

**CONSUMER PURCHASE INTENTIONS FOR CERTIFIED FARM-RAISED
ATLANTIC SALMON**

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ABSTRACT

The occurrences of food safety incidents like polychlorinated biphenyls in farmed Atlantic salmon in Canada heightened public awareness causing significant reduction in the consumption of the product. This has induced policymakers and stakeholders to implement traceability systems as part of enhancing consumers' trust and safety in the industry. This study provides information on consumers' awareness about traceability systems of farm-raised Atlantic salmon and their willingness to pay for traceable product in the province of Newfoundland and Labrador, Canada. In this study, we used a logistic regression model to assess consumers' preferences for farm-raised Atlantic salmon. To estimate the parameters of the model, a telephone survey was carried out in fall 2018 over 200 consumers in the province. The results of the study showed that age of the respondents, education level, household size, and household consumptions were significant determinants of the Newfoundlanders and Labradoreans' willingness-to-pay a premium price for the farm-raised traceable salmon. Moreover, a shortage of public knowledge about the traceability systems was also observed in the empirical evidence. To increase the consumers' knowledge about the value of traceability system and its aspects, provincial authorities and private food companies need to take further initiatives. Providing detail labeling could be one of the suitable ways of communicating traceability to consumers. Besides, comprehensive monitoring by the competent authorities is also required to guarantee the truthfulness of traceable information and to reveal the food safety problems for enhancing the degree of consumer confidence in traceability systems.

Keyword: Traceability systems, farm-raised Atlantic salmon, willingness to pay, Newfoundland and Labrador.

1. INTRODUCTION

Seafood industry in Canada substantially contributes to the gross domestic product of the province Newfoundland and Labrador (NL). The industry is mainly export oriented and near 130 countries all over the world imports these products from Canada (Agriculture and Agri-food

Canada 2016). The provincial Department of Fisheries and Land Resources records that aquaculture production in 2016 reached a peak volume and increased by 25.5 percent compared to 2015 and in 2016 aquaculture represented 19.2 percent of total seafood production in the NL seafood industry (Government of Newfoundland and Labrador 2017). The increasing production of farm-raised Atlantic salmon has been the main driver of growth in aquaculture production in 2016. According to Fisheries and Oceans Canada (2016), Canada is the fourth-largest producer of farm-raised salmon in the world.

In recent years, the media reports highlight illegal harvesting of seafood and the mislabeling of seafood products has increased (Boyle 2012). Besides, the outbreak of a series of communicable diseases in the agri-food market, such as the Avian Flu, Bovine Spongiform Encephalopathy, E-coliO157:H7 in beef, salmonella in Mexican tomatoes, Mexican cilantro and peppers, and polychlorinated biphenyls (PCBs) in salmon fish, has reduced the confidence of consumers in food processing along with the supply-chain (Magera and Beaton 2009). The incidents of PCBs in farm-raised salmon in 2003 created distrust among consumers about the quality and safety of Atlantic salmon which initially decreased its demand in the global market (Haghiri 2014). A research done by an environmental working group in 2003 found that 70 percent of farm-raised salmon purchased at grocery stores in Washington DC, San Francisco, Oregon, and Portland was contaminated with PCBs at levels that increased health hazard among the consumers (Environmental Working Group 2003). Besides, the widespread occurrences of seafood fraud and mislabeling in Canada make seafood industry as one of the vulnerable sectors (Levin 2018). As a result, along with the price, consumers are now concerns about the origin of the food products, harvesting procedures of these foods and also care about whether these foods are safe, healthy, or containing any allergens and organic components or not (Ratcliff and Boddington, 2009). In order to fulfill the consumers' demand of good quality and safe seafood products, to protect public health and to handle epidemics and to ensure consumer confidence on the seafood supply-chain such as for farm-raised salmon, policymakers have proposed various policies among whom the implementation of integrated traceability systems and quality control systems is highly recommended (Haghiri 2017). Traceability systems are highly concern about food risk issues and maintain food safety (Ovca et al. 2018) and quality properly (Rijswijk and Frewer 2008). An integrated traceability system works as an important tool to provide consumers the complete information about the food supply-chain (Bosona and Gebresenbet 2013, Rijswijk and Frewer 2011, Voordouw et al. 2011). By using existing traceability tools, an integrated food traceability system can build and improve existing tracing approach (Global Language of Business 2018).

Haghiri (2016, p.1) asserted that, in the aquaculture industry, integration of traceability systems consists of the following methods: "the Global GAP (internationally recognized standard for farm production), Quality Management Program (QMP), the Hazard Analysis and Critical Control Points (HACCP), and the radio frequency identification and quick response code-systems". For the administration and enforcement of different policies, acts, and plans, the Canadian Food Inspection Agency (CFIA) is considered as the responsible body to set standards for fish and seafood processing and distributing (CFIA 2019). To tackle the food incidents of PCBs on farmed salmon, the CFIA inspected all the steps of fishing-process related to farm-

raised Atlantic salmon (Haghiri 2014). In order to meet the sanitary conditions set by the importers of the seafood products of different countries, CFIA has revised some stages of fishing operations of Atlantic salmon fish. Moreover, farm-raised Atlantic salmon now goes through a series of tests to check the level of PCBs and acceptable limits of PCBs contamination are settled at 2ppm; that means if the contamination level of PCBs in Atlantic salmon fish has exceeded this border, fish will not be suitable for local and global trade (Haghiri 2017). To maintain Canadian traceability regulations, Canadian finfish farms are implementing sophisticated traceability systems to track finfish from egg to the marketplace to consumers' plate (CAIA 2017). Hansstein (2014, p.115) stated that "although traceability systems are becoming more common in the food chain, consumer knowledge about traceability is still spotted and unclear". So, it is important to investigate consumers' behaviors toward implementation of traceability systems.

The main objective of this study is to analyze consumer purchase intentions for certified farm-raised Atlantic salmon in the province of Newfoundland and Labrador, Canada. We try to shed light on how much the NL consumers are familiar with the term traceability system and their acceptability of traceability systems for farm-raised Atlantic salmon and investigate the factors that influence the consumers' willingness to pay (WTP) a premium price for traceable farm-raised Atlantic salmon in the region. The rest of the paper is organized as follows. Section 2 reviews the recent studies that examine consumers' perceptions and WTP for traceable foods and the effects of traceability systems on consumers' trust. Section 3 (i) presents a theoretical framework for the logistic model, also known as the dichotomous model, (ii) provides a summary of data and sample observations collected from the consumer survey, and (iii) discusses the estimation results obtained from the econometric model. Finally, Section 4 concludes the study, provides some policy recommendations, lists the limitations of the study, and suggests areas for further research.

2. LITERATURE REVIEW

The term traceability has been used frequently in the food industry as well as in the production industry. In the 14th century, documenting the information about the origin of animal products was first created concern to introduce traceability into food regulation (Sterling et al. 2015). Besides, reported scandals, accidents and incidents in food industry in different time period such as mercury poisoning in fish in 1970 in UK, radioactivity in lamb in 1986 in UK, dioxins and polychlorinated biphenyls in poultry farm in Belgium in 1999 and baby milk scandals in China in 2008 have made the concept food traceability as global concern. Golan et al. (2004) uttered that food is a complex item so the definition of food traceability is unavoidably broad. Olsen and Borit (2013, p.148) defined traceability as "the ability to access any or all information relating to that which is under consideration, throughout its entire lifecycle, by means of recorded identifications". In the view of Karlsen et al. (2010), traceability does not only provide the information about the product and process but also helps find out all these information again at a later date. In this regard, Bailey et al. (2016, p.26) also highlighted that traceability is "not the information itself, but rather the system or tool that makes the flow of this information possible and allows for records of production and product movement to be accessible at a future date and at distant places". In fact, as Adam et al. (2016) expressed a complete chain traceability system

permits to identify the causes of contamination in the supply chain and of recalling unsafe food. In particular, Karlsen et al. (2012) identified 10 drivers of food traceability, such as legislation, food safety, quality, sustainability, welfare, certification, competitive advantage, chain communication, bioterrorist threat, and production optimization.

2.1 Consumers' perception and willingness to pay for traceable foods

Feng et al. (2009) investigated consumers' perception, purchasing behavior, and WTP for safe fish products in Beijing. The study was carried out based on the survey of consumers and the result of the study showed that consumers had lacked knowledge about the traceability system of fish products in China. Most of the participants were well-acquainted with the nutritional benefits and the cooking process of fish but very few of them had idea about the storage, production, and processing of fish products. The researchers identified factors such as the age of consumers, educational level, the perception of safety and the average price, as the major determinants of consumer's WTP for traceable fish products. Feng et al. (2009) concluded that fish consumers of Beijing were ready to pay a 6 percent premium price for fishery products with a safe system of traceability compared to the products which do not maintain traceability system. The investigation of Zengjin et al. (2014), on consumers' WTP for traceable beef in China, had found the lower cognitive level of consumers about the traceability systems. The outcome of the study highlighted that after learning about the benefits of this system, 95.35 percent of the respondents became ready to pay a 20 percent premium price for traceable beef. Bai et al. (2013) noticed a strong desire for traceable milk among urban consumers, compared to rural people in China. Moreover, the study also discovered that urban consumers' WTP became higher, if certificates came from the government, followed by industrial associations and third parties. Lu et al. (2016) completed a research on consumer preferences for traceable pork in China by using a choice-based conjoint analysis and a multinomial logit model. The findings of the study showed that preference and demand for traceable pork were highly influenced by consumers' age, income level and education level, which were similar to the results of other studies, such as Feng et al. (2009), Rigueira et al. (2014), and Wu et al. (2012). Lu et al. (2016) found that four aspects, traceability information, certification of traceability information, the appearance of the meat and price, were also responsible to set consumer's demand for traceable pork. Government certification was preferred by lower educated citizens of China, whereas higher educated people preferred third-party certification of traceable information. Many studies have found brand preference as a potential attribute for consumers' WTP and purchasing choice (Ahmad and Anders 2012, Carrillo et al. 2012, Morales et al. 2013). In different countries, a considerable amount of research has been conducted on the consumers' perception of food traceability systems and their WTP for purchasing certified products (e.g., Feng et al. 2009, Haghiri, 2014; 2016, Hobbs et al. 2005, Jin et al. 2017, Lee et al. 2011, Loureiro and Umberger 2007, Lu et al. 2016, Olesen et al. 2010, Ortega et al. 2011, and Rigueira et al. 2014).

2.2 Impacts of traceable systems on consumers' trust

Knight and Warland (2005) noticed an inverse relationship between food product risks and consumers' trust. Many regulatory frameworks of the food supply chain such as the EC

Regulation 178/2002 are projected to save general people from any food safety incidents by ensuring food safety through maintaining traceability, proper labeling, and recalling the products if quality and/or safety are compromised (Kendall et al. 2018). Such regulations help boost up consumers' trust in the foodstuffs (Garcia Martinez et al. 2013). So, strengthening consumers' confidence, by preventing the spreading of food safety incidents, is one of the main objectives of applying traceability systems in food supply-chains (Sterling et al. 2015). Dopicoca et al. (2016) found that traceability is a very confusing term for consumers and they have very limited knowledge about it. The researchers mainly correlated the term with food safety and quality. Through the traceability systems, consumers would know about the origin of the products, which works as a quality indicator and gives consumers confidence (Giraud and Halawany 2006). The terms control, reliability, transparency of information are associated with traceability also help boost up consumers' security and confidence (Giraud and Halawany 2006, Rijswijk et al. 2008). Chen and Huang (2013, p.318) conducted a website-based questionnaire study in Taiwan to discover whether Food Traceability System (FTS) had any influence on consumers' purchasing intention regarding fast foods. The results of this empirical study disclosed that "when a fast food store adopts a FTS, then consumers' perceived uncertainty could be reduced because both their perceived information asymmetry and fears of seller's opportunism were also reduced, thereby strengthening their purchase intentions". The authors found that when consumers held better knowledge about the system, they accepted it more promptly. With the objectives of investigating the consumers' attitude towards and intention to purchase traceable chicken and honey in France and Italy, Menozzi et al. (2015) accomplished a study where they extended the traditional theory of planned behavior (TPB) model by adding new variables, such as trust, habits, and several demographic variables. The researchers found that among the variables, trust had the highest explanatory power for the intention to purchase chicken and honey for Italian consumers. They recommended that when consumers believed a product could be traced back to its origin and consumers trust that the information provided by the producers was authentic, it encouraged their purchasing intention. To assess the impact of traceability systems on consumers' confidence relating to food quality and food safety, Rijswijk and Frewer (2006) carried out a research in Germany, France, Italy, and Spain. The researchers examined how the perception of consumers about food safety and food quality varied among these countries. Rijswijk and Frewer (2006) observed that in consumers' minds, traceability systems were strongly connected with food safety compared to food quality and traceability systems had the power to boost up consumers' confidence by providing information about food safety and food quality.

3. EMPIRICAL ANALYSIS

This study used quantitative methods to examine how NL consumers' decisions to purchase farm-raised Atlantic salmon were influenced by the implementation of traceability systems in the provincial seafood industry. The province of Newfoundland and Labrador (NL) exports 90 percent of its seafood production every year (Newfoundland and Labrador 2019). All the people living in this province whose age was, at least, 20 years old were considered in the consumer survey. In particular, a total of 200 participants were randomly selected from the provincial population as the sample size of this study. The government of NL classifies the entire province

into four main areas including east, west, central, and the region of Labrador (Haghiri 2016). Required information of this study was gathered by dividing the respondents into these four geographic regions according to the conventional classification. On the basis of the number of the people living in each region, 40 percent of the respondents were chosen from the east region, 30 percent from the west, 20 percent from the central and the remaining 10 percent were chosen from the Labrador region. Using the random sampling technique, the samples were drawn separately from the provincial telephone directory of the four districts. The primary data for this study were collected from a survey through a structured questionnaire on consumers' preference and purchasing behavior for traceable Atlantic salmon in NL. The survey was conducted over telephone conversation and each questionnaire had taken around 15 minutes to complete during the last four months of 2018. To get 200 responses more than 500 telephone calls were made by the researchers (a 40 percent response rate). To minimize the bias in sampling, respondents were informed that the purpose of the survey was to know about their perceptions towards the consumption of Atlantic salmon fish in general, without mentioning the term traceability systems.

Table 1 shows the summary of the descriptive statistics of the sample observations. Amongst the 200 respondents, the number of female participants was 101(50.5 percent). The majority of the participants in the study (41.5 percent) ranged between 41 to 60 years of old. Collectively, 47 percent of respondents had a university degree and above and only 28 percent of the respondents earned an annual income between CAD30,000 and CAD49,999. Almost all of the participants of this survey (93 percent) preferred to consume fresh Atlantic salmon instead of the frozen one. Those respondents who declared to consume frozen fish were mostly fishermen who caught catch fresh salmon for their own consumption and preserved them as frozen for a long time period. During the survey, most of the participants' shared that they wanted to purchase wild-caught salmon because they thought that wild fish had a better taste, were healthier and had a higher nutritional value than the farm-raised fish. But due to the low wild fish population, the provincial Department of Fisheries and Oceans issued very few licenses for catching wild-salmon which were mainly for either self-consumption or for recreational purposes. So, the residence of NL was constrained to consume farm-raised Atlantic salmon. Data from the questionnaire survey indicated that very few of the respondents had knowledge about traceability systems and the PCB incidents. Approximately, 41 percent of the respondents declared that their monthly household salmon consumption was less than one pound. Altogether 73 percent of the participants had the tendency to read the label on the packet of salmon fish and 44 percent of the respondents stated that food price was important for them. Food safety and food quality are two important elements which play a crucial role in consumers' decision-making process. In this study, 42 percent of the respondents declared that during purchase of salmon fish they mainly looked forward to the quality of the fish whereas for 58 percent of the participants safety came first when they bought farm-raised Atlantic salmon. Table 1 shows that 46 percent of the participants in the survey chose food quality through certification for measuring the quality whereas 57 percent selected the option of food safety through certification for measuring the safety of farmed Atlantic salmon. This survey also identified that 51 percent of the respondents occasionally searched for the information related to the concept of food-safety during purchasing farm-raised Atlantic salmon fish though 55 percent of them agreed that traceable food was safer.

Table 1: Summary Statistics for the Variables

Variable Name	Frequency	Mean	Standard Deviation(S.D)
Gender			
Female*	101	.51	.501
Male	99	.50	.501
Age			
Between 20 and 30 years *	17	.09	.280
Between 31 and 40 years	33	.17	.372
Between 41 and 60 years	83	.42	.494
More than 60 years of age	67	.34	.473
Household size	200	2.54	1.190
Education level			
High school or less than high school*	44	.22	.415
College or higher professional school	62	.31	.464
University and above	94	.47	.500
Household income			
Less than \$29,999*	58	.29	.455
Between \$30,000 and \$49,999	56	.28	.450
Between \$50,000 and \$79,999	39	.20	.397
\$80,000 or more	47	.24	.425
Salmon type consumption			
Wild*	172	.86	.348
Farm-raised	28	.14	.348
Salmon preference			
Fresh*	186	.93	.256
Frozen	14	.07	.256
Monthly household consumption			
Less than one pound *	82	.41	.493
Between one and two pounds	73	.36	.483
Between three and four pounds	31	.16	.363
More than four pounds	14	.07	.256
Public-knowledge about traceability systems			
No*	168	.84	.368
Yes	32	.16	.368

Read salmon label			
No*	55	.27	.448
Yes	145	.73	.448
Importance of food price			
Not important*	6	.03	.171
Very important	76	.38	.487
Important	89	.44	.498
Somewhat somehow important	29	.15	.353
Public-knowledge about polychlorinated biphenyls			
No*	153	.76	.425
Yes	47	.24	.425
Concern about quality or safety			
Quality*	83	.42	.494
Safety	117	.58	.494
Measures of quality by consumers			
Quality through certification*	91	.46	.499
Quality through labeling/branding	61	.31	.462
Quality through origin	25	.12	.332
Quality not assured	23	.11	.320
Measures of safety by consumers			
Safety through certification*	113	.57	.497
Safety through labeling/branding	36	.18	.385
Safety through place of purchase	26	.13	.337
Safety not guaranteed	8	.04	.196
No safety knowledge	17	.09	.280
Search for food safety information			
Always*	39	.20	.397
Sometimes	101	.51	.501
Seldom	44	.22	.415
Never	16	.08	.272
Agree about safeness of traceable food			
Strongly agree*	45	.22	.419
Agree	111	.55	.498
Somewhat agree with	43	.22	.412
Disagree	1	.00	.071
Location			
Eastern region*	80	.40	.491
Western region	60	.30	.459

Central region	40	.20	.401
Labrador	20	.10	.301

4. RESULT AND DISCUSSION

This study uses the logistic model as an analytical technique for its characteristics of predicting probabilities within a range of 0 to 1. Here, the logistic model was utilized to observe the probability of individuals’ willingness to pay (WTP) a 6 to 10 percent premium price for purchasing farm-raised Atlantic salmon which is passing through various stages of a traceability and quality control system. This relationship is shown as a function of $\pi_i = \pi(X_i)$, where X_i represents the explanatory variables and π_i represents the aforementioned probability of individuals’ WTP a 6 to 10 percent premium price. Logistic regression estimates a multiple linear regression function:

$$\text{Log} \left(\frac{\pi_i}{1-\pi_i} \right) = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_n X_{in} + \epsilon_i \quad (i \text{ is used for } i^{\text{th}} \text{ individual})$$

Through the model, the effect of consumers’ knowledge and how their demographic and socio-economic characteristics impact their preference to buy farm-raised traceable Atlantic salmon was examined. The explanatory variables from four categories, namely 1) demographic variables 2) socio-economic variables 3) attitudinal variables and 4) knowledge variables were chosen for the model. From previous studies, the demographic factors, including gender, age, and family size, and socioeconomic variables, such as education level and family income, were taken (see, e.g., Haghiri 2014, Rigueira et al. 2014). In addition to the socio-economic and demographic factors, this study also focused on a number of behavioral factors and knowledge variables and hypothesized that they were relevant to identifying consumers’ WTP a premium price for buying farm-raised traceable salmon. For example knowledge about a product shapes consumers’ attitude. So, it is predicted that consumers with knowledge about traceability systems and polychlorinated biphenyls (PCBs) will be ready to pay more as a price premium for traceable salmon.

To predict consumers’ WTP a 6 to 10 percent price premium for purchasing traceable farm-raised Atlantic salmon in NL, the following regression model was developed. To avoid perfect collinearity in the model, one group from each of the group-category independent dummy variables was removed. A respondent whose age was between 20 and 30 years, a participant with high school or less than high school degree, and a respondent with less than CAD29,000 annual income were some of the groups considered as the base group.

$$\begin{aligned} \text{WTP}_{\text{traceablesalmon}} = & \gamma_0 + \gamma_1 \text{gen} + \gamma_2 \text{age}_2 + \gamma_3 \text{age}_3 + \gamma_4 \text{age}_4 + \gamma_5 \text{hsz} + \gamma_6 \text{edu}_2 + \gamma_7 \text{edu}_3 + \\ & \gamma_8 \text{hinc}_2 + \gamma_9 \text{hinc}_3 + \gamma_{10} \text{hinc}_4 + \gamma_{11} \text{stype} + \gamma_{12} \text{spre} + \gamma_{13} \text{hcon}_2 + \\ & \gamma_{14} \text{hcon}_3 + \gamma_{15} \text{hcon}_4 + \gamma_{16} \text{traceknow} + \gamma_{17} \text{readlabel} + \gamma_{18} \\ & \text{impfprice}_1 + \gamma_{19} \text{impfprice}_2 + \gamma_{20} \text{impfprice}_3 + \gamma_{21} \text{PCBknow} + \\ & \gamma_{22} \text{concern}_{q/s} + \gamma_{23} \text{measureQ}_2 + \gamma_{24} \text{measureQ}_3 + \gamma_{25} \text{measureQ}_4 \end{aligned} +$$

$$\gamma_{26}\text{measureS}_2 + \gamma_{27}\text{measureS}_3 + \gamma_{28}\text{measureS}_4 + \gamma_{29}\text{MeasureS}_5 + \gamma_{30}\text{searchfsI}_2 + \gamma_{31}\text{searchfsI}_3 + \gamma_{32}\text{searchfsI}_4 + \gamma_{33}\text{tfs}_2 + \gamma_{34}\text{tfs}_3 + \gamma_{35}\text{tfs}_4 + \epsilon \dots \dots \dots (1)$$

*WTP instead of $WTP_{\text{traceablesalmon}}$ was used in the rest of the thesis for simplicity.

Table 2 describes the variables used in the econometric model along with the expected sign of the coefficient. Here, it is hypothesized that consumers with a higher level of income will be more willing to pay the higher price premium for farm-raised traceable Atlantic salmon. It is also projected that higher education will make people more concerned about the information on the food they consume and, thus, they will pay more for the food which goes through traceability systems. It is expected that those households who consume more than four pounds of farm-raised salmon per month will be more willing to pay the high price premium for traceable salmon, because they will try to ensure that the salmon they consume passes through proper monitoring systems and contains no harmful ingredients. Likewise, it is anticipated the individuals who read the label on the packet of salmon, and show concern about salmons' quality and food safety, frequently search for food safety information and agree that traceable food is safer; they consequently will pay more for traceable salmon. On the other hand, a person with a bigger family comparatively will be less willing to pay a higher price for traceable salmon as it is more costly for them. Finally, it is expected that those individuals who place more values on the price of the product rather than its safety will be less likely to pay 6 to 10 percent more for farm-raised traceable Atlantic salmon.

Table 2: Variable descriptions for the logistic regression model

Variable name	Description	Expected sign
WTP	1 if the respondent was willing to pay 6 percent to 10 per cent premium to purchase farm-raised Atlantic salmon, and 0 otherwise	
gen	1 if the respondent is male, and 0 otherwise	?
age2	1 if the respondent is between 31 and 40 years, and 0 otherwise	+
age3	1 if the respondent is between 41 and 60 years, and 0 otherwise	+
age4	1 if the respondent is more than 60 years of age, and 0 otherwise	+
hsz	Household size	-
edu2	1 if the individual completed a college or a higher professional school degree, and 0 otherwise	+
edu3	1 if the individual completed at least a university degree, and 0 otherwise	+
hinc2	1 if the household income was between \$30,000 and \$ 49,000, and 0 otherwise	+
hinc3	1 if the household income was between \$50,000 and \$ 79,000, and 0 otherwise	+
hinc4	1 if the household income was \$80,000 or more, and 0 otherwise	+
stype	1 if the individual prefers farm-raised Atlantic salmon, and 0 otherwise	+

spre	1 if the individual prefers frozen salmon, and 0 otherwise	?
hcon2	1 if the household consumes between one and two pounds, and 0 otherwise	+
hcon3	1 if the household consumes between three and four pounds, and 0 otherwise	+
hcon4	1 if the household consumes more than four pounds, and 0 otherwise	+
traceknow	1 if the respondent doesn't know about traceability systems, and 0 otherwise	-
readlabel	1 if the respondent doesn't read the label on the packet of salmon, and 0 otherwise	-
impfprice1	1 if the respondent considers food price very important, and 0 otherwise	-
impfprice2	1 if the respondent considers food price important, and 0 otherwise	-
impfprice3	1 if the respondent consider food price somewhat important, and 0 otherwise	-
PCBknow	1 if the respondent doesn't know about PCB, and 0 otherwise	-
concernq/s	1 if the respondent is concerned about salmon safety, and 0 otherwise (quality)	+
measureQ2	1 if the respondent measures quality of farm-raised salmon through labeling/branding, and 0 otherwise	+
measureQ3	1 if the respondent measures quality of farm raised salmon through origin, and 0 otherwise	+
measureQ4	1 if the respondent is not assured about the quality of farm-raised salmon, and 0 otherwise	?
measureS2	1 if the respondent measures safety of farm-raised salmon through labeling/branding, and 0 otherwise	+
measureS3	1 if respondent measures safety of farm raised salmon through place of purchase, and 0 otherwise	+
measureS4	1 if the respondent is not assured about the safety of farm-raised salmon, and 0 otherwise	-?
measureS5	1 if the respondent has no knowledge about safety of farm-raised salmon, and 0 otherwise	-
searchfsI2	1 if the respondent searches for food safety information sometimes, and 0 otherwise	+
searchfsI3	1 if the respondent searches for food safety information seldom, and 0 otherwise	+
searchfsI4	1 if the respondent never searches for food safety information, and 0 otherwise	-
tfs2	1 if the respondent agrees that traceable food is safer, and 0 otherwise	+
tfs3	1 if the respondent somewhat agrees that traceable food is safer, and 0 otherwise	+
tfs4	1 if the respondent disagrees that traceable food is safer, and 0 otherwise	-
Loc W	1 if the respondent is from western NL and 0 otherwise	?
Loc C	1 if the respondent is from central NL and 0 otherwise	?

Loc Lab	1 if the respondent is from Labrador and 0 otherwise	?
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Source: Sample data

The parameters of the logistic regression model, specified in equation (1), were estimated by the maximum likelihood (ML) approach using SPSS version 25.0. The dependent variable ($WTP_{\text{traceablesalmon}}$) was coded 1 indicating individuals who were willing to pay a 6 to 10 percent premium price for purchasing farm-raised Atlantic salmon and zero otherwise (null hypothesis). Table 3 shows the estimation results of the logistic regression model. Overall, using the likelihood ratio (LR) statistic test, the calculated Chi-square was found to be 72.63, which rejected the null hypothesis that all slope coefficients were zero (p -value 0.001). Table 3 shows that with respect to consumers' WTP for farm-raised Atlantic salmon, some independent variables, such as education (**edu3**), household consumption (**hcon4**), knowledge about traceability systems (**traceknow**), perceived measures of quality (**measureQ2**, **measuresQ4**) had statistically significant effects on the dependent variable. Though it is expected that higher educated people will likely pay more as a price premium for traceable salmon, the result indicates that the level of education is negatively related to the consumers' WTP a premium price to purchase the product. Table 3 shows that those respondents holding a university degree and above (**edu3**) were 15 percent less likely to pay 6 to 10 percent more price premium than people with a high school or less than a high school degree to buy farm-raised traceable salmon. The coefficient of **edu3** was negative and statistically significant at the 0.01 level. This finding differed from the one reported in Haghiri (2014). According to the descriptive statistics, the average household size (**hsz**) of the sample data was three persons and our results demonstrated that for an additional increase in the household size, the chance of willing to pay 6 to 10 percent more premium price to buy farm-raised Atlantic salmon was 1.37 times of the chance of not willing to pay this amount (Table 3). The coefficient of the salmon preference variable (**spre**) was 1.31, which implied that when other variable remained constant, the respondents who liked to purchase frozen farm-raised salmon were more willing to pay 6 to 10 percent more premium price to purchase farmed Atlantic salmon than those who tended to buy the fresh product. The result also showed that the coefficient of the dummy variable mentioning the participants who consumed more than four pounds of salmon fish each month (**hcon4**) was positive and statistically significant at the 0.07 level, which implied that, *ceteris paribus*, this group of respondents was 5.27 times more likely to pay a 6 to 10 percent premium price to buy traceable farm-raised salmon than those households who consumed less than one pound of salmon every month. The result of the consumer survey indicated that 84 percent of the respondents knew nothing about traceability systems. The survey showed that when respondents were told about traceability systems most of them received these systems positively and wanted to pay more for the farm-raised Atlantic salmon which passes through rigorous traceability systems. Table 3 shows that the independent dummy variable representing the participants who have no idea about the traceability system for Atlantic salmon fish (**traceknow**) was positive and significant at the 0.09 level. The estimated coefficient of the (**traceknow**) variable was 1.45 implying that participants, after learning about the traceability systems, on average were 4.29 times more likely to pay the premium price for traceable salmon. The dummy variables denoting consumers' perceived measures of quality of farm-raised Atlantic salmon through labeling/branding and quality not assured (i.e., **measureQ2** and **measureQ4**) were statistically significant at the 10 and

5 percent, respectively. These results indicated that the respondents who measured the quality of farmed salmon by the label on the packet of salmon were 26 percent more willing to pay 6 to 10 percent premium price for traceable salmon compared to those respondents' group who measured the quality through certification. Surprisingly, the respondents who were not assured about the quality of farm-raised Atlantic salmon also wanted to pay 8.1 times more as price premium for traceable salmon in contrast with the respondents' measure of quality through certification. Table 3 shows that the last explanatory variable is **tfs2** which representing the respondents who agreed that traceable food is safer. This segment of consumers was, on average, 2.7 times more willing to pay 6 to 10 percent premium price to purchase traceable farm-raised salmon, when compared to those participants who strongly agreed that traceable food was safer.

Table 3: Estimated coefficients

Variable Name	Coefficient	Standard Error	Significance	Exp(Coefficient)
gen	-.724	.446	.105	.485
age2	-.744	.956	.436	.475
age3	-.206	.887	.816	.814
age4	-.723	.898	.420	.485
hsz	.317	.196	.106	1.373
edu2	-.621	.563	.270	.538
edu3*	-1.848	.643	.004	.158
hinc2	.417	.646	.518	1.518
hinc3	.829	.712	.245	2.291
hinc4	.627	.811	.439	1.872
stype	.480	.674	.476	1.617
spre	1.317	.842	.118	3.733
hcon2	.334	.494	.499	1.397
hcon3	-.211	.730	.773	.810
hcon4*	1.662	.913	.069	5.272
traceknow*	1.458	.874	.095	4.298
readlabel	.186	.526	.723	1.205
impfprice1	.942	1.636	.565	2.564
impfprice2	1.344	1.658	.417	3.836
impfprice3	1.071	1.649	.516	2.917
PCBknow	.783	.663	.238	2.188
concernq/s	.689	.499	.168	1.991
measureQ2*	.986	.555	.075	2.682

measureQ3	-.749	.762	.326	.473
measureQ4*	2.103	.965	.029	8.144
measureS2	-.113	.659	.863	.893
measuresS3	1.072	.723	.138	2.920
measureS4	-19.996	13848.060	.999	.000
measureS5	-.762	1.000	.446	.467
searchfsI2	-.457	.700	.514	.633
searchfsI3	-.060	.785	.939	.942
searchfsI4	-.300	1.025	.770	.741
tfs2	1.000	.629	.112	2.718
tfs3	-1.124	.773	.146	.325
tfs4	1.824	42511.688	1.000	6.194
Loc W	.581	.558	.297	1.788
Loc C	.743	.679	.274	2.102
Loc Lab	.703	.857	.412	2.020
Number of observations	200			
Cox & Snell R-squared	0.305			
Nagelkerke R-squared	0.440			
Likelihood ratio statistic	72.631			
Degrees of freedom	38			
Prob [ChiSqd _ value]	0.001			

Source: Sample data

Table 4 presents the frequencies of actual and predicted outcomes. Overall, the model correctly identified 79.5 percent of the total observations (159/200) against the naive prediction (herein, all one) suggesting a reasonable prediction.

Table 4: Frequencies of actual and predicted outcomes

		Predicted		Percentage Correct
		0	1	
Actual	0	131	14	90.3
	1	27	28	50.9

4. CONCLUSION AND POLICY IMPLICATION

The seafood industry in the province of Newfoundland and Labrador is growing rapidly and has been notably boosted by the input of aquaculture, especially with the production of farm-raised Atlantic salmon. Despite the food incidents of the polychlorinated biphenyls that have caused drastic decreases in demand for farmed-raised salmon worldwide in 2003, and other occurrences such as mislabeling of seafood, evidence shows that global demand for farm-raised Atlantic salmon has been increasing (Haghiri 2014). To maintain a steady growth rate in consumers' demand for farmed Atlantic salmon, the industry is going through a process of introducing an integrated traceability method and quality control system to ensure food safety and to provide quality assurance to consumers, for strengthening their trust and confidence in this industry. The results of this study showed that 84 percent of the total respondents could not able to understand the meaning of traceability and most of them did not have any idea related to the concept. Moreover, 76 percent of the participants were not aware of the incidents of polychlorinated biphenyls (PCBs) in fish. But, when the participants were provided with information about the traceability systems, they positively valued the concept and willing to pay more for the farm-raised traceable Atlantic salmon. Moreover, the findings showed that prior to the purchase of farmed Atlantic salmon, the majority of the respondents (83 percent) read the label on the packet of salmon, and for the quality and safety measures they emphasized the labeling or branding. In addition, the greater part of the participants (55 percent) in the survey agreed with the statement that traceable food was safer and they welcomed the use of traceability systems in the salmon industry, which could ensure them the safety of the product.

Based on the above conclusions, this study recommends the following policies. As Newfoundlanders and Labradoreans were still not familiar with the term traceability and receiving information about traceability systems, helped consumers valued its implementation in the salmon supply chain positively. So it is suggested that public authorities and food companies need to take further initiatives to increase the public's knowledge about the value of traceability and its aspects to consumers in the study area; that has not yet been done extensively. The provincial government can plan to include traceability knowledge in the high school curriculum so that from school life a person can get the idea about the traceability systems. Besides, in the study area, consumers have a good habit of reading labels on the packet of food items and they like to measure the safety and quality of the salmon through labeling; so, labels could be one of the most suitable ways of communicating traceability to consumers. But labels should be understandable and easily accessible, so that they can not create doubt among consumers rather than boosting up their confidence. Chrysochoidis et al. (2006) stated that consumers of most European countries prefer a visual symbol, or a hallmark, as a label for traceability, instead of a code. In case of using a code, salmon marketers in the province of Newfoundland and Labrador should design a leaflet to exemplify how consumers can easily use their smart phone to reclaim the traceable information about salmon. Similar to the regulations of European Union, the Canadian Food Inspection Agency should demand that all the information, such as ingredients,

nutritional data, a common name of the product, production and harvest methods and geographic origin, on the label of salmon from each salmon production farm. Comprehensive monitoring by competent authorities is also essential to address mislabeling, guaranteeing the truthfulness of traceable information and revealing food safety problems, in order to enhance the degree of consumers' confidence in traceable information. In such a case, policymakers should also design different mechanisms for attaining consumers' expectations of the existing traceability systems. Consumers want to get the best quality of salmon at the lowest price, but integrated traceability systems are complex mechanisms which require significant investments to track and share critical information across the entire supply chain. This study did not cover the monetary effects of implementing traceability systems on the production cost of farm-raised traceable Atlantic salmon. We suggest further research on the pecuniary aspects of implementing traceability systems. Furthermore, this study only considers farm-raised Atlantic traceable salmon rather than other seafood products. Thus, we recommend research projects to measure consumers' willingness to pay for other seafood products. Consumer surveys are usually time and region specific. During conducting the study, we were aware of such limitation, but due to the limited time frame, it was quite difficult to bring out all the different factors that could influence consumers' willingness to pay for farm-raised Atlantic traceable salmon. In addition, we only collected information through a telephone survey rather than spreading the questionnaire by e-mail or social media. So, the small sample size was also a limitation of the study. Despite such limitations, it is hoped that the findings of this research will provide helpful information for the stakeholders of this industry.

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