-commerce are lacking. Existing studies focus on consumer preferences for specific attributes of aquatic food in general but are limited in explaining consumer e-commerce satisfaction for salmon products. Traditional surveys on consumer satisfaction are often costly, time-intensive, and may not always capture consumer concerns. This study aims to fill this gap by analysing consumer comments from e-commerce platforms using sentiment analysis and opinion mining to assess satisfaction with salmon e-commerce in China. Additionally, secondary data analysis was conducted to provide insights into salmon import trends in China.

5.2 Methods and Materials

This study employs a mixed-method approach (Figure 15), integrating secondary data analysis to examine trends in salmon imports and sentiment analysis to assess Chinese consumer satisfaction with salmon e-commerce.

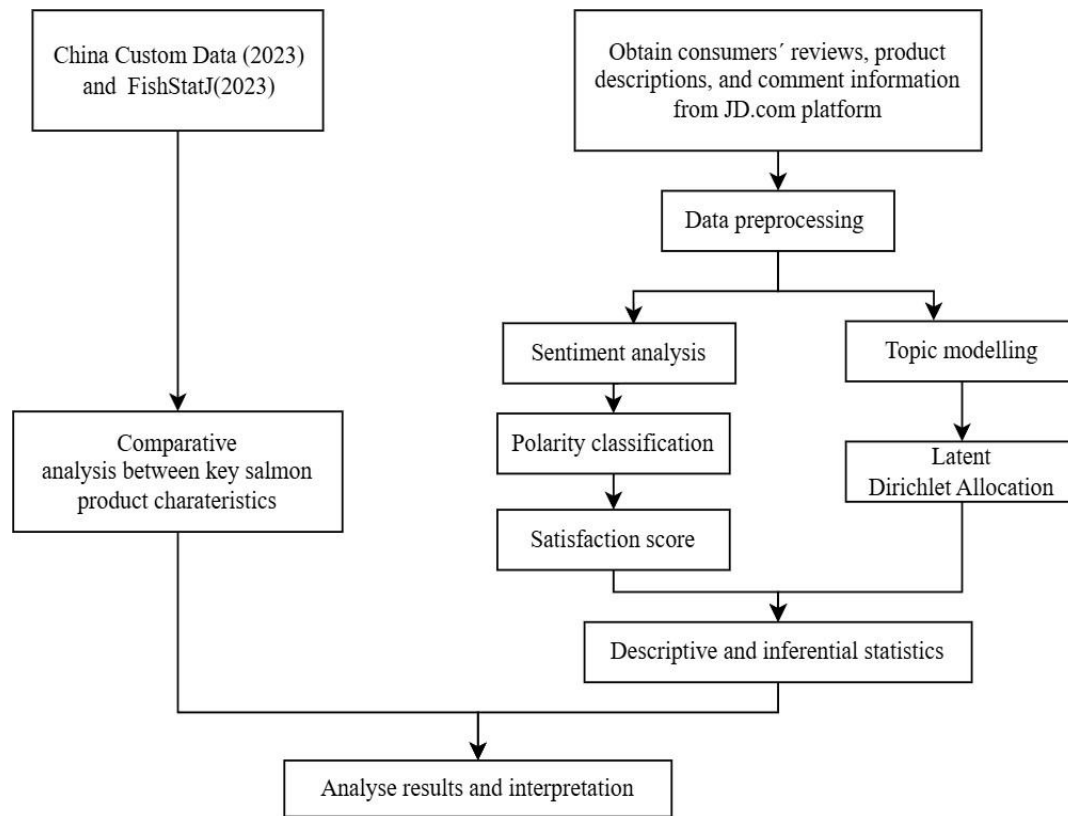


Figure 7. Research design for analysing salmon import trends and consumer satisfaction.

5.2.1 Data Collection and Preparation

At first, Salmon import data was collected from the China Customs website (General Administration of Customs of the People's Republic of China, 2023) and salmon production statistics from *FishstatJ* (FAO, 2023). Additionally, consumer comments were gathered from the JD platform (www.jd.com), one of China's major e-commerce sites, chosen for its strong focus on packaged and fresh seafood products, its appeal to affluent urban consumers, and the structured, high-quality, and publicly accessible review data available to researchers (Asian Development Bank, 2023; HL Bank Singapore, 2023). Raw data was collected using the Octopus web crawler, yielding 25,763 logistics-related comments posted between 2016 and 2023, from users who purchased salmon. These were saved in text format for further analysis. The dataset's broad timespan allows for trend identification over multiple years while focusing on a reputable platform like JD.com ensures data consistency. Recent research indicates that the primary demographic on JD.com consists of females (over 60 % of a 457,298-person dataset), aged 26–35 (approximately 40 %), with a bachelor's degree or higher (around 50 %), residing in tier 1 and tier 2 Chinese cities (about 70 %) (Shen et al., 2024).

Before analysis, the raw data underwent pre-processing and labelling. This pre-processing involved steps like translation, manual review, spelling corrections, text normalization, punctuation and number removal, deduplication, stop word removal, lemmatization, and tokenization, using Python's Natural Language Toolkit (NLTK) library. Two experts verified translations to ensure reliability and accuracy (Li & Hope, 2021). Chinese text segmentation was handled with the "jieba" library. For text vectorization, the Count Vectorizer technique from Scikit-learn was applied along with Latent Dirichlet Allocation (LDA) topic modelling, where each word in a comment was marked with a 1 if present, otherwise 0 (Arai et al., 2021). Since approximately 85 % of comments were positive, under-sampling was applied to achieve a balanced 3:1 ratio of positive to negative comments, with all neutral and negative comments retained. Ultimately, 10,064 out of 25,763 comments were analysed. In this study, the Chinese yuan (CNY) was converted to the United States Dollar (USD) at a rate of 1 CNY = 0.14 USD.

It is important to acknowledge that JD.com operates a self-operated product delivery and review system, which may differ from other platforms like Taobao which use a decentralized marketplace model (Chan et al., 2018; Wu & Gereffi, 2018). Such differences in logistics, product consistency, and seller accountability could potentially influence consumer sentiment and review behaviour, representing a possible source of platform-specific bias. JD.com's review ecosystem also incorporates engagement features that may influence user behaviour, particularly through its PLUS membership program, which targets high-frequency buyers. PLUS members are rewarded with loyalty points for submitting verified purchase reviews. While the exact percentage of reviews directly incentivized with rewards is not publicly available, this structure encourages active participation and may contribute to a higher proportion of positive sentiment. Understanding this gamified environment is essential when interpreting review tone, especially since PLUS members tend to represent JD's core base of affluent, urban consumers (Shen et al., 2020).

5.2.2 Data Analysis

First, a secondary data analysis was performed in Excel to examine trends in salmon imports to China, which was then illustrated in graph form. Next, a word frequency analysis identified the 20 most common words in consumer comments across positive, negative, and neutral categories for a preliminary overview. Sentiment analysis was conducted using the *TextBlob* Python package (Loria, 2018), which assigned a polarity score to each comment. This score ranged from -1 to 1, where -1 indicated very negative sentiment, 1 represented very positive sentiment, and scores near 0 indicated neutrality. Descriptive statistics were presented

as proportions and percentages for categorical data, and median values (with interquartile) for continuous non-normally distributed data. Based on data type, analysis of variance (ANOVA) or Chi-square tests were applied to identify significant differences in sentiment regarding salmon attributes.

To reduce the impact of outliers, polarity scores were normalized using z-scores before converting them into satisfaction scores. These scores were then linearly mapped to a 5-point scale centred at 2.5. For calculating the satisfaction, the following equation was used:

Equation 1

$$\text{Satisfaction score} = \text{Polarity Score} \times 2.5 + 2.5.$$

Equation 1 translates polarity scores linearly to the [0, 5] range, with 2.5 marking the midpoint as neutral. Satisfaction scores were categorized as follows: “Very Satisfied” (4.5 to 5.0), “Satisfied” (3.5 to 4.4), “Neutral” (2.5 to 3.4), “Unsatisfied” (1.5 to 2.4), and “Very Unsatisfied” (0 to 1.4). This classification offers a clear overview of consumer satisfaction levels based on sentiment analysis (Ali et al., 2016; Kausar et al., 2020). Topics were extracted from consumer comments using the Latent Dirichlet Allocation (LDA) method with the *Gensim* package (Rehurek & Sojka, 2011). Lastly, a binary logistic regression assessed the relationship between consumer satisfaction, topics derived from LDA, and salmon attributes. The dependent variable was whether consumers felt satisfied with their salmon purchases online, and independent variables included topic categories and salmon attributes. The binary logistic regression model used was:

Equation 2

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{11} X_{11} + e_0$$

Where, p is the probability of the consumer satisfaction with online salmon purchases, β_0 is the intercept, $\beta_1, \beta_2, \dots, \beta_{11}$ are coefficients for each independent variable $X_1, X_2, \dots, X_{11}$, respectively. e_0 is the model's error term. Statistically significant was set at $p < 0.05$.

For the integration of LDA topics into the logistic regression model, each topic was represented as a binary dummy variable indicating topic membership (1 = review primarily associated with the topic, 0 = otherwise). These topic indicators were included as independent variables in the regression model, alongside structured product attributes (e.g., price, weight, and country of origin) and consumer characteristics such as membership status. This hybrid modelling approach enabled the integration of unstructured textual insights from consumer reviews with structured e-commerce data, providing a more

comprehensive and behaviourally grounded understanding of the factors influencing consumer satisfaction with online salmon purchases. The practice of converting dominant LDA topic membership into binary variables for use in logistic regression models is increasingly common in text analytics research. It allows researchers to integrate unstructured review data with structured predictors, enabling interpretable and behaviourally meaningful insights in studies involving binary outcomes such as consumer satisfaction. Statistically significant was set at $p < 0.05$.

5.2.3 Sentiment Analysis using TextBlob

TextBlob provides a straightforward Application Programming Interface (API) for natural language processing (NLP) aimed at sentiment analysis. This widely used, lexicon-based Python library (compatible with versions 2 and 3) is designed for speed and efficiency (Mahmoudi et al., 2024). Lexicon-based sentiment analysis techniques depend on word banks, like SentiWordNet (Ribeiro et al., 2016), which categorize terms into four groups: positive, neutral, negative, and stop words (e.g., “and” “with”, and “in”). The TextBlob analyser identifies sentiment in each text by examining these categorized terms while ignoring stop words. It is also capable of translating consumer comments between languages, enhancing sentiment analysis accuracy (Chopra et al., 2016). According to Deitel and Deitel (2020), TextBlob’s pre-trained machine-learning models simplify the often-complex sentiment analysis process, making it a powerful tool for interpreting text sentiment. In a comparative study, Hasan et al. (2018) found TextBlob to outperform other lexicon-based models (like SentiWordNet and W-WSD) in sentiment classification accuracy. Numerous studies have further validated its reliability (Al-Natour & Turetken, 2020; Chandrasekaran & Hemanth, 2022; Sharma et al., 2023; Vijayarani & Janani, 2016). Al-Natour and Turetken (2020) concluded that TextBlob’s sentiment analysis accuracy surpasses methods like star ratings and Valence Aware Dictionary and sEntiment Reasoner (VADER), particularly for comments of short to medium length (1 to 99 words), which is relevant to our study. So far, no prior research has applied TextBlob specifically to assess consumer sentiment in aquatic food consumption and its role in decision-making.

5.2.4 Topic Modelling with Latent Dirichlet Allocation

Latent Dirichlet Allocation (LDA) is a generative probabilistic model used to categorize collections of text by identifying patterns across topics, each represented by a distribution of words. Originally introduced by Blei et al. (2003), LDA remains a leading method for topic modelling. Researchers have successfully applied LDA across numerous fields, including

software engineering, political science, medicine, linguistics, and food science (Jelodar et al., 2019). In food science, LDA has been used in studies such as analysing Atlantic salmon spoilage (Kuuliala et al., 2021), evaluating social actor narratives (Benites-Lazaro et al., 2018), investigating takeaway food safety (Song et al., 2020), exploring organic food trends (Singh & Glińska-Noweś, 2022), sustainable consumption (Brzustewicz & Singh, 2021), and developing new seafood products (Verza et al., 2023). For consumer satisfaction research, notable studies employing LDA include those by Guo et al. (2017), Tirunillai and Tellis (2014), Kumar et al. (2023), and Shao et al. (2023).

In this study, LDA was implemented using Python with the `scikit – learn` (Pedregosa, 2011) and `nltk` (Loper & Bird, 2002) libraries to identify dominant themes in consumer comments on JD.com about salmon purchases. Pre-processing involved converting text to lowercase, tokenization, removing punctuation, and filtering stop words using a custom list. The cleaned text was vectorised using `CountVectorizer`, with the number of features limited to 50.

LDA was applied to the resulting word matrix with parameters `n_components = 5`, `learning_method = 'online'`, and `max_iter = 10`. Each comment was assigned its most probable topic based on the topic distribution. To determine the optimal number of topics, we followed a standard iterative approach commonly used in topic modelling literature: fitting multiple LDA models with varying topic numbers and evaluating the semantic interpretability of each solution (Chang et al., 2009; Maier et al., 2018). For each configuration (ranging from 3 to 7 topics), the outputs were reviewed by examining the top keywords and representative comments to assess thematic coherence, redundancy, and coverage. The topics were then labelled through independent review by two researchers, who reached a consensus on descriptive names. A five-topic solution was ultimately selected based on its ability to produce distinct, interpretable, and non-overlapping themes that best reflected the diversity of topics and opinions present in consumer reviews.

5.3 Results

5.3.1 Import Trend of Salmon in China

The secondary data analysis revealed that a significant portion of frozen salmon imported into China is intended for processing and subsequent re-export, accounting for approximately 78 % of the total imported quantity. In contrast, fresh or chilled salmon is primarily imported for domestic consumption (Figure 16). The trade of salmon was notably affected by the restrictions during the COVID–19 pandemic, leading to a sharp decline in

farmed salmon imports, which hit their lowest levels in 2020-2021.

Additionally, the salmon export figures from ten salmon-producing countries to China were analysed, focusing on the preserved forms of salmon intended for domestic consumption in 2021 (Figure 17). The findings showed that aquaculture is the predominant source of salmon production. Norway and Chile are the leading producers, while Norway, Australia, and Chile are the top exporters of salmon to China. In contrast, Russia and the United States rely primarily on wild fisheries for their salmon production and predominantly export frozen salmon to China for reprocessing and re-exporting.

The analysis also compared the customs price per kg of salmon from the top five exporting countries (Figure 18). It was found that the customs price for salmon from Norway and the Faroe Islands was higher, while Russian salmon had the lowest price per kg. After experiencing a decline in prices since 2018, the price of salmon surged dramatically after 2020, reaching record highs. In 2021, the customs price for smoked salmon was more than twice that of fresh or chilled salmon, which was itself double the price of frozen salmon (Figure 19). The higher prices for smoked salmon can be attributed to weight loss during the smoking process, as well as increased labour and processing costs. Furthermore, the price of frozen salmon remained stable from 2015 to 2021, whereas the prices for smoked and fresh or chilled salmon began to rise after 2020. Several factors may contribute to this increase, including the perception of quality (with fresh salmon regarded as more premium than frozen), seasonality and harvesting fluctuations, and disruptions in the supply chain during COVID-19, which led to shortages and higher prices.

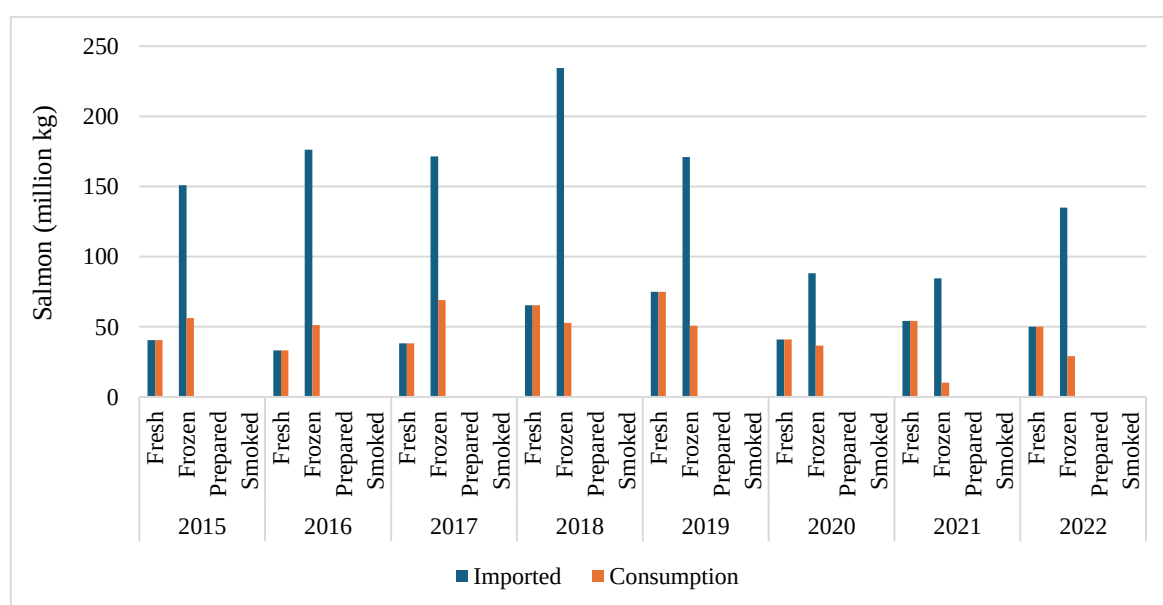
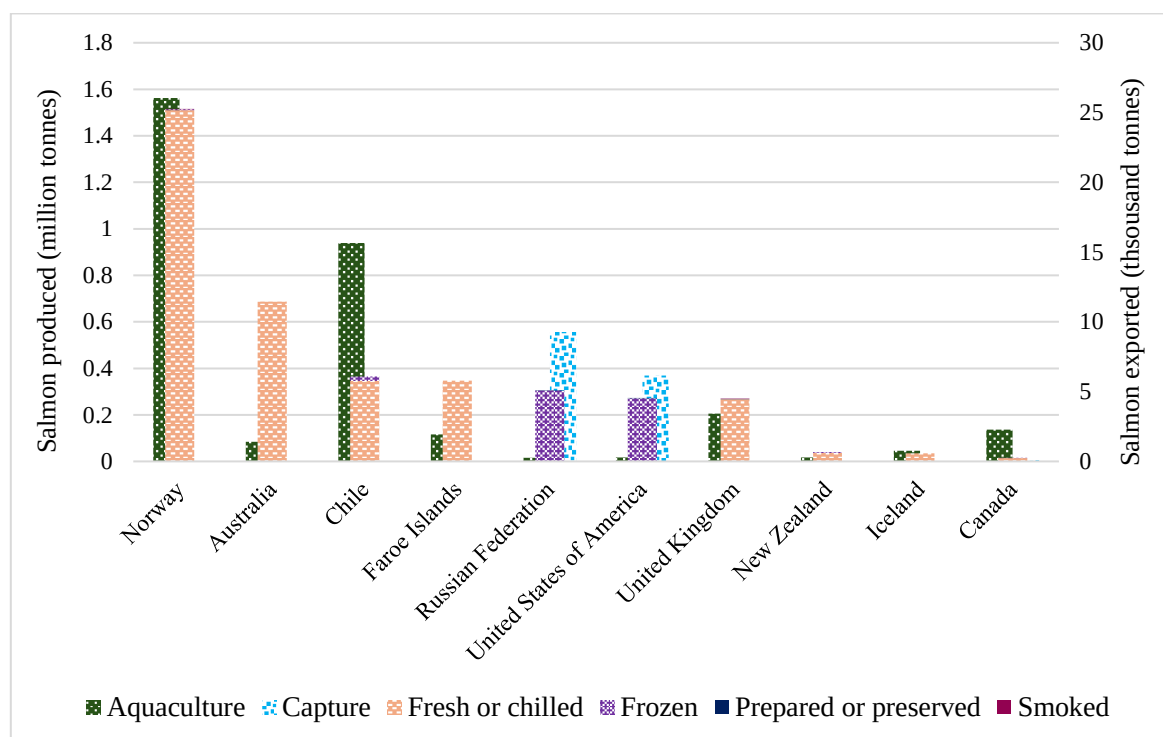
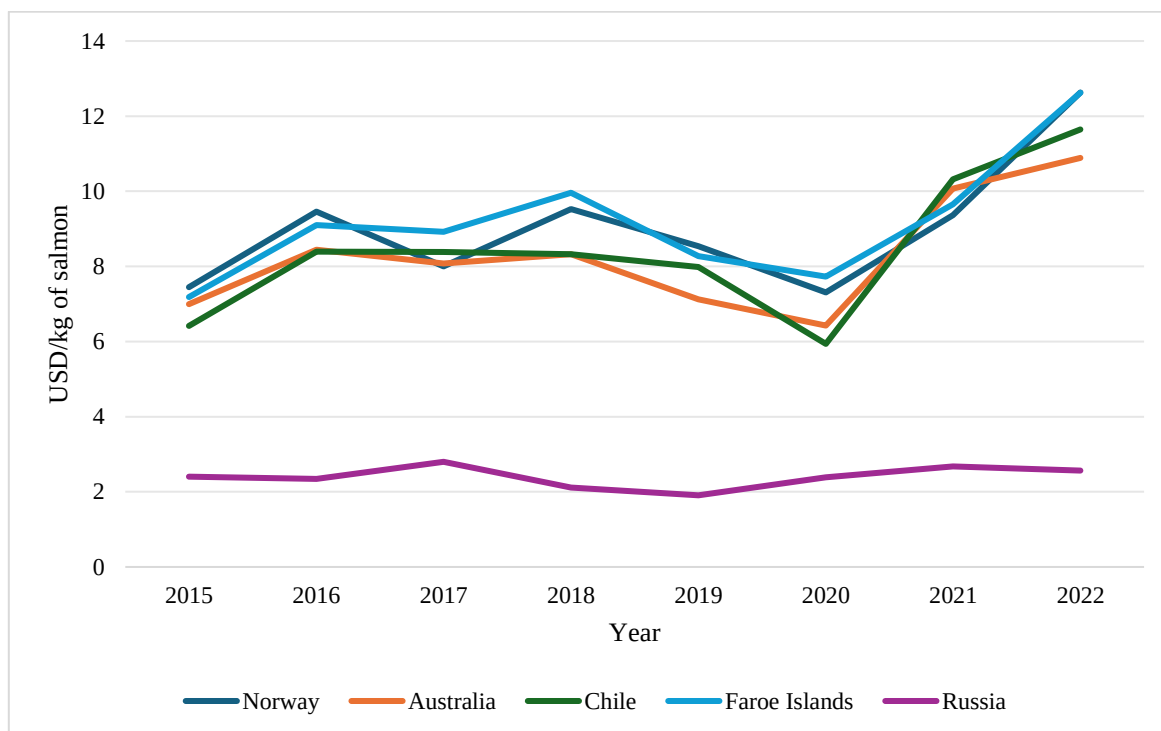


Figure 16. Total volume of salmon imported to and consumed in China, classified by preservation method, from 2015 to 2022.



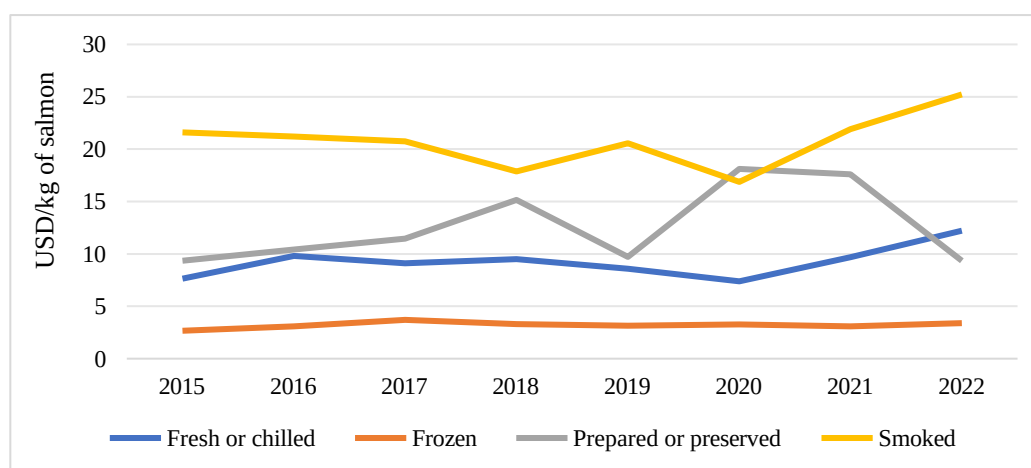
^are-exported salmon were not included in the analysis, and production data was obtained from the FAO FISHSTATJ. ^bSalmon exported from Russia to China is categorised as "Other frozen Pacific salmon" in the China Customs database and as "Atlantic salmon and Danube salmon, frozen" in the FAO database, primarily consisting of captured pink salmon and Danube salmon.

Figure 17. Countries exporting salmon to China by production form (in thousand tonnes on the right axis) and their salmon production from aquaculture and wild capture (in million tonnes on the left axis) for 2021. ^{a,b}



^aSalmon exported from Russia to China is categorised as "Other frozen Pacific salmon" in the China Customs database, and as "Atlantic salmon and Danube salmon, frozen" in the FAO database, primarily comprising captured pink salmon and Danube salmon.

Figure 18. Customs price per kg of salmon products from the top five exporting countries from 2015 to 2022.^a



Price in USD, adjusted for inflation.

Figure 8. Custom price per kg of various forms of salmon products from 2015 to 2022.

5.3.2 Word Frequency Analysis

The word frequency analysis revealed that the term “fresh” was the most frequently mentioned word ($n = 7697$), suggesting that online shoppers prioritize the freshness of salmon products (Figure 20). Other commonly noted words included 'delivery' ($n = 5,288$), 'delicious' ($n = 5,055$), 'time' ($n = 4,933$), 'quality' ($n = 4,884$), and 'taste' ($n = 4,687$), indicating key areas of interest for consumers regarding salmon e-commerce. Additionally, the analysis showed that 'delicious' was associated with a more positive sentiment, while 'frozen' exhibited a higher frequency of negative sentiment compared to positive. Using LDA topic modelling and a dataset overview, the 20 most frequent words can be classified as five topic categories: (1) Purchase decision: price, convenience; (2) Eating experience: fried, taste, appealing, like, meat, delicious, children; (3) Service quality and delivery: delivery, time, logistics, service, package; (4) Purchase history: repurchased, piece; and (5) General product quality: fresh, quality, frozen.

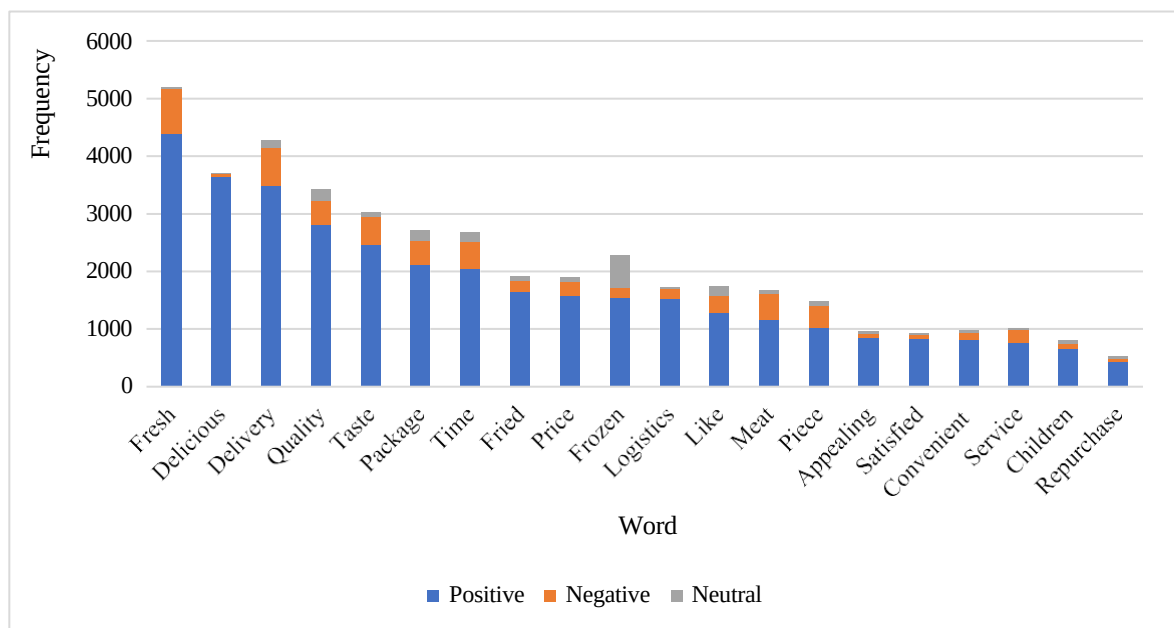


Figure 9. Word frequency distribution across positive, negative, and neutral categories.

5.3.3 Descriptive Analysis of the Salmon E-commerce Consumer Comment

As shown in Table 13, the analysis revealed that online salmon shoppers typically comment on products with a median weight of 480 g, priced at 16.76 USD, and a unit price of 32.25 CNY/kg. After applying LDA topic modelling to classify the 10,064 comments, it was found that 22.3 % focused on eating experiences, followed by service quality and delivery (20.6 %), general product quality (20 %), purchase decisions (19.5 %), and purchase history (17.5 %). Additionally, consumers with a PLUS membership tended to leave more positive feedback about their purchased salmon products compared to non-members, likely due to the

incentives associated with membership for commenting on their purchases (Ning & Tianyu, 2019).

In terms of the country of origin, most comments were about salmon products from Norway (49.6 %) and Chile (44.2 %), indicating that these countries lead in salmon e-commerce sales. Furthermore, salmon products from the United Kingdom (83.3 %), Iceland (66.7 %), Chile (67.4 %), Norway (64.1 %), and Denmark (59.2 %) received more positive feedback than from China (58.6 %) and New Zealand (48.6 %). Regarding product type and preservation method, most consumers purchased fillet salmon, resulting in 70.5 % of comments being about fillet salmon products.

Table 13. Descriptive analysis of the salmon e-commerce consumer comments.

Factors	Categories	Consumer comment			Total N = 10064	p-value
		Positive N = 6561	Neutral N = 1316	Negative N = 2187		
Weight in grams, median (IQR)		480(200)	480(400)	480(200)	480(109.96)	<0.001 ^a
Price (USD), median (IQR)		16.76(7.61)	118(9.01)	118(8.87)	16.76(7.61)	<0.001 ^a
Unit price (USD/kg), median (IQR)		32.24(15.32)	31.69(17.16)	32.23(15.32)	32.25(16.52)	0.109 ^a
LDA topic modelling, % (n)	Purchase decision	56.4(1108)	27.9(548)	15.6(307)	19.5(1963)	<0.001 ^b
	Eating experience	56.9(1279)	17.86(396)	25.5(574)	22.3(2249)	
	Service quality and delivery	84.4(1754)	3.2(67)	12.3(256)	20.6(2077)	
	Purchase history	45.5(802)	10(176)	44.5(785)	17.5(1763)	
	General product quality	80.5(1618)	6.4(128)	13.2(265)	20(2011)	
Membership, %(n)	Non-PLUS	57.5(2067)	14.8(530)	27.7(995)	35.7(3592)	<0.001 ^b
	PLUS	69.4(4494)	12.1(786)	18.4(1192)	64.3(6472)	
Country of origin, %(n)	Chile	67.4(3002)	13.2(587)	19.4(862)	44.2(4451)	<0.001 ^b
	China	58.6(136)	13.8(32)	27.6(64)	2.3(232)	
	Denmark	59.2(90)	21.7(33)	19.1(20)	1.5(152)	
	Iceland	66.7(56)	9.5(8)	23.8(20)	0.8(84)	
	New Zealand	48.6(72)	15.5(23)	35.8(53)	1.5(148)	
	Norway	64.1(3200)	12.7(632)	23.2(1159)	49.6(4991)	
	United Kingdom	83.3(5)	16.7(1)		0.1(6)	
Product style, %(n)	Fillet	67.6(4795)	12.2(868)	20.2(1433)	70.5(7096)	<0.001 ^b
	Middle section	62.3(953)	14.5(221)	23.2(355)	15.2(1529)	
	Smoked	60.1(184)	20.3(62)	19.6(60)	3(306)	
	Whole fish	55.5(629)	14.6(165)	29.9(339)	11.3(1133)	

Preservation form, %(n)	Fresh	63.3(2689)	12.1(513)	24.6(1046)	42.2(4248)	<0.001 ^b
	Frozen	66.6(3845)	13.8(795)	19.6(1131)	57.3(5771)	
	Room temperature	60(27)	17.8(8)	22.2(10)	0.4(45)	

^aANOVA, ^bChi-square, *n* represents a number, % represents a percentage, IQR represents the Interquartile range, and LDA represents Latent Dirichlet Allocation. USD represents the United States Dollar.

5.3.4 Factors Influencing Salmon E-commerce Satisfaction

Table 14 presents the relationship between consumer satisfaction and salmon attributes, as well as topic variables to identify the factors that affect consumer satisfaction in salmon e-commerce. The regression analysis results indicated that the model accounts for a significant portion of the variability in consumer satisfaction, with an adjusted R^2 of 0.609. Collinearity tests revealed no major issues with multicollinearity, as the variance inflation factor values were below 7, and tolerance values were above 0.10 (O'brien, 2007).

Among the LDA topics, all five—service quality and delivery, general product quality, purchase decision, eating experience, and purchase history—had significant positive effects on the likelihood of consumer satisfaction. Service quality and delivery showed the strongest association ($\beta = 0.405$), followed by general product quality ($\beta = 0.379$), indicating that logistics performance, packaging integrity, and product condition upon arrival are central to positive consumer experiences. The purchase decision topic ($\beta = 0.221$) likely reflects pre-purchase expectations and perceived value, while the eating experience ($\beta = 0.198$) captures comments about taste, texture, and cooking outcomes, showing that post-purchase satisfaction also plays a role. Although smaller in magnitude, the purchase history topic ($\beta = 0.155$) still had a significant positive effect, suggesting that repeat purchases and familiarity with the product enhance satisfaction.

These findings highlight the value of LDA topic modelling in identifying latent behavioural themes from unstructured consumer feedback—insights that structured variables alone may overlook. By converting these themes into binary indicators, the model gains behavioural depth, enabling a clearer understanding of the consumer journey and key satisfaction drivers in salmon e-commerce.

In addition to the LDA topics, several other factors were found to significantly impact the likelihood of consumer satisfaction. For instance, having a PLUS membership ($\beta = 0.102$, $p < 0.001$) was linked to a higher likelihood of satisfaction, implying that PLUS members generally report greater satisfaction. Additionally, the product style of fillet ($\beta = 0.076$, $p < 0.001$) was positively correlated, indicating that consumers who bought fillet products

tended to be more satisfied. Conversely, the preservation form of fresh salmon ($\beta = -0.040$, $p < 0.001$) showed a negative relationship, suggesting that those purchasing fresh salmon were generally less satisfied than those buying frozen products. However, several factors did not significantly impact consumer satisfaction. Weight ($\beta = -0.007$, $p = 0.509$), price ($\beta = 0.015$, $p = 0.342$), and country of origin ($\beta = 0.011$, $p = 0.369$) were not meaningfully associated with consumer satisfaction. This indicates that these variables do not have a significant effect on the likelihood of consumer satisfaction within the context of salmon e-commerce.

Table 2. Relationship between consumer salmon e-commerce satisfaction and the influencing factors.

Factors	Standardized Beta coefficient	Standard Error	p-value	Tolerance	VIF
LDA topic					
Purchase decision	0.221	0.016	<0.001	0.426	2.346
Eating experience	0.198	0.016	<0.001	0.385	2.596
Service quality and delivery	0.405	0.016	<0.001	0.403	2.479
Purchase history	0.155	0.016	<0.001	0.455	2.199
General product quality	0.379	0.016	<0.001	0.409	2.446
Weight (<500 g = 1)	-0.007	0.011	0.509	0.329	3.042
Price (<150 CNY = 1)	0.015	0.013	0.342	0.164	6.090
Membership (PLUS = 1)	0.102	0.010	<0.001	0.340	2.943
Country of Origin (Norway = 1)	0.011	0.013	0.369	0.256	3.092
Product style (Fillet = 1)	0.076	0.012	<0.001	0.222	4.500
Preservation form (Fresh = 1)	-0.040	0.014	<0.001	0.277	3.606

VIF represents the Variance Inflation Factor, adjusted $R^2 = 0.609$, $F = 1421.234$, $df = 11$, $p < 0.001$, CNY represents Chinese Yuan, and g represents gram.

5.4 Discussion and Strategic Implications

Existing literature widely documents the disruptive effects of COVID-19 on aquatic food imports (Dai et al., 2021; Love et al., 2021; Zhang et al., 2021), including increased prices for meat and seafood (Wang et al., 2023; Yu et al., 2020). However, the recovery of food imports in China post-COVID-19 has been slow. Research indicates that during the pandemic, Chinese consumers reduced both the frequency of purchasing aquatic food and the variety of species compared to pre-pandemic times (Hu, 2020; Zhang & Liao, 2024; Zhang & Liu, 2020). This decline is largely attributed to travel restrictions and city lockdowns (Mignogna et al., 2022; Yang et al., 2022). Our secondary analysis of trade trends and pricing patterns supports these findings, revealing that both the frequency of imports and the diversity of aquatic food species declined during the pandemic period. While our study was not specifically designed to evaluate COVID-related impacts, these patterns coincide

with the period of extensive travel restrictions, city lockdowns, and cold chain regulations, suggesting a likely influence.

Additionally, the Chinese government implemented stricter regulations on food imports through cold chains from September 2020 to January 2023. All overseas manufacturers of cold chain products had to undergo coronavirus nucleic acid testing, and non-compliance could result in the suspension of food products for a week, mandatory rectification within a set timeframe, suspension of imports, or revocation of (Global Times, 2022). These stringent regulations impacted stakeholders in the aquatic food trade, limiting access to salmon export markets (Song et al., 2024). Consequently, a limited supply of salmon products contributed to rising prices (Chang et al., 2023; Cui et al., 2023; Ruan et al., 2021). Reports emerged of frozen aquatic foods, particularly salmon, testing positive for the COVID-19 in Beijing, China, which were linked to contaminated cold-chain food sources (Dai et al., 2021; Feng et al., 2021; Welling, 2020). This might explain the stagnant prices of frozen salmon. A study found that for consumers in Beijing, Tianjin, and Shanghai, food safety significantly influenced their purchase intentions during the COVID-19 period, and the recovery from perceived risks associated with consuming salmon was slow (Yu & Bai, 2021). Furthermore, the lower prices for frozen salmon could be attributed to high volumes of salmon species other than Atlantic salmon being imported, such as trout from Russia and Pacific salmon from the United States. Policymakers should recognize the importance of a robust logistics and food supply system to address unforeseen shocks effectively. An enhanced emergency response mechanism for aquatic foods is necessary. Zhang et al. (2021) suggested two essential reforms to establish a sustainable supply system for future crises in China: improving domestic regulations to ensure a resilient food supply and fostering better international cooperation to manage uncertainties. Additionally, there is a need to accelerate the improvement of e-commerce intelligence by implementing a smart traceability system (Oliveira et al., 2021) and enhancing food safety and quality management protocols. These actions could transform food supply chains from a reactive to a proactive stance, enabling real-time monitoring, control, and optimization of various relevant parameters, including ambient conditions (Hafliðason et al., 2012; Ramundo et al., 2016). The perishable nature of salmon necessitates strict control over time, temperature, and microbiological risks throughout its supply chain, presenting greater challenges for e-commerce compared to other perishable goods. The various forms of salmon – fresh, frozen, smoked, and processed – require sophisticated logistics and robust food safety measures.

The study's findings indicated that service quality and delivery significantly influence consumer satisfaction, aligning with previous research on online purchasing of fresh produce

in China (Guan et al., 2022; Hong et al., 2019; Jiang et al., 2021; Lin et al., 2016). Overall, service quality and delivery are critical factors affecting the quality of perishable goods in cold logistic chains (Verbic, 2006).

Research by Jiang et al. (2021) highlighted that within logistics service quality, personnel contact quality, timeliness, and empathy significantly affect consumer satisfaction. A previous study analysing logistics service through consumer reviews in the 'fresh food' category on JD.com found that consumers were generally dissatisfied and concerned about the indices of 'service stability,' 'integrity of goods,' and 'service cost performance' (S. Chen et al., 2023). JD.com has successfully implemented three major logistics distribution modes: self-supporting (where JD.com operates its own warehouses and distribution centres for full control), third-party (partnering with external logistics providers for extended reach and flexibility), and co-distribution (a hybrid approach combining self-supporting and third-party methods for optimized service levels). Zhang (2018) concluded that the self-supporting logistic distribution mode is most effective for reducing costs and enhancing enterprise strength, distribution quality, and information processing quality.

This study also found that the overall quality of salmon products affects consumer satisfaction. With rising living standards, consumers increasingly prioritize the quality and freshness of aquatic foods (Budhathoki et al., 2022a), and traditional delivery methods can negatively impact the freshness of salmon (Yang & Tang, 2019). This could explain why "fresh" is the most frequently mentioned attribute in consumer comments, yet buyers appear to be more satisfied with frozen salmon products from JD.com. This apparent paradox can be explained by several factors. First, frozen salmon may better withstand the logistical challenges of e-commerce, particularly in long-distance cold chains, preserving its perceived quality upon delivery. In contrast, fresh salmon is more vulnerable to fluctuations in temperature and handling delays, which may degrade its quality by the time it reaches consumers. Second, consumers may associate the term "fresh" with high, and sometimes unrealistic, expectations—anticipating fish that matches the quality and immediacy of local wet market or in-store purchases. When these expectations are unmet due to the inherent constraints of e-commerce logistics, dissatisfaction can arise. This mismatch between consumer perception and the actual condition of fresh products likely contributes to the relatively lower satisfaction levels associated with fresh salmon, despite its popularity in comment frequency. A recent survey indicated that only 4.4 % of 1,016 participants believed that the freshness of online food is significantly better than in-store options (Zheng et al., 2020). Therefore, the literature recommends capturing and monitoring data on traditional environmental conditions like temperature, as well as other factors such as humidity and

vibrations, to create a real-time assessment of salmon product quality for decision-making in cold chains, including the potential rerouting of salmon products (Chaudhuri et al., 2018).

The findings from this study revealed that JD.com PLUS members contributed more comments than non-members. JD.com introduced its PLUS membership in October 2015, offering benefits like free shipping and member-specific price discounts. Members can elevate their status by contributing content and resources, leading to JD.com's PLUS program becoming one of the largest in e-commerce, with over 30 million members. Members earn points through purchases and comments, fostering higher consumption levels, activity, and loyalty, particularly for newer product categories like salmon.

JD.com provides extensive information on salmon products, including product names, country of origin, sustainability labels, cooking suggestions, nutritional content, weight, and brand information. Consumers can also learn about brand stories, their activities in China, and their collaboration with JD.com. Prior studies have highlighted that both online (website) performance and offline (physical) fulfilment are critical to consumer satisfaction and e-loyalty (Kim et al., 2009; Semeijn et al., 2005). But the greater amount of information can overwhelm online shoppers (Gao et al., 2012).

The findings of this study indicated that the country of origin, weight, and price of salmon products did not significantly affect consumer satisfaction with buying salmon from online platforms. This is consistent with findings from Budhathoki et al. (2022a), which suggested that sustainable production practices, country of origin, and eco-labels had a limited impact on consumer behaviour toward aquatic food. The consumption of salmon, a popular luxury aquatic food among affluent Chinese consumers, is often motivated by symbolic values such as social status and networking rather than the intrinsic value of the food itself. However, consumers also enjoy the taste of salmon, despite it being quite different from the more commonly consumed aquatic food in China, such as fish varieties with milder flavours and textures (Wang & Somogyi, 2020b). This might explain why price and weight were not significantly linked to consumer salmon e-commerce satisfaction. Furthermore, the lack of impact from the country of origin may stem from diminished trust in labelling, given past mislabelling incidents in China's seafood market (Xiong et al., 2016). Many online shoppers may also overlook or deprioritize origin information, focusing more on visible reviews, delivery speed, and preservation form. Thus, while origin carries weight in traditional markets, its influence appears diluted in e-commerce, where logistical performance and service quality more directly shape consumer satisfaction. These insights are likely specific to the nature of salmon purchases on digital platforms.

5.5 Conclusion and Limitation of the Study

In conclusion, recent disruptions in trade have affected the import of salmon to China, contributing to a slow but steadily increasing recovery in food imports. Analysis using the Textblob sentiment analyser categorized nearly two-thirds of the total comments as positive, about one-fifth as negative, and 13.1 % as neutral. Additionally, LDA topic modelling identified five key topics related to salmon e-commerce: (1) Purchase decision (19.5 % of consumer comments), (2) Eating experience (22.3%), (3) Service quality and delivery (20.6 %), (4) Purchase history (17.5 %), and (5) General product quality (20 %). Among these topics, service quality and delivery had a strong and significant influence on consumer satisfaction, while purchase history had the least influence. Therefore, e-commerce platforms should prioritize enhancing service quality and delivery, focusing on aspects such as timeliness, effective communication, order accuracy, efficient delivery, flexibility, and convenience to boost salmon sales. Furthermore, factors like membership status, product type, and preservation method significantly affected consumer satisfaction when purchasing salmon online, while the country of origin, weight, and price of the product did not.

Based on these insights, it is recommended that e-commerce platforms improve their service quality and delivery standards to enhance consumer salmon e-commerce satisfaction. This should include optimizing logistics efficiency through better time management, effective communication, and precise order fulfilment. Additionally, e-commerce platforms should tailor their product offerings to emphasize positive eating experiences and ensure high product quality. Enhancing membership benefits could cater to varying consumer preferences and promote long-term customer loyalty. Ongoing monitoring of consumer feedback and collaboration with regulatory agencies to maintain strict food safety standards are also essential for sustaining consumer trust in e-commerce platforms.

However, this study has some limitations. First, data was collected solely from JD.com, which may restrict the generalizability of the findings to other salmon e-commerce platforms, such as Taobao. This study serves as a proof-of-concept to demonstrate the feasibility of combining sentiment analysis and topic modelling in salmon-related e-commerce reviews. Due to the lack of demographic or behavioural data on the underlying consumer population, the findings cannot be generalized beyond the JD.com platform. Additionally, due to the generic terminology for salmon in China's Customs data, it was not possible to compare import trends across different salmon species from various countries. This is significant, as various species, such as king salmon from Australia and sea and rainbow trout from Russia, are sold under the broad term "salmon."

Secondly, this research only analysed consumer comments from JD's self-operated salmon e-

commerce platform. Future studies could examine other aquatic species and compare them across different categories. The linear transformation employed assumes a straightforward linear relationship between sentiment polarity and satisfaction, potentially oversimplifying the complexities of sentiment expression. Future research should validate and compare different transformation methods and incorporate contextual factors to improve the accuracy and relevance of satisfaction scores derived from polarity analysis.

In terms of methodology, TextBlob, a user-friendly interface that relies on a pre-trained pattern-based classifier, was used for sentiment analysis. However, TextBlob's sentiment analysis does not account for context or sarcasm in the comments. Similarly, although LDA effectively extracted dominant themes, it assumes a bag-of-words representation that may miss nuanced or overlapping topics. Future research could adopt more context-sensitive sentiment and topic modelling tools to enhance analytical precision.

Additionally, online comments were not segmented; future studies could investigate variations in comment content across different types of comments or segments based on consumer membership levels and other relevant factors to develop tailored service management strategies. A platform-specific limitation concerns the influence of JD.com's PLUS membership program, which may introduce bias in review sentiment. Gamification features—such as loyalty points, badges, and exclusive discounts—encourage frequent reviews and may unintentionally inflate positive reviews and ratings, particularly when additional incentives are tied to detailed or 5-star reviews. However, the proportion of reviews that receive such incentives is not publicly disclosed, making it difficult to assess the exact extent of bias. Consequently, while the dataset offers a rich source of consumer opinion, the findings may reflect a more favourable sentiment distribution than would be observed on less-incentivized or open-review platforms, or in offline survey contexts.

Chapter 6 Sensory Perception and Willingness to Pay for Farmed Salmon in China

Abstract

China's growing demand for farmed salmon is apparent, with the country importing 190 thousand tonnes valued at over USD 1.12 billion in 2023. In response, the Chinese government allowed rainbow trout to be labelled and sold as salmon starting in 2018, bridging the gap between domestically produced trout and imported Atlantic salmon. This study aimed to explore how country-of-origin information influences Chinese consumers' sensory perceptions and willingness to pay (WTP) for salmon. Using a within-subject design with two evaluation rounds (blind and informed), the study combined hedonic liking where Chinese consumers rated three salmon samples (from Norway, Chile, and China) with a discrete choice experiment.

The results indicated that under the blind taste test, Chinese consumers found no significant difference in sensory preference between domestic rainbow trout and imported Atlantic salmon from Norway and Chile. However, when informed of the product origins, consumer preferences shifted in favour of Norwegian and Chilean Atlantic salmon. Furthermore, consumers' WTP for salmon was unaffected by the country of production unless provenance was disclosed, at which point the origin significantly influenced their preferences. Ecolabels, price, overall liking, education, frequency of aquatic food consumption, and prior experience with salmon were also found to impact WTP for salmon.

These insights offer valuable insights for salmon producers/importers/marketers to customize their approaches in response to consumer preferences, refine product positioning, and seize upon opportunities within the competitive salmon market in China.

Keywords: Country-of-origin; Information; Sensory evaluation; Choice experiment

6.1 Introduction

China, the largest aquatic food market in the world, has steady growth and shift towards an increased amount of imported high-value aquatic species, e.g., salmon, lobster, abalone, and sea cucumber (Crona et al., 2020; Food and Agriculture Organization, 2020; Wang & Somogyi, 2020a). However, it is essential to acknowledge the regional variations within China's aquatic food consumption landscape (Cao et al., 2015; Crona et al., 2020). For instance, coastal regions exhibit different consumption patterns compared to inland areas, potentially influenced by factors such as proximity to fishing grounds, cultural preferences, and economic development levels (Fabinyi, 2012; Meng et al., 2023). Additionally, while there is an overall increase in aquatic food consumption, it is crucial to recognize that traditional species such as tilapia and carp continue to play an important role in the Chinese diet. The demand for imported high-value species does not necessarily translate to a decrease in the consumption of traditional species but rather reflects a diversification of consumer preferences and the incorporation of more expensive species into the diet (Newton et al., 2021c).

In 2022, China imported around 199 thousand tonnes of salmon worth USD 1.4 billion to become the largest importer of salmon in the world (China Customs, 2023). Currently, Atlantic salmon is the most preferred salmon species, known for its luxury and premium quality among Chinese consumers. It is mostly consumed in social gatherings in out-of-home dining settings and as a sushi/sashimi. While some consumers prefer to buy it conveniently at groceries or e-commerce platforms. Almost all the imported Atlantic salmon are farmed and originated from Norway, Chile, the United Kingdom, the Faroe Islands, Australia, Canada, and Iceland. Among these countries, Norway holds the biggest market share and dominates the Atlantic salmon market in China. The increasing dependency on salmon led the Chinese government to allow farmed rainbow trout to be labelled and sold domestically as salmon starting in 2018, providing consumers with more options. The Chinese government argues that rainbow trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*) both belong to the Salmonidae family and share similar characteristics (Smith, 2018; Tiffany, 2018). This controversial decision aimed to offer an alternative to consumers that bridged the gap between domestically produced rainbow trout and imported farmed Atlantic salmon. Currently, China's primary salmon production is focused on rainbow trout, with approximately 37 thousand tonnes (live weight) produced in 2022 (FAO, 2024). Although attempts have been made to produce Atlantic salmon in China, the production remains minimal due to the relatively high cost of breeding and the numerous technical challenges

associated with creating a suitable environment (Godfrey, 2020c; Lu, 2022).

Extrinsic product attributes play a crucial role in shaping consumers' preferences and influential extrinsic product attributes concerning aquatic food include country-of-origin, production method, packaging, price, and brand (Budhathoki et al., 2022a; Rodriguez-Salvador & Calvo Dopico, 2023). Evidence suggests that consumers may regard the origin as the foremost extrinsic attribute when making aquatic food purchases. Consumers may have preferences for aquatic species from specific regions or countries due to factors such as perceived quality, safety standards, trust, environmental sustainability, cultural associations, and emotional sensations (Alfnes et al., 2018; Banovic et al., 2019a; Budhathoki et al., 2021b; Cantillo et al., 2020b; Rodriguez-Salvador & Calvo Dopico, 2023). Bienenfeld et al. (2016) put forward that understanding the influence of country of origin on consumer behaviour has become essential to policymakers and food marketers. Certainly, available information on the country of origin accessible to consumers has the potential to shape their expectation-forming process, thereby impacting their attitudes, which subsequently influence their sensory perceptions.

Intrinsic product attributes, particularly sensory characteristics, are crucial determinants of food liking and choice. A recent survey of first-tier cities in China shows that the most important specific motives for high-value aquatic species such as salmon are umami, deliciousness, and freshness (Wang & Somogyi, 2020a). Taste, colour, smell, texture, and juiciness are key sensory attributes determining aquatic food consumption (Budhathoki et al., 2021b; Calanche et al., 2020). However, there are notable differences between oily fish such as salmon and 'white fish' such as cod. Salmon are often preferred for their rich, umami-filled taste, tender texture, and higher fat content, which contribute to their juiciness and distinct mouthfeel. In contrast, white fish typically have a milder flavour, firmer texture, and lower fat content, making them less juicy but more suitable for those seeking a lighter, leaner fish option (Dong et al., 2022; Sveinsdóttir et al., 2010). For salmon, the sensory attribute of fattiness is often linked to its omega-3 fatty acid content. This association is significant because omega-3 content is a key factor that influences consumers' preferences and decisions when purchasing salmon (Colombo & Mazal, 2020; Kris-Etherton et al., 2002). In addition to sensory characteristics, food production standards and safety play a crucial role in Chinese consumer preferences toward aquatic food consumption (Wang et al., 2009; Wu & Zhu, 2014; Yin et al., 2022; Zheng et al., 2021). Past studies have indicated that Chinese consumers recognise European food products as high quality and safe to eat (Agriculture Trade Office, 2018; Malcorps et al., 2021).

Previous researchers have argued that research integrating intrinsic and extrinsic product

attributes captures complete and realistic information about consumers' food choices in a real-life context (Asioli et al., 2017; Köster, 2009). To date, few studies have combined sensory evaluations with a choice experiment to assess how information affects consumer liking and willingness to pay (WTP). Table 15 shows previous food studies that integrated these two methods to understand consumer food preferences. Overall, these studies indicated that available information could influence consumer sensory perceptions and WTP. However, to our knowledge, no previous studies have combined sensory evaluation and choice experiments to examine the effect of information on consumer sensory perceptions and WTP for aquatic foods. Further, combining sensory evaluations for two condition types (blind and informed) with a binding discrete choice experiment, this study will be the first of its kind to evaluate an aquatic food product. The study evaluated whether there are subjective differences in sensory attributes (taste, smell, firmness, juiciness, and fattiness) between Norwegian and Chilean Atlantic salmon and Chinese Rainbow Trout products. Further, the chapter also aims to understand how country of origin information affects consumers' sensory liking and WTP for salmon among Chinese consumers.

Table 15. Previous food studies integrated sensory and choice experiments.

Reference	Country	Research focus	Food product	Sample size, study design, digital object identifier (DOI)
Gross et al. (2021)	Germany	Information about animal welfare practices affects consumers' liking and willingness to pay for a pork product.	Pork-cooked ham products	N = 154, Blind-Expected-Informed design, Classic hedonic testing + a non-hypothetical choice experiment DOI: 10.1016/j.foodqual.2020.104055
Gallardo et al. (2018)	United States	Preferences for external and internal quality characteristics of two fresh apple varieties "Honeycrisp" and "Gala"	Fresh fruit varieties	N = 384, Hedonic testing + Experimental auctions DOI: 10.1002/agr.21534
Teuber et al. (2016)	Germany	Perceive differences between value-added whole grain bread, WTP and information influencing liking scores and WTP.	Whole grain bread	N = 131, hedonic evaluation + experimental auctions DOI: 10.1016/j.foodqual.2016.05.002
Caputo et al. (2023)	United States	Preferences and demand for meat-based, plant-based, and hybrid burgers.	Plant-based and blended meat alternatives	N = 172, hedonic evaluation (Blind – Informed), + choice experiment DOI: 10.1002/aepp.13247

Meyerding et al. (2018)	Germany	Preferences and perceptions towards beef steaks, also including experience characteristics.	Beef	N = 55, sensory acceptance test, stated WTP, and choice-based conjoint analysis. DOI: 10.1016/j.appet.2018.05.008
Bi et al. (2015)	United States	Effect of Sensory Attributes and Organic Labels on Consumers' stated preference and marginal WTP for orange juice.	Orange juice	N = 98, hedonic evaluation + discrete choice experiment, DOI: 10.1111/ijcs.12164
Hong et al. (2023)	Ireland	Preferences and WTP towards two opposing reformulation strategies (i.e., nutrient "addition" and ingredient "reduction") in processed meat.	Pork sausages	N = 326 + conjoint experiment. DOI: 10.3390/agriculture13020234
Naspetti et al. (2019)	Italy	Information about some product characteristics (organic production, zero alcohol, brand and packaging) on sensory liking and WTP of a new organic sparkling mock-wine made of pasteurised must.	Wine	N = 204 (blind + informed) + choice experiment DOI: 10.1108/BFJ-06-2019-0469
Papoutsis et al. (2021)	Greece	Consumer compromises on taste for potential health benefits from functional snacks-hedonic judgments and willingness to pay.	Functional snacks	N = 160, (Blind+Informed) + a series of non-hypothetical second-price Vickrey auction DOI: 10.1108/BFJ-10-2018-0694
Henn et al. (2023)	Denmark	Information about the health or environmental benefits of pulses on the acceptance of novel pulse-based products from chickpeas, black beans, and fava beans	Pulse-based spreads	N = 202 (Blind+Informed) + discrete choice experiment DOI: 10.1111/1750-3841.16471

Kallas et al. (2019)	Spain, Italy, Sloven ia, Croati a	WTP and hedonic evaluation towards new pig breeds (Traditional, and Innovative) in Spain, Croatia, Italy, and Slovenia	Pork	N = ~120 each country (blind+informed) + Non-Hypothetical Discrete Choice Experiment. DOI: 10.1016/j.meatsci.2019.04.011
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6.2 Conceptual Framework and Hypothesis Development

The conceptual framework was based on the food choice model proposed by (Köster, 2009), which suggests that consumers' food decisions are influenced by both intrinsic attributes (such as sensory perceptions like taste, texture, and appearance) and extrinsic attributes (such as price, eco-labels, brand, and country of origin) (Symmank, 2019). Research has shown that sensory appeal is a key factor driving food choices, particularly among Chinese consumers, for whom liking a product is often strongly linked to its sensory characteristics (Budhathoki et al., 2022; Wang et al., 2015; Xu et al., 2024).

Price represents a monetary trade-off that consumers evaluate when considering products like aquatic food (Budhathoki et al., 2022). Several previous studies have indicated that price could influence consumers' evaluation of food products and ultimately impact their willingness to pay (Boccia et al., 2024; Pandey et al., 2024; Petrescu et al., 2020; Wang & Li, 2012). For instance, Petrescu et al. (2020) found that price was an important motive to judge food product quality or purchase. Studies have found that consumers often associate higher-priced food items with better quality (Kovacs & Keresztes, 2022). However, willingness to pay is influenced by factors such as consumers' environmental awareness, and product type (e.g., organic). For instance, Hu et al. (2009) found that price consistently had a negative effect across categories, indicating that, all else equal, consumers are less likely to choose higher-priced options.

In addition, ecolabels have become increasingly important extrinsic attributes (Majer et al., 2022), particularly for sustainable food products like farmed salmon, where concerns about environmental impact are growing (Budhathoki et al., 2024). Many consumers are willing to pay a premium for eco-labelled seafood products, reflecting the increasing importance of sustainability in food choices (Alfnes et al., 2018; Bronnmann & Hoffmann, 2018; Rickertsen et al., 2017; Uchida et al., 2014; Winson et al., 2022).

Country of origin information is another significant extrinsic factor, often serving as an indicator of product quality and reputation (Budhathoki et al., 2021; Götze & Brunner, 2019; Onozaka et al., 2023; Risius et al., 2017; Verlegh & Steenkamp, 1999). Previous studies indicated that the country of origin is one of the most important attributes for aquatic food choices (Maesano et al., 2019). This is particularly relevant in the case of farmed salmon, where countries like Norway are associated with high quality and strong brand recognition (Alfnes et al., 2018). Furthermore, several previous studies have indicated that country of origin can shape sensory perceptions such as taste (Depetris Chauvin et al., 2024; Iaccarino et al., 2006; Klöckner et al., 2013; Liu et al., 2022; Thøgersen, 2023).

However, consumers vary in the extent to which they prioritize intrinsic versus extrinsic attributes in their decision-making. For example, some consumers rely more heavily on intrinsic factors, while others place greater importance on extrinsic factors (Bi et al., 2015; Didier & Lucie, 2008; Mueller & Szolnoki, 2010). The conceptual model aims to test the impact of both intrinsic and extrinsic product attributes—namely, overall liking, price, ecolabels, and country of origin—on consumer food preferences. Specifically, this chapter will examine how these factors influence consumers' likelihood of choosing domestic versus imported salmon products and whether country of origin information impacts sensory perceptions of taste, smell, firmness, juiciness, fattiness, and overall liking.

Socio-demographic and lifestyle factors such as age, gender, education, income, and aquatic food consumption habits significantly influence consumer preferences for farmed salmon. Studies have shown that older consumers, those with higher education, and individuals with higher income are more inclined to regularly consume aquatic food and prioritize quality and sustainability in their preferences (Budhathoki et al., 2022; Cantillo et al., 2021; Govzman et al., 2021; Xu et al., 2024; Zander & Feucht, 2018). Gender also plays a role, with women generally more concerned about food safety and eco-labelled aquatic food, eventually affecting their willingness to pay (Xu et al., 2012). Additionally, frequent aquatic food consumers tend to prefer familiar products like salmon, and household size or point of purchase can affect preferences for attributes such as freshness, production method, and origin (Budhathoki et al., 2021; Carlucci et al., 2015; Onozaka et al., 2023). These factors were also considered when selecting taste testers in this study to ensure a representative sample reflecting diverse consumer segments and preferences.

Based on the extant literature, this study proposes a conceptual framework (Figure 21) and develops the following hypotheses:

H1: Country of origin information impacts overall liking (an intrinsic attribute) of farmed salmon.

H2: Country of origin information positively influences consumer preference for farmed salmon.

H3: Overall liking positively influences consumer preference for farmed salmon.

H4: Price negatively influences consumer preference for farmed salmon.

H5: Ecolabels positively influence consumer preference for farmed salmon.

H6 (a-h): Sociodemographic and lifestyle factors (age, gender, household size, education, income, aquatic food consumption, point of purchase, tasted salmon before) significantly influence consumer preference for farmed salmon.

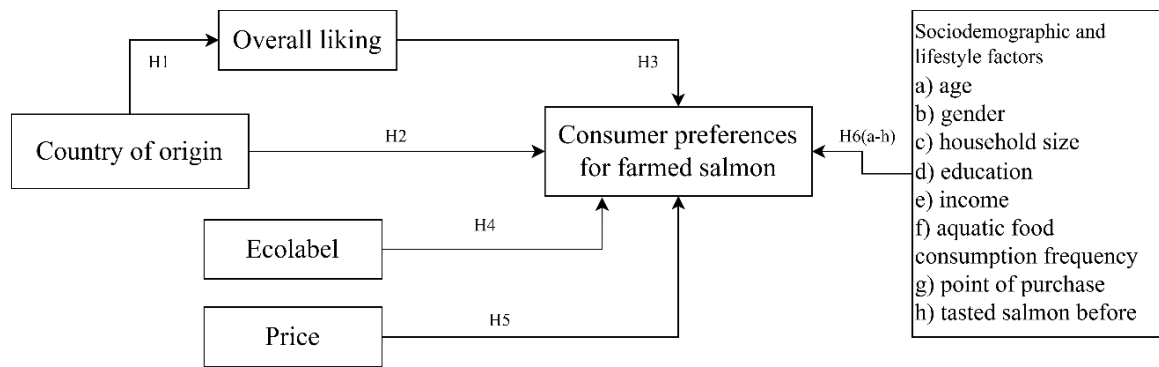


Figure 10. Conceptual framework and testing hypotheses.

6.3 Methods and Materials

6.3.1 Consumer Sample

The initial plan was to conduct consumer tastings at local food festivals to ensure a broad demographic reach and simulate real-life consumption scenarios. However, this approach proved unfeasible due to logistical and regulatory challenges. At the time of fieldwork in China, no major food festivals were scheduled, and serving food in public settings required special permits from the Chinese government—a process that could not be aligned with the fixed travel timeline of the researcher. As an alternative, consumer testing was conducted at the sensory laboratory of the College of Food Science and Technology, Shanghai Ocean University, Shanghai, China. A purposive convenience sampling strategy was employed to recruit participants, most of whom were students and staff from the college. Recruitment was carried out via posters and emails circulated within the college. A total of 110 participants completed the tasting sessions, which exceeds the recommended sample size of 90 needed to detect statistical differences in hedonic responses (Lawless & Heymann, 2010). Inclusion criteria for participating in the study include (1) participants willing to taste salmon products twice, (2) participants without any previously known history of allergies after consuming aquatic food, and (3) participants over 18 years old. Exclusion criteria include (1) participants not willing to consume salmon, (2) participants allergic to aquatic food and are less than 18 years old. Upon arrival in the laboratory, each participant was greeted, briefed, and asked to sign a written consent form. All participants received a small monetary incentive at the end of the session. The total duration of the experiment was around 20 – 30 minutes. The study was approved by the Ethics Committee of the Institute of Aquaculture, University of Stirling (Reference number, 15652).

6.3.2 Salmon Sashimi Products

In this study, sashimi salmon products were used, which were characterised by their high-quality, raw fish preparation and packaging designed for direct consumption. These products adhere to stringent standards ensuring freshness and quality suitable for raw consumption. It is important to note that sashimi-grade in our study refers to aquatic food handled under conditions suitable for raw consumption, which may include both frozen and thawed processes. While the exact freezing history of sashimi-grade salmon from the e-commerce platform is hard to verify even though they are stated as ice-fresh or frozen for raw consumption (Xiong et al., 2016). Previous research supports the use of both frozen and non-frozen thawed sashimi products (Murase, 2005). For instance, a recent study indicated that consumer preferences did not differ between frozen and non-frozen thawed sashimi under blind conditions (Watanabe et al., 2020). Similarly, sensory evaluations have shown that the quality of frozen Norwegian Atlantic salmon transported to Japan is comparable to that of chilled (Redo et al., 2024).

For our experimental samples, three commercially available sashimi-grade salmon products from each country of origin: one from Norway (farmed Atlantic salmon: ice fresh), one from Chile (farmed Atlantic salmon: frozen and thawed), and one from China (farmed Rainbow trout: frozen and thawed) were selected. The salmon products were purchased from the e-commerce platform *www.JD.com* one day before the experiment. Upon arrival, samples were stored under consistent refrigeration conditions at 2 – 4 °C and were served at room temperature during the taste testing sessions.

The tasting area was lit with red lighting to mask the colour of the salmon samples (Figure 22). The use of red lighting aimed to eliminate colour bias, which can strongly influence consumer perception of sensory attributes like taste and overall liking (Lawless & Heymann, 2010). This setup focused the participants' attention solely on the sensory qualities of the samples, such as taste, firmness, juiciness, and fattiness, without the influence of colour-based expectations. Although red lighting may differ from typical consumer settings, it provides a controlled environment to isolate the sensory evaluation from visual biases. Each sample maintained a consistent colour (warm, orangish pink) to minimize any additional variations in consumer perception. Norwegian and Chilean samples had no nutritional information, while China samples had a fat content of 17.8 g per 100 g. Samples of approximately 8 – 10 g were placed in a small container and were served with toothpicks. Between each sample tasting, participants received small pieces of cucumber and wholegrain biscuits for palate cleansing (Figure 22). Participants were asked to fill in their socio-demographic characteristics and aquatic food consumption behaviour (age, gender,

household size, education, monthly income, and aquatic food consumption frequency, point of purchase, meal context, and factors for consuming aquatic food) and were then served salmon samples. Each participant received 6 salmon sashimi samples in total: 2 from Norway, 2 from Chile, and 2 from China.

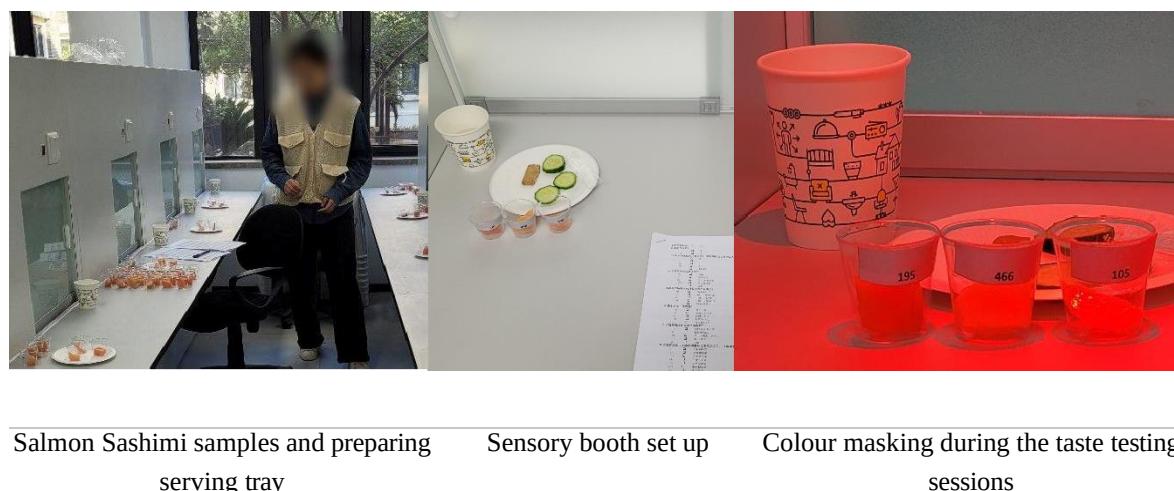


Figure 11. Illustrative set-up of salmon sashimi samples.

6.3.3 Experiment Design

Figure 23 shows the experimental protocol that included two rounds of sensory evaluation: one blind round without any country-of-origin information, followed by a second round where country-of-origin information was disclosed. In our study, participants were informed of the country of origin of each sample in the 'informed' phase, but they were not provided with specific regulatory details concerning the labelling practices for rainbow trout as salmon in China. The decision not to provide participants with additional regulatory information was based on our goal of assessing consumer preferences and sensory perceptions based on typical market conditions, as consumers typically encounter products labelled simply as 'salmon' in China.

In sensory evaluation, each sample was assigned three randomly drawn numbers, each falling within the range of 0 to 100. The serving order was counterbalanced with 6 variant arrangements and the samples were randomly served. Figure 22 shows a tray was set up with all samples and was later served by a facilitator. After tasting each sample, participants were asked to rate overall liking and liking of sensory attributes on a 7-point hedonic scale (1 = “extremely dislike” to 7 = “extremely like”) for overall liking, smell, taste, firmness, juiciness, and fattiness (see Appendix D).

In both the blind and informed tasting sessions, participants engaged in a Discrete Choice

Experiment (DCE) exercise. The attributes selected were based on key factors that are relevant to consumer decision-making for farmed salmon products. These attributes were informed by existing literature on Chinese consumer preferences for aquatic food (Budhathoki et al., 2022; Xu et al., 2024; Zheng et al., 2021). The following criteria were used to select the attributes and their levels:

Country of Origin: The countries of Norway and Chile were chosen as these represent major exporters of farmed Atlantic salmon to the Chinese market. Rainbow trout from China was selected as a third option due to the specific focus of the research question, which aims to explore consumer preferences for domestic versus imported salmon, including domestically produced rainbow trout that is marketed as “salmon” in China. This allows for a comparison between consumer perceptions of imported Atlantic salmon and domestic alternatives.

Ecolabel: The inclusion of ecolabels as an attribute reflects growing consumer awareness of sustainability and environmental issues related to aquaculture. The ecolabel attribute was varied between two levels: with and without ecolabel, to assess its impact on consumer choice.

Price: Price was included as an essential attribute reflecting market condition. The six price levels (CNY 50, CNY 75, CNY 100, CNY 125, CNY 150, and CNY 175) were based on the market price range for a 500 g salmon sashimi product on JD.com at the time of the study. The choice design used in this study is a full-profile discrete choice design, where each alternative in a choice set is described by a combination of attribute levels. A full factorial design to explore all possible combinations of attribute levels results in 36 unique choice profiles ($3 \text{ countries} \times 2 \text{ ecolabels} \times 6 \text{ prices}$). To reduce the cognitive load on participants, 36 choice questions were divided into 2 blocks, with each block containing 6 sets of 3 choice questions. Participants were randomly assigned to one of the two blocks, and within each block, the order of the alternatives was randomized to mitigate potential ordering effects. The choice sets presented to participants included a "no-buy" option, allowing them to opt out of purchasing any of the salmon alternatives if they preferred not to buy (Appendix D).

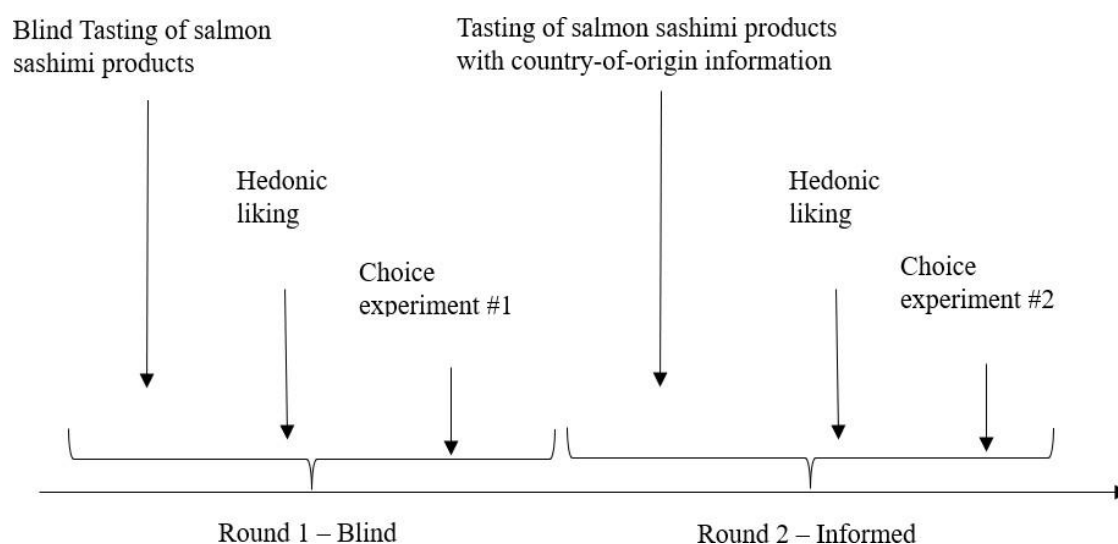


Figure 23. Study design for determining sensory perception and willingness to pay for sashimi products.

6.3.4 Choice Model

In this study, the Multinomial Logit (MNL) model was employed to analyse consumer preferences for salmon products. The MNL model is widely used in choice modelling due to its ability to provide interpretable results, making it a suitable tool for examining preferences among multiple alternatives with discrete outcomes. Our decision to use the MNL model was based on the relatively homogeneous characteristics of our sample, which included similar age, education, income, and consumption habits. Given this homogeneity, the assumption of uniform consumer preferences to be reasonable was considered. While the MNL model assumes homogeneity in consumer preferences, it remains an effective tool for analysing choice behaviour in contexts where variability within the sample is limited. The MNL model is well-established in fields such as economics, transportation, and marketing (Feng et al., 2022) and is based on the theory of random utility, which assumes that individuals make choices by maximizing their utility (McFadden and Zarembka, 1974). By modelling utility maximization behaviour, the MNL model provides a robust framework for evaluating consumer decision-making processes, making it particularly relevant in studies of food product preferences. In the MNL model, the systematic and random parts of utility can be expressed mathematically as follows:

Equation 3

$$U_{ij} = \beta V_{ij} + e_{ij}$$

In equation 3, U_{ij} is the total utility of alternative j for individual i , βV_{ij} is the systematic part of utility that represents the characteristics of the alternative, and e_{ij} is the random part of utility that represents random variation in individual preferences.

The utility model includes origin, ecolabel, and price as primary attributes directly manipulated in the choice experiment, as these factors are essential in consumer decision-making for farmed salmon products. Additionally, overall liking and the informed condition are included to account for intrinsic preferences and contextual effects that realistically influence consumer choices. Overall liking reflects consumers' sensory satisfaction, which might impact utility even though it was not a direct attribute in the choice experiment. The informed condition captures the effect of providing country-of-origin information, enabling the model to examine how consumer preferences shift with added information about product provenance. Thus, in Equation 3, the systematic part of utility was structured as follows:

Equation 4

$$\begin{aligned} V_{ij} = & \beta_1(\text{Origin})_{ij} + \beta_2(\text{Ecolabel})_{ij} + \beta_3(\text{Price})_{ij} + \beta_4(\text{Overall liking})_{ij} \\ & + \beta_5(\text{Informed condition})_{ij} + \beta_6(\text{Age})_{ij} + \beta_7(\text{Gender})_{ij} \\ & + \beta_8(\text{Household size})_{ij} + \beta_9(\text{Education})_{ij} + \beta_{10}(\text{Income})_{ij} \\ & + \beta_{11}(\text{Aquatic food consumption frequency})_{ij} + \beta_{12}(\text{Point of purchase})_{ij} \\ & + \beta_{13}(\text{Tasted salmon before})_{ij} \end{aligned}$$

Where, β_1 represents the coefficient for origin (for Norway, Chile, or China), β_2 represents the coefficient for ecolabel, β_3 represents the coefficient for the price, β_4 represents the coefficient for overall liking, β_5 represents the coefficient for informed condition, and β_6 through β_{13} represent the coefficients for sociodemographic and lifestyle factors, such as age, gender, household size, education, income, aquatic food consumption, point of purchase, and whether the individual has tasted salmon before.

Furthermore, the probability of each alternative j for a given observation n based on the values of the predictor variables $X_{n,k}$ and their associated coefficients β_k in the context of MNL (McFadden & Train, 2000) can be expressed mathematically as follows:

Equation 5

$$P_{n,j} = \frac{e^{\sum_{k=1}^K \beta_k X_{n,j,k}}}{\sum_{j=1}^J e^{\sum_{k=1}^K \beta_k X_{n,j,k}}}$$

In equation 5, $P_{n,j}$ represents the probability of alternatives j for observation n , $X_{n,j,k}$

represents the value of predictor variable k for observation n and alternatives j , β_k represents the coefficient associated with predictor variable k , K represents the total number of predictor variables, and J represents the total number of alternatives.

After the estimation of the multinomial logit model, the coefficients were used to calculate the willingness to pay for each type of salmon through the Delta method (Daly et al., 2012). Assuming that an individual has a binary choice situation (e.g., to either buy or not to buy), the willingness to pay for a particular attribute can be calculated using the following mathematical formula:

Equation 6

$$WTP_{\text{attribute } k} = -\frac{\beta_{\text{attribute } k}}{\beta_{\text{attribute price}}} \text{ with } SE_{WTP_k} \text{ and } p \text{ value}$$

Where, $\beta_{\text{attribute } k}$ is the coefficient for the attribute k , $\beta_{\text{attribute price}}$ is the coefficient for the price, SE_{WTP_k} is the standard error for WTP (calculated using the propagation formula, and $p \text{ value}$ is the significance level of the WTP estimate.

In terms of implementation, alternative specific constants (ASCs) were included for three of the four product alternatives, with the fourth serving as the reference category. All sociodemographic and behavioural control variables—including age, gender, household size, education, income, seafood consumption frequency, and previous tasting experience—were introduced as individual-level covariates. Ordinal variables such as education, income, and consumption frequency were treated as continuous predictors under the assumption of monotonic effects on utility. This approach aligns with common practice in discrete choice modelling, allowing for more parsimonious estimation and reducing the risk of multicollinearity (Train, 2009). Binary variables were dummy coded (e.g., gender: male = 1, female = 0), and product-level attributes such as origin, ecolabel, and price were alternative-specific. The price variable was log-transformed to capture diminishing marginal utility. Including these control variables allows us to capture the influence of individual characteristics and prior experiences on utility, thus improving model fit and interpretability by accounting for sources of systematic variation in preferences. A detailed description of all variables, their types, and coding schemes is provided in Appendix (Table E.1.) Full estimation procedures are outlined in Appendix E.

6.3.5 Data Preparation and Analysis

Initially, the collected data was entered and organised in Excel and analyses were performed in RStudio for Windows 1.4.1103 (RStudio Team, 2024). Several R packages were employed, each chosen for its specific functionality in addressing the needs of the study. The *ImerTest* package (Kuznetsova et al., 2017) was used to perform significance testing for mixed-effects models, which assess both fixed and random effects in our data. This was crucial given that the study design included both fixed factors (e.g., product attributes) and random factors (e.g., individual differences). The *emmeans* package (Lenth, 2022) was used to estimate and compare marginal means for the sensory attributes (smell, taste, firmness, juiciness and fattiness) of the sashimi samples under two conditions: blind and informed tasting. To evaluate the relative importance of sensory traits for overall liking, *relaimpo* package was utilised (Grömping, 2007) to determine which sensory attributes (e.g., taste, texture, smell) had the greatest impact on consumer sensory perceptions. The *Apollo* package (Hess & Palma, 2019) was employed to estimate a multinomial logit (MNL) model, a method commonly used in discrete choice experiments for analysing consumer choice data. The *Apollo* package was specifically selected due to its flexibility in handling complex choice models and its efficiency in managing large datasets.

Descriptive analysis was conducted for socio-demographic characteristics, and aquatic food consumption behaviour/habits. Data were presented in mean (standard deviation) for continuous variables and percentage (number) for categorical variables. Hedonic liking data was analysed employing a linear mixed model through the *lm()* – a function of the *lme4* package. The model comprised “samples” (Atlantic salmon from Norway versus Atlantic salmon from Chile versus Rainbow Trout from China), “condition types” (blind versus informed), and their “interaction effect” (salmon samples versus condition types). In the model, consumers were entered as a random effect, while fixed factors considered were age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase and previously tasted salmon. Overall liking, and sensory attributes (smell, taste, firmness, juiciness and fattiness) were coded as dependent variables. *F*-statistics with Satterthwaite approximations for a denominator of freedom was used to determine the effects of categorical fixed factors. Further, the relative importance analysis for determining the contributions of smell, taste, firmness, juiciness, and fattiness to overall liking was determined. The multicollinearity between the considered sensory attributes was determined through the variance inflation factors (VIF). Estimated marginal means (*emmeans*) were estimated using Tukey adjustment to see how samples and conditions interacted.

The choice experiment data was formatted in “wide” format, with one row per observation, before applying the MNL model in the preference space through a five-step procedure as *initialization > data > model parameters > model definition > estimation and model output* in the Apollo package. The model included an alternative-specific constant (ASC) to account for baseline utility differences across the salmon alternatives, adjusting for unobserved factors affecting consumer preferences. Using a Revealed Preferences (RP) and Stated Preferences (SP) approach, the model settings defined unique individual IDs and output parameters, followed by loading and processing the dataset. Initial parameter estimates included ASCs and attribute coefficients for attributes such as country of origin, ecolabel, price, and overall liking. The RP and SP segments were defined separately within the model: the RP segment represented choices made without country-of-origin information, while the SP segment reflected choices made when this information was disclosed. The RP utilities were scaled by a *mu_blind* parameter and SP utilities by *mu_informed*, indicating preference differences depending on origin information. In the model, the price variable was log-transformed to account for the non-linear relationship between price and consumer preferences. The natural logarithm of price was used to model diminishing marginal utility for price increases. This transformation helps stabilize model estimates and ensures that the effect of price on consumer utility diminishes as the price level increases. The price variable was log-transformed to account for the non-linear relationship between price and consumer preferences. The natural logarithm of price was used to model diminishing marginal utility for price increases. This transformation helps stabilize model estimates and ensures that the effect of price on consumer utility diminishes as the price level increases. The log-transformed price was included as a key attribute in the model, and its coefficient was interpreted as the percentage change in utility associated with a percentage change in price. The models were then combined, with panel data handling incorporated to account for multiple observations per individual. The final estimation step used all inputs and defined probabilities. The model was estimated using Bierens-Green-Williams algorithm (Bunch et al., 1993).

The MNL model coefficients in the preference space were subsequently used as priors for MNL estimates in the willingness-to-pay (WTP) space through the *apollo_deltaMethod* function. WTP values were derived by converting MNL model coefficients into WTP values, with the price attribute as the numeraire in the WTP-space model. The Delta method results provide estimated WTP coefficients based on price changes for different salmon origins, reflecting the amount consumers are willing to pay for each attribute and the impact of price changes on preferences for Norwegian and Chilean Atlantic salmon and Chinese rainbow.

The R script used for model estimation is provided in Appendix E. In the model, categorical variables were dummy coded with one level omitted as the reference category. For example, in the case of country of origin, 'domestic' served as the reference. Income, education, and consumption frequency were treated as continuous variables under the assumption of monotonic effects on utility, whereas binary variables such as gender and previous tasting experience were coded as 0/1. All coding decisions and reference categories are detailed in Appendix E (Table E.1).

6.4 Results

6.4.1 Socio-demographic Characteristics

Table 16 presents the socio-demographic characteristics of the participants. The results show that a total of 110 individuals took part in the taste-testing session. The majority of the participants were females (59.1 %) aged 25 years or younger, possessing a level of monthly income between CNY 3,001 and CNY 6,000, and holding educational qualifications at the level of Master and above. Regarding the aquatic food consumption frequency, 40.9 % of participants consume aquatic food 1–4 times per week. The preferred point of purchasing seafood is seafood market/speciality shops (43.6 %), followed by restaurants/takeaways (33.6 %), supermarket/discount stores (13.6 %), and e-commerce platforms (7.3 %). Further, the majority of the participants prefer to eat seafood at dinner as a cold dish (41.8 %). Participants consider health and nutrition (76.4 %), sensory appeal (66.4 %), quality (37.3 %), food safety (36.4 %), and price (30.9 %) as the top five important factors for consuming seafood. The majority of the participants had previously consumed salmon (70 %).

Table 16. Socio-demographic characteristics of the participants, N = 110.

Sociodemographic characteristics	Categories	Percent (n)
Age, y, mean $\pm$ SD		24 $\pm$ 2
Gender, % (n)	Male Female	40.9(45) 59.1(65)
Household size, % (n)	2 3 4 or more	20(22) 29.1(32) 50.9(56)
Education	High school degree Bachelor degree Masters and above	1.8(2) 25.5(28) 72.7(80)
Income (monthly)	¥ 3,000 and less ¥ 3,001 – 6,000 ¥ 6,001 – 9,000 ¥ 9,001 – 12,000 ¥ 12,001 and above	17.3(19) 33.6(37) 23.6(26) 17.3(19) 8.2(9)

Aquatic food consumption frequency	Rarely Less than once per week 1 – 2 times per week 3 – 4 times per week More than 4 times per week	17.3(19) 33.6(37) 23.6(26) 17.3(19) 8.2(9)
Preferred Point of Purchase	Aquatic food market/Speciality stores Supermarket/discount stores Online (Taobao, JD.com) Restaurants/Takeaway Others	43.6(48) 13.6(15) 7.3(8) 33.6(37) 1.8(2)
Preferred meal contextS	Breakfast and cold dish Breakfast and hot dish Lunch and cold dish Lunch and hot dish Snack and cold dish Snack and hot dish Dinner and cold dish Dinner and hot dish	5.5(6) 2.7(3) 30.9(34) 30.9(34) 34.5(38) 12.7(14) 41.8(46) 30(33)
Important factor for consuming aquatic food ^M	Health and nutrition Food safety Sensory appeal (Taste, Colour, etc) Price Quality (freshness, naturalness) Country of origin Production method (capture, farmed) Sustainability profile (better for climate change) Animal welfare (better for fish health and wellbeing)	76.4(84) 36.4(40) 66.4(73) 30.9(34) 37.3(41) 12.7(14) 8.2(9) 3.6(4) 1.8(2)
Have you ever consumed salmon before?	Yes No	70(77) 30(33)

^MMultiple-response options, SD represents Standard deviation, % represents a percentage, n represents a number, and CNY represents Chinese Yuan.

6.4.2 Blind and Informed Tasting Sessions

Table 17 displays the estimated marginal means ($\pm$ standard error) for consumer preferences regarding sensory attributes and overall liking of salmon from Norway, Chile, and China under both blind and informed tasting conditions. The findings showed that when consumers received information about the provenance of Norwegian Atlantic salmon, their appreciation for sensory attributes – such as taste, firmness, juiciness, and fattiness – as well as their overall liking significantly increased. Additionally, the sensory attribute of ‘taste’ and overall liking for Chilean Atlantic salmon also saw a significant rise ($p < 0.05$) when consumers were informed about its country of origin. In contrast, no significant changes in sensory attributes or overall liking were observed for Chinese trout salmon.

Table 3. Estimated marginal means ($\pm$ standard error) and the difference in consumer liking scores for sashimi under blind and informed conditions.^{ab}

Sashimi sample	Sensory Attributes	Type		Difference	p-value
		Blind	Informed		
Norway	Smell	4.49 $\pm$ 0.24	4.73 $\pm$ 0.24	0.236	0.144
	Taste	4.74$\pm$0.27	5.14$\pm$0.27	0.391	0.036
	Firmness	4.93$\pm$0.28	5.31$\pm$0.28	0.381	0.032
	Juiciness	4.86$\pm$0.28	5.40$\pm$0.28	0.545	0.001
	Fattiness	5.21$\pm$0.27	5.61$\pm$0.27	0.400	0.026
	Overall liking	4.90$\pm$0.26	5.43$\pm$0.26	0.527	0.002
Chile	Smell	4.18 $\pm$ 0.24	4.33 $\pm$ 0.24	0.145	0.368
	Taste	3.96$\pm$0.27	4.40$\pm$0.27	0.436	0.019
	Firmness	4.49 $\pm$ 0.28	4.45 $\pm$ 0.28	-0.045	0.799
	Juiciness	4.60 $\pm$ 0.28	4.84 $\pm$ 0.28	0.236	0.176
	Fattiness	4.66 $\pm$ 0.27	4.76 $\pm$ 0.27	0.100	0.578
	Overall liking	4.28$\pm$0.26	4.79$\pm$0.26	0.518	0.003
China	Smell	4.24 $\pm$ 0.24	4.36 $\pm$ 0.24	0.118	0.464
	Taste	4.24 $\pm$ 0.27	4.38 $\pm$ 0.27	0.145	0.436
	Firmness	4.77 $\pm$ 0.28	4.62 $\pm$ 0.28	-0.154	0.386
	Juiciness	5.02 $\pm$ 0.28	4.90 $\pm$ 0.28	-0.118	0.499
	Fattiness	4.86 $\pm$ 0.27	4.80 $\pm$ 0.27	-0.054	0.761
	Overall liking	4.61 $\pm$ 0.26	4.84 $\pm$ 0.26	-0.227	0.192

^aData gathered from 110 untrained consumers. ^bFixed factors considered were age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase and previously tasted salmon, and consumers as random factors. Degrees-of-freedom method: kenward-roger. Bold numbers represent significant differences.

6.4.3 Contributions of Sensory Traits to Overall Liking

Table 18 outlines the contributions of various sensory traits to overall liking. The findings reveal that taste had the largest impact at 34.48 %, followed by fattiness at 20.29 %, juiciness at 19.56 %, smell at 18.07 %, and firmness at 6.58 %, resulting in a total R^2 of 41.52 %. The variance inflation factors (VIF) for the variables are all below 3.3, indicating no multicollinearity and confirming the reliability of the contributions to overall liking for these sensory traits.

Table 18. Relative Important sensory attribute for overall liking.

Sensory attribute	Relative importance percentage	95% lower confidence interval	95% upper confidence interval	VIF
Smell	19.58	0.129	0.258	2.005
Taste	34.49	0.380	0.527	2.476
Firmness	16.31	0.081	0.212	2.485
Juiciness	13.31	-0.040	0.103	2.829
Fattiness	16.31	0.085	0.223	2.862

R^2 represents 71.22%, VIF represents the Variance Inflation Factor

6.4.4 Impact of the Country-of-Origin Information on the Overall Liking Score

Table 19 showed that the overall liking score was significantly influenced by whether participants had previously tasted salmon ($F(1, 627) = 11.071$; $p = 0.000$), the type of sample ($F(2, 627) = 7.199$; $p = 0.000$), and the condition type ($F(1, 627) = 6.009$; $p = 0.014$). Additionally, post hoc analysis results (Table 19) indicated that the estimated marginal mean ($\pm$ standard error) for the overall liking score of Chinese trout salmon was higher than that of Chilean Atlantic salmon ($\Delta = 0.609 \pm 0.236$, $p = 0.027$) but lower than that of Norwegian Atlantic salmon sashimi ($\Delta = 0.018 \pm 0.236$, $p = 0.996$) in the blind condition. In this condition, Norwegian Atlantic salmon had a significantly higher overall liking score compared to Chilean Atlantic salmon ($\Delta = 0.627 \pm 0.236$, $p = 0.021$).

Table 19. Mixed effect model of overall liking.

Factors	Overall Liking Score			
	<i>F</i>	<i>Df1</i>	<i>Df2</i>	<i>p-value</i>
Age	1.153	9	191	0.327
Gender	0.498	1	191	0.480
Household size	0.631	2	191	0.532
Education	3.883	2	191	0.022*
Income	1.023	4	191	0.396
Point of purchase	1.639	4	191	0.166
Seafood consumption frequency	1.552	3	191	0.202
Tasted salmon before	9.604	1	191	0.002**
Sashimi Samples	14.684	2	436	0.000***
Condition types	16.028	1	191	0.000***

Fixed effect = age, gender, household size, education, income, seafood consumption frequency, point of purchase and previously tasted salmon, consumers as a random factor.

In the informed condition (Table 20), the overall liking score for Chinese trout salmon was not significantly different from that of Chilean Atlantic salmon ($\Delta = 0.045 \pm 0.236$, $p = 0.979$). However, both Chilean Atlantic salmon ($\Delta = 0.636 \pm 0.236$, $p = 0.019$) and Chinese trout salmon ($\Delta = 0.590 \pm 0.236$, $p = 0.033$) were significantly different from the Norwegian

Atlantic salmon sample.

Table 20. Impact of country-of-origin information on overall liking score.^{abdc}.

Condition types	Sashimi Sample	Estimates	Standard error	Df	t ratio	p-value
Blind	Chile – China	-0.336	0.169	436	-1.989	0.116
	Chile – Norway	-0.627	0.169	436	-3.709	0.000
	China – Norway	-0.018	0.169	436	-1.720	0.198
Informed	Chile – China	-0.045	0.169	436	-0.269	0.961
	Chile – Norway	-0.636	0.169	436	-3.763	0.000
	China – Norway	-0.590	0.169	436	-3.494	0.001

^a determined through post hoc comparison with Tukey adjustment, ^b dependent variable is the overall liking score, ^c fixed factors in the model were age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase and previously tasted salmon, ^d random factor in the model was consumer. Df represents degrees of freedom. Bold numbers represent significant differences.

6.4.5 Choice Experiments

The goodness-of-fit statistics for the Multinomial Logit (MNL) model suggest a reasonable fit (Table 21). The Pseudo R^2 value of 0.153 indicates a moderate level of explanatory power, while the Adjusted R^2 of 0.144 accounts for the number of predictors in the model. The log-likelihood value of -1523.85, the Akaike Information Criterion (AIC) of 3081.7, and the Bayesian Information Criterion (BIC) of 3169.52 provide additional metrics for evaluating the model's fit and relative quality, with lower values suggesting a better fit (Vrieze, 2012). Although the model reveals significant predictors such as ecolabel, price, overall liking, and sociodemographic and lifestyle factors, it explains a moderate proportion of the variation in preferences, as indicated by the Pseudo R^2 .

Based on the MNL model parameter estimates (Table 21) consumers' preferences for salmon reveal several key insights. The alternative-specific constants (ASC) for alternatives 2 and 3 are not statistically significant, with p -values of 0.06 and 0.07, respectively, suggesting that these alternatives do not stand out to consumers in any significant way based on unobserved factors. The result indicated that the country of production did not impact consumer utility unless consumers were informed about the provenance. This suggests that country-of-origin information plays a role in shaping consumer preferences when it is available, supporting H2: consumer preference for farmed salmon is positively influenced by country-of-origin information when disclosed. Additionally, the results show that overall liking of the salmon was associated with higher utility, meaning consumers derived greater satisfaction from products they rated more favourably. This confirms H3, as overall liking positively

influences consumer preference for farmed salmon. Conversely, as the price of salmon products increased, the level of consumer utility decreased, indicating a negative relationship between price and consumer preference. Therefore, H4 is supported. Further, product eco-labels had a positive impact on utility, suggesting that consumers are willing to pay a premium for salmon produced to international certification standards. This supports H5, as eco-labels positively influence consumer preference for farmed salmon. Education and aquatic food consumption frequency also significantly influence preferences, with education having a positive effect and frequent seafood consumption having a negative effect, supporting hypotheses H6 d and f. Tasted salmon before has a significant negative impact, indicating that those who have previously tasted salmon are less likely to choose it, supporting H6h. Other factors such as age, gender, household size, income, and point of purchase were not statistically significant, rejecting hypotheses H6a, b, c, e, and g.

Table 21. The results of the multinomial logit (MNL) model estimate of consumers' salmon preferences.

Attributes and model details	Multinomial logit model			
	Coefficient	Standard Error	t-ratio	p-value
ASC (alternative 1)	Reference			
ASC (alternative 2)	0.096	0.060	1.6	0.06
ASC (alternative 3)	-0.105	0.070	-1.5	0.07
Norway Atlantic salmon	1.158	1.576	0.7	0.23
Chile Atlantic salmon	1.159	1.576	0.7	0.23
China trout salmon	1.465	1.586	0.9	0.18
Ecolabel	0.355	0.077	4.6	0.000***
Price	-0.485	0.114	-4.3	0.000***
Overall liking	0.293	0.043	6.7	0.000***
Informed about country of origin	1.597	0.223	7.2	0.000***
Age	0.034	0.084	0.4	0.34
Gender	0.082	0.462	0.2	0.43
Household size	0.124	0.298	0.4	0.34
Education	0.496	0.296	1.7	0.05*
Income	-0.023	0.271	-0.1	0.47
Aquatic food consumption frequency	-0.434	0.251	-1.7	0.04*
Point of purchase	-0.046	0.149	-0.3	0.38
Tasted salmon before	-1.122	0.327	-3.4	0.000***
Observations				
Pseudo R ²		0.153		
Adjusted R ²		0.144		
Log-likelihood		-1523.85		
Akaike Information Criterion		3081.7		
Bayesian Information Criterion		3169.52		

* $p < 0.05$, *** $p < 0.001$, bold numbers represent statistically significant.

The WTP estimates from Table 22 provide significant insights into consumer preferences for salmon. Importantly, there are no significant differences in WTP across countries of origin, as indicated by the estimates for Norway, Chile, and China ($p > 0.05$). This finding challenges the expectation that imported Atlantic salmon would command a price premium over domestic trout salmon, suggesting that the country of production alone does not justify higher consumer spending when sensory attributes and other factors are considered. However, the presence of ecolabel (WTP = 0.731) is influenced by their overall liking of the product (WTP = 0.603). Education also has a positive effect on WTP (1.023), with more educated consumers willing to pay higher prices. However, the result for being informed about the country of origin is particularly notable, as it significantly reduces WTP (-3.291), contradicting the hypothesis that country-of-origin information would enhance consumer preferences (H2). This suggests that consumers may have negative associations with certain countries when informed about the origin, rather than being positively influenced by the disclosure. Consumers who have tasted salmon before also show a lower WTP (-2.312), indicating that prior experience with salmon results in a lower willingness to pay a premium for salmon. Demographic factors, such as age, gender, household size, and income, do not significantly influence WTP, and factors like point of purchase show no significant impact. Frequent aquatic food consumption negatively affects WTP (-0.894), suggesting that regular aquatic food consumers are less willing to pay a premium price for salmon.

Table 22. Willingness-to-Pay (WTP) estimates for consumer preferences related to salmon.

Factors	WTP	Standard Error	p-value
ASC (alternative 1)	Reference		
ASC (alternative 2)	0.096	0.060	0.06
ASC (alternative 3)	-0.105	0.070	0.07
Norway Atlantic salmon	2.386	2.627	0.359
Chile Atlantic salmon	2.389	2.631	0.359
China trout salmon	3.019	2.650	0.247
Ecolabel	0.731	0.166	0.000***
Overall liking	0.603	0.106	0.000***
Informed about country of origin	-3.291	0.599	0.000***
Age	0.069	0.085	0.414
Gender	0.169	0.385	0.660
Household size	0.256	0.249	0.298
Education	1.023	0.356	0.001**
Income	-0.047	0.177	0.788
Aquatic food consumption frequency	-0.894	0.264	0.000***
Point of purchase	-0.094	0.134	0.480
Tasted salmon before	-2.312	0.580	0.000***

****** $p < 0.01$, ******* $p < 0.001$, bold numbers represent statistically significant.

6.5 Discussion and Strategic Implications

The result of the study shows that country of origin significantly affects consumer preferences in the Chinese salmon market. In a blind taste test, Chinese consumers did not perceive a significant quality difference between domestic rainbow trout and imported Atlantic salmon from Norway and Chile. Interestingly, they preferred domestic rainbow trout over Chilean Atlantic salmon. However, informing consumers of the origin significantly shifted their preference toward Norwegian and Chilean Atlantic salmon. This shift can be partly explained by the prevailing perception in China that imported food, particularly from developed countries, undergoes stricter quality control, traceability, and inspection processes. Historical food safety scandals in China—such as melamine in milk powder (Li et al., 2019) and counterfeit meat incidents (Niu et al., 2024)—have made consumers more cautious and inclined to trust foreign-sourced foods. Thus, when the provenance was revealed, Norwegian and Chilean salmon may have been viewed as safer or more premium choices, even though sensory differences were not readily perceived in the blind condition. This suggests that country of origin information influences Chinese consumers' perceptions of salmon sensory quality. These findings are consistent with previous literature that emphasizes the importance of provenance in consumer food choices (Boncinelli et al., 2018; Cantillo et al., 2020; Rodriguez-Salvador & Calvo Dopico, 2023; Sigurdsson et al., 2020).

Interestingly, while the country of production did not enhance WTP overall, the disclosure of country-of-origin information led to a notable reduction in WTP in certain cases, contrary to the hypothesis that it would enhance consumer preferences (H2). This unexpected outcome suggests that consumers may harbour negative associations or scepticism about specific origins, likely influenced by food safety concerns or cultural biases. Although Norwegian and Chilean Atlantic salmon benefit from reputations for high quality, reinforced by origin information, domestic rainbow trout faced challenges in achieving similar perceptions. These findings highlight a critical trust gap in domestically produced salmon, highlighting the importance of building consumer confidence through certifications and effective communication about quality and safety.

The lack of significant differences in WTP between Norwegian and Chilean Atlantic salmon and domestic trout further complicates the narrative. While prior assumptions might expect higher WTP for imported products due to their perceived quality, this result suggests that Chinese consumers do not assign a monetary premium based solely on origin when other factors, such as sensory attributes, are comparable. This finding emphasizes the need for domestic producers to focus on competitive differentiation through sustainability certifications or traceability systems to compete effectively with imported salmon.

The stronger preference for Norwegian and Chilean Atlantic salmon in the informed condition can be partially explained by the familiarity and positive associations Chinese consumers have with these countries. Norwegian Atlantic salmon has enjoyed longstanding popularity in sushi and sashimi dishes in Japan and has successfully penetrated the Chinese market (Norwegian Seafood Council, 2022). In contrast, the practice of eating raw fish originated in southern China before 200 C.E., with dishes like “Shunde-style sashimi”, but trout—often sold as salmon in China—is not widely consumed across the country. This limited familiarity may contribute to consumers being less discerning about the sensory quality of salmon products (Newman, 2004). Consumers' evaluation of food products is influenced by their familiarity with the items. Maheswaran (1994) found that when consumers are not familiar with a country's product, they use the country's image as a “halo effect” for evaluating the products.

The proximity of production to consumers may partly explain why Chinese rainbow trout was equally liked as Norwegian Atlantic salmon in the blind test. Shorter transportation distances can help maintain product freshness, a critical factor in quality perception (Carlucci et al., 2015). Additionally, in the absence of contextual cues like country of origin, consumers likely relied solely on intrinsic sensory attributes such as taste and texture—areas where domestic trout performed comparably. However, China's relatively recent experience with farming rainbow trout, compared to traditional species like tilapia or carp, means that consumer familiarity and confidence in this product are still developing. Once country-of-origin information was revealed, consumer judgments appeared to shift from purely sensory to more perception-driven evaluations. Pre-existing biases or heuristics—such as the belief that Norwegian salmon is of higher quality due to its international reputation and stringent regulation—overrode their initial impressions (Monaco et al., 2024). This indicates that consumer perception of quality is not just shaped by taste but is strongly influenced by trust, familiarity, and branding. To compete more effectively, domestic producers should aim to strengthen consumer trust by emphasizing third-party certifications, sustainability practices, and transparent traceability—attributes increasingly appreciated by Chinese consumers (Xu et al., 2024; Xu et al., 2012; Yin et al., 2022; Zhang et al., 2020).

The study also highlights the persistent issue of food fraud in China, where consumers are increasingly sceptical about the authenticity of domestically produced food. In this context, transparency regarding origin and the use of certification labels may help alleviate consumer concerns and build trust. As suggested by Kendall et al. (2018), the inclusion of authenticity cues—such as traceability information or certification labels—can enhance consumer trust in food safety and quality.

The study indicated that consumers' overall liking of salmon significantly influences their utility, with sensory attributes such as taste, colour, and appearance being crucial factors in their purchasing decisions, and these findings are consistent with previous studies (Dang, 2010; Wang, De Steur, et al., 2015). Marketers targeting the Chinese market should focus on sensory-related strategies, such as promoting the darker red colour of salmon, which has been shown to increase consumer willingness to pay (Zheng et al., 2021). Organizing taste-testing events at various retail locations, including grocery stores, farmers' markets, or food festivals, enables consumers to try the salmon to determine sensory appeal and increase familiarity.

In addition to the key factors such as ecolabels, price, and overall liking, the analysis revealed that education positively influences consumer preferences, suggesting that more educated consumers may place greater value on attributes like product quality or sustainability. Frequent seafood consumption and prior experience with salmon, however, were associated with lower preferences, potentially indicating a saturation effect or unmet expectations from past experiences. Conversely, most demographic factors such as age, gender, and income showed no significant impact, except for education, which had a positive and significant effect on consumer preferences. This highlights the need to tailor marketing strategies based on lifestyle, sensory attributes, and educational levels to better resonate with consumers.

In sum, these findings add new insights into Chinese consumer preferences for aquatic food, showing that provenance information can significantly shift preferences toward imported salmon, despite similar sensory qualities between domestic and international products. It highlights that Chinese consumers tend to prioritize food safety and trust in product origin, suggesting that domestic products can gain favour if these concerns are addressed. The study emphasizes the importance of certification and transparent supply chains in building consumer trust, recommending that the Chinese aquaculture industry promote the safety, traceability, and quality of local products.

6.5.1 Strengths and Limitations of the Study

This study makes a novel contribution by integrating sensory evaluation with a hypothetical choice experiment to assess Chinese consumer preferences for salmon, focusing particularly on the influence of country-of-origin information. By linking sensory liking data with discrete choice behaviour, it advances our understanding of how extrinsic cues and intrinsic quality perceptions interact in shaping consumer decision-making.

One strength of the study lies in the use of a joint revealed preference (RP) and stated preference (SP) multinomial logit (MNL) model, which allowed for the evaluation of

consumer choices in both blind and informed conditions. The model incorporated a range of product attributes—origin, ecolabel, price, and liking—as well as sociodemographic and behavioural covariates. This structure provided a robust framework to evaluate the effect of contextual information on consumer utility. The Apollo package in R enabled the flexible estimation of RP and SP scale parameters, and the use of a log-transformed price variable captured diminishing marginal disutility, improving model interpretability.

Nevertheless, there are several limitations. First, although the choice experiment included a real sensory tasting component, the choice task itself was hypothetical. This introduces the potential for hypothetical bias, where consumers stated preferences may not reflect actual purchasing behaviour (Caputo & Scarpa, 2022). Future studies should consider using incentivized or real-choice scenarios to enhance ecological validity.

Second, the sample size, while typical for sensory studies, was relatively small and demographically narrow. The participants were predominantly female, under the age of 25, and highly educated. This lack of diversity limits the generalizability of the findings to the broader Chinese population. Future research should employ larger, more representative samples and apply segmentation analyses to explore how preferences vary by consumer group, such as age, income, or education.

From a modelling perspective, another limitation concerns the assumption of homogenous preferences in the MNL framework. The MNL model assumes that consumer preferences are consistent across individuals and satisfies the independence of irrelevant alternatives (IIA) property. These assumptions may not hold, especially given the potential unobserved heterogeneity in preference structures. Although observable heterogeneity was partially addressed through the inclusion of individual-level covariates (e.g., age, income, education, consumption frequency), more flexible models such as mixed logit or latent class analysis could better capture variation in taste parameters and decision strategies.

Additionally, all ordinal control variables (e.g., income, education, taste rating) were treated as continuous in the model under the assumption of monotonicity. While this is a common and parsimonious approach in discrete choice modelling, it does not capture potential non-linear or threshold effects that could exist across categories. Future research could explore alternative coding strategies (e.g., dummy coding or categorical effects) where sample size allows.

Product-level limitations should also be noted. Differences in storage and handling may have influenced the sensory quality of samples. Specifically, while the Norwegian Atlantic salmon sample was ice-fresh, the Chilean Atlantic salmon and Chinese rainbow trout samples were previously frozen and thawed, which may have altered sensory attributes such as texture and

flavour (Alizadeh et al., 2007). These differences were unavoidable but should be controlled in future studies to ensure comparability of samples.

Lastly, the study introduced regulatory information regarding the classification of rainbow trout as salmon. While necessary for clarity, this may have influenced perceptions beyond sensory or origin attributes, introducing a possible framing effect. Future studies should investigate how consumers respond to regulatory cues and whether such information alters preference formation. Moreover, future research could expand the model to include other relevant extrinsic factors such as food safety certifications, farming methods, or nutritional information, which are increasingly important in consumer decision-making.

6.6. Conclusion

This study demonstrates that Chinese consumers initially perceived no significant sensory differences between domestic rainbow trout and imported Atlantic salmon from Norway and Chile in blind taste tests, with a preference for domestic trout over Chilean Atlantic salmon. However, when informed of the product's origin, consumer preferences shifted in favour of Norwegian and Chilean Atlantic salmon, emphasizing the significant role that provenance information plays in shaping perceptions of imported aquatic food. Interestingly, no significant differences were observed in consumers' WTP for salmon based on the country of origin, indicating that origin alone does not warrant higher consumer spending when sensory attributes and other factors are comparable. Moreover, when informed about the country of origin, WTP decreased in certain cases, highlighting potential negative associations or scepticism tied to specific origins. Furthermore, sociodemographic factors (such as education) and lifestyle factors (such as prior experience with salmon and frequency of aquatic food consumption) influenced consumer preferences. Consumers prioritized taste in their overall satisfaction, while other factors such as country of origin, eco-labels, price, and product appeal also affected their WTP.

In comparing the Chinese and European markets, European consumers often value local products for their freshness and environmental benefits, while Chinese consumers tend to prefer international salmon, likely due to concerns about local food safety. Improving the perception of domestic products in China will require enhanced quality controls and greater supply chain transparency to address these concerns. Emphasizing the safety and unique qualities of local products could build consumer trust and increase willingness to pay for domestic aquatic food options.

Additionally, the study highlights an opportunity to spotlight the comparable sensory qualities of domestic rainbow trout to imported Atlantic salmon. Country-of-origin labelling

regulations further support this goal by providing transparency and reassuring consumers about product authenticity, quality, and safety. From a marketing standpoint, domestic trout marketers should focus on sensory qualities—taste, smell, colour, and texture—and consider offering tasting events or samples to build familiarity and boost purchase intent. Economically, the study highlights that consumers' willingness to pay depends on both sensory qualities and product origin. Thus, domestic producers can position Chinese rainbow trout competitively by emphasizing its sensory profiles, along with targeted promotional efforts. Meanwhile, premium imported Atlantic salmon holds potential in the high-end market, where consumers are willing to pay more for certifications related to sustainability and traceability.

Industrially, the study highlights the importance of transparency and certification in building trust. Both domestic and international salmon producers and suppliers should invest in ecolabels and traceability to meet the growing demand for sustainably sourced aquatic food, especially where food safety is a primary concern. Enhanced food safety standards and traceability for domestic aquatic food products could shift consumer perceptions and boost demand for Chinese rainbow trout.

Chapter 7 General Discussion on the Strategic Recommendations for European Aquaculture

This chapter outlines strategic recommendations to enhance the growth and development of the European aquaculture sector, based on insights from Chapters 2 to 6. Central to these recommendations are three priorities: enhancing societal acceptance, promoting quality, safety, and environmental sustainability, and improving transparency – vital for fostering long-term growth and public trust. This chapter also serves as a broader synthesis of the study's contributions to the literature on global aquaculture markets, consumer behaviour, and aquatic food trade. Drawing from the six objectives outlined in Chapter 1, the findings reveal significant insights into how cultural, socioeconomic, and informational factors shape aquatic food consumption across regions, particularly in China. While the strategic lens remains central, this final chapter highlights novel contributions, emerging contradictions, and future directions for advancing international aquaculture research.

7.1 Enhancing Societal Acceptance of European Aquaculture

Chapter 2 highlighted that societal perceptions of aquaculture in Europe are shaped by concerns over sustainability, environmental impact, and ethical practices. To address these concerns and foster broader societal acceptance, the aquaculture industry must adopt a multifaceted strategy that emphasizes education, transparency, collaboration, and innovation. A key priority is to develop targeted communication strategies that dispel misconceptions about aquaculture's role in food security and sustainability. Similar approaches have worked in sectors like renewable energy, where public campaigns highlighting benefits and addressing concerns have increased acceptance (Devine-Wright, 2011; Wolsink, 2007), and genetically modified crops, where education and evidence-based outreach improved understanding in regions with initial resistance (Bennett et al., 2013; Hails & Kinderlerer, 2003; Lucht, 2015). Collaborative efforts with mainstream media, bolstered by partnerships with social media influencers and educational institutions, can help bridge the knowledge gap among the public. Tailored messaging, particularly on social media platforms, can resonate with younger demographics by highlighting aquaculture's contributions to sustainable food systems, offering a compelling counter-narrative to the often-negative portrayals in traditional media.

Promoting sustainability credentials is another essential step toward building consumer confidence. Certifications such as the Aquaculture Stewardship Council (ASC) and Global

Good Agricultural Practices (Global GAP) demonstrate industry commitment to responsible practices. However, their visibility and consumer awareness need to be enhanced. Transparency in labelling and clear communication about sustainability achievements—such as reductions in antibiotic use and pollution—can reassure consumers and encourage support for eco-labelled products. However, certifications are often criticized for greenwashing or supporting 'good actors,' raising credibility concerns. Similar issues occur in sectors like wild-capture fisheries and textiles. For instance, while eco-labels like the Marine Stewardship Council (MSC) promote sustainable seafood, they sometimes overlook unsustainable practices within certified operations (Jacquet et al., 2010; Nygaard, 2023). Similarly, ethical certifications in Bangladesh's textile industry have faced scrutiny for weak enforcement and failure to address systemic issues like worker exploitation (Khan et al., 2020; Sakamoto et al., 2019). To address such criticisms, certification schemes must strengthen criteria, enforce robust auditing, and prioritize transparency to ensure their credibility and effectiveness. Additionally, adapting these schemes to regional preferences and emerging market requirements could further enhance their impact and public trust.

Engaging stakeholders through inclusive and transparent practices is critical to building trust and addressing resistance to aquaculture initiatives. Actively involving local communities and environmental organizations in decision-making processes can create mutually beneficial outcomes and foster goodwill. Transparency in operations, such as sharing accessible data on environmental impacts and antibiotic usage, demonstrates accountability and reinforces public confidence in the industry's sustainability commitments. For example, involving local communities in the site selection process can help address concerns about habitat disruption and ensure that environmental and social considerations are considered (Guthrie et al., 2024). Additionally, setting clear employment norms, such as fair wages and safe working conditions, can help address potential labour concerns, as seen in the efforts to improve labour standards in agriculture, where addressing these issues has been central to ensuring sustainability and social responsibility (Raikes & Gibbon, 2000). Transparency in operations, including sharing accessible data on environmental impacts, antibiotic usage, and adherence to labour standards, demonstrates accountability and reinforces public confidence in the industry's sustainability commitments (Leith et al., 2014; Weitzman et al., 2023). Acknowledging these complexities and taking proactive steps to address them can help foster greater social license to operate and increase industry legitimacy.

Innovation plays a crucial role in enhancing aquaculture's environmental performance and public image. Diversifying production to include species groups like shellfish and seaweed and other finfish such as trout, tilapia, or even species like carp and catfish, can help mitigate

concerns about intensive aquaculture practices. These species have different environmental requirements and growth characteristics, which can spread the ecological impact across a broader range of farming systems. For example, tilapia and catfish are hardy species that can be farmed in diverse conditions (Cucherousset et al., 2018; Fitzsimmons et al., 2011; Kumar et al., 2023), while trout farming often utilizes sustainable freshwater systems, particularly in Europe, where efficient flow-through and RAS technologies help minimize environmental footprints while maintaining high production standards (d'Orbcastel et al., 2009; Martins et al., 2010). Integrating these species with shellfish and seaweed can create diverse aquaculture systems that help balance ecological impacts, reduce waste, and improve the overall sustainability of the industry (Chopin et al., 2001, 2012). Further, Integrated Multi-trophic Aquaculture (IMTA), which creates balanced ecosystems by farming complementary species, offers an opportunity to minimize waste, improve nutrient cycling, and increase overall sustainability (Buck et al., 2018; Troell et al., 2009). However, in Europe, these practices remain largely at the pilot scale, with limited commercial adoption due to challenges such as market readiness, regulatory barriers, and investment costs. Advancing alternative feed sources, such as plant-based or insect protein, and reducing reliance on antibiotics through improved management practices and vaccines are key innovations, though these approaches are subject to ongoing debate. While plant-based and insect protein has the potential to reduce environmental impacts and improve sustainability, challenges related to feed efficiency, nutritional adequacy, and consumer acceptance remain (Ansari et al., 2021; Gómez et al., 2019; Kaiser et al., 2021; Van Huis, 2013). For instance, plant-based diets may not fully replicate the nutritional profile of fishmeal, leading to concerns about growth rates and overall fish health (Tacon & Metian, 2015). Additionally, consumer acceptance of insect-based proteins remains mixed, with cultural and sensory perceptions influencing their adoption (Verbeke et al., 2015). Similarly, the reduction of antibiotic use is a complex issue, with concerns around disease management and the development of resistance (Hossain et al., 2022; Santos & Ramos, 2018). However, by focusing on research and development, along with more effective regulatory frameworks, the industry can work towards solutions that align with both consumer expectations for sustainability and the industry's need for operational efficiency.

Harmonizing policies across European Union member states is a crucial step in fostering societal acceptance and strengthening the aquaculture sector. Clear and consistent regulatory frameworks can support the adoption of innovative technologies, enhance governance, and tackle shared challenges such as disease management, climate change adaptation, and sustainable resource use across various species and farming systems (Bostock et al., 2016;

Martins et al., 2010). For example, species like salmon and trout, which dominate European markets, require high welfare and environmental standards that can also influence consumer preferences and export opportunities. Aligning welfare standards regionally is particularly critical, given the growing emphasis on animal welfare among European consumers (Ankamah-Yeboah et al., 2019; Budhathoki et al., 2021). Welfare-friendly practices, certifications, and technologies are not only essential for maintaining ethical aquaculture but can also enhance the competitiveness of European producers in their domestic and international markets. Tailored marketing approaches are necessary to strengthen the perception of European aquaculture products as high-quality, sustainable, and welfare-compliant, drawing parallels with successful branding efforts in other sectors, such as organic farming or the protected designation of origin (PDO) for European cheeses, whiskey, and wines (Mora & Menozzi, 2009; Padel & Foster, 2005).

Exporting this model to Asia or other regions requires caution, as the distinct preferences and regulatory environments in emerging markets may not align with European standards (Bush et al., 2019). While European welfare and sustainability credentials could appeal to premium consumers in Asian markets, the broader demand in these regions often prioritizes affordability over certifications (Budhathoki et al., 2022; Malcorps et al., 2021). This highlights the need for European producers to focus on consolidating their image within their home market while selectively exploring external opportunities where their standards are valued. A dual strategy—tailoring marketing efforts to European consumers while cautiously expanding to niche global markets—can help reinforce the industry's leadership and reputation in ethical and sustainable aquaculture.

7.2 Enhancing European Aquaculture's Competitiveness in the Chinese Aquatic Food Market

Objective 2 and Objective 3 are addressed through an in-depth analysis of Chinese consumption behaviour and the growing demand for high-value aquatic food. By identifying key attributes valued by urban Chinese consumers (e.g., food safety, nutrition, and traceability), this study provides new empirical insights that contribute to a richer understanding of Asia's evolving aquatic food landscape. The complexity of this market is highlighted by diverging preferences among demographic groups, including urban vs. rural and young vs. older consumers, suggesting that segmentation strategies are essential for market penetration. The growing demand for aquatic food in Asia, particularly among safety- and health-conscious consumers in China, presents a significant opportunity for European aquaculture to expand its market share. This thesis highlights that Chinese consumer

preferences have evolved significantly due to economic growth, urbanization, and heightened health awareness. Affluent urban consumers increasingly demand high-value imported species like salmon, lobster, abalone, and sea cucumber, driven by perceptions of superior safety and quality, often associated with international brands and robust traceability systems. To effectively penetrate this lucrative market, European aquaculture producers, along with broader supply chain actors such as feed manufacturers, seed suppliers, and equipment providers, must adopt a multifaceted strategy that emphasizes product safety and quality, sustainability, and consumer education. Collaboration across the supply chain is vital to ensure consistent quality and traceability, from the sourcing of high-quality feed and seed to the adoption of advanced farming equipment and technologies that enhance production efficiency. Additionally, enhancing the attributes of aquatic products—including taste, texture, safety, and quality—should be a priority. This effort must be complemented by attractive and informative packaging that effectively communicates freshness, sustainability credentials, safety, and nutritional benefits. A cohesive approach across the supply chain will strengthen the reputation of European aquaculture and its ability to meet the expectations of discerning Asian consumers.

Strengthening distribution channels is also crucial for ensuring that European aquatic foods are readily available across diverse retail settings, particularly in e-commerce platforms like JD.com and Alibaba, which have reshaped consumer purchasing habits in China. These channels target urban consumers seeking convenient foods, who increasingly favour modern retail options over traditional wet markets. Lessons from these retail innovations could inform future European policies to enhance domestic consumption, such as utilising e-commerce to improve access to fresh, sustainable aquatic food while reducing reliance on environmentally taxing distribution channels (Dannenberg et al., 2020; Zeng et al., 2017). Technologies such as advanced refrigeration, vacuum packing, and sea freight optimisation can significantly reduce the carbon footprint associated with fresh salmon air freight (Farmery et al., 2015), aligning with sustainability goals and addressing consumer demand for environmentally responsible products. By optimizing logistics and supply chain efficiency, European aquaculture products can guarantee the timely delivery of high-quality products, aligning with sustainability goals and further enhancing consumer satisfaction while minimizing environmental impact (Budhathoki et al., 2024).

Building brand trust through rigorous food safety and quality standards is another critical aspect of this strategy but should be complemented with marketing strategies specifically tailored to the Chinese market. European aquaculture producers are recognized for their high safety standards and robust traceability systems. However, there is an opportunity to

strengthen marketing strategies aimed at the Chinese market. Emphasizing adherence to international certifications, such as Best Aquaculture Practice (BAP) and Aquaculture Stewardship Certification (ASC), could enhance credibility among Chinese consumers, who prioritize safe, premium products. From a Chinese consumer perspective, an eco-label may not only signify sustainability but also serve as a marker of 'Western provenance,' which is often associated with higher quality. As a result, eco-labelling could influence purchasing decisions by acting more as a symbol of product prestige and foreign origin than as a direct signal of environmentally responsible practices. Additionally, promoting the nutritional benefits of aquatic foods—particularly the omega-3 fatty acids found in species like salmon—can effectively resonate with the health-conscious segment of the Chinese market. Such targeted efforts can enhance the industry's appeal in this lucrative and rapidly evolving consumer landscape.

This thesis found diverse consumer preferences in Asia (Budhathoki et al., 2022); thus, European aquaculture should develop tailored marketing strategies that resonate with different demographic segments, respecting cultural dietary preferences and highlighting health benefits. For example, in China, health-conscious urban consumers prioritize the nutritional benefits of omega-3-rich species like salmon (Meng et al., 2023; Xu et al., 2024), while in Japan, the emphasis on freshness and traditional preparation methods aligns with a preference for sashimi-grade fish (Oehlenschläger, 2014). Meanwhile, markets in Southeast Asia often value affordability and the versatility of species such as tilapia in local cuisine (DeSilva, 2004). By offering premium aquatic species alongside affordable alternatives, producers can capture a wider consumer base, maximizing market penetration. For instance, promoting high-value species such as salmon and oysters as luxury items while also providing accessible options such as European catfish for everyday consumption can appeal to both affluent and budget-conscious consumers.

Furthermore, engaging with local stakeholders, such as Chinese processors, distributors, and culinary experts, will be crucial to fostering long-term partnerships and adapting to the unique consumer preferences within China. Lessons can be drawn from the Norwegian Seafood Export Council's successful efforts to position farmed salmon alongside popular wild-caught species in the Chinese market, emphasizing quality, taste, and versatility (Yeping, 2024). By aligning farmed species with the established appeal of wild seafood, European producers can enhance market acceptance and broaden their reach. Collaborating with local partners will not only streamline operations but also provide valuable insights into market dynamics, enabling swift responses to evolving consumer demands. Contradictorily, Chapter 5 and Chapter 6 indicate that the country of origin, and price of salmon products did

not significantly affect consumer satisfaction when purchasing salmon from online platforms, while Chapter 6 reveals that country of origin and price significantly influence the willingness to pay (WTP) for salmon among Chinese consumers. This difference can be reconciled by recognizing that satisfaction and WTP are distinct aspects of consumer behaviour. Satisfaction primarily reflects post-purchase experiences and the degree to which a product meets expectations, which may not be heavily influenced by pre-purchase considerations like country of origin or price. On the other hand, WTP is a measure of how much consumers value certain attributes before purchase, such as quality or perceived prestige linked to country of origin, or affordability linked to price. These results highlight the complexity of consumer decision-making, where pre-purchase priorities and post-purchase satisfaction do not always align. This distinction highlights the importance of examining multiple dimensions of consumer behaviour to gain a comprehensive understanding, especially in the context of Chinese consumers. It also highlights the need for European aquaculture producers to consider both pre-purchase factors, such as country of origin and price, and post-purchase experiences, such as freshness to better align their offerings with consumer expectations and satisfaction.

All in all, by implementing these strategic initiatives, European aquaculture can effectively enhance its competitiveness and appeal in the burgeoning Asian aquatic food market. The combination of product innovation, robust marketing strategies, and an emphasis on sustainability and safety & quality will position European aquaculture as a leader in supplying high-value aquatic foods to discerning Asian consumers. Through these efforts, European aquacultural products can build a strong presence in Asia, ensuring the long-term viability and growth of their market share.

7.3 Synthesis of Key Contributions and Unanswered Questions

Across the six objectives, this thesis makes the following contributions:

Objective 1: Provides a comparative perspective on societal perceptions of aquaculture in Europe and globally, emphasizing the importance of sustainability, ethics, and stakeholder engagement.

Objective 2: Identifies behavioural trends and preference drivers among Chinese consumers, particularly around trust, health, and product quality.

Objective 3: Assesses the demand for high-value aquatic species in China, showing the value placed on provenance, nutrition, and branding.

Objective 4: Demonstrates that while price and origin information do not significantly impact satisfaction in e-commerce, they are more relevant to pre-purchase decision-making.

Objective 5: Shows how sensory attributes, especially taste and texture, contribute to overall liking and partially influence willingness to pay for farmed salmon.

Objective 6: Integrate insights into a set of actionable, evidence-based strategic recommendations for improving the positioning of European aquaculture in global markets.

Unanswered questions remain, including how trust in domestic versus imported food changes over time, how middle-income inland Chinese consumers view aquaculture, and how consumers interpret sustainability certifications beyond branding. These issues should be explored through longitudinal and comparative methods.

Overall, this PhD thesis serves not only as a strategy guide for European aquaculture stakeholders but also as a foundational piece for global aquatic food market research. It reveals the layered complexity of Chinese consumer behaviour, illustrates the interplay between perception and product characteristics (intrinsic and extrinsic), and emphasizes the need for both strategic adaptation and deeper academic inquiry into the evolving global aquatic food market.

7.4 Future Research

Future research should focus on several key areas to further enhance our understanding of the aquatic food market in China, particularly in the context of the ongoing debate about domestically produced versus imported aquatic food and its implications for environmental sustainability. First, conducting a comprehensive comparative environmental impact assessment of imported Atlantic salmon and domestically produced rainbow trout will provide insights into sustainability metrics like carbon footprint, water usage, and the environmental impacts of production methods. This analysis should also consider the carbon emissions associated with the transportation of imported aquatic food products versus locally sourced options. Examining current sustainability practices in both European and Asian aquaculture can highlight best practices and areas for improvement. Analysing the impact of regulatory frameworks on environmental outcomes will be critical for understanding market dynamics and the effectiveness of policies aimed at promoting sustainable practices in both domestic and imported aquatic food products. Additionally, investigating consumer awareness and perceptions regarding the environmental sustainability of aquatic food can reveal how environmental information influences purchasing decisions, particularly concerning the benefits of domestic versus imported options. Exploring trends in consumer preferences for sustainably sourced aquatic food will help identify market gaps and opportunities for European aquatic food products, especially as consumers become

increasingly environmentally conscious. Finally, longitudinal studies on consumer behaviour will track changes in Chinese consumers' preferences over time, particularly regarding perceived sustainability aspects of farmed aquatic food, while investigating technological innovations may unveil new strategies to reduce the environmental footprint of aquaculture products. The findings also highlight the methodological and contextual challenges of conducting consumer behaviour research in culturally diverse and rapidly evolving markets like China. Urban-rural divides, regional food culture, varying levels of environmental awareness, and access to online platforms all influence results. Future studies should employ more granular segmentation, and mixed method approaches to capture this heterogeneity.

This PhD thesis combines insights from sensory perception, willingness to pay, e-commerce behaviour, and trade considerations to better understand the aquatic food market in China. Although it does not present a formal framework, it contributes to a more integrated understanding of how these factors interact in shaping consumer decision-making in a complex and evolving aquatic food market. It establishes a foundation for future cross-cultural research on consumer responses to imported aquaculture product in emerging aquatic food markets.

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Appendixes

Appendix A. Coding scheme to understand societal perception of aquaculture in newspaper articles.

Table A1. An example

Headline	Date	Country	Article types/genres	Stakeholder	Their role	Types of aquacultures	Topic	Sustainability attributes/topics	Any major aspects/summary of mentioned sustainability attributes	Sentiments/Tones
Offshore fish farms: a new wave of food production...or the 'wild west' of ocean pollution?	20 July 2022	UK	Opinion including 4 expert statements	Advocates (Environmental group)	-,-	Offshore	Growth and development	Multiple dimensions	Some experts described it as an opportunity for sustainable production of fish such as Atlantic salmon, seabass. Other describes them as factory farming of the sea where it is branded as a solution to overfishing but, feeding fish requires more wild fish.	0 (balanced)
				Aquaculture industry	+					
				Scientist	+					

Headline: Headline of article

Date: Date published (dd-mm-yy)

Media genre: Opinion

Feature

News

Stakeholders: Government officials

Municipal

Provincial

Federal

Advocates

Environmental groups

- Community groups
- Environmental activists
- Business Leaders
 - Retailers/wholesalers
 - Technology industry
 - Other industries (fisheries, tourism)
- Public groups
 - Indigenous groups
 - Celebrities or person of interest
 - Public servants (Member of Parliament, Senate)
 - Public (residents)
- Scientists
 - Researchers
 - Students
 - Other experts (e.g. law)
- Fish Farming Industry
 - Fish farmers
 - Industry associations or groups

Role: Proponent – arguing the benefits or defending the interests of aquaculture (+)
 Critic – raising concerns or criticisms about an event or issue related to (*) aquaculture
 Proponent – disagreeing the benefits of aquaculture (-)

Types of aquacultures: Aquaculture in general
 Aquaculture products in general
 Finfish aquaculture
 Marine aquaculture
 Integrated multi-trophic aquaculture
 Shellfish aquaculture
 Organic aquaculture
 Offshore aquaculture
 Other (cage, inland, freshwater, etc)

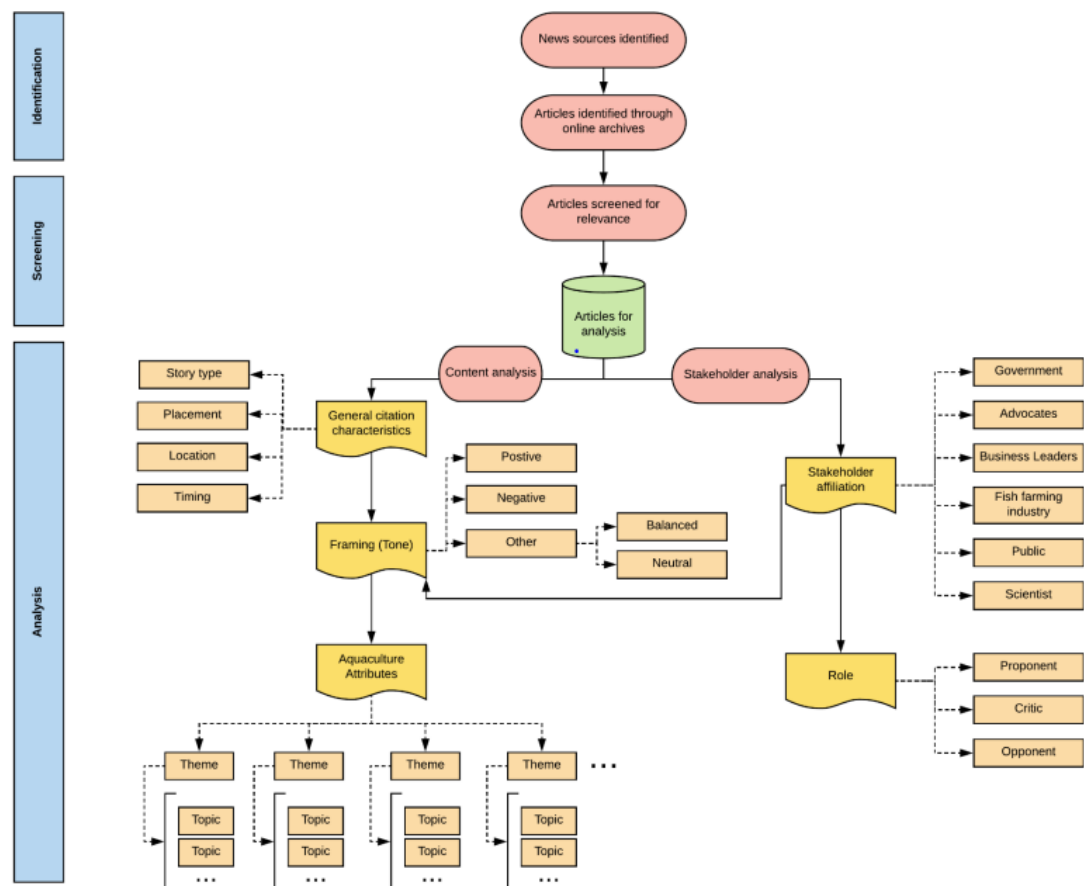
Topic: Growth and development
 Multiple sustainability aspects
 Policy and regulation

Profitability
Conflict of interests
Social acceptability
Risk perception
User perception
User impacts
Public perception
Transparency and communication

Aquaculture/sustainability attributes: Social, economic, environment
Multiple dimensions (social, health, environmental, quality, etc.)
Risks and benefits
License
Perception in general
Others (not specified)

Sentiments/Tones of coverage: Positive = 1
Negative = -1
Neutral = 0

Figure A1. Flowchart of media content analysis (Adapted from Witzman and Bailey, 2019).



Appendix B. Information of Identified Studies in the Systematic Scoping Review

Thematic Research Cluster 1: RED = Product attributes, availability, and accessibility

(27 publications) Thematic Research Cluster 2: Yellow = Willingness to pay for

aquatic foods (28 publications) Thematic Research Cluster 3: Purple = Psychosocial

factors (19 publications)

Thematic Research Cluster 4: Blue = Sociodemographic and lifestyle factors (24

publications) Thematic Research Cluster 5: Green = Aquatic food miscellaneous

factors (15 publications)

SN	References	Focus	Country	Research design, sampling, data collection method and period	Sample size	Sample composition	Age range	Data analysis method	Type of products analysed
1	(Chuenban & Sawmong, 2018)	Determinants of canned seafood product	Thailand	Cross-sectional, systematic random, face- to-face interview, Sep 2016	400	Consumers who purchased and consumed canned and processed seafood	21-60 and older	Structural equation modelling	Canned and processed seafood
2	(Devadawson et al., 2015a)	Drivers and barriers to fish consumption	Sri Lanka	Cross-sectional, purposive, face-to-face interview, Dec	150	Consumer who purchases and consume fish	n/a	Quantitative descriptive analysis	Fish and seafood in

				2013 – Oct 2014					general
3	(Das et al., 2013)	Drivers and barriers to fish consumption	India	Cross-sectional, multistage stratified random, face to face interview, June-July 2011	160	Fish consumers	25 and younger – 45 and older	Rank-based quotient	Fish and seafood in general
4	(Akter et al., 2019)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, purposive, face-to- face interview, Feb 2018	100	Households participated in USAID funded projects	n/a	One way ANOVA and Tukey's post hoc test	Fish in general
5	(Chokenukul et al., 2019)	Drivers and barriers to fish consumption	Thailand	Cross-sectional, multi- stage simple random, face-to- face interview, Oct 2015-Dec 2015	700	Consumer purchased processed fish products	n/a	Structural equation modelling	Processed fish products
6	(Chuenban et al., 2021)	Drivers and barriers to fish consumption	Thailand	Cross-sectional, systematic random, face- to-face interview, n/a	400	All types of consumers	n/a	Structural equation modelling	Canned tuna

7	(Hossain et al., 2021)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, stratified simple random, self-administered, Nov 2017-Feb 2018	300	All types of consumers	n/a	Hedonic price model	Tilapia
8	(Hossain, 2021)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, simple random, face-to-face interview, Dec 2020	200	All types of consumers	35 and younger-45 and older	Hedonic price model	Fish in general
9	(Intyas & Primyastanto, 2020)	Consumers' preferences for fish attributes	Indonesia	Cross-sectional, convenience, face-to-face interview, n/a	38	Consumers of preserved Mackerel tuna fish products	20 and younger- 49	Cross-tabulation, multiple regression, F test and t-test	Mackerel tuna fish
10	(Mitra et al., 2021)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, simple random, face-to-face interview, Feb 2019 – Mar 2020	138	Consumers who buy capture and culture fishes	n/a	Logit model, hedonic pricing model	Capture and culture fish
11	(R. D. Tan et al., 2017)	Consumers' preferences for fish attributes	Philippines	Cross-sectional, multistage stratified random, face to face, NA	378	All types of consumers	20 and younger-60 and older	Descriptive statistics, ordinal least square	Milkfish

								regression	
12	(Uddin et al., 2019)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, purposive random, face to face, NA	150	All types of consumers	15 and younger-55 and older	Descriptive statistics, Logit model	Pangas and Tilapia Fish
13	(O. Wang et al., 2021)	Consumers' preferences for fish attributes	China	Cross-sectional, convenience, web-based questionnaire, Dec 2016	981	All types of consumers	32.1±n/a	Descriptive statistic, binary logistic regression	Lobster

14	(O. Wang & Somogyi, 2018)	Drivers and barriers to shellfish consumption	China	Cross-sectional, quota, web-based questionnaire, Dec 2016	643	All types of consumers	18 – 40 and older	Descriptive statistics, structural equation modelling	Shellfish in general
15	(A. F. Ahmed et al., 2011)	Drivers and barriers to fish consumption	Malaysia	Cross-sectional, simple random, face-to-face interview, Dec 2007	700	Household member responsible for purchasing food	18 and younger – 55 and older	Descriptive statistics, Logit model	Fresh fish
16	(M. Omar et al., 2011)	Drivers and barriers to fish consumption	Malaysia	Cross-sectional, convenience, self-administered, n/a	212	Fish snack consumers	n/a	Cross-tabulation, correlation, t-test	Fish snack
17	(M. Sajeev et al., 2021)	Drivers and barriers to fish consumption	India	Cross-sectional, purposive random, face-to-face interview, 2019-2020	97	Consumers purchasing fish online	39.28±11.13	Cross-tabulation, ordinal alternative least square	Fish in general

18	(Wijayanto et al., 2021)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, cluster, self-administered, 2019	720	All types of consumers	32 and younger -59 and older	Regression and correlation analysis	Fresh shrimp
19	(Linh et al., 2019)	Drivers and barriers to fish consumption	Vietnam	Cross-sectional, convenience, self-administered, n/a	300	All types of consumers	20-35 and older	Word association, factor analysis,	Fish sauce products
20	(M. Castro et al., 2016)	Consumers' preferences for fish attributes	Philippines	Two stages, focus group, convenience, Jun-Jul 2015 + cross-sectional, convenience, face-to-face interview, n/a	69 (focus group) + 204 (survey)	Consumers who purchase canned tuna	16-75	Content analysis + hierarchical and k-mean cluster analysis, probit model	Canned tuna

21	(Izzhati et al., 2018)	Drivers and barriers to fish consumption	Indonesia	Two stages, Focus group + conjoint analysis, Cross sectional, convenience, self-administered, n/a	n/a + 100	All types of consumers	18-60	Content analysis + cross tabulation, correlation	Smoked fish
22	(Rejula et al., 2021)	Drivers and barriers to fish consumption	India	Cross-sectional, purposive random, face- to-face interview, Dec 2018-Mar 2020	400	Fish consuming households	19-77	Cross-tabulation	Fish in general
23	(P. H. Mugaonkar et al., 2011)	Consumers' preferences for fish attributes	India	Two-stage, convenience, face to face interview + sensory evaluation, Jan-Feb 2009	140 (survey) + 50 (sensory test)	All types of consumers + willingness to taste value-based products	25 and younger – 35 and older	Cross-tabulation, factor analysis	Fish in general
24	(Zaeema & Hassan, 2016)	Drivers and barriers to fish consumption	Maldives	Cross-sectional, convenience, self-	450	All types of consumers	18 to 50 and older	Structural equation modelling, one	Canned tuna

				administered, n/a				way ANOVA	
25	(Sajiki & Lu, 2022)	Drivers and barriers to fish consumption	Japan	Cross-sectional, convenience, web-based questionnaire, Nov 2018	1000	Household member responsible for purchasing seafood	20 or older	Conditional logit model and random parameter logit model	Raw fish
26	(Kitano & Yamamoto, 2020)	Drivers and barriers to fish consumption	Japan	Cross-sectional, convenience, web-based questionnaire, n/a	493	Consumers responsible for household's fresh food purchasing decision	50.89±16.0	Factor analysis, Poisson model, ordinal least square	Fish in general
1	(P. H. Mugaonkar et al., 2013)	Drivers and barriers to fish consumption	India	Cross-sectional, simple random, face-to-face interview, Jul-Oct 2012	120	Household member responsible for food purchasing/cooking	n/a	Ordered probit model	Fish and seafood in general

2	(Alam & Alfnes, 2020)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, convenience, face-to-face interview, Feb-Mar 2016	400	Household heads responsible for at least 50% of food purchasing	25-60	Mixed logit model	Pangasius and Rohu
3	(Ariji, 2010)	Consumers' preferences for fish attributes	Japan	Cross-sectional, convenience, web-based questionnaire, Mar 2009	12000	All types of consumers	20-40 and older	Conjoint analysis	Bluefin tuna
4	(Hoque, 2021)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, convenience, face-to-face interview, Aug -Oct 2018	490	Household member responsible for buying fish	20-69	Multinomial logit model, latent class logit model	Fish in general
5	(Hoque, Akhter, et al., 2021)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, stratified random, face-to-face interview, Aug-Oct 2019	660	Household member responsible for buying fish	33.93±8.97	Descriptive analysis, Rank-ordered logit model	Shrimp

6	(Hoque & Alam, 2020)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, stratified random, face-to-face, Mar-Apr 2018	498	households who prefer fish and are responsible for buying for household	20-70 and older	Structural equation modelling	Farmed fish in general
7	(Hoque, Bashar, et al., 2021)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, random, face-to-face interview, Jan-Apr 2019	1053	All types of consumers	41.25±13.28	Structural equation modelling	Farmed fish in general
8	(Hori et al., 2020)	Consumers' preferences for fish attributes	Japan	Cross-sectional, convenience, web-based questionnaire, 2017 and 2019	3000	All types of consumers	20 and older	Factor analysis, multiple regression analysis, marginal willingness to pay	Fish and seafood in general

9	(Karnad et al., 2021)	Drivers and barriers to fish consumption	India	Two stage, semi- structured interview + cross-sectional, convenience, Jun-Oct 2018	40 (interview) + 531 (survey)	Seafood eaters	20 and younger -60 and older	Content analysis + crosstabulation	Fish and seafood in general
10	(B.-T. Kim & Lee, 2018)	Drivers and barriers to fish consumption	South Korea	Cross-sectional, simple random, web-based questionnaire, Jun-Jul 2017	2773	Household member responsible for food purchasing/cooking	20-69	Descriptive statistics, ordered probit model	Seafood in general
11	(Murakami et al., 2017)	Drivers and barriers to fish consumption	Japan	Cross-sectional, simple random, web-based questionnaire, Dec 2015	1148	All types of consumers	20-69	Post-hoc test, logistic regression, t-test	Fish and shellfish in general
12	(Prince & Saira Wahid, 2020, p.	Drivers and barriers to fish consumption	Bangladesh	Cross sectional, stratified random, face to face	320	Organic fish consume	24-60 and older	Structural Equation modelling	Organic fish

	19)			interview, Mar-Jun 2020		rs			
13	(Zheng et al., 2021)	Consumers' preferences for fish attributes	China	Cross-sectional, simple random, face-to-face interview, 2015	1017	All types of consumers	37.20±13.51	Descriptive statistics, random parametric logit model, ordinal least square regression model	Salmon
14	(N. A. Omar et al., 2021)	Drivers and barriers to fish consumption	Malaysia	Cross sectional survey, purposive, self-administered, NA	307	Sardine consumers	NA	Structural equation modelling	Canned sardine
15	(Sayeed et al., 2021)	Consumers' preferences for fish attributes	Singapore	Cross sectional, stratified, web-based questionnaire, Mar-Apr 2021	312	All types of consumers	18-55 and above	Descriptive statistics,	Mud crabs

								conditional logit model	
16	(R. D. Tan, 2017)	Drivers and barrier to fish consumption	Philippines	Cross-sectional, multistage stratified random, face-to face interview, n/a	378	All types of consumers	20 and younger-60 and older	Cross-tabulation, One-way ANOVA	Milkfish
17	(Uchida et al., 2014)	Consumers' preferences for fish attributes	Japan	Cross sectional, convenience, web-based questionnaire, Mar 2009	3370	All types of consumers	42.5±10.6	Mixed logit model	Eco labelled seafood
18	(Wakamatsu et al., 2017)	Consumers' preferences for fish attributes	Japan	Cross-sectional, convenience, face-to-face interview, Jun 2009	159	Females who are responsible for purchasing/cooking food	40 and younger -50 and older	Latent class, multinomial logit, Chi-Square	Eco labelled seafood
19	(Wakamatsu & Miyata, 2017)	Consumers' preferences for fish attributes	Japan	Cross sectional, convenience, web-based questionnaire, Nov 2015	2378	General domestic seafood consumers	15-60	Random utility model, conditional logit model	Seafood in general

20	(P. Xu et al., 2012)	Consumers' preferences for fish attributes	China	Cross-sectional, convenience, face-to-face interview, Nov 2009	386	All types of consumers	39.53±13.38	Descriptive analysis, probit regression	Seafood in general
21	(B. Xuan et al., 2021)	Drivers and barriers to fish consumption	Vietnam	Cross-sectional, stratified random quota, face to face interview, Mar-Apr 2019	754	All types of consumers	36.79±12.89	Cross-tabulation, ordered logistic regression, multiple indicators multiple causes model	Shrimp

22	(B. B. Xuan, 2021)	Consumers' preferences for fish attributes	Vietnam	Cross-sectional, random quota, face-to-face interview, Mar-Apr 2019	353	Household member responsible for purchasing/cooking food	37.38±11.43	Multinomial logit model, mixed-logit model	Aquaculture products
23	(Yi, 2019a)	Drivers and barriers to fish consumption	South Korea	Cross-sectional, stratified, web-based questionnaire, Nov-Dec 2018	960	All types of consumers	20-60 and older	Descriptive statistics, structural equation model	Aquaculture products
24	(Yi, 2019b)	Drivers and barriers to fish consumption	South Korea	Cross-sectional, convenience, web-based questionnaire, n/a	1000	All types of consumers	20-60 and older	Factor analysis, double bounded dichotomous choice model, contingent valuation model	Red seabream

25	(Yin et al., 2020)	Consumers' preferences for fish attributes	China	Two stages, focus group: convenience, Oct-Nov 2016 + cross-sectional, simple random, face-to-face interview, Jan - Mar 2018	Focus group n/a + survey 996	Household member responsible for purchasing and had purchased seafood within the last month	18 and older	n/a + descriptive statistics, generalised mixed logit model	White shrimp
26	(X. Zhang et al., 2020a)	Consumers' preferences for fish attributes	China	Cross-sectional, purposive, web-based questionnaire, May -Jun 2018	372	Seafood and salmon consumers	18 and older	Mixed logit model, conditional logit model, equality constrained latent class	Salmon

27	(Peng et al., 2021)	Drivers and barriers to fish consumption	China	Secondary data analysis, face-to-face interview, 2004, 2006, 2009	13,386	Households from the China Health and Nutrition Survey (CHNS)	48.96±15.22	Chi-Square, Tobit model	Seaweed
1	(Ghosh et al., 2018)	Drivers and barriers to fish consumption	India	Cross-sectional, simple random, face to face interview, Dec 2014 - Feb 2015	120	All types of consumers	15 – 60 and older	Rank-based quotient	Ready to eat fish products
2	(Abidin et al., 2021)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, convenience, web-based questionnaire, n/a	144	Fish consumers	20-23	Structural equation modelling	Fishery functional foods
3	(T. Chen & Wang, 2021)	Drivers and barriers to fish consumption	China	Cross-sectional, random stratified, web-based questionnaire, Jun 2020	1096	All types of consumers	30 and younger – 60 and older	Structural equation modelling	Wild freshwater fish
4	(Y. Dai et al., 2021)	Drivers and barriers to fish consumption	China	Cross-sectional, convenience, web-based questionnaire,	4221	All types of consumers	18 and older	multinomial ordinal logistic	Aquatic products

				May – July 2019				regression model	
5	(Fiandari et al., 2019)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, Convenience, face-to- face interview, Jun 2017- Feb 2018	365	Consumed fish for at least one year	17 and older	Structural equation modelling	Fish in general
6	(Gajaria & Mantri, 2021)	Drivers and barriers to seaweed consumption	India	Cross-sectional, convenience, web-based questionnaire, Jun 2020 – Jun 2020	310	All types of consumers	15-50 and older	Student's t-test, ANOVA	Seaweed

7	(A. Ghifarini et al., 2018)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, Purposive, web-based questionnaire, Jan-Feb 2016	120	All types of consumers	30 and younger -40 and older	Structural equation modelling	Shrimp
8	(Y. Li & Zhong, 2017)	Drivers and barriers to fish consumption	China	Cross-sectional, convenience, web-based questionnaire, May-Jun 2016	337	All types of consumers	18 and younger -60	Structural equation modelling	Green aquatic products
9	(Novita & Rowena, 2019)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, convenience, self-administered, n/a	307	All types of consumers	20-50	Structural equation modelling	Fish in general
10	(Pethiyagoda & Olsen, 2013)	Drivers and barriers to fish consumption	Sri Lanka	Cross sectional, convenience, face to face interview, NA	207	All types of consumers	33±12	Confirmatory factor analysis and structural equation	Fish in general

								modelling	
11	(Quan et al., 2014)	Drivers and barriers to fish consumption	China	Cross sectional, simple random, face to face interview, Nov 2009	386	All types of consumers	21-60	Structural Equation modelling	Eco labelled fish
12	(Siddique, 2012)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, convenience, face to face, Feb-Apr 2011	558	All types of consumers	18-45	Exploratory factor analysis, multiple regression	Dry fish
13	(Thong & Olsen, 2012)	Drivers and barriers to fish consumption	Vietnam	Cross sectional, convenience, face-to face interview, Aug 2006	208	All types of consumers	25-55	Descriptive statistics, structural equation modelling	Fish in general

14	(O. Wang & Somogyi, 2019)	Drivers and barriers to fish consumption	China	Cross-sectional, quota stratified random, web-based questionnaire, Dec 2016	643	All types of consumers	18-40 and older	Descriptive statistics, structural equation modelling	Shellfish in general
15	(Fauziyah, 2020)	Drivers and barriers to fish consumption	India	Cross-sectional, convenience, face-to-face interview, Apr 2019	150	Adolescents	15-17	Chi-Square, multiple logistic regression	Fish in general
16	(Junaidi et al., 2020)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, convenience, web-based questionnaire, n/a	55	All types of consumers	26-40	Structural equation modelling	Fresh fish
17	(Ho Huy et al., 2013)	Drivers and barriers to fish consumption	Vietnam	Cross-sectional, convenience, face-to-face interview, n/a	466	Eat fish at least once a week	18-76	Structural equation modelling	Fish and seafood in general
18	(Duy & Ai, 2019)	Drivers and barriers to fish consumption	Vietnam	Cross-sectional, systematic random, self-administration, n/a	299	All types of consumers	n/a	Factor analysis, linear regression model	Fish and seafood in general

19	(Rotuauli et al., 2020)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, accidental, self-administered, n/a	100	All types of consumers	21-69	Cross-tabulation, correlation	Freshwater fish
1	(P. Mugaonkar et al., 2017)	Drivers and barriers to fish consumption	India	Cross-sectional, convenience, face to face interview, 2012	120	Fish consumers	15 and younger – 45 and older	Rank-based Quotient	Pangasius
2	(G. Danso et al., 2017)	Consumers' preferences for fish attributes	Vietnam	Cross-sectional, simple random, face-to-face interview, 2014	136	Household member responsible for food purchasing/cooking	25 and younger- 65 and older	Latent class model, conditional logit and random	Fish products

								parameters logit models.	
3	(Ahmad et al., 2016)	Drivers and barriers to fish consumption	Malaysia	Cross-sectional, two- stage proportionate stratified, face-to-face interview, Feb 2008 – May 2009	2675	Household member responsible for food purchasing/cooking	43.4±16.2	Student's t-test, one way ANOVA, Mann-Whitney U and Kruskal-Wallis H test	Fish in general
4	(Arthatia ni et al., 2021)	Socio-economic determinants of preserved fish consumption	Indonesia	Data were taken from the National socio-economic survey for Indonesia, 2019	96,360	All types of consumers	40 and younger – 55 and older	Probit regression model	Preserved fish
5	(Devadawson et al., 2015b)	Drivers and barriers to fish consumption	Sri Lanka	Cross-sectional, stratified random, face-to-face interview, 2014	1777	Fish consumers	25-75	Crosstabulation, Kruskal – Wallis test	Fish in general

6	(Fu et al., 2019)	Drivers and barriers to fish consumption	China	Cross-sectional, simple random, face-to-face interview, Jun 2017-Jan 2018	451	All types of consumers	36.36±17.74	Mann-Whitney U-tests, Kruskal-Wallis tests	Asian horseshoe crabs
7	(Haque et al., 2019)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, convenience, quota-based, self-administered, 2018	120	Household member responsible for purchasing seafood	35 and younger -60 and older	Descriptive statistics and chi-square	Fish in general
8	(Hoa & Käre, 2017)	Drivers and barriers to fish consumption	Vietnam	Cross-sectional, purposive, Face-to-face interview, 2010	413	Teenagers	12-20	Factor analysis, t-test and ANOVA	Fish in general

9	(Islam et al., 2018)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, convenience, self-administered, n/a	658	Consumers responsible for their household purchasing	16 to 65 and older	Factor analysis, cross-tabulation, F-test	Fish in general
10	(Kashem et al., 2021)	Drivers and barriers to fish consumption	Bangladesh	Cross-sectional, convenience, web-based questionnaire, Jul-Aug 2020	300	All types of consumers	24 and younger – 45 and older	Descriptive statistic, correlation	Fish in general
11	(Lee & Nam, 2019)	Drivers and barriers to fish consumption	South Korea	Cross-sectional, stratified random sampling, telephone-based interview, Jul 2012	800	Household member responsible for food purchasing/cooking	20-69	Descriptive statistics, ordered Probit model	Live fish
12	(Poti et al., 2021)	Drivers and barriers to fish consumption	Malaysia	Case study, opportunistic, semi-structured interview, Jul-Sep 2017	73	Household member responsible for buying fish	20-80	Binary logistic regression	Sea turtle egg

13	(Rahman & Islam, 2020)	Consumers' preferences for fish attributes	Bangladesh	Cross-sectional, simple random, self-administered, Dec 2019-Jan 2020	128	All types of consumers	n/a	Linear regression	Fish in general
14	(M. V. Sajeew et al., 2021)	Drivers and barriers to fish consumption	India	Cross-sectional, stratified proportional, face-to-face interview, Dec 2019-Feb 2020	200	Household member responsible for purchasing food	n/a	Cross-tabulation, Henry Garret ranking test	Fish in general
15	(Shashikanth H & Somashekar, 2020)	Drivers and barriers to fish consumption	India	Cross-sectional, simple random, self-administered, n/a	n/a	All types of consumers	n/a	Cross-tabulation	Fish in general

16	(Supartini et al., 2018)	Drivers and barriers to fish consumption	Singapore	Cross-sectional survey, stratified random, web-based questionnaire, Jan 2017	600	All types of consumers	20-69	Chi-Square, t-test, multiple logistic regression	Fish in general
17	(Zhou et al., 2015)	Drivers and barriers to shellfish consumption	China	Secondary data analysis – China Health and Nutrition Survey (2000, 2004, 2006)	731, 918 and 1083	Household member responsible for purchasing/cooking food	n/a	Generalised least square regression model	Fish in general
18	(Yadav et al., 2021)	Drivers and barriers to fish consumption	Maldives	Cross-sectional, convenience, face-to-face interview, n/a	100	Household member responsible for purchasing/cooking food	18-80	Two-way ANOVA, generalised linear mixed model	Reef fish and tuna

19	(Tezzo et al., 2021)	Fish consumption practices	Myanmar	Qualitative case study, purposive, semi- structured interview, n/a	13 households, 46 individuals in total	All types of consumers	28-62	Social practices approach + Thematic analysis	Fish in general
20	(Salim et al., 2020)	Drivers and barriers to fish consumption	India	Cross-sectional, purposive and simple random, face-to-face interview Mar-May 2019	355	Fish consumers	25-60	Cross-tabulation	Fish in general
21	(Goh et al., 2013)	Drivers and barriers to fish consumption	Malaysia	Cross-sectional, purposive, self-administered, 2015-2016	385	All types of consumers	18 – 60 and older	Cross-tabulation, ANOVA, Tukey post hoc	Fish and seafood in general

22	(Salim, 2020)	Consumers' preferences for fish attributes	India	Cross-sectional, convenience, self-administered, Jan-Dec 2012	600	Household member responsible for buying fish	35 and younger -60 and older	Cross tabulation, logit model	Fish and seafood in general
23	(H. Zhang et al., 2021a)	Drivers and barriers to shellfish consumption	China	Cross-sectional, stratified, face-to-face interview, 2012-2016	1201	Household member responsible for purchasing/cooking food	44 and younger - 89	Ordered probit model, Tobit model	Fish and seafood in general
24	(Huang et al., 2020)	Drivers and barriers to fish consumption	China	Cross-sectional, probability-proportional-to-size, face-to face interview, Aug 2018	424	Household member responsible for food purchasing/cooking	52.33±12.66	Structural equation modelling	Fish in general
1	(Zheng et al., 2017)	Drivers and barriers to fish consumption	China	Cross-sectional, simple random, face-to-face survey, Jun-Jul 2015	1017	All types of consumers	37.80-13.51	Cross tabulation	Alaska salmon

2	(Zheng et al., 2018)	Drivers and barriers to shellfish consumption	China	Cross-sectional, simple random, face-to-face interview, Jun-Jul 2015	1017	All types of consumers	18-85	Descriptive statistics, ordered logit model	Wild salmon
3	(O. Wang et al., 2018)	Drivers and barriers to fish consumption	China	Cross-sectional, purposive, web-based questionnaire, Dec 2016	882	Consumed lobster before	18-41 and older	Cross-tabulation, t-test, one way ANOVA, partial least squares regression	Lobster

4	(O. Wang & Somogyi, 2020a)	Drivers and barriers to fish consumption	China	Cross-sectional, convenience, web-based questionnaire, May 2018	967	All types of consumers	18-70	Descriptive statistic, linear regression model, factor analysis, two-step cluster analysis	Seafood in general
5	(Skallerud et al., 2012)	Drivers and barriers to fish consumption	China	Cross-sectional, random stratified, telephone interview, NA	1200	Female member of the household	15-69	Multinomial logit analysis	Norwegian salmon
6	(Meng et al., 2021)	Drivers and barriers to fish consumption	China	Convenience, face-to-face interview, simple random, self-administered, Jun 2016	394	Household member responsible for food purchasing/cooking	39.24±12.22	Descriptive statistics and Tobit model	Aquatic products
7	(Juwitaningtyas et al.,	Consumers' preferences for fish attributes	Indonesia	Cross-sectional, convenience, self-	101	Fresh fish consumers	n/a	Importance-performance analysis	Fish in general

	2018)			administered, n/a					
8	(Y. Hu & Yuan, 2015)	Drivers and barriers to fish consumption	China	Cross-sectional, purposive, self- administered, Dec 2011- Feb 2012	1020	University students	19-30	Cross- tabulation	Fish and seafood in general
9	(Farradia & Sunarno, 2020)	Drivers and barriers to fish consumption	Indonesia	Cross-sectional, convenience, self- administered, n/a	107	Consumers who prefer to buy online	n/a	Regression and correlation , ANOVA	Fresh fish
10	(Fabinyi et al., 2016)	Drivers and barriers to fish consumption	China	Cross-sectional, quota, web-based questionnaire, Jan – Mar 2015	300	All types of consumers	18-60	Chi-Square test	Aquatic products

11	(Fabinyi & Liu, 2014)	Drivers and barriers to seafood consumption	China	Case study, Convenience, semi-structured interview, Apr – Jul 2012	34	20 seafood restaurants managers or chefs, 7 seafood restaurant consumers, 7 trading sector informants	n/a	Thematic analysis	Seafood in general
12	(Fabinyi & Liu, 2016)	Drivers and barriers to seafood consumption	China	Ethnographic study, interviews and observations, 2011-2014	n/a	n/a	n/a	Thematic analysis	Seafood in general
13	(Newton et al., 2021a)	Drivers and barriers to fish consumption	China	Cross-sectional, simple random, face-to face interview + web-based questionnaire, n/a	267	All types of consumers	n/a	Crosstabulation	Fish and seafood in general
14	(Altintzoglou et al., 2018)	Drivers and barriers to fish consumption	Japan	Cross-sectional, convenience, web-based	897	All types of consumers	18-64	Crosstabulation, correlation, ANOVA	Sushi and seafood

	2016)	consumption		questionnaire, n/a				tests	sashim i
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Appendix C. Key Informant Semi-Structured Interview Guide

Objective: To gather in-depth insights on the demand for high value imported aquatic food in China from key informants involved in the aquatic food trade show.

Before beginning, provide participants with the EATFISH leaflet, a consent form, and an information sheet. Confirm consent to participate.

Consent given? (Yes/No) If no, specify the reason:

Company Name:

Country:

Primary Business Activity:

Type(s) of Aquatic Food Products Specialization:

Age:

Gender:

Position in Company:

Years of Experience in the Field:

1. For foreign companies only: What motivated your company to enter the Chinese market and participate in this seafood show?
2. How would you describe the current demand for imported aquatic food in China? Has it been increasing?
3. Why do you think Chinese consumers choose imported aquatic foods? What product attributes are most valued by Chinese consumers?
4. Who are the primary consumers of imported aquatic foods in China? What characteristics define these consumers?
5. In your view, what are the strengths of importing aquatic foods into China?
6. What are the challenges or weaknesses associated with importing aquatic foods into China?
7. What opportunities do you see for the growth of imported aquatic food in China?
8. What potential threats or risks do you foresee in the import market for aquatic foods?
9. What types of product information do you typically look for when importing aquatic food? (e.g., from – fresh, frozen, smoked; size, brand, certifications, shelf-life). Alternatively, what key information do you provide to potential buyers?
10. What strategies or measures does your company use to ensure the quality of imported aquatic food? (e.g., quality control processes, inspection standards).

11. How is imported aquatic food transported into China? Does the method vary by species or preservation form? Are there any technological challenges in importing fresh or chilled products?
12. Does information on production methods (wild, farmed, eco-labelled) influence your decision to import certain products?
13. Do you incorporate any sustainability practices in your trade activities, including environmental and social considerations?
14. For European aquatic food products only:
 - a) Do you believe European aquatic foods are competitive in the Chinese market? Why or why not? What attributes are prioritized when importing European aquatic food products? Are there variations by species or preservation form?
 - b) Are there specific opportunities and challenges to import European aquatic foods to China?
 - c) What makes European aquatic food products appealing for import?

Appendix D. Survey Questionnaire to determine Chinese Consumers' Sensory Perception and Willingness to Pay for Salmon.

a) Sociodemographic characteristics

1. What is your age?..... years

2. What is your gender?

(1) ☐ Male

(2) ☐ Female

3. What is your current household size? (Please indicate the total number beside you)

(1) ☐ 0

(2) ☐ 1

(3) ☐ 2

(4) ☐ 3

(5) ☐ 4 or more

4. What is your highest educational attainment?

(1) ☐ Primary School

(2) ☐ High school degree

(3) ☐ Bachelor/Professional bachelor

(4) ☐ Master and above

(5) ☐ Others

5. What is your family's approximate monthly income?

(1) ☐ CNY 3,000 and less

- (2) ☐ CNY 3,001 – 6,000
- (3) ☐ CNY 6,001 – 9,000
- (4) ☐ CNY 9,001 – 12,000
- (5) ☐ CNY 12,001 and above
- (6) ☐ Prefer not to say

6. How often do you consume seafood?

- (1) ☐ Rarely
- (2) ☐ Less than once per week
- (3) ☐ 1 – 2 times per week
- (4) ☐ 3 – 4 times per week
- (5) ☐ More than 4 times per week

7. Where do you prefer to buy seafood?

- (1) ☐ Seafood market/Speciality stores
- (2) ☐ Supermarket/discount stores
- (3) ☐ Online (Taobao, JD.com)
- (4) ☐ Restaurants/Takeaway
- (5) ☐ Others

8. Which of the following meal contexts do you prefer to eat seafood? (Please feel free to select more than one option)

- (1) ☐ Breakfast and cold dish
- (2) ☐ Breakfast and hot dish
- (3) ☐ Lunch and cold dish
- (4) ☐ Lunch and hot dish
- (5) ☐ Snack and cold dish
- (6) ☐ Snack and hot dish
- (5) ☐ Dinner and cold dish
- (6) ☐ Dinner and hot dish

9. Which of the following factors are important when buying seafood? (Please feel free to select more than one option)

- (1) ☐ Health and nutrition
- (2) ☐ Food safety
- (3) ☐ Sensory appeal (Taste, Colour, etc)
- (4) ☐ Price
- (5) ☐ Quality
- (6) ☐ Country of origin
- (7) ☐ Production method (capture, farmed)

- (8) ☐ Sustainability profile (better for climate change)
- (9) ☐ Animal welfare (better for fish health and well-being)
- (10) ☐ Others (Please specify)

10. Have you ever tasted salmon?

- (1) ☐ Yes
- (2) ☐ No

b) Hedonic liking

SAMPLE number.

1. Please taste the given salmon sample and express your overall liking. How much do you like this sample?

	Extremely Dislike	Dislike	Somewhat Dislike	Neither like nor dislike	Somewhat like	Like	Extremely Like
Overall liking	☐	☐	☐	☐	☐	☐	☐

2. To what extent do you like or dislike each of the following aspects?

	Extremely Dislike	Dislike	Somewhat Dislike	Neither like nor dislike	Somewhat like	Like	Extremely like
Smell	☐	☐	☐	☐	☐	☐	☐
Taste	☐	☐	☐	☐	☐	☐	☐
Firmness	☐	☐	☐	☐	☐	☐	☐
Juiciness	☐	☐	☐	☐	☐	☐	☐
Fattiness	☐	☐	☐	☐	☐	☐	☐

SAMPLE number.

1. Please taste the given salmon sample and express your overall liking. How much do you like this sample?

	Extremely Dislike	Dislike	Somewhat Dislike	Neither like nor dislike	Somewhat like	Like	Extremely Like
Overall liking	☐	☐	☐	☐	☐	☐	☐

2. To what extent do you like or dislike each of the following aspects?

	Extremely Dislike	Dislike	Somewhat Dislike	Neither like nor dislike	Somewhat like	Like	Extremely like
Smell	☐	☐	☐	☐	☐	☐	☐
Taste	☐	☐	☐	☐	☐	☐	☐
Firmness	☐	☐	☐	☐	☐	☐	☐
Juiciness	☐	☐	☐	☐	☐	☐	☐
Fattiness	☐	☐	☐	☐	☐	☐	☐

SAMPLE number.

1. Please taste the given salmon sample and express your overall liking. How much do you like this sample?

	Extremely Dislike	Dislike	Somewhat Dislike	Neither like nor dislike	Somewhat like	Like	Extremely Like
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Overall liking	☐	☐	☐	☐	☐	☐	☐
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2. To what extent do you like or dislike each of the following aspects?

	Extremely Dislike	Dislike	Somewhat Dislike	Neither like nor dislike	Somewhat like	Like	Extremely like
Smell	☐	☐	☐	☐	☐	☐	☐
Taste	☐	☐	☐	☐	☐	☐	☐
Firmness	☐	☐	☐	☐	☐	☐	☐
Juiciness	☐	☐	☐	☐	☐	☐	☐
Fattiness	☐	☐	☐	☐	☐	☐	☐

c) Choice set

BLOCK 1

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Chile Ecolabel CNY 150.00 (500 gram)	China CNY 175.00 (500 gram)	Norway Ecolabel CNY 125.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway Ecolabel CNY 75.00 (500 gram)	Chile Ecolabel CNY 100.00 (500 gram)	China CNY 150.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway Ecolabel CNY 100.00 (500 gram)	Chile CNY 75.00 (500 gram)	China CNY 50.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway CNY 75.00 (500 gram)	Chile Ecolabel CNY 50.00 (500 gram)	China Ecolabel CNY 125.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
China CNY 150.00 (500 gram)	Chile CNY 125.00 (500 gram)	Norway Ecolabel CNY 50.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway CNY 100.00 (500 gram)	Chile CNY 175.00 (500 gram)	China Ecolabel CNY 175.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Block 2

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
China CNY 100.00 (500 gram)	Norway Ecolabel CNY 150.00 (500 gram)	Chile CNY 50.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway CNY 100.00 (500 gram)	Chile CNY 150.00 (500 gram)	China Ecolabel CNY 50.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
China Ecolabel CNY 125.00 (500 gram)	Norway CNY 175.00 (500 gram)	Chile Ecolabel CNY 125.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway CNY 75.00 (500 gram)	China CNY 75.00 (500 gram)	Chile Ecolabel CNY 150.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Norway CNY 50.00 (500 gram)	Chile Ecolabel CNY 125.00 (500 gram)	China Ecolabel CNY 175.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Among the four following sashimi salmon options, which one would you prefer to purchase?

Option A	Option B	Option C	Option D
			
Chile CNY 175.00 (500 gram)	Norway Ecolabel CNY 75.00 (500 gram)	China Ecolabel CNY 100.00 (500 gram)	If these were my only options, I would not purchase
☐	☐	☐	☐

Appendix E. Model Implementation and R Script

As described in Section 6.3.4, the model was implemented using the Apollo package in R (Hess & Palma, 2019). The table below summarizes the key features of the model structure and estimation process.

Table E.1 Key features of the model structure and estimation process.

Variable	Treatment in Model	Notes
ASCs	Included for alt1–alt3	alt4 used as a reference category
Age	Continuous	Natural scale (years)
Gender	Dummy variable (0/1)	Male = 1, Female = 0
Household Size	Continuous	Assumed linear impact on utility
Education	Treated as continuous	Ordinal scale (e.g., 1 = low, 4 = high); assumes monotonic utility
Income	Treated as continuous	Ordinal scale (1–5); monotonicity assumed
Seafood Consumption	Treated as continuous	Frequency-based ordinal scale
Buy Seafood	Dummy variable (0/1)	1 = buys seafood, 0 = does not
Prior Salmon Experience	Dummy variable (0/1)	1 = Yes, 0 = No
Origin	Alternative-specific dummies	Separate indicators for Norway, Chile, China
Ecolabel	Alternative-specific dummy	1 = ecolabel present, 0 = absent
Price	Log-transformed	log(price) used to capture diminishing marginal disutility
Overall Liking	Continuous	Captures sensory satisfaction
Stated Preference vs Revealed Preference	Separate scale parameters	mu_blind (fixed at 1), mu_informed (estimated)

Note: Although several control variables were ordinal, they were modelled as continuous variables. This decision was made to maintain model parsimony, minimize collinearity, and because the ordinal scales used (e.g., for education and income) reflect logically ordered constructs with relatively few levels. Treating such variables as continuous is consistent with standard practice in discrete choice experiments when monotonic effects are assumed (Train, 2009).

R script for model estimation.

```
# Clear environment
```

```

rm(list = ls())

# Load required libraries
library(apollo)
library(readxl)

# Initialize Apollo
apollo_initialise()

# Set Apollo control settings
apollo_control = list(
  modelName      = "MNL_RP_SP",
  modelDescr     = "RP-SP model on mode choice data",
  indivID        = "id",
  outputDirectory = "output"
)

# Load data
final_data <- read_excel("D:/WTP Analysis - MNL model/final_data_wtp.xlsx")
database <- final_data

# Define model parameters (including sociodemographics)
apollo_beta = c(
  asc1 = 0, asc2 = 0, asc3 = 0,
  b_norway = 0, b_chile = 0, b_china = 0,
  b_ecolabel = 0, b_price = 0, b_liking = 0,
  mu_blind = 1, mu_informed = 1,
  b_age = 0, b_male = 0, b_householdsize = 0,
  b_education = 0, b_income = 0,
  b_seafoodconsumption = 0, b_buyseafood = 0,
  b_salmon taste = 0
)

# Set fixed parameters
apollo_fixed = c("asc1", "mu_blind")

# Validate inputs
apollo_inputs = apollo_validateInputs()

# Define utility function
apollo_probabilities = function(apollo_beta, apollo_inputs, functionality = "estimate") {
  apollo_attach(apollo_beta, apollo_inputs)
  on.exit(apollo_detach(apollo_beta, apollo_inputs))

  V = list(
    alt1 = asc1 + b_norway * alt1_norway + b_chile * alt1_chile + b_china * alt1_china +
      b_ecolabel * alt1_ecolabel + b_price * log(alt1_price) + b_liking * alt1_liking +
      b_age * age + b_male * male + b_householdsize * householdsize + b_education *
education +
      b_income * income + b_seafoodconsumption * seafoodconsumption +
      b_buyseafood * buyseafood + b_salmon taste * salmon taste,

    alt2 = asc2 + b_norway * alt2_norway + b_chile * alt2_chile + b_china * alt2_china +

```

```

    b_ecolabel * alt2_ecolabel + b_price * log(alt2_price) + b_liking * alt2_liking +
    b_age * age + b_male * male + b_householdsize * householdsize + b_education *
education +
    b_income * income + b_seafoodconsumption * seafoodconsumption +
    b_buyseafood * buyseafood + b_salmon taste * salmon taste,

    alt3 = asc3 + b_norway * alt3_norway + b_chile * alt3_chile + b_china * alt3_china +
    b_ecolabel * alt3_ecolabel + b_price * log(alt3_price) + b_liking * alt3_liking +
    b_age * age + b_male * male + b_householdsize * householdsize + b_education *
education +
    b_income * income + b_seafoodconsumption * seafoodconsumption +
    b_buyseafood * buyseafood + b_salmon taste * salmon taste,

    alt4 = 0
)

P = list(
  blind = apollo_mnl(list(
    alternatives = c(alt1=1, alt2=2, alt3=3, alt4=4),
    avail = list(alt1=1, alt2=1, alt3=1, alt4=1),
    choiceVar = choice,
    utilities = lapply(V, function(x) mu_blind * x),
    rows = (blind == 1)
  ), functionality),

  informed = apollo_mnl(list(
    alternatives = c(alt1=1, alt2=2, alt3=3, alt4=4),
    avail = list(alt1=1, alt2=1, alt3=1, alt4=1),
    choiceVar = choice,
    utilities = lapply(V, function(x) mu_informed * x),
    rows = (informed == 1)
  ), functionality)
)

P = apollo_combineModels(P, apollo_inputs, functionality)
P = apollo_panelProd(P, apollo_inputs, functionality)
return(apollo_prepareProb(P, apollo_inputs, functionality))
}

# Estimate the model
model = apollo_estimate(apollo_beta, apollo_fixed, apollo_probabilities, apollo_inputs)

# Extract estimates and standard errors
params <- model$estimate
se <- model$se

# Calculate WTP:  $-\beta_{\text{attribute}} / \beta_{\text{price}}$ 
b_price <- params["b_price"]
wtp <- -params / b_price

# Calculate standard errors of WTP via delta method
calculate_se_wtp <- function(b_x, se_x, b_price, se_price) {

```

```

    sqrt((se_x / abs(b_price))^2 + ((b_x * se_price) / b_price^2)^2)
  }

se_wtp <- mapply(calculate_se_wtp, params, se, MoreArgs = list(b_price = b_price, se_price =
sel["b_price"]))

# Calculate t-stats and p-values for WTP
t_stats <- wtp / se_wtp
p_values <- 2 * (1 - pnorm(abs(t_stats)))

# Create summary data frame
wtp_summary <- data.frame(
  Attribute = names(params),
  WTP = round(wtp, 3),
  SE = round(se_wtp, 3),
  `p-value` = signif(p_values, 3)
)

# Display results
print(wtp_summary, row.names = FALSE)

```