Do Integrated Traceability Methods Cause Conflict of Interest in the Farm-raised Atlantic salmon Industry?

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Policy Article

ABSTRACT

Farm-raised Atlantic salmon is the most important finfish species produced by the Canadian aquaculture industry, which has been facing drastic reduction in its demand since the food incidence of polychlorinated biphenyls occurred. Different policies at various stages of production, processing, distribution and marketing channels have been proposed to assure consumers that farm-raised Atlantic salmon is safe. Amongst the suggested policies, the integrated traceability methods and quality control system may be the right policy that benefits both consumers and producers. It consists of different methods applied to the food chain, such as the Global GAP and Quality Management Program, the Hazard Analysis and Critical Control Points, and the radio frequency identification and quick response code-systems. The implementation of traceability system, however, imposes additional cost to the industry that may neither be absorbed by producers nor be paid by consumers. As a result, conflicting interests between producers and consumers may arise. In addition, consumers' decisions may be affected by their lack of knowledge about different stages of aquaculture production processes. A traceability system can help consumers make informed decisions in purchasing certified farm-raised Atlantic salmon. Reviewing

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the existing literature, this article examines the impact on producers and consumers of implementing the integrated traceability methods on the farm-raised Atlantic salmon industry in the province of Newfoundland and Labrador, Canada. The article concludes by suggesting the use of intermediary firms to facilitate the implementation of integrated traceability systems in the industry.

1. INTRODUCTION

The seafood industry in the province of Newfoundland and Labrador (NL) continues to play an important role in the vibrant economy of the province. In 2013, the industry gained significant increases in both commercial capture fisheries landings and aquaculture production volume. In the same year, the growth in the value of aquaculture production caused an increase in the value of total production in the industry. Although the average market prices for many species decreased in 2013, the NL seafood industry was able to generate nearly USD824.67 million in revenue due to significant growth in the value of aquaculture production, representing 8 per cent growth in comparison to the same figure in 2012 [1]. The industry also benefited from the global increase in demand for different types of seafood products (e.g., fish, shellfish, roe, etc.) that, in turn, led to an increase in the exports of provincial seafood products to more than 40 countries, including the United States and China as the major importers of these types of products, in 2013 [2]. In terms of employment, the NL seafood industry created year-around jobs for more than 18,000 people, mostly in the rural areas of NL, in both the harvesting and fish processing sectors [2]. The aquaculture industry also observed a significant increase in the volume of production by 25.1 per cent in the same year. This substantial growth in the industry production (74.3 per cent) was related to the increase in the production of Atlantic salmon, followed by mussels [2]. Despite of all these achievements, the aquaculture industry has been facing a serious reduction in the demand for farm-raised Atlantic salmon caused by the food incidence of polychlorinated biphenyls [3,4]. For instance, according to independent laboratory tests experimented in Sydney, BC, polychlorinated biphenyls were found for the first time in 70 per cent of farm-raised salmon purchased at grocery stores in Washington DC, San Francisco, and Portland, Oregon at levels that put consumers' health at serious risk [3]. Policy makers have been trying to introduce different proposals in various stages of the business from production to processing, distribution channels, and marketing to lessen the current mistrust of consumers in the quality of farmed Atlantic salmon.

To meet the increased demand for food safety, the industry is obliged to develop a comprehensive policy that considers the needs of both consumers and producers. One possible policy is the integrated traceability methods and quality control system. It consists of a series of chain operations in the food industry that enables consumers to have more access to information about a product, which in turn, can boost consumer confidence in its safety and authenticity [5]. There are three methods that have recently been the focus of stakeholders in the aquaculture industry. They are the Hazard Analysis and Critical Control Points (HACCP), the radio frequency identification and quick response code- systems, and the GlobalGAP and Quality Management Program (QMP). The QMP method requires the aquaculture industry, in general, and the farm-raised Atlantic salmon industry, in particular, to adopt concise and solid plans based on the HACCP method. The use of the second method forces the industry to manage in-house salmon cultivation, inspection, distribution, and retailing in global markets [6]. The implementation of the above methods imposes additional costs to the industry, and in the absence of public policies, it is not yet clear who is responsible for absorbing those costs. Consumers may demand the implementation of the aforementioned traceability methods, but whereas producers do not want to be in a position that may put them in a less competitive financial position when compared to other producers who use conventional methods of salmon farming.

This article analyzes consumer views on buying certified farm-raised Atlantic salmon in the province of Newfoundland and Labrador, Canada. A certified farmed Atlantic salmon is defined as a product that is undergoing the integration traceability methods to ensure buyers that the product is safe for consumption. We also examine the impact of implementing the integration traceability methods (i.e., QMP,

HACCP, and the radio frequency identification and quick response code- systems) on farmed Atlantic salmon producers. Finally, it reviews various policies that government agencies could follow to facilitate the integration traceability systems in the farm-raised Atlantic salmon industry.

2. BACKGROUND

The Canadian Food Inspection Agency (CFIA) designs, monitors, and implements one of the most rigorous and comprehensive food inspection and quality-control systems in the world. The CFIA, founded in April 1997, is a regulatory institution that combines and integrates the inspection services of three governmental departments including the Agriculture and Agri-Food Canada, Fisheries and Oceans Canada, and Health Canada. The CFIA's mission is to operate as a science-oriented institution that Canadian consumers and producers as well as international communities can trust and rely on for any matters related to food safety [7]. The CFIA sets standards for all types of fish that are either domestically produced or imported that include farm-raised Atlantic salmon and other seafood and aquaculture products. The responsibilities of CFIA are not solely related to federally registered fish and seafood processing establishments, importers, fishing vessels, and equipment used for handling, transporting, and storing fish [8]. The Agency establishes requirements that clarify fish processing plants follow the rules and regulations of QMP plan and HACCP. The food safety incident of farm-raised Atlantic salmon in 2003 prompted the CFIA to revise the various stages of fishing operations so that they meet the sanitary conditions set by the major importers of the seafood products in the world [9]. For instance, farm-raised Atlantic salmon should constantly undergo a series of sanitary tests for PCBs. The current acceptable level of PCBs contamination is 2 ppm which means that if the amount of the PCBs contamination is above this limit, the products will not be supplied to the global food markets [9].

Any integrated traceability and quality control system should be built on the following four pillars [5]. First, it must be able to identify (i.e., place of origin, the ability to follow their movements and their final destination) animals and/or food products.

Second, a proper traceability system should detect where the animals and/or food products come from. Third, it must be able to track down the movement of animals and/or food products, and finally a well-established traceability system should be able to locate the final destination of animals and food products. To meet such a standard, the federal government designed a knowledge-based policy in early 2000s in which an integrated traceability system played a pivotal role in the agri-food industry [9]. In the 1990s, there was a voluntary and unsophisticated method of identification in the cattle industry using tags, brands, and paper-based logbooks as traceability methods. The province of Quebec was the first to address the concept of traceability in its current framework in 2001 [10]. In addition, the Canadian Livestock Identification Agency (CLIA) was founded in 2004 to expedite the establishment of traceability system in the cattle industry, which led to the foundation of the same mechanisms for other industries in the livestock, fishery and aquaculture sectors.

The Canadian Aquaculture Industry Alliance (CAIA) established its own sets of rules and regulations to implement a traceability and identity preservation system in the industry that conformed to current world standards [11]. The CAIA is a national institution that supports its stakeholders, such as the aquaculture operators, finfish and shellfish growers, and feed companies and suppliers [12]. The mission of the CAIA is to make sure that the Canadian Aquaculture Industry maintains its current competitiveness in the world seafood market by "(*i*) representing the industry's points of interest, (*ii*) building a sound-promising industry, and (*iii*) using proper market strategies targeting different segments of consumers to promote domestically produced aquaculture products" [12]. The CAIA's main objectives are highlighted as follows. First, the institution tries to present a strong and independent organization that fosters the needs of the national aquaculture industry. Secondly, it supports the industry's interests in relation to national public policy. Finally, the CAIA designs and develops national aquaculture strategies that contemplate the interests of all stakeholders in the industry, which eventually, will lead to providing real and measurable benefits to its members [12]. In accordance to the aforementioned mission and objectives, a globally-accepted traceability system for aquaculture products has been developed by the Canadian Aquaculture through introducing a National Code System (NCS) which sets national standards for food safety and environmental management [5]. For the time being, the collegial

efforts of the CAIA and CFIA, to some extent, reduce consumers' mistrust in the national seafood and aquaculture industries and, for example, farm-raised Atlantic salmon is being tested by a third party on a regular basis to ensure that the product meets the standards of the global markets [12].

In 2009, the Industry Government Advisory Committee (IGAC) was founded by the collaboration of the federal, provincial, and territorial governments and the livestock industry [13]. The main task of IGAC was to "lead the development and implementation of the National Agriculture and Food Traceability System (NAFTS)" through an initial five-year strategic plan for the Canadian Agriculture and Food Traceability Research and Development that serve as a guideline to channel the complementary and collaborative interests of key stakeholders [14]. The IGAC consisted of 37 members in total of which 15 members from federal, provincial, and territorial governments and another 22 industry members to design a series of guidelines which monitor traceability systems and expedite its operational procedures in the country. While this plan offers strategic consistency, operational flexibility is the domain of the stakeholders, which can be found from the IGAC's vision [14]. A strategic management system is ultimately needed to differentiate and address the required elements of planning, leadership, implementation, and change management geared toward strengthening collaborative work. Interested readers can find more about the IGAC strategic plan in [14] and [8].

3. ECONOMIC ASPECTS OF TRACE-ABILITY

A comprehensive review of the literature shows that the idea of establishing an integrated traceability system in the food industry began amongst stakeholders including producers, food professionals, economists and policy makers in the 2000s. Similar to [15], we identify five groups who may be interested in the concept of traceability, labelling, and identity preservation systems for farmed Atlantic salmon. These groups are (*i*) consumers who consistently seek food safety, (*ii*) environmental supporters, (*iii*) domestic and foreign producers who are persistently trying to assure consumers that their products are safe, (*iv*) governmental agencies which are actively working to find proper solutions to mitigate consumers mistrust in the

food safety, and (*v*) policy makers and researchers who carefully examine consumer and producer attitudes toward traceability and labeling systems in different food sectors. In addition, three potential outcomes of implementing an integrated traceability system in the farm-raised Atlantic salmon industry would justify its vital role in the food safety. These three functions are (*i*) ability to reduce both public and private costs by tracking down a safety problem when it occurs, (*ii*) ability to strengthen the enforcement of Tort Liability law that requires producers to consider safety of food they produce, and (*iii*) ability to raise public awareness on information related to animal well-being, product ingredients, and environmentally-friendly agricultural practice through proper and comprehensive labelling. This articles encourages interested readers to find more details on various functions of traceability systems in [16-20]. In the followings, we briefly review the recent studies that have examined the concept of traceability in the livestock, seafood and aquaculture industries.

Consumers' willingness to pay a premium price for certified farm-raised Atlantic salmon in the province of Newfoundland and Labrador was investigated by [5]. The author hypothesized that the adoption of bar code systems and the utilization of GlobalGAP at the farm level and the HACCP at the processing and packaging plants would assist the industry to ensure households that the product is safe. The author used the contingent valuation method and specified a probit regression model to measure consumers' attitudes toward purchasing certified farmed Atlantic salmon. The researcher used a primary sample data collected from 120 participants, who were randomly selected from the telephone directory, throughout the province of Newfoundland and Labrador in early 2010 [5]. The information in the survey questionnaire comprised of demographic, socio-economic characteristics, and attitudinal variables. The dependent variable of the model was a dichotomous one implying whether the respondents were willing to pay a 15 per cent premium price to buy certified farm-raised Atlantic salmon, which was passed through various stages of traceability and quality control systems. The result od the study showed that (*i*) the respondents with higher level of education and higher income bracket as well as seniors were among the participants in the survey who were most willing to pay the premium price to purchase the certified farm-raised Atlantic

salmon, (*ii*) the respondents welcomed the use of integrated traceability methods and quality control systems in the salmon industry in spite of the fact that such implementation could possibly drive up the price of farm-raised Atlantic salmon, and (*iii*) the implementation of the integrated traceability system in the salmon industry could potentially change consumers' demand for such product [5].

A conjoint experimental research was conducted by [21] to examine consumer preferences for wild and certified farmed salmon and shrimp in Rhode Island, USA. The researchers defined a 'certified product' as the one that was passed through a series of experimental traceability and quality control systems and met the standard criteria set by the regional aquaculture certification group. The criteria were sustainability of fish feed, the level of antibiotic used, water quality, and stocking density. A conditional logit model was specified to assess consumers' choices between the purchase of wild or certified farm-raised salmon and shrimp. The authors collected related information for a sample of 250 consumers in 2010. The results showed that if the stated standard criteria were met then the respondent would purchase wild and certified salmon and shrimp. In addition, consumers' decisions were affected by their lack of knowledge about different stages of aquaculture production processes.

A cost/benefit analysis was used to examine how the Iceland seafood industry could gain from implementing traceability systems [22]. The authors evaluated net benefits perceived by a couple of firms at each stage (i.e., production and distribution) of the seafood supply chain and hypothesized that the costs and benefits were not evenly distributed between the two firms. The main objective of the study was to measure the percentage share of the costs and benefits of traceability between the two companies throughout the supply chain. The findings of the researchers' study were to identify the sources that caused discrepancy between the costs and benefits resulting from implementing the traceability systems [22]. These sources were market growth, recall reduction, liability claim and lawsuits reduction, labour savings, and process improvement [23].

There is general consensus that cultural diversities could have direct impact on consumer decision-making [24] and lack of quality assurance methods [25] and the use of improper risk management methods [26] could have negative effects on consumers' understanding about the implementation of integrated traceability systems in the global food markets. A cross sectional comparison of consumers' benefits perceived from implementing integrated traceability systems amongst France, Germany, Italy, and Spain was carried out by [27]. The analytical tool was the means-end-chain laddering method by taking into account of some of the consumers' attributes, such as health, quality, place of origin and naturalness, safety, animal welfare, and control. The result of the study showed that the use of integrated traceability systems strengthened consumers' trust in the food industry.

Consumer preferences were examined in quality, traceability and originality for beef labels in Belgium [28]. The authors broke down consumers' interest, specified as the "level of perceived importance attached to and attention paid to label cues" on gaining more information from reading beef labels and raise their common knowledge on the quality and originality of the product. The focus of their study was to evaluate the mandatory traceability and product originality methods that were applied to European beef products. The result of the study indicated that (*i*) consumers placed great values for acquiring information related to quality guarantee seal and/or expiration date of the product than other attributes such as originality and traceability mechanisms, (*ii*) consumers believed that improving their knowledge would directly affect their perceptions on food quality and originality.

Evidence showed that integrated traceability systems in the food supply chains could also be emerged by regulatory and industry initiatives [29]. Traceability and liability would make all the stakeholders in the industry better off so that they could examine their rights in due diligence. An experimental auction was designed to assess consumer preferences for credence attributes for pork and beef. A credence good is the one for which consumers can neither ascertain its utility impact nor can measure its utility gain or loss even after consumption. The author showed that certified products were usually recognized and highly valued by consumers, especially if they were bundled with other criteria related to quality assurance information. Similar to the results of other studies, [29] concluded that the integrated traceability systems could entice food safety and quality assurance in the food industry [8,30-34].

4. CONFLICT OF INTEREST

Sustainable fish farming practices should be the core of any economic development in both rural and urban areas. An example of sustainable fish farming practices is the one that has recently been established in Centre Burlington, Nova Scotia after eight years of investing in research and development where locally farmed Atlantic salmon is produced in large tanks on land [35]. In a fish farming practice on land all saltwater in the tanks of fish-raising is recycled, all waste is transformed into fertilizer, and the safety guidelines (e.g., less than 2 ppm PCBs) have been met at the same time. Organic fish food is used to feed the salmon in the tanks with no use of antibiotics. It has been estimated that the product price per pound will be between 10 to 15 per cent higher than other salmon fish on the market [35]. The above evidence implies that the use of new technologies, at first, will possibly lead to increase the product price until the minimum efficient scale is obtained in the long run. Moreover, as mentioned earlier, the implementation of integrated traceability methods will increase the price of farm-raised Atlantic salmon. This is the point where conflict of interest may be arisen because neither producers nor consumers are willing to absorb the additional costs of implementing traceability system even though its benefits in the future would be inevitable. Conflict of interest is defined as anything that may arise between stakeholders of an industry (usually between consumers and produces) for a couple of reasons: (*i*) a disparity between the beliefs and ultimate objectives of trading partners which could differ about possible results of their decisions and their relative chances of occurrence, and/or (*ii*) a disparity between ordinal ranking of trading partners' preferences over the results of their decisions [36]. In addition, the emergence of conflict of interest could stem from the fact that some results of a decision might create an imbalance benefits amongst decision-takers in the industry; thus, such conflict could be prevented if trading partners reprioritize their own self-interest to the one that encompasses moderate benefits to all of them. However, this suggestion contradicts with the economic theories; especially for the farm-raised Atlantic salmon industry; a proxy of contestable market [37,38].

The findings of the above discussion show that the implementation of integrated traceability systems will possibly drive up the price of farm-raised Atlantic salmon, at least, at early stages of production until the minimum efficient scale of the production is reached. This increase in the product price may prevent consumers from buying certified farm-raised Atlantic salmon as much as they used to and, as a result, a drastic decrease in the product's sales is anticipated, which would consequently cause the emergence of conflict of interest between the certified farmed Atlantic salmon producers and consumers on the grounds of who bears the costs of implementing integrated traceability systems. Empirical analysis showed that Newfoundlanders and Labradoreans were willing to pay a maximum premium price of 15 per cent to purchase certified farm-raised Atlantic salmon [5,8]; however, those findings should cautiously be interpreted because they are relied solely on sample data which is always exposed to common sampling caveat, including the existence of hypothetical bias and/or incentive compatibility [39]. Nevertheless, since farmed Atlantic salmon in Newfoundland and Labrador is mostly produced (67 per cent of total provincial aquaculture production), marketed, and exported (more than 85 per cent of total provincial aquaculture production) by private sector [40] the aforementioned limitations can, to some extent, be abated [5].

To overcome the conflict of interest, this article suggests the use of intermediary firms on marketing certified farm-raised Atlantic salmon. This suggestion may raise this concern that the addition of intermediary firms to the economic system would increase marketing cost since intermediary firms would not be directly involved with consumers and simply act as a bridge between producers and wholesalers/exporters. An intermediary firm is an economic entity whose main task is to create and manage markets by acting as intermediaries between buyers and sellers [41]. Just as producing certified farm-raised Atlantic salmon use scarce resources, the establishment and operation of its market also requires scarce resources. Farm-raised Atlantic salmon producers incur both explicit and implicit costs in adjusting prices and communicating price information to buyers for the newly produced product; however, the types of information they can eventually obtain from the market-response are not perfect and because of that they need intermediation activities from other firms that enable them to sell their product. Intermediary firms seek suppliers, find and encourage buyers, select buy and sell prices, define the terms of transaction, manage the payments and record keeping for transactions,

and hold inventories to provide liquidity or availability of goods and services [41-43]. We can list the role of an intermediary firm in the market for certified farm-raised Atlantic salmon as follows. First, it may provide liquidity by buying and selling the product when there is demand and supply randomness. Second, transactions in the salmon market can be coordinated through normal functioning of the intermediary firm (i.e., matchmaking and brokering activities), especially when willingness to pay a premium price and/or opportunity costs of trading partners do not exist. Third, the use of intermediary firm to market certified farm-raised Atlantic salmon is imperative particularly when potential buyers and sellers are unobservable. Fourth, the intermediary firm can generate market information and provide guarantees for product quality to address adverse selection. Fifth, it can provide monitoring and contracting services for certified farm-raised Atlantic salmon when the actions of consumers or producers are costly to observe. Finally, the intermediary firm would find methods of clearing the market, i.e. pricing to match purchases to sales, which in this case market equilibrium prices are attained. In summary, the above roles clearly distinguish an intermediary firm from an independent certifying firm and a marketing firm in a sense that the last two entities are highly-

specialized type of enterprises with distinct features, expertise, and responsibilities. While each one of these entities can potentially become an intermediary firm some barriers to entry, such as knowledge-based expertise, substantially amounts of initial investment, economies of scale of incumbent firms, predatory pricing, vertically integrated incumbent firms, network effects, distributor's agreements, and cost advantages independent of scale may prevent them from entering the industry.

Fig. 1 shows the role of intermediary firms in the market of certified farm-raised Atlantic salmon. In this diagram, three distinct economic agents, such as consumers, farm-raised Atlantic salmon producers, and intermediary firms are identified pertaining to have positive impact in the market of certified farm-raised Atlantic salmon. The economic role of each group is explained as follows. Consumers are market–takers implying that they take the product price as what it is and try to maximum their level of satisfaction subject to the factors that determine their demands for the product. In contrast, certified farm-raised Atlantic salmon producers create and operate markets for the product. This group of economic agents has the ability to operate as market-makers because they are price-making, going
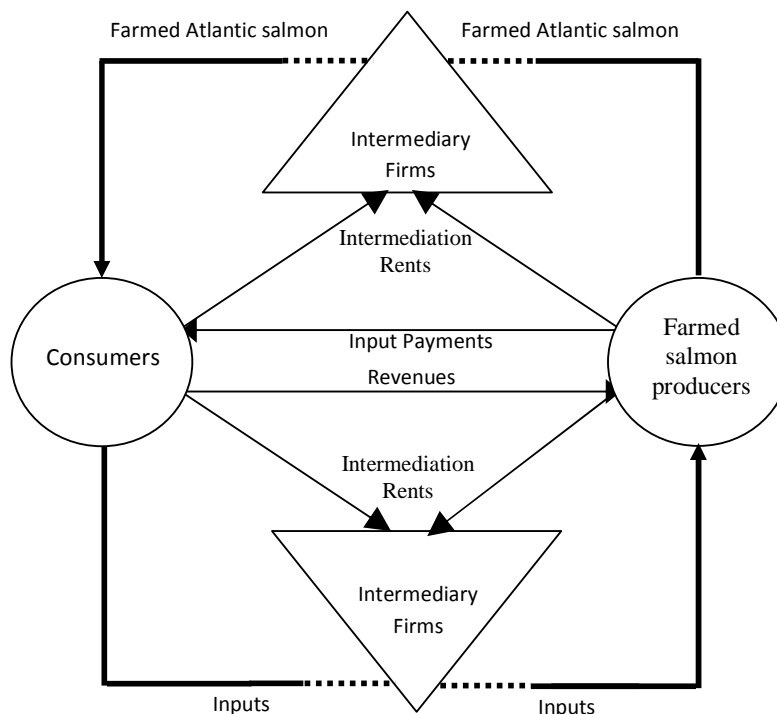
Fig. 1. The role of intermediary firms in the market of certified farm-raised Atlantic salmon
Source: Adopted from [41]

beyond traditional farm-raised Atlantic salmon producers by coordinating transactions between consumers and other intermediary firms. Consumers send expenditures to certified farm-raised Atlantic producers in return for purchasing the product and receive incomes from intermediary firms in return for different types of factors of production they supply in the market. Similarly, certified farm-raised Atlantic salmon producers receive revenues from intermediary firms in return for the products they produce in the market and make factor payments and intermediation rents to consumers and intermediary firms, respectively, in return for the services received. In a perfect competitive market, prices adjust to clear markets, which is not the case for the certified farm-raised Atlantic salmon market because the nature of the product will yield some market power caused by various factors, such as product differentiation, innovation methods, consumer switching costs, transaction costs, barriers to entry, intellectual property rights, and incomplete information about future prices. For the certified farm-raised Atlantic salmon producers setting prices alone can be costly. They need to gather information for demand and supply, monitor competitors' prices at the same time and also need to perform concise calculations to determine the profit-maximizing prices. Certified farm-raised Atlantic salmon producers also need to communicate prices to its consumers and suppliers. They may incur menu costs in changing prices by improving public awareness about the benefits of consuming their products through printing new catalogs or issuing price lists. Finally, it is no doubt that certified farm-raised Atlantic salmon producers will be willing to pass the task of creating and finding markets for their product onto intermediary firms that not only arbitrage between buyers and sellers, but also coordinate their transactions through price signals as well as ability to provide immediacy by holding inventories, and as a result, adjusting prices to maintain inventories [42,43].

5. CONCLUSION

In 2011, the total amount of finfish sales was around USD628.25 million with farmed Atlantic salmon comprising more than 88 per cent of the total sales, which clearly shows how important the industry is in the country despite the food incidence of polychlorinated biphenyls that caused drastic changes in demand for farmed

Atlantic salmon worldwide [5]. An integration traceability method and quality control system has been proposed for the farm-raised Atlantic salmon industry to ensure food safety and to deliver quality assurance for consumers to strengthen their confidence in the industry. The implementation of the suggested policy would drive up the product price (i.e., certified farmed Atlantic salmon) and might prevent consumers from purchasing the product, which is passed through various stages of traceability methods. This may generate conflict of interest since it is ambiguous as who bears the additional costs of traceability methods. This article proposes the use of intermediary firms as proper institutions to market certified farm-raised Atlantic salmon. Wherever public regulators are weak, markets for these new credence-like products may not be forthcoming, leading to fragmentation. The theory of intermediation suggests that without intermediation there is the possibility that the entire market might not be realized, which would seriously impede adoption of the new technologies. Therefore, innovators would face lower rates of return and would respond with lower research and development, which would translate over time into lost consumer and producer benefits. Furthermore, given the difficulty in segregating certified farm-raised Atlantic salmon from non-certified farmed Atlantic salmon, incumbent producers of farmed Atlantic salmon could face higher marketing costs from the unmediated introduction of certified farm-raised Atlantic salmon.

This paper is obviously a preliminary application of the theory of market microstructure that requires to be developed and applied more concretely to other similar markets (e.g., genetically modified foods versus conventional foods) to determine its general applicability. It would also be helpful to "trace out" how this theory could be applied from a practical perspective. For example, this article suggests presenting a clear separation of a process for certified farm-raised Atlantic salmon and the role of an intermediary firm for marketing. On the face of it, however, this study offers a refreshingly new and potential useful framework for analyzing markets in the making.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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