# Consumers' perceptions of implementing traceability systems in farm-raised Atlantic salmon in Newfoundland and Labrador

by

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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 farm-raised salmon. This has induced policymakers and stakeholders to implement traceability systems as part of enhancing consumers' trust and safety in farm-raised salmon. This thesis aims to provide information on consumers' awareness about traceability systems of farm-raised Atlantic salmon and their willingness to pay (WTP) for traceable farm-raised salmon in Newfoundland and Labrador (NL), Canada. The thesis uses 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 show that the gender and age of the respondents, education level, household size, and household consumptions are significant determinants of NL consumer's WTP 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 and traceability aspects, public authorities and food companies need to take further initiatives in NL. 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, to ensure seafood sustainability and to reveal the food safety problems for enhancing the degree of consumer confidence in traceability systems.

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

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## Lists of Acronyms

**ASC**: Aquaculture Stewardship Council

**BAP:** Best Aquaculture Practices

**BIM:** Bord Iascaigh Mhara

**BSE:** American bovine spongiform encephalopathy

**CAIA:** Canadian Aquaculture Industry Alliance

**CFIA**: Canadian Food Inspection Agency

**COOL:** Country of Origin Legislation

**DFO:** Department of Fisheries and Oceans

**EC:** European Commission

**EEA:** European Economic Area

**EU**: European Union

**FDA:** Food and Drug Administration

**FDCA:** Federal Food, Drug, and Cosmetic Act

**FSSSB**: Fisheries, Science Stewardship and Sustainability Board

**FSMA:** Food Safety Modernization Act

**FTS**: Food Traceability System

**HACCP:** Hazard Analysis and Critical Control Points

**ID:** Identification

**IGAC:** The Industry Government Advisory Committee

**ITDS:** The International Trade Data System

**IUU:** Illegal, unreported, and unregulated

**ISO:** The International Standardization Organization

**MSC**: Marine Stewardship Council

**NAFTS:** National Agriculture and Food Traceability System

**NIFES:** Norwegian National Institute of Nutrition and Seafood Research

**NL:** Newfoundland and Labrador

**NOAA:** National Oceanic and Atmospheric Administration

**PCB:** Polychlorinated biphenyls

**PO:** Purchase Order

**QMP:** Quality Management Program

**RSS:** Responsibly Sourced Seafood

**SFCR**: Safe Foods for Canadians Regulations

**SFPA**: Sea Fisheries Protection Agency

**SIMP:** Seafood Import Monitoring Program

**TCPS**: Tri-Council Policy Statement

**U.S:** The United States

**WTP:** Willingness to pay

# Chapter-1

## 1. Introduction

### 1.1 Background

Nowadays, globalization in the seafood trade increases the distance of food travel from producers to consumers (Aung & Chang, 2014). Seafood is well-known as a diverse and complex protein provider industry. In the long path of seafood from the boat to the dinner plate, it requires to pass from fishermen to consumers through processing, distribution and final sale. This may generate many opportunities of mislabeling or fraudulent treatment of seafood (Oceana, 2018). So, consumers are now globally concerned with the quality, healthfulness, price, and safety of fish and seafood products, and consumers demand for verified evidence that these products are coming from authorized and sustainable fisheries and aquaculture operations is increasing day by day. The ability to trace fish and seafood products is now a growing requirement not only for the consumers but also for the government of Canada (Fisheries and Oceans Canada, 2015).

Seafood industry is one of the key industries in Canada. The fish and seafood industry in Canada is mainly export oriented and around 130 countries all over the world import these products from Canada (Agriculture and Agri-food Canada, 2016). Among them, the U.S, China and Japan are the top three countries. Canada exported around 51 percent seafood products to the U.S, 13.9 percent to China and 5.3 percent to Japan in 2014(SeaChoice.org, 2018). The fishing industry of Canada generated around $6billion CAD by exporting fish and seafood products in 2015 (Agriculture and Agri-food Canada, 2016). The provinces of Atlantic Canada harvested and processed the majority of the seafood products in Canada. Moreover, Atlantic Canada is the pioneer in the aquaculture industry and has started its production with farm-raised salmon along with other fishes (Atlantic Canada Opportunities Agency, 2010).

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 (BSE), 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 the processing of food along the supply-chain (Magera & Beaton, 2009). As a result, besides the price, consumers have 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 & Boddington, 2009). In order to uphold the confidence of the consumers about the seafood products of Canada and to increase the volume of exports, it is a growing concern of the Canadian seafood industry, of nongovernmental organizations (NGO) and of the government offices to maintain the food safety of seafood products (Boyle, 2012). The term seafood safety portrays all the necessary practices that are required to keep seafood safe. Food safety ensures proper handling and preservation of food for protecting people from food borne diseases caused by microorganisms (Ministry of Health and Long-Term Care, 2018)

In the seafood industry, quality assurance has now become a cornerstone of food safety and to maintain food safety 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" (Haghiri, 2017, p.3). The mission of CFIA is maintaining the trust of Canadian and international consumers along with the producers on food safety issues (CFIA, 2015). Integrated traceability systems are considered as important instruments complying with legislation, to provide consumers authentic information about the event of food safety recalls, and to give assurance regarding the sources of food (Ratcliff & Boddington, 2009). The term traceability means the ability to follow and identify a product through all stages of production, processing and distribution (Archipelago, 2005). According to Aung & Chang (2014), integrating traceability systems is an effective safety and quality monitoring arrangement that assists in the process to increase food safety within supply-chains and helps connect the producers and consumers. Many countries, including the United States, member countries of European Union (EU), China and Japan, have applied the traceability systems to trace the quality of their food products and to reduce the information asymmetry problems of adverse selection (which means sellers have information that's buyers do not have or vice-versa) in the food supply-chain (Feng et al., 2009). Rijswijk and Frewer (2011) show that in Germany, France, Italy, and Spain traceability systems help to meet the consumers' demand for different information about foods. Moreover, through traceability systems, firms can deal with safety and quality problems and can prevent low-quality products from reaching consumers and can avoid the damage to their brand loyalty and product recalls (Choe et al., 2009).

In 2009, through the association of federal, provincial, territorial governments and the livestock industry, the Industry Government Advisory Committee (IGAC) was established in Canada with the aim to secure the development and implementation of a National Agriculture and Food Traceability System (NAFTS) (Haghiri, 2017). The IGAC has developed a five-year strategic plan from 2010-2015 for the Canadian Agriculture and Food Traceability Research and Development (Haghiri, 2014). The history of traceability in Canada started earlier, in 1998 with the establishment of CCIA (Canadian Cattle Identification Agency), whose aim is to contain and eradicate animal disease. Both fishery and aquaculture owners and operators, along with their associations, are also playing a vital role in attaining sustainability in the seafood industry by pursuing certification aligned with internationally-recognized standards and implementing traceability programs in Canada. Certification provides the assurance that a product conforms to specified requirements or standards in sustainable manner for getting access in a market. In some cases, individual aquaculture operators are developing own business codes of practice as required by provincial governments (Fishery and Oceans Canada, 2016).

## 1.2 Problem Statement

The seafood industry has been playing a significant role in the economy of Newfoundland and Labrador (NL). In 2016, the fishing and aquaculture industry contributed as an important source of employment opportunities for the people of NL province; especially for the rural people. The total contribution of this industry to the provincial economy in 2016 was approximately $1.4 billion CAD (Department of Fisheries and Land Resources, 2017). Moreover, the Department of Fisheries and Land Resources in Newfoundland and Labrador records that aquaculture production in 2016 reached a peak volume and increased by 25.5% compared to 2015 and in 2016 aquaculture represented 19.2% 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. The major portion of farmed salmon production in Newfoundland and Labrador comes from the Bay d'Espoir and Fortune Bay region (CAIA, 2017). According to Fisheries and Oceans Canada (2016), Canada is the fourth-largest producer of farm-raised salmon in the world.

Along with the food safety concern, the increasing rate of globalization of seafood industry, the environmental sustainability of the aquaculture seafood industry in Canada also becomes an issue of growing concern. The incidents of polychlorinated biphenyls 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% of farm-raised salmon purchased at grocery stores in Washington DC, San Francisco, Oregon, and Portland was contaminated with polychlorinated biphenyls (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). Food safety and food quality are two imperative factors of consumers' perception, which are closely related to food choice decision-making (Rijswijk & Frewer, 2006). Usually, food safety provides assurance that food is safe to consume and will not harm consumers when it will be eaten according to its intended use, and food quality indicates the features and characteristics of a product, such as freshness and tenderness, that bear on its ability to satisfy stated or implied needs. 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, policy-makers have proposed various policies in which 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 & Frewer, 2008).

After the outbreak of a series of communicable diseases and food incidents of polychlorinated biphenyls (PCBs) in farm-raised salmon, consumers are demanding complete information about the process of food supply chain from the harvesting place to consumers' plate (Magera & Beaton, 2009). Besides, some incidents of providing inaccurate information about food origin, food production, manufacturing process and ingredients of foods create awareness among the consumers about the information that they receive from food producers (Rijswijk & Frewer, 2012). The survey reports of the UK Food Standard Agency show that 75% of consumers are now concerned about food safety (Choe et al., 2009). Golan et al., (2004) and Rijswijk & Frewer, (2011) suggest that by providing more information to the consumers about food quality or safety attributes, their confidence could be partly rebuilt. An integrated traceability system works as an important tool to provide consumers the complete information about the food supply-chain (Rijswijk & Frewer, 2011; Voordouw et al., 2011; Bosona & Gebresenbet, 2013). By using existing traceability tools, an integrated food traceability system can build and improve existing tracing approach (Global Language of Business, 2018). Bosona & Gebresenbet (2013, p.35) projected a comprehensive definition of food traceability as follows: "food traceability is part of logistics management that capture, store, and transmit adequate information about a food, feed, food-producing is correct animal or substance at all stages in the food supply chain so that the product can be checked for safety and quality control, traced upward and tracked downward at any time required".

According to Haghiri (2016, p.1), 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 in 2003, 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).

Implementation of new food safety policies such as traceability systems increases the production cost of the fish industry which has also impact on the price of these fish products (Haghiri, 2017). Hansstein (2014, p.115) asserts 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 and to know how much consumers are concerned about these systems and how much they are willing to pay for traceable fish products.

This study will analyze consumers’ perception of implementing traceability systems in farm-raised Atlantic salmon in NL. The farm-raised Atlantic salmon is the most important finfish species produced by the Canadian aquaculture industry, and it already is going through the integrated traceability system to establish confidence among the consumers. Besides, implementation of a new food safety system such as traceability systems increases the production costs from breeding to selling which raises the retail price of the fish products. This study will try to shed light on how much the NL consumers are familiar with the term traceability system and the role of these systems in consumers' purchasing behavior and decision-making to pay for safe farm-raised Atlantic salmon.

This study has been conducted mainly on farm-raised Atlantic salmon in Canada for the following four reasons. Firstly, Canada is the members of G8 countries (G8 stands for Group of Eight and is made up of leaders from Canada, France, Germany, Italy, Japan, Russia, the UK and the United States) and multinational or multilateral trade agreement (multinational trade agreement shapes international trade unions like as WTO and EU). Moreover, it is a large exporter of farm-raised Atlantic salmon in the global seafood market (Agriculture and Agri-food Canada, 2016). So, examining consumers' perception about traceability systems in farm-raised salmon will help producers and policy makers to get an idea about how accessible the systems are to the consumers regionally and nationally and what strategies they need to adopt for reaching international consumers. This will also help to uphold the country's competitiveness in the global seafood markets. Secondly, media reports about mislabeling of seafood products make consumers highly conscious about food safety and quality (Boyle, 2012), so an understanding of Canadian consumers' interest about traceability systems will help the suppliers provide them better service and formulate market strategies. Thirdly, a significant amount of research has been conducted on consumers' preferences about agricultural foods, such as meat and vegetables in Canada (Dickinson et al., 2003; Hobbs et al., 2005; Dickenson & Bailey, 2006; Forbes-Brown, 2015), but very scarce literature exists on the consumers' views about traceability systems of seafood in aquaculture production (Haghiri, 2017) in the context of Canada. By presenting the consumers' consciousness, knowledge and attitude about seafood traceability systems, particularly in the case of farm-raised Atlantic salmon, this study tries to contribute to the existing literature. Fourthly, the study aims to provide recommendations to the policymakers in the farmed-salmon industry to provide an equal focus on demand-side along with the supply-side so that consumers can have the chance to exercise their rights to buy safe seafood (Haghiri, 2014; Loureiro & Umberger, 2007).

### 1.3 Research Objectives

The Canadian province of NL is bustling with the burgeoning activities of aquaculture and fishing industry. But, after the food incidents of the polychlorinated biphenyls in farmed Atlantic salmon, the fisheries and aquaculture industry has experienced a major decline in the demand for the product. To recover customers' confidence in the safety and quality of farmed Atlantic salmon, this product needs to be passed through traceability systems in the province of Newfoundland and Labrador, Canada. This study is conducted to get an understanding of the role of implementation of traceability systems in consumers' decision-making process with respect to farm-raised Atlantic salmon in NL. As it has been found from the existing literature that consumers' knowledge about traceability systems is insufficient, this study will also analyze the acceptability of traceability systems for farm-raised Atlantic salmon among consumers and will investigate the subjective factors that influence the consumers' willingness to pay (WTP) for traceable farm-raised Atlantic salmon in NL.

## 1.4 Research Questions

Bryman (2007) asserts that the research question is an important step of a study which provides a point of orientation for an investigation. Moreover, the formulation of research questions helps to militate against undisciplined data collection and to analyze the study effectively (Bryman, 2007).

This study aims to answer the following research questions:

1. What is the role of implementation of traceability systems in the consumers' decision to buy traceable farm-raised Atlantic salmon in NL?
2. How much are consumers prepared to willingly pay for traceable farm-raised Atlantic salmon?
3. What are the subjective factors influencing of consumers' WTP for traceable farm-raised salmon?

## 1.4 Significance of the Study

The study provides an insight into consumers' perception and their willingness to pay for implementing traceability systems in farm-raised Atlantic salmon in NL. It also, points out consumers' concern for food safety information, labeling, traceability, and quality of seafood. In the era of globalization, traceability systems are working as essential elements to maintain food safety and transparency standards in the seafood supply chain. So, traceability systems have effects on the consumers' purchasing decisions. Thus the significance of this study consists in theoretical implications for academics and in practical implications for policy makers. A very limited number of studies have focused on consumers' perception of implementing traceability systems in farm-raised Atlantic salmon in Canada (e.g Haghiri, 2014, Haghiri, 2012). Therefore, by utilizing a logistic regression model, this study has tried to contribute to the academic literature on the issue of consumers' perception of traceability systems in NL's farm-raised salmon supply chain. For practical implication, the salmon producers and policymakers could also benefit by finding out about consumers' concerns regarding traceability systems from this study. The outcome of this study provides insights into the development of a traceability policy so that producers can maintain a steady growth rate in consumers' demand for farmed Atlantic salmon.

### 1.6 Organization of the Study

This thesis consists of six chapters which will try to explore consumers' perceptions of implementing traceability systems in farm-raised Atlantic salmon in Newfoundland and Labrador. Here is an overview of the content of each chapter.

Chapter one introduced the research by providing a background, objectives and research questions of the study. It also introduced the scope of the research along with the methods employed in carrying out the research.

Chapter two provides a critical literature review on the concepts of traceability systems, benefits of the traceability systems, consumers' perception and willingness to pay for traceable foods and impacts of the traceability systems on consumers' confidence. This chapter tries to depict the overall concept of traceability systems. Moreover, this chapter presents relevant information for a deeper understanding of the study.

Chapter three focuses on the research methodology employed throughout the research. This chapter provides the framework for research design and approach, which includes the research technique, selection criterion of the study area, study population and sample size, methods of data collection and analysis. A brief discussion of the binary logistic regression model is presented here. Ethical aspects such as confidentiality and trustworthiness are also introduced in this chapter.

Chapter four shows a comparative analysis among seafood traceability policies in North America and major European Countries. This chapter briefly explains the traceability policies of Canada, the United States and the European Union.

Chapter five provides answers to the research questions by analyzing the participants' perception of traceability systems. The description of data, including demographic characteristics of the sample, is presented in this chapter. Principal empirical results are critically discussed and major findings relating to the research objectives are also presented in this chapter. This chapter explores the most significant themes that have emerged from the empirical work.

The final chapter briefly discusses the implications of the results and draws a conclusion of the research. It also identifies the limitations of the study and proposes areas for future research.

# Chapter-2

## 2. Literature Review

This chapter reviews the literature regarding different components of traceability systems. Traceability systems are defined here from different perspectives, to understand the terms deeply. The cost and benefits associate with traceability systems and how these systems effect on consumer trust which varies their willingness to pay for a product are identified in this chapter. Literature on traceability systems are taken from several countries such as Canada, China, USA, Brazil, Korea and Norway. Most of these literatures are not backward then 2000.

### 2.1 Traceability Systems

Food safety is a crucial issue for health generally. So, to avoid the potential risk, it is essential to trace the source of food and food components. Recently, the term traceability has been used frequently in the food industry as well as in the production industry. In the $14^{th}$ 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. Different international regulations, standards and scientific articles such as the EU Regulation 178/2002, ISO (2007), GS1 Standards documents and International food standards provide various definitions of food traceability systems.

Golan et al. (2004) state that food is a complex item so the definition of food traceability is unavoidably broad. To define traceability, Olsen & Borit (2013, p.148) consider necessary "the ability to access any or all information relating to that which is under consideration, throughout its entire lifecycle, by means of recorded identifications". The International Standardization Organization ISO (2007) describes the traceability system as an operating system which can maintain the required information of a product during it all or part of the production process. Archipelago (2005, p.9) also says that "traceability is the ability to follow and identify a product unit or batch through all stages of production, processing and distribution, both forward and backward". In the view of Karlsen et al. (2010), traceability does not only provide the information about the product and process but also helps to find out all these information again at a later date. In this regard, Bailey et al. (2016, p. 26) also highlight 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 practice, the traceability system is used to identify a product's pathway related to supply chain procedures. Traceability systems of food are involved in developing information stocks by following the food product's physical trail. The Task Force on Foods derived from Biotechnology describes traceability as "a system that guarantees a continuous flow of appropriate information at all stages of placing on the market of foods" (Choe et al. 2009, p.168). According to Golan et al. (2004), the efficiency of a traceability system depends on how much information can the system collect, how far back or forward the system can track the information and on how accurately the system can obtain the information about the location of a food product. So, a complete chain traceability system permits to identify the causes of contamination in the supply chain and of recalling unsafe food (Adam et al., 2016). Aung & Chang (2014) assert that firms apply traceability systems to attain three primary objectives, such as improving supply management, facilitating tracing back for food safety and quality and distinguishing foods with slight or unnoticeable quality attributes. A traceability system helps to address from where the product came and the place where the problem occurred (Rigueira, et al., 2014), which is important for maintaining food safety, making certain the legality of products is secured and for confirming the sustainability (Boyle, 2012). Karlsen et al., (2012) identify ten drivers of food traceability, such as legislation, food safety, quality, sustainability, welfare, certification, competitive advantage, chain communication, bioterrorist threat, and production optimization.

Traceability systems are changing from simple, paper-based records which are traditionally known as the paper trail to complex electronic data systems which include software, barcodes and radio frequency identification (RFID) tags (Magera & Beaton, 2009). But, Sterling et al. (2015) assert that effective traceability systems mostly rely on the movement of reliable and standardized information through the supply -chain rather than the way data are collected and stored.

In recent years, various seafood traceability systems have arisen in different countries. Traceability is categorized into two streams, such as internal and external or chain traceability. Internal traceability systems record information about the product within a particular company or production facility, from the reception of raw materials to the dispatch of products (Ukessays, 2017). External traceability systems are complex information-sharing systems which keep information about the products, its ingredients, and packaging in the entire or part of the supply chain, outside of one business entity (Archipelago Marine Research Limited, 2005). Downward or backward traceability and upward or forward traceability are the forms of external traceability systems where "backward traceability allows to trace the previous history of the product coming in the company, where do ingredients come from, who is the supplier, in which quantity does it come or the date of reception"; on the other hand, upward traceability allows "to know the product's destination, spotting customers, knowing the number of products supplied, their batches and the date" (Dopico et al., 2014, p.95).

Buchanan et al., (2012) consider that the definition of traceable entities, the unique identification of traceable entities and key data elements (KDEs) are the main elements that traceability systems should include. Definition of traceable entities includes trade units, logistics units or shipments as a part of external traceability and batch number or lot number should be included as part of internal traceability. GS1 (Global Standards One) coding and RFID tracking are considered as the elements of the unique identification of traceable entities. Recording and storing related information about the product is taken as key data elements.

From January 2005, traceability has become a legal obligation within the European Union (EU) through Regulation EC2002. Similarly, FDA 2008 and MAFF 2007 contain the requirements for traceability systems in the United States and Japan (Lanlan, 2010).

## 2.2 Benefits and Costs Associated with Traceability Systems

Traceability systems produce various costs and benefits for producers in food industry but for consumers they only provide benefits.

### 2.2.1 Benefits:

According to FishWise (2017), improved traceability systems within seafood supply chains could assist to identify and alleviate risks such as food safety concerns, mislabeling and fraud, illegal, unreported, and unregulated (IUU) fishing, and human rights and labor abuses.

For a nation, traceability systems can play a vital economic and social role by reducing the costs and risks of food safety problems by distributing the responsibility for the food-chain and allowing it to respond quickly (Mora & Menozzi, 2008). According to Magera & Beaton (2009), traceability systems offer numerous advantages to the suppliers such as health and safety assurance, recall effectiveness, market access, and protection of the company's brand name, along with the increase of consumers' trust about the products. A traceability mechanism in the seafood industry meets the challenges associated with food safety and the difficulties related to efficient control of the food-chain processes to reduce the risk of food-borne diseases by presenting comprehensive information about the origin, processing, transfer, and distribution of a seafood product (Rigueira et al., 2014).

Fisher (2015) says that the traceability systems provide the assurances to the suppliers and customers about legal, safe and fairly traded foods. Besides, the traceability systems also assist in mitigating forge and counterfeiting of food. As counterfeit food has a greater risk of causing food safety incidents that affect the entire food industry, by having the visibility of the supply chain, it is easy to alleviate the counterfeiting of food (Fisher, 2015). Traceability systems help to prohibit misplaced information in the food supply chain and keep the product safe from losing its identity (Choe et al., 2009). Traceability can also decrease information asymmetry by providing quality information to consumers. So, it helps the consumers to feel confident that the seafood for which they are paying money are harvested in a responsible way. The information written on the labels can help to improve consumer trust and perception of food safety and quality. Ward et al., (2005) explain that after the American bovine spongiform encephalopathy (BSE) crisis in 2003, the implementation of traceability systems in the beef meat industry has made this product more acceptable among the consumers.

Moreover, traceability is the process that allows transparency in all the steps of the supply chain and makes a connection between harvesters and consumers, where producers can see where their products are consumed and can get feedback from consumers (FFAW-Unifor, 2016). Improved traceability systems assist international trade by taking domestic products to markets outside of the country and creating a demand for them (Fisher, 2015). According to Mai et al., (2010), through traceability systems, companies can obtain strong supply chain management, product quality improvement, product differentiation and can reduce customers' complaints. Besides, traceability systems also have the potential to boost up production efficiency by reducing the cost of procurement, movement, and storage and by employing proper management of manufacturing. Thus, there are many reasons why every stakeholder associated with the supply-chain of seafood should be thinking about traceability and why it is important to them. Same benefits of traceability systems are also recorded by Smith et al., (2005).

From a US perspective, the outcome of the research done by Smith et al., (2005) shows how traceability systems are used in their livestock, poultry, and meat industries to control foreign animal diseases and to fulfill international as well as national consumers' requirements about food origin and origin labeling. The traceability systems also help these industries to improve their supply chain management and to minimize product recalls and improve crisis management. By developing a cost-benefit evaluation framework of an electronic-based traceability system, Chryssochoidis et al., (2009) also prove that in a Water-Co natural mineral water Company, the electronic-based traceability system helps to minimize labor costs and operating costs, improves inventory by reducing misplacements and mistaken shipments, improves supply-side management and saves the company from recalls and risk management. Trebar et al., (2013) consider that for ensuring fish quality and freshness, the radio frequency system (RFID) is very beneficial during product storage and transport.

Dopicoa et al., (2016) conducted a cross-national comparison with the objective to investigate the benefits perceived by consumers related to the implementation of traceability systems in the following countries, Portugal, Spain, France, UK, and Germany. To fulfill the objective, the researchers performed an electronic questionnaire survey in these five EU countries. From the study, it has been found that the probable benefits for consumers associated with traceability systems mainly focus on food safety and food quality and, according to the consumers' viewpoint, there is a significant link between traceability and quality. Dopicoa et al., (2016, p.101) conclude that consumers' demand for clear and correct information about the quality attributes of a product and "relevant information about traceability should focus on salient intrinsic quality attributes such as specific origin, common name, species, production method, date of capture (if the product was fresh); food safety (sanitary control, best before date) and sustainability (method of capture, conservation)".Through the implementation of traceability systems, consumers get the benefits of knowing about the relevant intrinsic properties and origin of a product, which is a sign of quality measurement.

Alfaro & Rabade (2009) try to explore the benefits of implementing a computerized traceability system in a Spanish vegetable firm. By conducting in-depth interviews with multiple employees, the study has found that the traceability system helps the firm to produce a double amount of vegetables by using the same number of employees, which decreases the firm's indirect costs.

Besides, the system also assists to reduce the disturbance in the production process of the firm. Moreover, the firm was able to achieve qualitative benefits such as increases in the trust of customers.

In their research, Asioli et al., (2011) discuss the benefits of traceability systems by categorizing them into four groups: regulatory benefits constitute the first category which includes the benefits of avoiding penalties for non-compliance and no legal barriers to market access. The 2nd category is recall and risk management which comprises the benefits of more targeted, quicker recall, reduced cost and reduced cost of liability insurance. The third category of benefits are market and customer response benefits; examples of such benefits are reputation (build-up or regained after a crisis), new customers and easier market access, real-time information for sales calls and increased demand/price for output. The last category is supply chain operations benefits, such as improved inventory management and more efficient communication with customers and/or suppliers.

### 2.2.2 Costs:

To elucidate the apparent costs and benefits of traceability in the fisheries supply chain in Italy, Asioli et al., (2013) state that the costs of traceability systems are associated with the firm's size, its adopted strategy and technology, its products quality and production process and the required total information. The authors identify the total costs related to traceability systems by dividing them into six categories: time and effort, equipment and software, training, external consultants, materials, certification, and audits. Time and effort are allied with implementation and maintenance cost of the traceability system, which includes recruiting administrative staff, those who have specialized skills and knowledge to implement and use such a system, to supervise the staff's time and to manage disruption in product operations. The cost associated with equipment and software such as computers, laptops, barcode systems, printers, and software's are essential costs for managing traceability systems. Training of internal staff and hiring of external consultants are also important costs related to implementation and operation of traceability systems. Material costs are related to conducting physical handling of traceability, where certification and audit costs depend on the adoption of traceability certification standards by the firm.

Based on a survey data and information, Chen et al., (2019) conducted an analysis on the extra cost of traceability systems for agro-product enterprises in China. The authors found that agro-product enterprises with traceability systems are facing the same regular costs as other enterprises along with some extra costs. They classified the extra costs into eight categories: software development, system maintenance, relevant hardware facilities, training, labeling, printing, internet and the relevant human resources necessary. Extra costs can increase the price of the product and consumers may find it difficult to accept overpriced products. So, the authors suggest considering consumers' willingness to pay for traceable products before setting the prices.

Chryssochoidis et al., (2009) construct a cost-benefit evaluation framework of an electronic-based traceability system for a mineral water company. In this research the authors calculate the costs of the system separating them into two portions namely initial investment costs and ongoing cost. According to the study, initial investment costs occur during the time of planning, testing, and implementation phases of the system. These initial investment costs include hardware, software, communication, data input/ conversion, system integration, education and training, and business process reengineering related costs where ongoing costs include hardware/software maintenance, support, ongoing training, upgrades, staff-related cost, consumables, and licenses costs.

## 2.3 Consumers' Perception and Willingness to Pay for Traceable Foods

Feng et al., (2009) accomplished a study to investigate consumers' perception, purchasing behavior, and willingness to pay (WTP) for safe fish products in Beijing, China. The study was carried out based on the survey of consumers and the result of the study shows that consumers lacked knowledge about the traceability system of fish products in China. Most of the participants are well-acquainted with the nutritional benefits and the cooking process of fish but very few of them have an idea about the storage, production, and processing of fish products. The researchers identified the 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 are ready to pay a 6% premium for fishery products with a safe system of traceability compared to the products which do not maintain a traceability system. The investigation of Zengjin et al. (2014), on consumers' WTP for traceable beef in China, also mentions the lower cognitive level of consumers about the traceability systems. But the outcome of the study highlights that after learning about the benefits of this system, 95.35% of the respondents become ready to pay a 20% 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' willingness to pay became higher, if certificates came from the government, followed by industrial associations and third parties.

Haghiri (2014) performed a research to examine consumers' WTP a premium price for purchasing certified farmed Atlantic salmon in Newfoundland and Labrador, Canada. The researcher collected required information from a sample of 120 consumers in 2010 and used the contingent valuation (CV) method by estimating a probit regression model to examine consumers' decisions to buy certified farmed Atlantic salmon. According to the study, salmon fish consumers of NL, especially seniors and the respondents with a higher level of education, think that applying traceability systems in certified farmed Atlantic salmon will raise the price of this product, but this increased price would not be able to reduce the preference of consumers for certified farmed Atlantic salmon. Moreover, households of NL are willing to pay a 15% premium to purchase certified farm-raised Atlantic salmon, which goes through traceability and quality control systems.

To bring forth the willingness to pay of Chinese consumers for produce submitted to traceability systems with abbreviated and detailed information, Jin et al., (2017) conducted a research where they adopted a random experimental auction as the study method. The researchers have found that traceability systems are positively accepted by the general community of China and on average they are ready to pay a 10% higher premium for traceable food with detailed information compared to abbreviate information. Another finding of this study indicates that lower educated people willingly invest a higher premium for traceability with detailed information.

Rigueira et al., (2014) assessed Brazilian consumers' willingness to pay for beef with certification of origin. This research was done on the consumers who have knowledge about bovine traceability. The main objective of this study was to identify the important attributes of beef that influence the decision of consumers to choose it. The researchers have found that visual appearance (color and apparent texture of the meat), price, shelf-life, smallest amount of fat, Federal Inspection System certification and place of purchase are the main attributes behind meat purchase in Brazil. Morkbak et al., (2008) found out that consumer's willingness to pay for meat also increased when food safety aspects were present with other attributes. In the case of demographic variables, this study explored both gender and age range, which also have an influence on willingness to pay for meat with certification of origin. In their research, Grunert et al., (2004) also emphasized the assurance of origin of a product which indicated the good manufacturing practices regarding the food processing. Moreover, the certification of origin increased the level of confidence of a consumer to purchase the product.

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 are highly influenced by consumers' age, income level and education level, which are similar to the results of other studies, such as Feng et al., (2009), Wu et al., (2012) and Rigueira et al., (2014). Besides, 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.

Ortega et al., (2011) also assessed urban Chinese consumer preferences for selected food safety information attributes in pork. The results of this study show that Chinese consumers are rather concerned about the safety of the pork and they are willingly ready to pay a positive price for safe pork. Besides, Chinese consumers' have more confidence in the government certification program followed by third-party certification, a traceability system, and a product-specific information label.

Claret et al., (2012) showed that labels that bear the country of origin have an effect on consumers' food purchasing behavior. Also Lim et al., (2013) reported that in the United States, consumers' WTP for domestic beef is higher than their WTP for imported beef steaks from Canada and Australia. Many studies found brand preference as a potential attribute for consumers' WTP and purchasing choice (Areset et al., 2010; Carrillo et al., 2012; Ahmad & Anders, 2012; Morales et al., 2013). Ahmad & Anders (2012) stated that many consumers use brand name as a search attribute for their food consuming decision, especially those consumers whose previous experience with a brand has been successful; they depend on it to make a decision for future purchases and choose the desired product quality (Berges et al., 2015).

By using non-hypothetical choice experiments, Olesen et al., (2010) analyzed Norwegian consumers' WTP for organic and welfare-labeled salmon. The researchers recruited 115 consumers for a choice experiment and have found that Norwegian consumers are equally concerned about animal welfare and environmental effects of farming, and they are likely to pay a 15% price premium for organic and Freedom food (the production of this salmon complies with the production criteria necessary to earn the international Freedom food label) salmon, compared to conventional salmon( this salmon fulfills the Norwegian laws and legislation production criteria). Giraud & Halawany (2006) found that consumers of Spain are more interested to pay for the product with a better quality rather than the traceability system, as they consider this system is assumed by the producers.

In different countries, a considerable amount of research has been conducted at different times on the consumers' perception of food traceability systems and their WTP for it, such as in USA (Loureiro & Umberger, 2007), China (Feng et al., 2009; Ortega et al., 2011; Lu et al., 2016; Jin et al., 2017), Brazil (Rigueira et al., 2014), Canada (Hobbs et al., 2005; Haghiri, 2014; Haghiri, 2016), Korea (Lee et al., 2011), and Norway (Olesen et al., 2010).The results of all of these studies indicate that consumers from different corners of the world are willing to pay a premium price for food with traceability attributes.

### 2.4 Impacts of Traceable Systems on Consumers' Trust

Trust or confidence of a consumer can be defined by his/her personal intention of accepting the vulnerability and by his/her beliefs that traders will not act opportunistically (Pavlou & Gefen, 2004). Knight & Warland (2005) notice a contrary 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 to boost up consumers' trust in the foodstuffs that they purchase (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).

In their study, Dopicoa et al., (2016) found that traceability was a very confusing term for consumers and they have very limited knowledge about it. They mainly correlate the term with food safety and quality. Through the traceability systems, consumers can know about the origin of the products, which works as a quality indicator and helps to give consumers confidence (Giraud & Halawany, 2006). The terms control, reliability, transparency of information are also associated with traceability and also boost up consumers' security and confidence (Rijswijk et al., 2008; Giraud & Halawany, 2006 ; Chryssochoidis et al., 2006).

Chen & Huang (2013, p.318) conducted a website-based questionnaire study in Taiwan to discover whether Food Traceability System (FTS) have any influence on consumers' purchasing intention regarding fast foods or not. The results of this empirical study disclosed that "when a fast food store adopts a FTS, then consumers' perceived uncertainty can be reduced because both their perceived information asymmetry and fears of seller's opportunism are also reduced, thereby strengthening their purchase intentions". Besides, this system also helps to boost up their trust in farmers' records kept for FTS. The authors found out that if consumers had better knowledge about the system, they would accept it more. So, they suggested that the authorities and the sellers ought to promote consumers' acceptance of FTS in order to protect their rights.

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) conducted a study where they extended the traditional theory of planned behavior (TPB) model by adding new variables, including trust, habits, and several demographic variables; they have found that among the variables, trust has the highest explanatory power for the intention to purchase chicken and honey for Italian consumers. Menozzi et al., (2015) suggested that when consumers believed a product can be traced back to its origin and they trusted that the information provided by the producers was authentic, it encouraged their purchase intention.

To assess the impact of traceability systems on consumers' confidence relating to food quality and food safety, Rijswijk & Frewer (2006) carried out a research on four European countries, namely Germany, France, Italy, and Spain. In this study, the authors examined how the perception of consumers about food safety and food quality varied among different EU countries.

Food quality refers to its freshness, tenderness, etc., where as food safety indicates the production process, processing plants and distribution system (Haghiri, 2014). The researchers have found that in consumers' minds, traceability systems are strongly connected with food safety compared to food quality and traceability systems have the power to boost up consumers' confidence by providing information about food safety and food quality. In this regard, Rijswijk & Frewer (2012) asserted that complete information of traceability systems helps to increase the trust of users in them, as these systems allow recognition of the aspects related to the production process.

Innes & Hobbs (2011) studied the Canadian public's trust in private, third-party, and government organizations to facilitate credible quality assurance for production-derived quality attributes. They found out that consumers in Canada trust both third parties and government organizations for providing authentic information about the farming methods and they have a clear preference for a more proactive government, as government standards relating to environmental sustainability are perceived as being the most effective ( Literature on sustainable seafood is discussed on pages 41 and 42). Besides, Steiner et al., (2010) claimed that type of certification also plays a significant role in consumers' trust. They examined the customers' WTP for traceability to the farm of origin and for meat produced free of GMOs and discovered that consumers are ready to pay more premium prices for that meat which is produced without the use of genetic modification.

Finally, Choe et al., (2009) asserted that a well-managed and up-to-date traceability system is the prerequisite for running a successful business in the food market and failing to implement this system properly leads to the loss of reputation and consumer trust. From a survey performed in Korea, Choe et al., (2009) have found that the traceability system plays an important role in the purchasing intention of consumers. A traceability system helps to reduce consumers' fear of producer's opportunism, decrease information asymmetry as well as mitigate uncertainty. As a result, Korean consumers are willing to pay more for those foods managed with traceability systems.

# Chapter-3

## 3. Overview of Methods

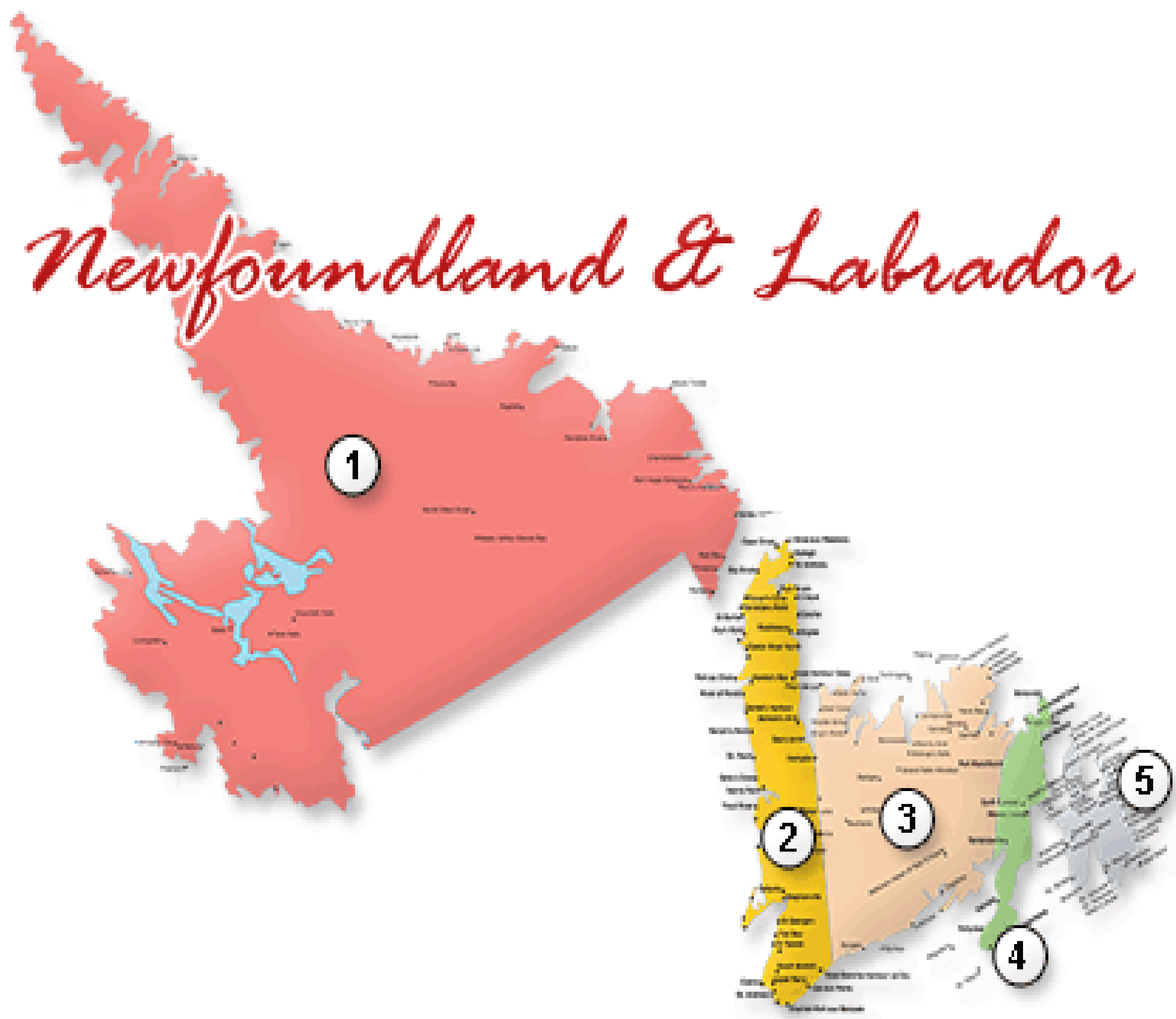
### 3.1 Research Technique

It is important for a researcher to select the correct techniques for data collection and analysis, and understand these techniques adequately to utilize them properly (Babbie, 1998). Bryman & Bell (2007) suggest that a quantitative technique is suitable for analyzing any social issues. Here, to answer the research question about how consumers' decisions to purchase farm-raised Atlantic salmon are influenced by the implementation of traceability systems in this industry, can be categorized as social behavior. So, a quantitative technique was used in this study. A quantitative method is defined by Sarantakos (1998, p.6) as "a number of methodological approaches, based on diverse theoretical principles, employing methods of data collection and analysis that are qualitative  used to explore social relations and to describe reality as experienced by the respondents". The quantitative method usually starts with data collection based on a hypothesis and theory which is followed by the application of descriptive or inferential statistics.

### 3.2 Selection of the Study Areas

In this study, the province of Newfoundland and Labrador (NL), which is the most easterly province of Canada, has been chosen as a study area. Newfoundland and Labrador has pristine, cold water and technological advances in harvesting which facilitated to produce high quality and superior taste seafood and exports nearly 1 billion of seafood every year. This province exports 90% of its produced seafood every year (Newfoundland and Labrador, 2019). Local people are the consumers of the remaining 10% seafood. The province includes an island, namely Newfoundland, and a part of mainland Canada called Labrador. The government of Newfoundland and Labrador classifies the total area of the province into four geographic regions such as 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 (East, West, Central, and Labrador), according to the conventional classification.

**Graph 1:** Map of Newfoundland and Labrador (Study Area)



Source :(http://www.comeexplorecanada.com/newfoundland_labrador/)

Here, area one indicates Labrador region, area two points to the Western region, area three shows the Central region, area four points to the Eastern region and area five stands for the Avalon region. Through this map is showing the Avalon region, according to the conventional classification total NL are divided into four areas which do not mention about the Avalon region. That’s why, in this study, no data was collected from region five.

### 3.3 Study Population and Sample Size

According to Ghauri (2002), population refers to a group of individuals, objects or items from which samples are taken for measurement. All the people living in the province of Newfoundland and Labrador whose age is more than 19 years or at least 20 years old were considered as the population for this study. Anderson et al., (2013) state that a sample is a small group of respondents which is drawn from the population about whom the researcher is interested to obtain information. So, a sample comprises those set of elements of the population that are considered for actual inclusion in the study. The total population of Newfoundland and Labrador was 528,817 in 2017 (Government of Newfoundland and Labrador, 2017). A total of 200 participants including both males and females were selected from this population as the sample size of this study. The entire area of Newfoundland and Labrador is 370,510.76 square km and the population density is 1.4 persons per square kilometer. About 92% of the province’s population lives on the island of Newfoundland and 40% of the total population lives in the eastern part of the province (Canada Population 2018, 2017). On the basis of the number of the people living in each region, 40% of the respondents of this study were chosen from the east region, 30% from the west region, 20% from the central and the remaining 10% were chosen from Labrador region. Using the random sampling technique, the samples were chosen from the provincial telephone directory of the four regional districts in NL. Any person whose age is less than 20 years was not accepted as respondent here. To get 200 responses more than 500 telephone calls were made by the researcher that means the response rate is around 40%. Respondents who did not participate in this survey provided different causes ( i.e have no time or not interested) for not participating. To minimize the bias in sampling, respondents have been 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.

## 3.4 Sources of Data

Both primary and secondary data collection techniques were used in this research to get the best possible answers to the research questions.

Shukla (2008, p. 30) defines secondary data as a "collection of data that already exists". Here, secondary data helped to understand the concept of traceability by studying existing scholarly literature related to the theme. The necessary information from secondary sources was gathered through a literature review. In order to obtain reliable secondary documents, peer-review journal articles, books, government policies, newspapers, reports, government websites, conference papers, published reports, published and unpublished theses were searched thoroughly by using the Google Scholar search engine. The search was done by using keywords related to the concepts of traceability systems, consumer perception about traceability systems and how traceability systems influence the consumers' decision-making process. About 80 percent of the literature used in this study is not backdated more than the last 10 years and the remaining 20 percent goes beyond 10 years.

In this study, most of the data required was gathered by primary data collection technique. According to Shukla (2008, p. 32) primary data is “originated by the researcher for the specific purpose of addressing the problem at hand”. The primary data for this study was collected from a survey through a structured questionnaire on consumers’ preference and purchasing behavior for traceable Atlantic salmon in the province of NL. The questionnaire survey was the main data collection instrument of this research, as it is a convenient method to reach all the general communities in NL. The survey was conducted over telephone conversation and each questionnaire has taken around fifteen minutes to complete. During weekdays and weekends and different times of the day telephone calls were made to carry on the survey. The survey was administrated by the researcher of the study from September 2018 to December 2018.

### 3.4.1 Structured Questionnaire

According to Creswell (1994), a questionnaire survey provides a numerical description of a certain part of the population. Delport & Roestenburg (2011) assert that it is important to take a decision about the nature of the questionnaire and what information should be collected. In this study, a close-ended self-administered structured questionnaire was constructed for all local and indigenous people residing in the province of NL to collect required quantitative information. The questionnaire about consumers’ perception of implementing a seafood traceability system and their WTP for safe farm-raised Atlantic salmon consists of eighteen questions and is organized into three sections, including a consumer’s demographic profile, socio-economic information, and product attributes. The first section of the questionnaire is related to the demographic profile of consumers and comprised questions related to gender, age, and household size. The second section of the questionnaire deals with the level of education, and household income of consumers. The third section of the questionnaire focuses on consumers' purchasing behavior and awareness to quality and safety of salmon fish, such as regularity of purchase, amount of consumption in a month, information-seeking responsiveness, knowledge about food certification, polychlorinated biphenyls and food traceability systems, concern about food quality and safety incidents and consumers' WTP for traceable salmon. Every question included several options. Respondents were asked to choose an option from them.

**Table 1: Questionnaire's Structure**

| **Question** | **Related to** |
|---|---|
| Questions no 1- 3 | Demographic Information |
| Questions no 4-5 | Socio-economic Information |
| Questions 6-18 | Product Attribute |

**Source:** Author's own design

### 3.5 Data Analysis

Data analysis is a procedure where data are being broken down into smaller units in order to reveal their characteristics, elements, and structure (Dey, 1993). In this study after receiving the survey responses, the raw data were checked to identify any inconsistencies and potential errors. The quantitative data collection phase was completed after retrieving the raw data. This study utilized a logistic regression model or logit model to measure consumers' willingness to pay a premium price for traceable farm-raised Atlantic salmon. To do so, at first, the sample data were entered into an Excel worksheet, and then the summary descriptive statistics of responses was produced by using Statistical Package for Social Science (SPSS) software version 25.0.

## 3.6 Logistic Regression Model

Logistic regression, also known as the logit model, is commonly utilized to analyze survey rankings and rating data in empirical work (Quagrainie, 2006). A logistic regression model analyzes the influence of different independent variables on a dichotomous outcome by examining the probability of the occurrence of the event. Binomial/binary logistic regression and multinomial logistic regression are two different types of the logit model. To show the relationship between a dichotomous dependent variable and continuous or categorical independent variables, a binary logistic regression is usually employed. On the other hand, a multinomial logistic regression is utilized when the dependent variable is not dichotomous.

The logit model is used in this study as the analytical technique for its characteristics of predicting probabilities within a range of 0 to 1. Normally, when the dependent variable is binary, in that case the logit model is used as a methodological tool. "Among the beneficial characteristics of maximum likelihood estimation are its consistent and asymptotically efficient parameter estimates" (Naanwaab et al., 2014, p.5). Here, the logit model is used to observe the probability of individuals' willingness to pay a 6 to 10 percent more price premium for 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 $\pi_i$ represents the aforementioned probability of individuals 'willingness to pay a 6 to 10 percent more price premium.

Logistic regression estimates a multiple linear regression function:

$$\text{Log}\left(\frac{\pi i}{1-\pi i}\right) = \beta_0 + \beta_1 X_{i1} + \beta_2 Xi_2 + \ldots\ldots\ldots + \beta_n Xi_n + €i \quad \text{(i is used for } i^{th} \text{ individual)}$$

A binary logistic regression gives each independent variable a coefficient which measures its contribution to the variation in dependent variable. Co-efficient β stands for the slope value, and € stands for error term. The slope can be interpreted as the change in the average value of the dependent variable for a one unit change of the independent variable.

Literature shows that to explain consumers' perception and willingness to pay for a product, the logit model is widely used (Naanwaab et al., 2014, Haghiri et al., 2009, Yilmaz & Belbag, 2016). The objectives of this study are to explore consumers' knowledge and acceptability of traceability systems and find out the factors influencing WTP for farm-raised traceable Atlantic salmon among consumers in NL. The logit model is used here to estimate the effects of a variety of factors on WTP. 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 will be examined. So, in this study, 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 as the influence of these factors on consumers' WTP for the certified product. These variables are directly mentioned in some of the literature (Haghiri, 2013, Rigueira et al., 2014). Here, it is hypothesized that, with larger family size, a household will be less willing to pay a 6 to 10 percent price premium for traceable farm-raised Atlantic salmon, because it will be more costly for them. On the other hand, with a higher education level, a person will be more likely to pay 6 to 10 percent more as a price premium, as it is expected that they are more concerned about the traceable fish.

Besides socio-economic and demographic factors, this study also focused on a number of behavioral factors and knowledge variables and hypothesized that they are relevant to identifying consumers WTP for farm-raised traceable salmon. For example, it can be predicted that a consumer who searches for food-safety information frequently, will be more concerned about traceable food and will show a positive WTP for farm-raised traceable salmon. Knowledge about a product shapes consumers' attitude. So, it is predicted that consumers with knowledge about traceability systems and polychlorinated biphenyls (PCB) 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:

$$WTP_{traceablesalmon} = \gamma_o + \gamma_1\, gen + \gamma_2\, age_2 + \gamma_3\, age_3 + \gamma_4\, age_4 + \gamma_5 hsz + \gamma_6 edu_2 + \gamma_7 edu_3 + \gamma_8\, hinc_2 + \gamma_9 hinc_3 + \gamma_{10} hinc_4 + \gamma_{11} stype + \gamma_{12} spre + \gamma_{13} hcon_2 + \gamma_{14} hcon_3 + \gamma_{15} hcon_4 + \gamma_{16}\, traceknow + \gamma_{17} readlabel + \gamma_{18}\, impfprice_1 + \gamma_{19}\, impfprice_2 + \gamma_{20} impfprice_3 + \gamma_{21}\, PCBknow + \gamma_{22} concern_{q/s} + \gamma_{23}\, measureQ_2 + \gamma_{24} measureQ_3 + \gamma_{25}\, measureQ_4 + \gamma_{26} measureS_2 + \gamma_{27} measureS_3 + \gamma_{28} measureS_4 + \gamma_{29}\, MeasureS_5 + \gamma_{30} searchfsI_2 + \gamma_{31} searchfsI_3 + \gamma_{32} searchfsI_4 + \gamma_{33}\, tfs_2 + \gamma_{34} tfs_3 + \gamma_{35} tfs_4 + €\text{……………} \text{(equation 1)}$$

*WTP instead of WTPtraceablesalmon is used in the rest of the thesis for simplicity.

To avoid perfect collinearity in the model, one group from each of the group-category independent dummy variables such as gender, age, education, and income were removed. The following groups are considered as the base group: a respondent whose age is between 20 and 30 years, a participant with high school or less than high school degree, and a respondent with less than CAD $29,000 annual income, a household who consumes less than one pound salmon fish in a month and an individual with knowledge about traceability systems.

### 3.7 Ethical Considerations

Respect for persons, concern for welfare and justice are the three core principles of the Tri-council ethical policy (CIHR et al., 2014). To conduct the study, these three principles were strictly followed. The respect for the research participants was the first priority. Full consent from the participants was taken before collecting data from them. Respondents' were informed that the questionnaire aimed to gain insight with regard to the understanding of consumer perception of implementing a traceability system in farm-raised Atlantic salmon.

According to the second principle of the Tri-council ethical policy, this study has also maintained the welfare of the respondents by ensuring the protection of the privacy of each research participant (CIHR et al., 2014). The study also strongly assured the respondents that there is no right or wrong answers and the information regarding demographics will be merely used for statistical purposes and will never be shared with third parties. Participants were informed that their participation is absolutely voluntary and they may withdraw from the survey at any time during completing the questionnaire without giving any reason, and all the data given by them before withdrawing will be destroyed.

The fairness of the study was maintained by showing equal respect and concern for all participants in this research (CIHR et al., 2014). The study has acknowledged the works of other researchers which will be used in the study by referring them properly. Besides, the researcher has completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics (TCPS 2: CORE).

# Chapter-4

## 4. Seafood Industry in North America & Major European Countries: A Comparative Public Policy on Traceability

Seafood industry is considered one of the most diverse, global, and complex protein provider industry, which makes seafood traceability logistically complicated. For the last five decades, global seafood production has been increasingly rising which brings forth several environmental, economic and societal challenges for managing the seafood trade (Cao et al., 2015). Seafood traceability systems can be a good sustainable management tool for fisheries, though Leal et al., (2015) have found that most fisheries all over the world are still unsustainable.

Globally, many seafood companies are struggling to implement suitable software to trace the seafood as they have found it too costly and complex (Fraser, 2018). Because of this high cost, many seafood companies chose to stay with the paper-based traceability rather than switch to software (Fraser, 2018). Moreover, consumers' concern about the ecological impact related to seafood is forcing them to demand sustainable seafood. SeaChoice.org describes sustainable seafood as "fish or shellfish that is caught or farmed with consideration for the long-term viability of harvested populations and for the health of marine ecosystems" (Magera & Beaton, 2009, p.19). Weak labeling and traceability regulations can create spaces where economic fraud, illegal, unregulated, and unreported (IUU) seafood can occur in the supply chain. Seafood traceability helps to disrupt the unsustainable exploitation practices of fishing resources. After analyzing the current traceability practices, Andre (2013) identified international standards and guidelines, regulatory standards, and industry and NGO non-regulatory standards as the three major kinds of traceability standards and regulations. Among them, international standards and guidelines are constructed to present the best practices related to tracing food products and provide guidance to different countries in dealing with illegal, unreported and unregulated (IUU) fishing (Borit & Olsen, 2016). Globally and nationally, many regulations and policies are initiated to develop suitable traceability systems for seafood. To supply seafood in international markets, every country needs to meet the traceability requirements and regulations of seafood trading provided by other countries (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010).

## 4.1 Traceability Practices in the Canadian Aquaculture Industry

Canada is the first country which introduced a mandatory food safety system on the basis of Hazard Analysis Critical Control Point (HACCP) under the Canadian Food Inspection Agency's (CFIA) Quality Management Program (QMP) for seafood industry in 1992. But, limited amount of HACCP data collected under the QMP has been found as useful for developing upgraded seafood traceability systems in Canada (Magera & Beaton, 2009). Now, at the federal level, DFO is the responsible body to monitor fish landings and identify problems regarding to IUU fish and seafood. DFO issues non-IUU certification for those Canadian fish which come through legal sources (ThisFish, 2013). Canadian Food Inspection Agency (CFIA) is working as an administered authority to implement all the fish inspection regulations and labeling requirements of Canada and inspects all Canadian seafood processors whether they are doing interprovincial trade or export trade (Ron Bulmer Consulting Inc, 2004). The main goals of implementing traceability systems in the Canadian aquaculture industry are to meet up regulatory requirements, market requirements, production management requirements, and to achieve third-party certifications. Therefore, sustainability/environmental concerns, regulatory requirements, internal quality management, health/safety/recall concerns and getting market access are playing as the driving factors of implementing traceability systems in the Canadian aquaculture business (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010).

Canadian finfish aquaculture companies are involved in different stages of the aquaculture supply-chain, which allows them to implement effective traceability systems from breeder to processor. Normally, Canadian finfish aquaculture businesses need to record fundamental traceability information, specifically required information and commercially desirable information to maintain traceability regulations (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010). Fundamental traceability information helps to identify the product and trace its physical movement throughout the entire supply chain (Donnelly et al., 2008). As a part of fundamental traceability information, every company has to record the quantity, nature and unit IDs of product received/ dispatched by the business, dates/times and places of reception/ dispatch and mapping relationships between the units received and dispatched (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010). Specific information includes the name of the species, the method of production and area of origin, which is required by the US Country of Origin Legislation (Cool); description of the full product, required by the US Bioterrorism legislation and Animal health, and disease control information. For "maximizing the efficiency of operations; limiting liabilities under product liability and safety legislation; assuring the safety and quality of products; enabling accurate labeling; meeting third party certification and audit requirements and substantiating marketing claims", finfish aquaculture companies record commercially desirable information required by legislation (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010, p. 22).

Batch or lot numbering, barcodes or RFID technology, logistic unit numbers, trade unit numbers and EAN/UCC numbering system (known as the Uniform Code Council)for trade unit numbers are the identifiers that Canadian finfish firms (e.g salmon firms) are using currently to trace finfish (e.g salmon)fish. Through this batch or lot numbers and Purchase Oder (PO) numbers, finfish business firms can record the ID of transporters by linking product identification information to data elements associated with source and destination (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010).

In Canada, all finfish aquaculture firms have to record their traceability information in computer-based data recording systems. They need to do it to meet the requirements for selling product required by regulation, for acquiring industry and third-party certification standards and for boosting up internal quality management that can drive productivity (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010). Fishtalk and ThisFish are examples of some commercial computer-based traceability systems currently used by the finfish aquaculture industry in Canada in order to maintain sustainable and responsible fishing. By implementing a single traceability system, one manager can easily access any specific information throughout the full vertical integrated business. But still now all finfish firms in Canada could not be able to maintain full vertical integrated businesses (Archipelago Marine Research Ltd. & Blue Revolution Consulting Group, 2010).

All Canadian fish products importers must request an import license issued by CFIA, before importing fish items in Canada. Besides, for imported seafood, it also needs to follow the requirements for labeling provided by the CFIA, where the quality and type of the product, country of origin and name of the producer must be declared (Petersen & Green, 2006). Normally, in Canada, if 51 percent of a product is made within the country, only then the product can be labeled as “Made in Canada”. But fish which goes through “substantial transformation” in Canada at a federally registered establishment could be marked as “Product of Canada” (Magera & Beaton, 2009, p. 22). This transformation comprises salting, canning, battering and breading of a fish, which may change its originality.

On the label of most of Canadian seafood products, it is required to mention the common name, the country of origin, net quality grade, size and quality of the product (Canadian Food Inspection Agency, 2008). In Canada, it is not required to mention whether seafood is wild or farm-raised, which is mandatory in the USA and Europe. Even mentioning the colorants and sulfites ingredients is also not mandatory in Canadian seafood (Magera & Beaton, 2009). To prohibit false or misleading information on fish leveling, Canada follows Canada Food and Drug Act; Consumer Packaging and Labeling Act, and the Fish Inspection Act (Roebuck et al., 2017). Canadian seafood importer countries, especially the United States, European Union, Japan, and China, are continuously pressuring the Canadian exporters for delivering more traceability information (Magera & Beaton, 2009).In June 2018, CFIA has announced new traceability regulations, namely the Safe Foods for Canadians Regulations (SFCR), to be implemented from January 2019. Unfortunately, the regulations do not put in place the need to prevent seafood fraud, take initiative for honest labeling or keep illegally caught seafood out of the Canadian supply chains (Oceana, 2018).

Canada does not have any specific traceability regulations for food commodities, including seafood, other than for livestock (International Trade Centre, 2015), and the development of traceability systems in the Canadian seafood industry is not considered important but substantial actions such as eco-certification program are trying to initiate the meeting of traceability regulations and market expectations (Magera & Beaton, 2009).  An NL Atlantic halibut and lobster traceability project has undertaken in 2011 by the Fisheries, Science Stewardship and Sustainability Board (FSSSB) to ensure the resource is harvested sustainably (FFAW-UNIFOR, 2019).

### 4.2 Seafood Traceability Regulations in the United States

Globally, the United States is considered as the world's largest fish importer. In 2015, it has imported more than 2.6 trillion kilograms of seafood alone (Willette & Cheng, 2017). In the United States, both imported foods and domestically produced foods follow the same legal traceability requirements. From 1997, all the domestic processors and importers of fish and fishery products in the U.S. require obeying the Seafood Hazard Analysis and Critical Control Point (HACCP) Regulation, applied by the Food and Drug Administration (FDA) to prevent hazards from occurring (U.S. Food and Drug Administration, 2018). Under the Seafood HACCP Regulation, all the aquaculture firms in the U.S. are required to know the hazard associated with unapproved drugs and are required to take sufficient initiatives to ensure the legal and appropriate use of drugs in fish products. The execution of the Seafood HACCP Regulation helps the seafood industry to ensure safety in seafood and enhance consumers' confidence in seafood (U.S. Food and Drug Administration, 2018).

Through the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, United States has constructed required traceability regulations to maintain the records of each person who is involved with manufacturing, processing, packing, transporting, distributing, receiving, holding or importing seafood into the U.S. One of the requirements of this act mentions about the documentation record of the last previous supplier and the next subsequent buyer of food and food packaging which is widely known as "one-up, one-down" traceability system (Magera & Beaton, 2009). According to the U.S. Bioterrorism Act, it is mandatory for every imported food shipments in the U.S. to submit a prior notice to the FDA before import. In that notice, they require to mention about the identification of products such as brand name, quality, lot code, the name of the manufacturer, name of the country from where the food is shipped, the name of the shipper, importer, owner and consignee (U.S Food and Drug Administration, 2013). U.S importers need to ensure that the offered fish and fishery products are processed by following the Seafood HACCP Regulation; otherwise the Seafood HACCP Regulation has a potential mechanism to traceback imported seafood to the preceding firm all the way to the processor that received the product from the fisherman or aquaculture producer (U.S. Food and Drug Administration, 2018).

According to the requirements of the Federal Food, Drug, and Cosmetic Act (FDCA), the U.S. Fair Labeling and Packaging Act, and the Nutrition Labeling and Education Act, every retail packet of seafood products needs to include the identity of the product, the name, and address of the accountable business firm (whether it is foreign or domestic), list of ingredients, net weight on labeling. Besides nutritional information, it is also required to highlight on the label for that processed seafood which is mixed with other ingredients (Olsen, 2012).

The U.S. Country of Origin Legislation (COOL), under section 10816 of the 2002 Farm Bill, also requires carrying labeling for all seafood products designated for consumption. The requirements of COOL include that importers, suppliers, and retailers have to provide the country of origin for all fresh or frozen seafood and mention the method of product categories, such as whether the fish are wild or farmed (Magera & Beaton, 2009). But these conditions are not applicable to processed seafood, for example, sea fish which are cooked, cured, smoked, restructured or combined with other foods. To some extent, this statute helps to diminish mislabeling and fraudulent use of documentations in U.S. seafood sector, but it could not mitigate IUU fishing completely (He, 2018).

In 2011, U.S. has signed the FDA Food Safety Modernization Act (FSMA) which brings some changes to the Federal Food, Drug, and Cosmetic Act (FDCA), especially in the case of sourcing, transportation, and importation into the U.S and in the distribution of seafood. According to the law, FDA is the responsible authority to verify whether seafood products that are coming into the U.S. are safe or not (Olsen, 2012). Previously, FDA reacted to any problems after the occurring of the incidents, but to strengthen the food safety system, this FSMA grants FDA more authorization to focus on preventing food safety problems rather than cure them (International Trade Centre, 2015). For the first time, this law ensures importers' accountability that their foreign suppliers which have enough capability to produce and send safe food to U.S. Besides, FSMA also set-up third-party certification to certify those foreign seafood firms which comply with U.S. standards (Olsen, 2012). In the U.S., this third party could be a private corporation or a governmental body.

Since 2014, the US National Oceanic and Atmospheric Administration (NOAA), under the Department of Commerce, has been trying to introduce an explicit traceability system in order to combat the IUU fishing and mislabeled seafood from inflowing into the U.S. market (He, 2018). In January 2017, NOAA has passed the Seafood Import Monitoring Program (SIMP), in order to deter IUU catches and improve the U.S. seafood traceability requirements, as a holistic and well organized system (Willette & Cheng, 2018). Along with preventing IUU fishing and to stop misrepresented seafood from entering into the U.S. market, the SIMP also aims to offer extra protection to the U.S. national economy, to ensure global food security and the sustainability of

U.S. shared ocean resources (National Ocean Council Committee, 2018). The final rule of SIMP requires data reporting, recordkeeping and verifying each imported shipment for those certain fish and fish products that have been identified as vulnerable to IUU fishing or seafood fraud (Willette & Cheng, 2018). In this case, to check whether these certain sea foods are legally harvested or not, the International Trade Data System (ITDS) provides sufficient data to trace these seafood species from the entry point into the U.S. market back to the point of production. "The SIMP is implemented under the U.S. Magnuson– Stevens Fishery Conservation and Management Act's prohibition on importing or trading fish captured, transported, or sold in violation of U.S. and foreign treaties and regulations" (Willette & Cheng, 2018, p. 26).

### 4.3 Seafood Traceability Regulations in the European Union (EU)

According to EU's law, traceability means "the ability to track any food, feed, food-producing animal or substance that will be used for consumption, through all stages of production, processing and distribution" (Health and Consumer Protection, 2007, p.1). In 2002, the EU has made the traceability systems mandatory for all seafood businesses in order to trace the information from where the products are coming and where they will go (Magera & Beaton, 2009). The EU and all member state competent authorities have made public their general guidelines on the European Commission (EC) website, which said that all business operators require recording the name and address of every suppliers and customer. Besides, they also need to document the nature of the product and delivery date, the quantity of the product and batch number (Health and Consumer Protection, 2007). The general rule for keeping records is a five years period. The responsibilities of member state competent authorities are to monitor the production, processing, and distribution of food products, to ensure whether business operators are maintaining the EU requirements properly or not, and they also have the power to enforce punishments to operators for not meeting the requirements of traceability (Health and Consumer Protection, 2007). When risk is identified for any product, immediately the business operator must withdraw the affected product from the market and sometimes they also recall the product from consumers when they find it necessary. Besides, when a product fails to fulfill the food requirements, the business firms also destroy the batch, or lot of the products (Health and Consumer Protection, 2007).

The Common Fisheries Policy and the Food Hygiene Legislation are two main sets of legislation which influence aquaculture imports to the EU. Through fleet and quotas management, the Common Fisheries Policy directly influences EU's fish production. Every year, the ministers and the European Parliament set up which member states can take how many fish from an area and given time period (Roper, 2011). Besides, this policy has also authority power over the imports of fish from third countries. With the help of the Food Hygiene Legislation, EU ensures that imported food fulfills the EU's minimum hygiene standards and also offers safe seafood to consumers (Ulmas, 2013).

To export fish in EU, the national authority of a country first needs to ensure an approval from the Directorate-General for Health and Consumer Protection of the European Commission (EC). Normally, the EC issued the approval based on the public health and control systems of a country. That means the EC first needs to confirm that the exported seafood products are able to meet the health requirements of EU before granting the approval (CBI Ministry of Foreign Affairs, 2018). Since 2010, to prevent, deter and eliminate IUU fishing, EU has decided to import fish and fishery products when they will be accompanied by a catch certificate. If a country doesn't follow the guideline of EU, it can be temporarily banned from the seafood market in the European Union, such as Belize, Cambodia, Guinea and Sri Lanka (CBI Ministry of Foreign Affairs, 2018).

To import aquaculture live fish, their eggs and gametes from third countries, they need to comply with the animal health conditions and certification requirements of EU. To trace the aquaculture production within EU, every business operators need to keep the record of all movements of aquaculture fish within and out of the farming area and the mortality in each epidemiological unit. Every aquaculture firm has to record the movements of fish in such a way that the tracing of the place of origin and destination can be assured (Ulmas, 2013).

General labeling rules are applicable for fishery products in EU and, according to the general rules of leveling, the label on the packet of fishery products has to include the name of the product, list of ingredients, percentage of these ingredients, net weight, date of best before, business name and address of the manufacturer and lot marking Since December 2014, stricter traceability rules have applied for seafood products within EU. Along with the general label rule, in this traceability rule, the business operators have to provide accurate information about the harvesting or production area and production method of the seafood. This is applicable for all unprocessed seafood, and even for some processed seafood. The new labeling rules provide the chance for consumers to choose seafood produced in a more sustainable way and from detailed sources.

### 4.3.1 Norway

Norway was among those countries which first initiated a traceability system, in order to track the harvesting method of salmon and other fish to ensure the food safety. Norway is the largest producer of farmed salmon and 2$^{nd}$ largest exporter of seafood (Seafood from Norway, 2018). To export salmon, Norwegian salmon firms provide all the traceability information, such as the spawning stock, the name of the company and the farm location, the salmon feed, any treatments and health monitoring, where the salmon are slaughtered, processed, and also information about the packaging (NORGE, 2013). Through the European Economic Area (EEA) agreement, Norway comes under the EU's single market rule (EFTA, n.d). Traceability statutes of Norwegian salmon are controlled according to the EU's regulations. The Norwegian Food Safety Authority, the Norwegian Directorate of Fisheries, the Norwegian Coastal Administration, the County Governor and the Norwegian Water Resources and Energy Directorate are the respective authorities to supervise salmon quality in Norway, in accordance with EU regulations. To ensure environmental, ecological, fish welfare and food safety, GLOBAL G.A.P., Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP) certify the Norwegian salmon farming (Seafood from Norway, 2018). To ensure food safety and quality control, the Norwegian Scientific Committee for Food Safety, the Norwegian National Institute of Nutrition and Seafood Research (NIFES) and the Norwegian Veterinary Institute carry out more than 11000 tests approved by the Norwegian and EU authorities (NORGE, 2013), and mention that Norwegian salmon are safe and maintain proper quality (Seafood from Norway, 2018).

### 4.3.2 Scotland

Scotland started salmon farming in the 1970's and in the last 25 years the production of farmed salmon in Scotland has increased by 6 times (ISFA, 2018).Globally, Scotland is now one of the top producers of farmed Atlantic salmon. Scientific research and innovation was the main focus of Scotland to improve the quality of farmed salmon. The United Kingdom is the main market for the Scottish salmon. To export salmon, Scotland strictly follows the regulations of European

Union. Besides, Scottish salmon producers also need to obey many other national standards, such as Label Rouge, the environmental standards of Global Gap and fish welfare standards (ISFA, 2018).For maintaining superior quality and taste, the French Ministry of Agriculture approved a prestigious quality mark to any farm or company, which is known as Label Rouge, and to attain this acknowledgment a product need to maintain some standards rigorously throughout the entire production chain. Scottish farmed salmon was the first fish which obtained the Label Rouge quality mark in 1992 (Loch Duart Ltd, 2018).Salmon producers in Scotland are committed to maintain the Code and good practices for managing good health of fish that has been developed by EU, UK and Scottish legislations. Marine Scotland Science (MSS) and the Scottish Environment Protection Agency (SEPA) are two public bodies of the Scottish Government which are responsible to inspect and monitor the salmon farms regularly (Code of Good Practices, 2015). To ensure healthy fish quality, SEPA fixed the medicinal treatments and vaccination for farmed salmon in Scotland, which every farm strictly needs to follow (Code of Good Practices, 2015).

### 4.3.3 Ireland

Ireland has a thriving fish farming industry where finfish (e.g salmon and trout) are mostly produced. Ireland's Seafood Development Agency, Bord Iascaigh Mhara (BIM) has developed Responsibly Sourced Seafood (RSS) standards to promote consumers' confidence in the Irish fishing practice (Responsibly Sourced Seafood, 2017). Besides, as a part of EU, the Ireland seafood industry also needs to maintain the (EC) 1224/2009 and EC 404/2011 traceability regulations throughout the production to distribution stages (GS1 Ireland, 2016). With an aim to increase the seafood sale by Euro 1 billion in a year, BIM fixed the goal of 'capturing Ireland's share of the global seafood opportunity' in its 2013 - 2017 strategy. In 2012, to fulfill the strategic objective and to ensure that the Irish fishing industry is utilizing the latest equipment and software, all the stakeholders of fishing industry such as BIM, the Sea Fisheries Protection Agency (SFPA), GS1 Ireland and the fishing cooperatives and processors started a project to offer the best traceability system for the fish sector in Ireland (GS1 Ireland, 2018).

BIM and the SFPA have started an EU-funded project named e-LOCATE (Lots to Origin, the Control, Assurance and Traceability of EU seafood), via GS1 standards to support the Irish seafood industry by new hardware and software for implementing the best traceability systems, such as barcode scanning and facilitating the storing and sharing of information in a standardized electronic way (GS1 Ireland, 2016). The use of GS1 standards, in compliance with the EU fish traceability regulations, helps to improve the risk management and recall system for increased food safety, along with improving the monitoring capacities of Ireland's fish industry (GS1 Ireland, 2016).

Denis O'Brien, Director of Standards and Solutions, GS1 Ireland, asserts that in the future, with the assistance of GS1 standards, consumers will be able to access product information, for instance ingredients, nutritional data, sustainability credentials or country of origin. This will help to position Ireland as a global leader in seafood supply, for its assurance of quality and sustainability, up-to-date production capabilities and its implementation of international best practices and standards for traceability (GS1 Ireland, 2018).

### 4.4 Comparative Analysis of Seafood Traceability Regulations among Canada, U.S. and EU

Proper labeling and traceability systems are the two best dynamics to identify the environmentally sustainable seafood (SeaChoice.org, 2018). The Marine Stewardship Council (MSC), which is a non-profit independent organization and sets standard for sustainable fishing asserts that seafood will be addressed as sustainable if it is fished from a stock with healthy population; have minimum impacts on the marine environment and are cultivated in an area with effective, responsive and responsible management (MSC, 2019).

Charlebois & Shoyama (2010) have conducted a comparative study among 17 OECD countries to evaluate the depth of the traceability systems of these countries and score them on the basis of their comprehensiveness. Risk assessment, management and communication are the three performance indicators for labeling progressive or regressive performance of any country. The authors have rated EU countries as progressive, while they rated Canada and U.S. as regressive. Lack of a comprehensive traceability system at that time is the main reason for rating the traceability system of Canada as well as the U.S. as regressive. EU countries, such as Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Sweden, the United Kingdom, all scored as superior, as they follow the mandatory traceability procedure for a wide range of food and animal products of both domestic and imported origin. For most prepared foods, the U.S. FDA regulations make food labels mandatory in the United States, but the findings of this study show that “despite the passage of the FSMA and the opportunity to strengthen traceability, the United States is still lacking regulations dealing with national traceability of food products in general” (Charlebois & Shoyama,2010, P.1120). Though Canada is strengthening its traceability requirements through mandatory livestock identification, for other commodities, this study found that Canada does not have any specific legislation on the seafood traceability.

Meyer (2017) also asserts that in comparison with European Union and the United States, Canada requires less information on it seafood label. From news of Canada's National Observer it is found that an association of environmental groups named SeaChoice has run a sustainable seafood program and released a report on labeling system of seafood among different countries in March 2017, where they gave Canada an "F" grade for requiring only two out of six types of information (Meyer, 2017). In that program, SeaChoice compared the Canadian traceability regulatory requirements with those of the European Union and the United States. It graded the labeling system on the basis of six elements, namely: the common name of the product; the scientific name of the species; production and harvest methods; geographic origin and country of last major transformation/processing. According to the report, the Canadian Food Inspection Agency (CFIA) requires only the common name and the country of origin, whereas the United States requires the information of the production method along with these two. The European Union's regulation requires all these six types of information (Meyer, 2017). The seafood exports from Canada are more sustainable compared to the imported seafood. Due to poor traceability requirements, imported seafood in Canada is less sustainable and sometimes un-rankable. Because of the poor labeling and traceability system, almost one third of the imported seafood in Canada cannot be ranked (SeaChoice.org, 2018).

The new Safe Foods for Canadians Regulations (SFCR) were an opportunity for Canada to address the system of documenting and tracing seafood from the boat-to-plate which could help the country to catch up to the United States and the European Union regulations. Not addressing the requirements to stop seafood fraud and prevent illegally caught seafood in these regulations, leaves Canada well behind international best practices (Oceana, 2018).

# Chapter-5

## 5. Empirical Analysis

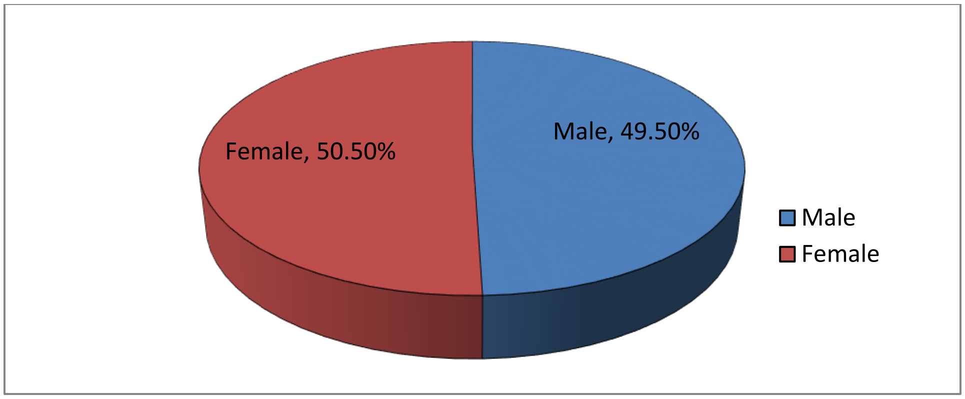
Descriptive statistics provide simple summaries about the sample which measures with the help of simple graphics analysis. In this thesis with the help of descriptive statistics the dummy variables used in this study are described. Gender, age, education, income, household salmon consumption, public knowledge about traceability systems and PCB, willingness to pay for salmon fish and label reading habit of consumers are the explanatory variables of this thesis.

### 5.1 Descriptive Statistics

#### 5.1.1 Gender:

Among the 200 respondents of this survey, the number of female participants is 101(50.5%) whereas the other 99 participants (49.5%) are male (see table 2, which presents a summary statistics for the independent variables). According to the Government of Newfoundland and Labrador (2017), the total number of female and male residents of NL was 268, 207 (50.72 %) and 260,610 (49.28 %), respectively. So, the respondents of this study are corresponding to the half a million population of the province of NL in 2017.

**Figure 1: Gender of the respondents (N=200)**



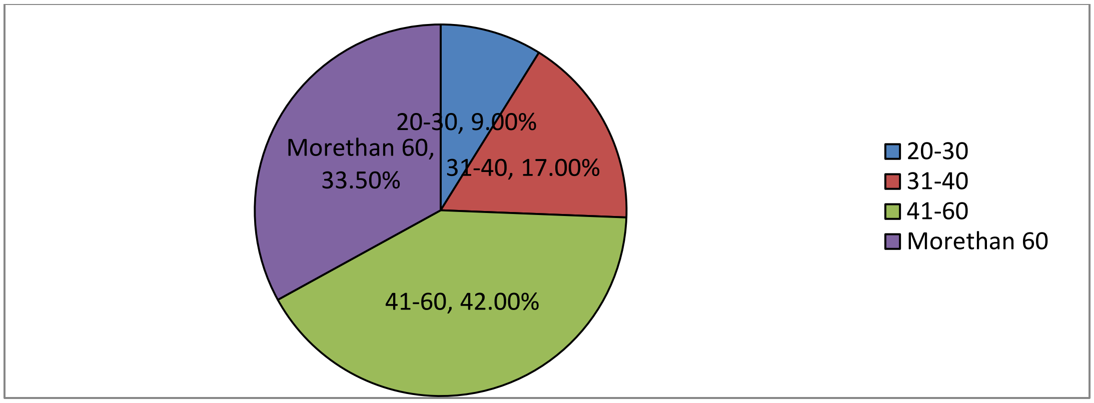

**Source: Sample data**

### 5.1.2 Age Distribution of the Respondents and Household Size

For this study, individuals who are more than 19 years old have been selected as respondents. According to the data gathered from the questionnaire survey, the majority of the participants (41.5%) ranged in age between 41 and 60 years (Figure 2). This is followed by the respondents' group who are more than 60 years of age (33.5%). The third is the group of individuals who ranged between the ages of 31 and 40 years (16.5%). Finally, individuals between 20 and 30 years old formed the smallest group (8.5%). The majority of the respondents are within an age range during which an individual can experience an increasing level of financial freedom which allows them to spend more on healthy food.

The data obtained from the questionnaire survey show that on average three people including the respondents reside in every house of the study area.

**Figure 2: Age distribution of the respondents (N=200)**

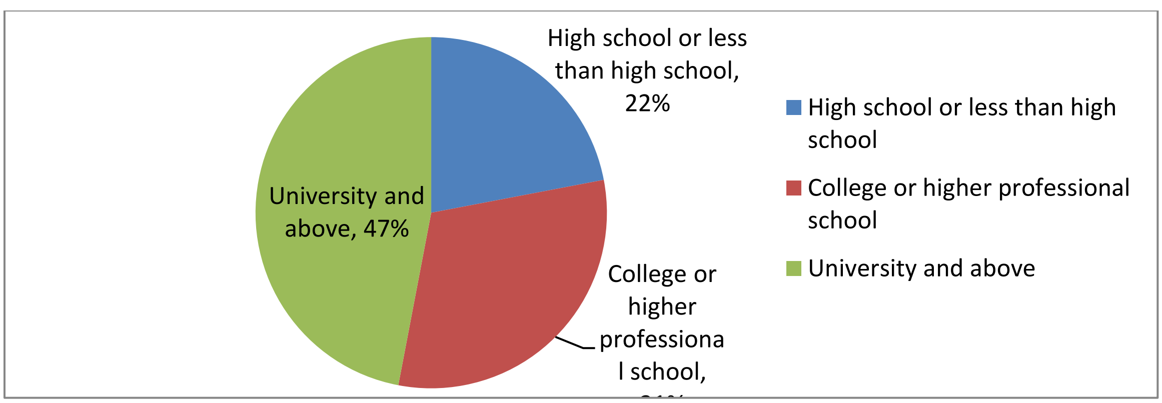



**Source: Sample data**

### 5.1.3 Education Level of the Respondents

Figure 3 indicates that 47% of respondents have a university degree and above, 31% of respondents declare that they have either a college degree or higher professional school degree, and the rest (22% of the participants in the survey) did not continue their education after completing high school, even if some of them could not be able to reach high school.

**Figure 3: Education level of the respondents (N=200)**

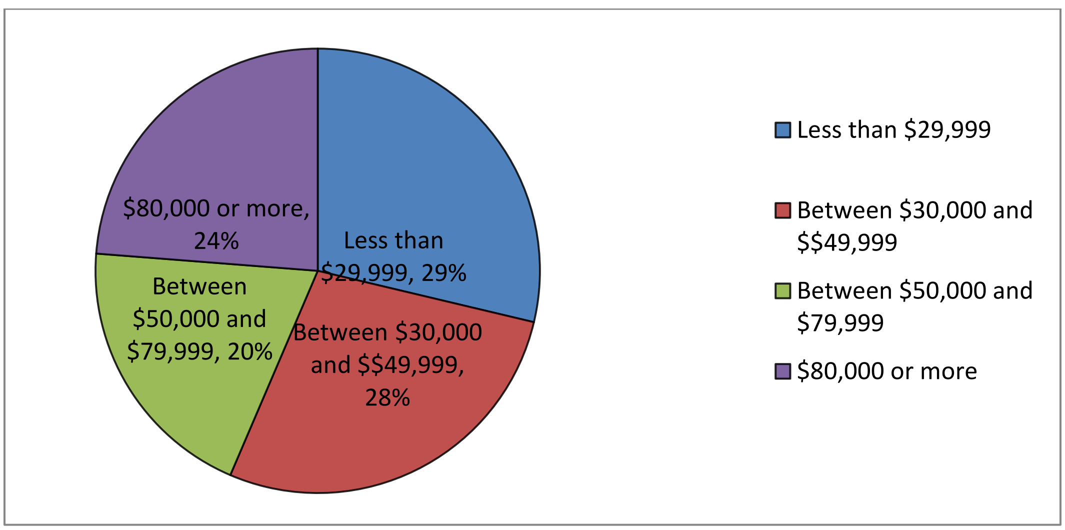



**Source: Sample data**

### 5.1.4 Income Distribution

Figure 4 illustrates the annual household income of the respondents of this study. The result shows that 29% of the survey respondents earn less than $29,999 annually whereas 28% of respondents earn between $30,000 and $49,999. Only 24% of the participants earn $80,000 or more annually. According to the Conference Board of Canada (2019), the average per capita income of NL was $46,088 in 2016. So the information drawn from the sample observations conforms to the data. The province of NL is mostly hosting residents who go outside of the province for work and earning money, and after retirement they return to this region (Haghiri, 2014).

**Figure 4: Annual income distribution of the respondents (N=200).**

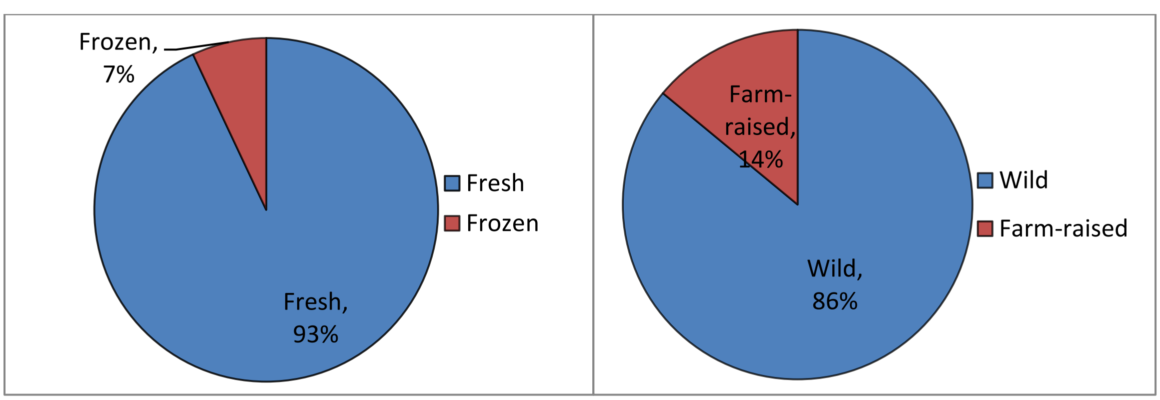



**Source: Sample data**

### 5.1.5 Salmon Preference

From Table 2 it is clear that almost all of the respondents of this survey (93%) prefer to consume fresh Atlantic salmon instead of frozen one and the remaining (7%) of the survey respondents who have chosen frozen fish are mostly fishermen who catch fresh salmon for their own consumption and preserve these fish frozen for a long time period. Some respondents have chosen farm-raised salmon with respect to the availability. The data from the survey also show that 86% of the participants incline to consume wild-caught Atlantic salmon instead of farm-raised. During the survey, most of the participants shared that they wanted to purchase wild-caught salmon because they think that wild fish have a better taste, are healthier and have a higher nutritional value than farmed fish. But due to the low wild fish population, the Department of Fisheries and Oceans issues very few licenses for catching wild-salmon which are mainly for either own consumption or for sport-fishing purposes not for commercial use. So, the people of NL are constrained to consume farm-raised Atlantic salmon.

**Figure 5: Salmon preference (N=200)**

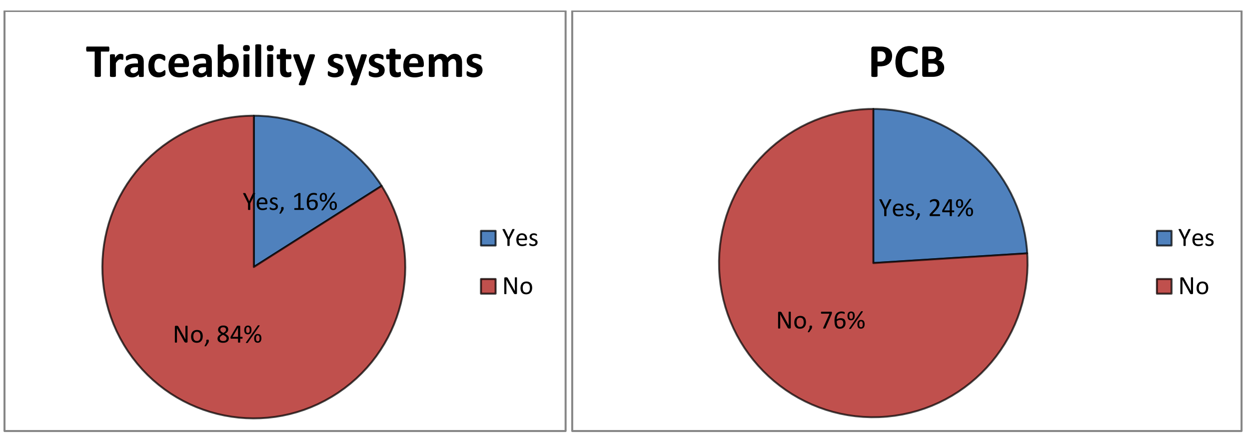



**Source: Sample data**

### 5.1.6 Public Knowledge about Traceability Systems and Polychlorinated Biphenyls (PCB)

Data from the questionnaire survey indicate that very few of the respondents have knowledge about traceability systems and the PCB incidents. Only 16% know about traceability systems and 24% of the respondents are familiar with the term PCB, and the remaining 76% of the respondents had no idea about the effect of PCB on human life. During the survey time, some of the respondents who declared that they had an idea about traceability systems, showed doubts about the quality of fishery products with traceability and were anxious about food safety. They also shared that though they had heard the name of traceability systems their knowledge is very limited about these. This is indicating the inadequate public knowledge among the people of NL about traceability systems and PCB.

**Figure 6: Consumers' public knowledge (N= 200)**

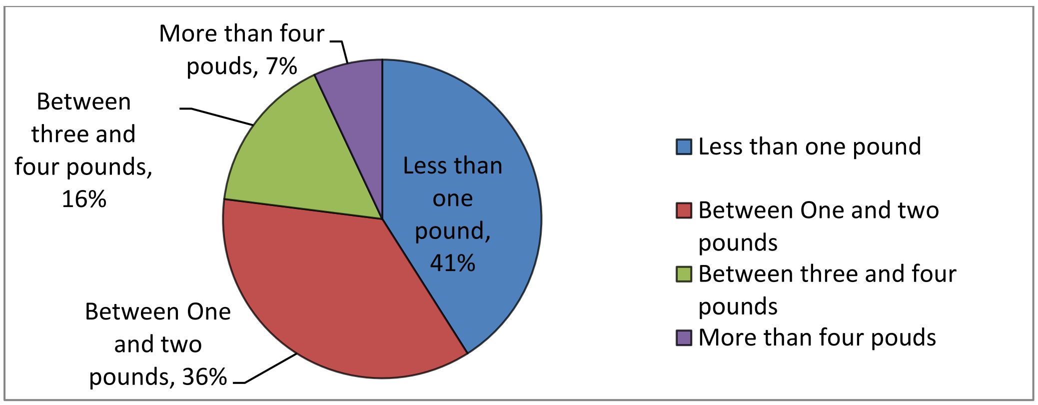



**Source: Sample data**

### 5.1.7 Household Consumption of Salmon per Month

Table 2 indicates that 41% of the survey respondents declared that their monthly household salmon consumption is less than one pound, whereas 36% of the participants stated that they consume between one and two pounds in a month. Only 7% of the respondents have a habit to consume more than four pounds of salmon in a month.

**Figure 7: Household salmon consumption per month (N=200)**

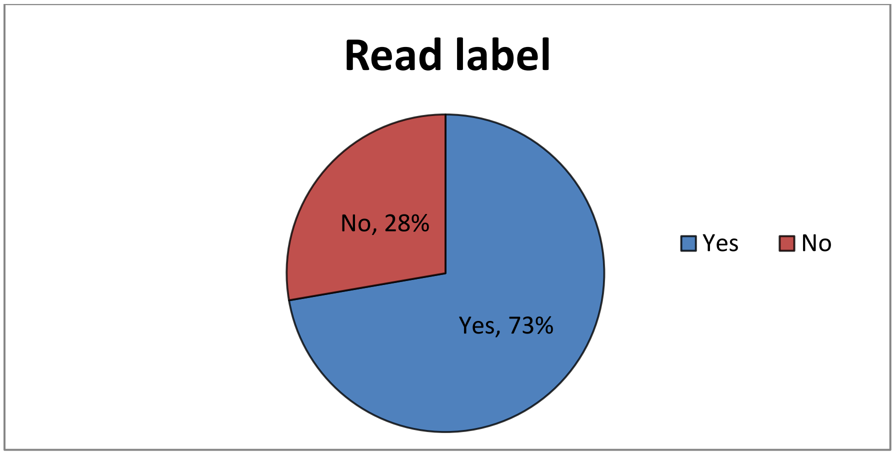



**Source: Sample data**

### 5.1.8 Consumers' Habit of Reading the Label on the Packet of Salmon

Labeling is one of the components of traceability systems. Through the questionnaire survey, consumers were asked about their habit of reading the label on the packet of salmon before purchase. It was found that 73% of the participants have the tendency to read the label on the packet whereas 27% of respondents don't care about it. However, some of them care about the place from where they are purchasing the salmon. Some of the respondents shared that on the label of the packet of salmon fish very few information is provided about the food quality and safety and the origin of the fish. The respondents stated that they wanted information to be easily available and easily accessible, and they wished to easily see that the farmed salmon in NL is traceable.

**Figure 8: Consumers' habit of reading the label on the packet of salmon (N=200)**

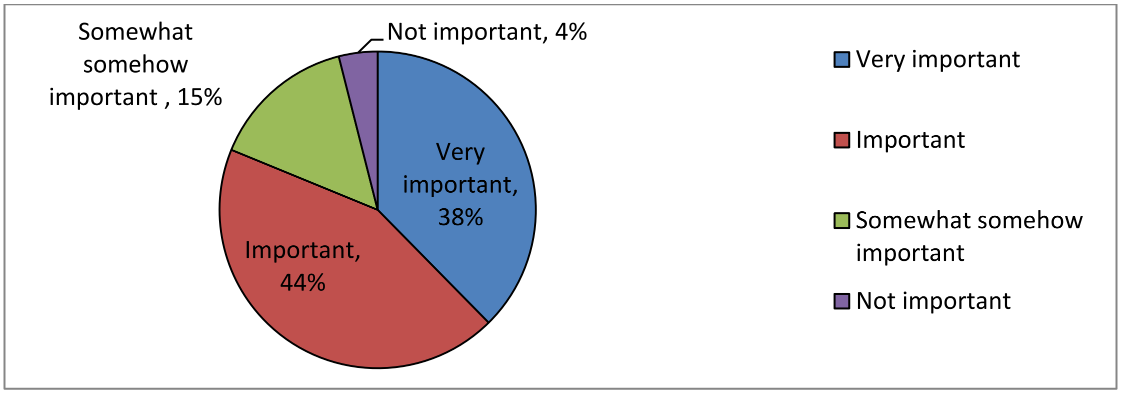



**Source: Sample data**

### 5.1.9 Importance of Food Price for the Consumers

Does food price matter to the consumers? To answer this question, 44% of the respondents stated that they consider food price important, 38% of the participants mentioned price is very important to them as their income is limited, and 15% of the respondents declared that food price is somewhat important for them. For purchasing the essential products these respondents are ready to pay a higher price. For 4% of the participants food price is not important.

**Figure 9: Importance of food price for the consumers (N=200)**

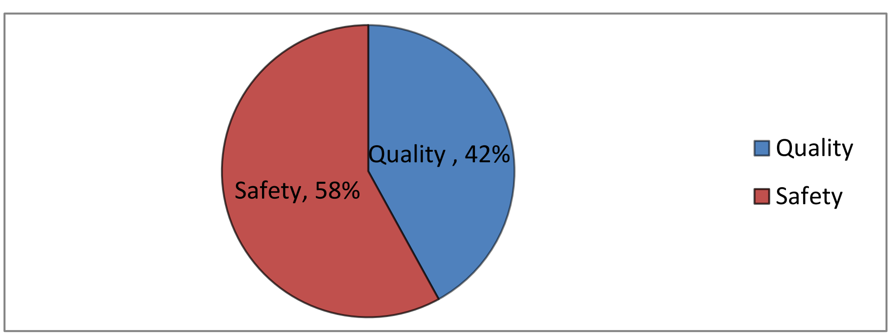



**Source: Sample data**

### 5.1.10 Concern about Quality and Safety

Food safety and food quality are two important elements which play a crucial role in consumers' decision-making process. Food safety provides a guarantee about the safeness of consumption of a food product whereas food quality confirms the freshness and tenderness of that food.42% of the respondents declared that during purchase of salmon fish they mainly look forward to the quality of the fish whereas for 58% of the participants safety comes first when they buy farm-raised Atlantic salmon.

**Figure 10: Concern about quality and safety (N=200**

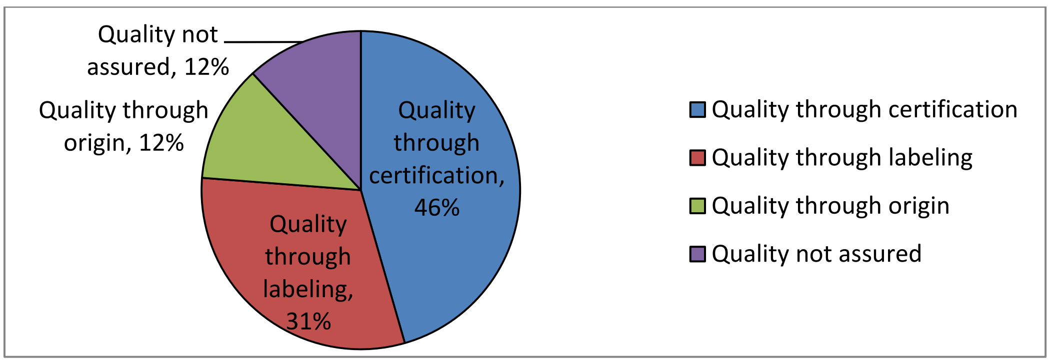



**Source: Sample data**

### 5.1.11 Perceived Measures of the Quality of Farm-raised Atlantic Salmon

How do consumers measure the quality of farm-raised Atlantic salmon? To answer this question, 46% of the respondents chose quality through certification for measuring the quality of farmed Atlantic salmon whereas 31% of the participants preferred safety through labeling, and 12% alleged that they measure quality through the origin of the product.

**Figure 11: Perceived measures of the quality of farm-raised Atlantic salmon (N=200)**

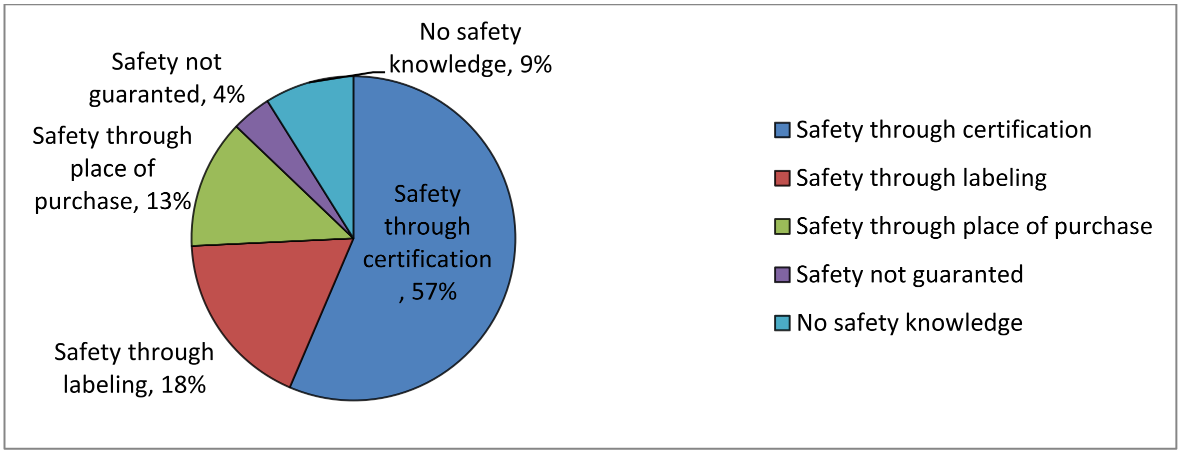



**Source: Sample data**

### 5.1.12 Perceived Measures of the Safety of Farm-raised Atlantic Salmon

To answer the same question about safety of farmed Atlantic salmon, most of the respondents (57%) (Figure12) chose the option safety through certification whereas 18% and 13% of the participants preferred safety through labeling and safety through the place of purchase, respectively. Only, 9% of the respondents declared that they don’t have any safety concern.

**Figure 12: Perceived measure of the safety of farm-raised Atlantic salmon (N=200)**

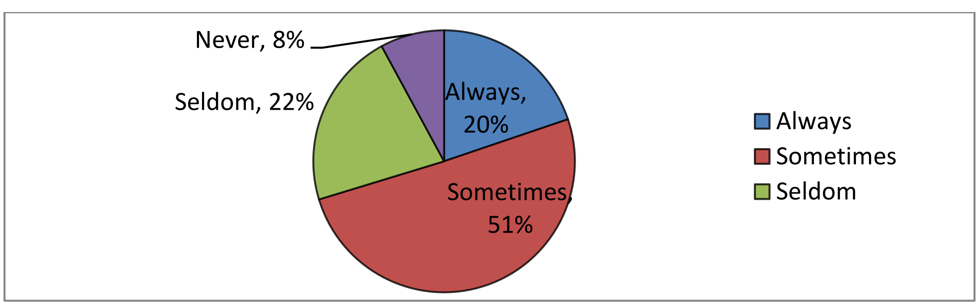



**Source: Sample data**

### 5.1.13 Frequency of Searching Food-safety Information

The survey also attempted to identify the respondents' frequency of searching for food-safety information. The majority of respondents (51%) noted that sometimes they search the food-safety information whereas 22% of the participants seldom search for such type of information. Only8% of the respondents stated that they just buy whenever they need to purchase salmon and never search for food-safety information.

**Figure 13: Search for food safety information (N=200)**

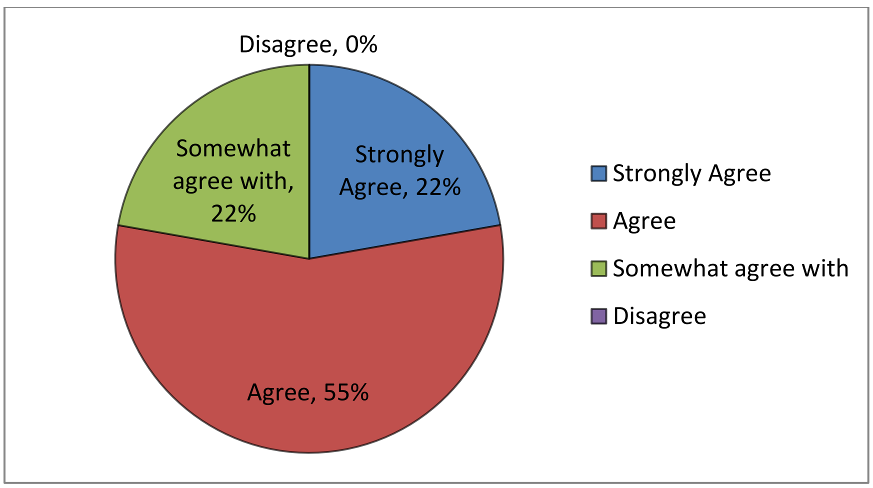



**Source: Sample data**

#### 5.1.14 Perceived Safety about Traceable Food

Do respondents agree with the safeness of traceable food or not? From the questionnaire survey, it is shown that 55% of the respondents agree that "traceable food is safer" and 22% of the respondents stated that they "somewhat agree with the statement". Another 22% of the respondents are very sure about the safety of traceable food (see table 2).

**Figure 14: Perceived safety of traceable food (N=200)**




**Source: Sample data**

**Table 2: Summary Statistics for the Independent Variables**

Statistical information such as frequency, mean and standard deviation about the independent variables that have taken in this thesis is given bellow:

| 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 |

**Table 2: Summary Statistics for the Independent Variables (Cont'd)**

| | | | |
|---|---|---|---|
| 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 |

**Table 2: Summary Statistics for the Independent Variables (Cont'd)**

| | | | |
|---|---|---|---|
| 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 |

**Source: Sample data**

*Shows the group-category explanatory variable omitted from the regression model to avoid the problem of perfect collinearity.

## 5.2 Variable Descriptions for the Regression Analysis

In Table 3 the descriptions of the variables used in the model along with the expected sign of the coefficient are illustrated. 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. Therefore, respondents whose average income is $80,000 and more (hinc4) will be more likely to pay 6 to 10 percent as a price-premium compared to those with an average income between $30,000 and $49,999 (hinc2) and between $50,000 and $79,999 (hinc3). It is also expected that senior persons compared to young people have more concern about their health and will pay more for traceable salmon. Likewise, it is also projected that higher education will make people more concerned about the information on the food they are consuming and they will pay more for the food which goes through traceability systems. The consumers who consume more than four pounds of farm-raised salmon in a month will be more willing to pay the high price premium for traceable salmon, because these consumers will try to ensure that the salmon they are consuming each month is coming through proper observation and contains no harmful ingredients. In addition, it is projected that a knowledgeable person about traceability systems and the effect of PCB on human life will likely pay more for the salmon that goes through a traceability system. Likewise, 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 they will find it costly for them, and the person for whom food price is more important rather than the safety will be less likely to pay 6 to 10 percent more for farm-raised traceable Atlantic salmon.

**Table 3: Variable Descriptions for the Regression Analysis**

| Variable name | Description | Expected sign |
|---|---|---|
| **WTP** (Willingness to pay) | 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** (Male) | 1 if the respondent is male, and 0 otherwise | **?** |
| **age2** (Between 31 and 40 years) | 1 if the respondent is between 31 and 40 years, and 0 otherwise | + |
| **age3** (Between 41 and 60 years) | 1 if the respondent is between 41 and 60 years, and 0 otherwise | + |
| **age4** (More than 60 years of age) | 1 if the respondent is more than 60 years of age, and 0 otherwise | + |
| **hsz** (Household size) | Household size | **-** |
| **edu2** (College or higher professional school) | 1 if the individual completed a college or a higher professional school degree, and 0 otherwise | + |
| **edu3** (University and above) | 1 if the individual completed at least a university degree, and 0 otherwise | + |
| **hinc2** (Household income between $30,000 and $ 49,000) | 1 if the household income was between $30,000 and $ 49,000, and 0 otherwise | + |
| **hinc3 (**Between $50,000 and $ 79,000) | 1 if the household income was between $50,000 and $ 79,000, and 0 otherwise | + |
| **hinc4 (**$80,000 or more) | 1 if the household income was $80,000 or more, and 0 otherwise | + |
| **stype** (Atlantic salmon prefer to purchase) | 1 if the individual prefers farm-raised Atlantic salmon, and 0 otherwise | + |

**Table 3: Variable descriptions for the regression analysis (Cont'd)**

| | | |
|---|---|---|
| **spre** (Types of salmon prefer to purchase) | 1 if the individual prefers frozen salmon, and 0 otherwise | **?** |
| **hcon2**(Household consumption between one and two pounds) | 1 if the household consumes between one and two pounds, and 0 otherwise | + |
| **hcon3 (**Between three and four pounds) | 1 if the household consumes between three and four pounds, and 0 otherwise | + |
| **hcon4 (**More than four pounds) | 1 if the household consumes more than four pounds, and 0 otherwise | + |
| t**raceknow** (Knowledge about traceability systems) | 1 if the respondent doesn't know about traceability systems, and 0 otherwise | - |
| **readlabel** (Label reading habit of consumers) | 1 if the respondent doesn't read the label on the packet of salmon, and 0 otherwise | - |
| **impfprice1**(When food price is very important) | 1 if the respondent considers food price very important, and 0 otherwise | - |
| **impfprice2** (When food price is important) | 1 if the respondent considers food price important, and 0 otherwise | - |
| **impfprice3** (When food price is somewhat important) | 1 if the respondent consider food price somewhat important, and 0 otherwise | - |
| **PCBknow** (Knowledge about PCB) | 1 if the respondent doesn't know about PCB, and 0 otherwise | - |
| **concernq/s** (Concern about quality and safety) | 1 if the respondent is concerned about salmon safety, and 0 otherwise (quality) | + |
| **measureQ2** (Quality measures through labeling) | 1 if the respondent measures quality of farm-raised salmon through labeling/branding, and 0 otherwise | + |
| **measureQ3** (Quality measures through origin) | 1 if the respondent measures quality of farm raised salmon through origin, and 0 otherwise | + |
| **measureQ4** (Quality not assured**)** | 1 if the respondent is not assured about the quality of farm-raised salmon, and 0 otherwise | **?** |

**Table 3: Variable Descriptions for the Regression Analysis (Cont'd)**

| | | |
|---|---|---|
| **measureS2** (Safety measures through labeling/branding) | 1 if the respondent measures safety of farm-raised salmon through labeling/branding, and 0 otherwise | + |
| **measureS3** (Safety measures through place of purchase) | 1 if respondent measures safety of farm raised salmon through place of purchase, and 0 otherwise | + |
| **measureS4** (Safety not assured) | 1if the respondent is not assured about the safety of farm-raised salmon, and 0 otherwise | **-?** |
| **measureS5** (No safety knowledge) | 1 if the respondent has no knowledge about safety of farm-raised salmon, and 0 otherwise | - |
| **searchfsI2** (Search food safety information sometimes) | 1 if the respondent searches for food safety information sometimes, and 0 otherwise | + |
| **searchfsI3** **(**Search food safety information seldom) | 1 if the respondent searches for food safety information seldom, and 0 otherwise | + |
| **searchfsI4** **(**Never search food safety information) | 1 if the respondent never searches for food safety information, and 0 otherwise | - |
| **tfs2** **(**Agree that traceable food is safer) | 1 if the respondent agrees that traceable food is safer, and 0 otherwise | + |
| **tfs3** (Somewhat agree that traceable food is safer) | 1 if the respondent somewhat agrees that traceable food is safer, and 0 otherwise | + |
| **tfs4** **(**Disagree that traceable food is safer) | 1 if the respondent disagrees that traceable food is safer, and 0 otherwise | **–** |
| **Loc W**( Western region) | 1 if the respondent is from western NL and 0 otherwise | **?** |
| **Loc C** (Central region) | 1 if the respondent is from central NL and 0 otherwise | **?** |
| **Loc Lab** (Labrador region) | 1 if the respondent is from Labrador and 0 otherwise | **?** |

**Source: Sample data**

## 5.3 Estimation Results

The logistic model, specified in equation (1), is estimated using the maximum likelihood (ML) approach. The dependent variable ($WTP_{traceablesalmon}$) is coded as 1 indicating individuals who are willing to pay 6 to 10 percent more price premium for farm-raised Atlantic salmon and zero otherwise (null hypothesis). Using the likelihood ratio (LR) statistic test, the calculated Chi-square statistic is found to be 72.63, which rejects the null hypothesis that all slope coefficients are zero (p-value 0.001). Table 4 demonstrates the coefficient estimates influencing respondents' WTP for farm-raised salmon. The following points mentioned here are derived from the findings of the estimation results and the model specification.

Table 4 shows that with respect to consumers' WTP for farm-raised Atlantic salmon, some independent variables considered in the model, such as education (**edu3),** household consumption (**hcon4**), knowledge about traceability systems (**traceknow**), perceived measures of quality (**measureQ2**, **measuresQ4**) and perceived measure about traceable food (**tfs2**) have statistically significant effects on the dependent variable.

Table 4 describes that males are .485 times less likely to pay 6 to 10% more as premium price to buy farm-raised Atlantic salmon than the female respondents of this survey. The **gen** variable is negative. According to the descriptive statistics, the average household size (**hsz**) of the sample data is three persons and table 4 demonstrates that for an additional increase in house size, the chance of willing to pay 6% to 10% more premium price to buy farm-raised Atlantic salmon is 1.37 times of the chance of not willing to pay this amount. The sign of the coefficient **hsz** is positive and P value is .106. 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 for farmed salmon. Table 4 shows that those respondents holding a university degree and above (**edu3**) are 15% percent less likely to pay 6 to 10% 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 i**s negative and statistically significant at the 0.004 level. This finding differs from the previous research results of Haghiri (2014).

The magnitude of the coefficient is 1.31 for the dummy variable salmon preference **(spre).** This implies that when other variable remains constant, the respondents who liked to purchase frozen farm-raised salmon are approximately 373.3% more willing to pay 6 to 10% more premium to purchase farmed salmon than those who tend to buy fresh salmon. The coefficient of **spre** is positive and P-value is 0.11. The result also shows that the coefficient of the dummy variable mentioning the participants who consumed more than four pounds of salmon fish each month **(hcon4)** is positive and statistically significant at the .07 level, which implies that everything else is constant, this group of respondents is 5.27 times more likely to pay a 6 to 10% premium to buy traceable farm-raised salmon than those who eat less than one pound of salmon every month.

Descriptive statistics indicate that 84% of the respondents don't know anything about traceability systems. The survey shows that when respondents are told about traceability systems most of them receive these systems positively and want to pay more for the farm-raised Atlantic salmon which passes through rigorous traceability systems. Table 4 shows that the independent dummy variable representing the participants who have no idea about the traceability system for Atlantic salmon fish **(traceknow)** is positive and significant at the .09 level. The magnitude of the estimate of the **(traceknow)** variable is 1.45 implying that participants, after learning about the traceability systems, on average are 4.29 times more likely to pay the premium for traceable salmon.

The dummy variable denoting consumers' perceived measures of quality of farm-raised Atlantic salmon through labeling/branding and quality not assured (**measureQ2** and **measureQ4**) is statistically significant at the .10% and .5% level of significance respectively. These results indicate that the respondents who measure the quality of farmed salmon by the label on the packet of salmon are 26% more willing to pay 6 to 10% premium for traceable salmon compared to those respondents' group who measures the quality through certification. Surprisingly, the respondents who are not assured about the quality of farm-raised Atlantic salmon also want to pay 8.1 times more as price premium for traceable salmon in contrast with the respondents' measure of quality through certification. Table 4 shows that the last explanatory variable is **tfs2** which representing the respondents who agree that traceable food is safer. This segment of consumers is, 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 agree that traceable food is safer. The co-efficient of this variable is positive.

**Table 4: 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 |

**Table 4: Estimated coefficients (Cont'd)**

| | | | | |
|---|---|---|---|---|
| **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**

Through the $R^2$ values show approximately how much variation in the outcome is explained by the model. The Nagelkerke's $R^2$ shows that the model explains roughly 44% of the variation in the outcome.

Table 5 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 5: Frequencies of Actual and Predicted Outcomes**

**Predicted**

| | | 0 | 1 | Percentage Correct |
|---|---|---|---|---|
| **Actual** | 0 | 131 | 14 | 90.3 |
| | 1 | 27 | 28 | 50.9 |
| | | | | Overall Percentage 79.5 |

**Source: Sample data**

## 5.4 Comparison of the Estimation Results between the Eastern and the Western Region

Table 8 and Table 9 (see Appendix) are presenting the estimated coefficients for the Eastern and the Western regions of the province, where the Eastern region includes the central area and the Western region includes the Labrador area of NL. Using the likelihood ratio (LR) statistic test, the calculated Chi-square statistic is found to be 91.73 for the Eastern region and 47.9 for the Western region, which rejects the null hypothesis that all slope coefficients are zero (p-value 0.001).

Table 8 and table 9 shows that with respect to consumers' WTP for farm-raised Atlantic salmon some independent variables of the model which have statistically significant effects on the dependent variable for the Eastern region are different than the independent variables that have statistically significant effects on the dependent variable for the Western region except **gen and edu3.** From table 8 and table 9 it is clear that for both regions females are less willing to pay 6 to 10% more premium price to purchase farmed salmon which is going through traceability systems than their male counterpart of this survey. The **gen** variable is negative for both areas and statistically significant at the .03 level for the Western region and at the .106 level for the Eastern region. Table 8 and table 9also show that the respondents having a university degree (**edu3**) in the Eastern as well as the Western areas are respectively **.**6% and 2.3% less willing to pay 6 to 10% more in price for traceable farm-raised Atlantic salmon, compared to the people who have a high school or less than a high school degree. The sign of the coefficient **edu3** for these regions is negative (with a P-value .09 for the Western region and .05 for the Eastern region).

Table 8 shows that the coefficient of the dummy variable mentioning the respondents who like to purchase frozen salmon rather than fresh salmon is positive and statistically significant at the .04

level, which denotes that everything else being equal, these participants of the Eastern region are 89 times more willing to pay 6 to 10% more in premium for traceable farmed salmon. The results of the Eastern region also indicate that the independent dummy variables representing the respondents groups who used to consume between one and two pounds (**hcon2**) and more than four pounds of salmon (**hcon4**) each month are positive and statistically significant at the .10 level and .02 level, respectively. These findings assert that the respondents who consume between one and two pounds (**hcon2**) each month are 21 times, and the respondents who consume more than four pounds (**hcon4**) a month are 1434961.498 times more likely to pay a 6 to 10% premium to buy traceable farm-raised salmon in contrast with the respondents who eat less than one pound of salmon every month. The magnitude of the coefficient is 6.7 for the dummy variable (**measure Q4**) in the Eastern region, which implies that when other variables remains constant, the consumers who are not confident about the quality of the salmon are 844 times more willing to pay 6 to 10% more in price premium for traceable farmed salmon, compared to those respondents' group who measure the quality of salmon through certification. Table 8 also shows that the signs of the coefficient of the explanatory variables **searchfsI2, searchfsI3, searchfsI4,** representing the groups of participants who search for food-safety information sometimes, seldom and never, respectively, are negative which indicates that these groups of respondents are less willing to pay 6 to 10% more in price premium for traceable salmon, compared to the respondents who always search for food-safety information. The magnitude of the coefficient is 5.2 for the dummy variable (**tfs2**) in the Eastern region; that implies that the participants who agree that traceable food is safer are 188 times more willing to pay 6 to 10% more in price premium to purchase traceable farmed salmon than the respondents who strongly agree that traceable food is safer. The coefficient of **tfs2** is positive and statistically significant (P-value 0.03).

Table 6 presents the frequencies of actual and predicted outcomes for the Eastern region of NL. Overall, the model correctly identified 96.7 percent of the total observations (116/120) against the naive prediction (herein, all one) suggesting a reasonable prediction.

**Table 6: Frequencies of Actual and Predicted Outcomes for the Eastern Region**

| | | **Predicted** | | |
|---|---|---|---|---|
| | | 0 | 1 | Percentage Correct |
| **Actual** | 0 | 87 | 1 | 98.9 |
| | 1 | 3 | 29 | 90.6 |
| | | | | Overall Percentage 96.7 |

**Source: Sample data**

Table 9 (see Appendix) shows that the groups of respondents in the Western region whose annual income is between $50,000 and $79,999 (**hinc3**) and more than $80,000 (**hinc4**) are 178 times and 274 times, respectively, more likely to pay 6% to 10% price premium to buy traceable farm-raised Atlantic salmon than the respondents who earn less than $29,999 annually. The signs of the coefficients for **hinc3** and **hinc4** are positive and statistically significant at the .05 and .06 level, respectively. Table 9 shows that for the Western region the coefficient of the dummy variable mentioning the consumers' perceived measures of quality of farmed Atlantic salmon through origin is negative and statistically significant at the .02 level. This result indicates that the participants who measure the quality of farm-raised salmon through origin are .4% less willing to pay the 6 to 10% premium for traceable salmon, in contrast with the respondents' measure quality through certification. Table 9 also illustrates that the coefficient of the explanatory variable (**tfs3),** representing the participants who somewhat agree that traceable food is safer, has a negative sign which implies that this segment of consumers is .2% less willing to pay 6 to 10% more in premium price to purchase traceable farm-raised Atlantic salmon compared to the respondents who strongly agree that traceable food is safer.

Table 7 presents the frequencies of actual and predicted outcomes for the Western region of NL. Overall, the model correctly identified 86.3 percent of the total observations (69/80) against the naive prediction (herein, all one), suggesting a reasonable prediction.

**Table 7: Frequencies of Actual and Predicted Outcomes for Western Region**

| | | **Predicted** | | |
|---|---|---|---|---|
| | | 0 | 1 | Percentage Correct |
| **Actual** | 0 | 54 | 3 | 94.7 |
| | 1 | 8 | 15 | 65.2 |
| | | | | Overall Percentage 86.3 |

**Source: Sample data**

# Chapter- 6

## 6. Summary and Conclusion

The seafood industry in NL 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. Through this study, consumers' perception, preference and demand for traceable farmed salmon are examined using the logistic regression model, based on a telephone survey over 200 consumers in four different regions of NL. The main conclusions are summarized as follows:

All the respondents in this study are more than 19 years old. The number of male participants is 50% and compared with the female participants, they are more willing to pay for farm-raised salmon which is passing through a traceability system. The majority of respondents is ranging between the ages of forty-one and sixty years of age (42%). The average household size of the study area is three persons, and the finding of the study indicates that with this household size respondents are more willing to pay for traceable salmon. The results of this study also show that though 47% of the respondents who took part in this study have a University degree, 84% of the total respondents were not able to understand the meaning of traceability and most of them do not have any idea related to the concept. The 16% remaining participants, who have an idea about traceability systems, could not provide an exact definition of the term and, in some cases, they were unable to describe it. This result is consistent with Kehagia et al., (2007). Moreover, 76% of the participants don't know about the incidents of polychlorinated biphenyls (PCB) in fish. But, when the participants were provided with information about the traceability systems, they positively valued these and were willing to pay more for the farm-raised traceable Atlantic salmon. Moreover, the findings show that the respondents whose monthly household salmon consumption was more than four pounds were more willing to pay for farm-raised traceable salmon. Prior to their purchase of farmed Atlantic salmon, the majority of the respondents (83%) of this study, did read the label on the packet of salmon, and for the quality and safety measures they emphasized the labeling or branding more than any other criterion, such as certification and place of purchase. But, unfortunately, Canada requires less information on its seafood products. In addition, the majority of the participants (55%) in the survey agreed with the statement that traceable food is safer and they welcome the use of traceability systems in the salmon industry, which could ensure them the safety of the product.

The findings of the study, in terms of the perceived acceptance of traceability systems from the consumers' point of view, can contribute to policy and scholarly knowledge.

### 6.1 Policy Implication

Traceability systems are very significant instruments for offering fresh and high quality seafood products and could be the mechanism for increasing the global trade of seafood, in terms of quality. Based on the above conclusions, some policy implications follow:

By applying Canadian traceability regulations, Canadian finfish farms are implementing sophisticated traceability systems to track salmon from eggs to the marketplace, to consumers' plate. However, traceability as a term is still something that most NL consumers are not familiar with. As the results show, receiving information about traceability systems, help consumers valued its implementation in the salmon supply chain positively. This suggests 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, the consumers have a good habit of reading the label 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 could not create doubt among consumers rather than boosting up their confidence. Chryssochoidis et al., (2006) state 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 NL can design a leaflet to exemplify how consumers can easily use their smart phone to reclaim the traceable information about salmon when they are uncertain about their purchase decision. Besides, similar to the regulations of European Union, the Canadian Food Inspection Agency (CFIA) also should demand that all the information, such as ingredients, nutritional data, a common name of the product, production and harvest methods and geographic origin, be on the label of salmon from each salmon production farm. Competent authorities such as DFO should also take the initiative to improve sustainability in the farming practice of Atlantic salmon in

Canada. To upgrade and maintain sustainability in seafood industry, improvement in the effectiveness of market-based approach is essential. Providing detailed labels to consumers could be one of the ways to ensure sustainability in the Atlantic salmon farming. Different non-government organizations (NGOs) can assist in the sustainable seafood procurement in Canada, by adopting a shared data gathering tool to track program's effectiveness. Improving fisheries' sustainability is essential to ensure that eco-certification programs are credible and aligned with Canadian law and policies. Conditions required by the Marine Stewardship Council need to be adopted by Canadian laws and policies relating to sustainable fisheries, and salmon fisheries certified by the Marine Stewardship Council have to meet the conditions within a reasonable timeframe. Aquaculture Stewardship Council certification (e.g salmon certification standard) needs to hold up a high standard for disease control to maintain the standard of farm-raised Atlantic salmon. 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, authorities could also design different mechanisms for attaining consumers' expectations of the existing traceability systems. The main objective of this study was to examine consumers' willingness to pay for farm-raised Atlantic salmon which could be one of these mechanisms.

## 6.2 Further Research

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. The objective of this study did not cover the monetary effects of implementing traceability systems on the production cost of farm-raised traceable Atlantic salmon. So, further researches on the pecuniary aspects of implementing traceability systems are suggested. Besides, this study has only taken account of the farm-raised Atlantic traceable salmon, rather than other seafood products which are also passing through the traceability systems. Thus, another study is suggested to measures consumers' willingness to pay for other seafood products besides the farm-raised salmon. In this study, the elasticity of consumers' willingness to pay for farm-raised traceable salmon with respect to their different incomes and prices of salmon has not been measured. Therefore, further research could explore the elasticity matter in more depth. This research concentrates only on the consumers' thinking about traceability systems rather than on the producers' side. So, further studies could pay attention to the producers' thinking related to these systems, as both consumers and producers are two important segments of the economy.

## 6.3 Limitations of the Research

We know that consumer surveys are usually time and region specific. During conducting the study, the researcher was 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. Besides, the researcher 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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**Appendix:**

**Table 8: Estimation Coefficients for the East and the Central Region**

| Variable Name | Coefficient | Standard Error | Significance | Exp(Coefficient) |
|---|---|---|---|---|
| **gen*** | -2.249 | 1.404 | .109 | .106 |
| **age2** | 15.478 | 11332.220 | .999 | 5270619.137 |
| **age3** | 20.319 | 11332.220 | .999 | 667338876.2 |
| **age4** | 16.687 | 11332.220 | .999 | 17654756.29 |
| **hsz** | .536 | .614 | .382 | 1.710 |
| **edu2** | .295 | 1.543 | .849 | 1.343 |
| **edu3*** | -5.184 | 2.668 | .052 | .006 |
| **hinc2** | 1.970 | 2.201 | .371 | 7.171 |
| **hinc3** | 1.709 | 2.258 | .449 | 5.525 |
| **hinc4** | .930 | 2.605 | .721 | 2.535 |
| **stype** | -2.410 | 1.781 | .176 | .090 |
| **spre*** | 4.492 | 2.181 | .039 | 89.304 |
| **hcon2*** | 3.069 | 1.874 | .101 | 21.529 |
| **hcon3** | 4.542 | 3.305 | .169 | 93.859 |
| **hcon4*** | 14.177 | 6.444 | .028 | 1434961.498 |
| **traceknow** | 2.886 | 1.938 | .136 | 17.920 |
| **readlabel** | 2.572 | 2.155 | .233 | 13.089 |
| **impfprice2** | 23.274 | 13426.711 | .999 | 1.282E+10 |
| **impfprice3** | 27.108 | 13426.712 | .998 | 5.926E+11 |

**Table 8: Estimated coefficients for East and Central Region (Cont'd)**

| | | | | |
|---|---|---|---|---|
| **impfprice4** | 26.309 | 13426.712 | .998 | 2.665E+11 |
| **PCBknow** | 3.318 | 2.962 | .263 | 27.601 |
| **concernq/s** | 1.602 | 2.221 | .471 | 4.964 |
| **measureQ2** | 1.395 | 1.891 | .461 | 4.034 |
| **measureQ3** | .403 | 4.203 | .924 | 1.496 |
| **measureQ4*** | 6.738 | 3.047 | .027 | 844.269 |
| **measureS2** | -.318 | 1.817 | .861 | .728 |
| **measuresS3** | .246 | 2.153 | .909 | 1.278 |
| **measureS4** | -25.038 | 11138.866 | .998 | .000 |
| **measureS5** | -3.824 | 3.729 | .305 | .022 |
| **searchfsI2*** | -.7.453 | 3.211 | .020 | .001 |
| **searchfsI3*** | -.4.187 | 2.159 | .052 | .015 |
| **searchfsI4*** | -.8128 | 3.844 | .034 | .000 |
| **tfs2*** | 5.240 | 2.540 | .039 | 188.673 |
| **tfs3** | -1.056 | 1.884 | .575 | .348 |
| **tfs4** | 16.887 | 41707.904 | 1.000 | 21584081.62 |

| | |
|---|---|
| Number of observations | 120 |
| Cox & Snell R-squared | 0.534 |
| Nagelkerke R-squared | 0.778 |
| Likelihood ratio statistic | 91.73 |
| Degrees of freedom | 36 |
| Prob [ChiSqd _ value] | 0.000 |

**Source: Sample data**

**Table 9: Estimation Coefficients for the West and Labrador Region**

| Variable Name | Coefficient | Standard Error | Significance | Exp(Coefficient) |
|---|---|---|---|---|
| **gen*** | -3.456 | 1.703 | .042 | .032 |
| **age2*** | -7.668 | 3.664 | .036 | .000 |
| **age3** | -.326 | 2.040 | .873 | .722 |
| **age4** | -1.121 | 2.006 | .576 | .326 |
| **hsz** | -.022 | .701 | .975 | .979 |
| **edu2*** | -3.538 | 2.131 | .097 | .029 |
| **edu3*** | -3.767 | 2.256 | .095 | .023 |
| **hinc2** | 4.461 | 2.857 | .118 | 86.531 |
| **hinc3*** | 5.187 | 2.701 | .055 | 178.921 |
| **hinc4*** | 5.614 | 2.797 | .045 | 274.314 |
| **stype** | 4.125 | 2.884 | .153 | 61.852 |
| **spre** | 8.491 | 5.540 | .125 | 4870.030 |
| **hcon2** | .953 | 1.544 | .537 | 2.594 |
| **hcon3*** | -3.856 | 2.061 | .061 | .021 |
| **hcon4** | -1.972 | 1.993 | .322 | .139 |
| **traceknow** | 4.024 | 3.618 | .266 | 55.914 |
| **readlabel** | .637 | 1.314 | .628 | 1.890 |
| **impfprice2** | 4.095 | 126.880 | .974 | 60.042 |
| **impfprice3** | .497 | 126.873 | .997 | 1.643 |

**Table 9: Estimated coefficients for the West and Labrador Region (Cont'd)**

| | | | | |
|---|---|---|---|---|
| **impfprice4** | .543 | 126.874 | .997 | 1.722 |
| **PCBknow** | .844 | 1.702 | .620 | 2.326 |
| **concernq/s** | 1.614 | 1.252 | .197 | 5.025 |
| **measureQ2** | .945 | 1.393 | .497 | 2.572 |
| **measureQ3*** | -5.542 | 2.455 | .024 | .004 |
| **measureQ4** | 1.801 | 2.390 | .451 | 6.056 |
| **measureS2** | 1.823 | 1.670 | .275 | 6.190 |
| **measuresS3** | 1.520 | 1.677 | .365 | 4.572 |
| **measureS4** | -7.778 | 40192.971 | 1.000 | .000 |
| **measureS5** | -1.154 | 2.712 | .671 | .315 |
| **searchfsI2** | 1.780 | 3.739 | .634 | 5.932 |
| **searchfsI3** | 2.287 | 3.537 | .518 | 9.848 |
| **searchfsI4** | 4.081 | 3.746 | .276 | 59.200 |
| **tfs2** | 1.605 | 1.430 | .262 | 4.979 |
| **tfs3*** | -6.429 | 2.736 | .019 | .002 |
| **tfs4** | | | | |

| | |
|---|---|
| Number of observations | 80 |
| Cox & Snell R-squared | 0.451 |
| Nagelkerke R-squared | 0.645 |
| Likelihood ratio statistic | 47.9 |
| Degrees of freedom | 35 |
| Prob [ChiSqd _ value] | 0.072 |

**Source: Sample data**

**Questionnaire**

**i. Demographic information:**

1) Gender

a) Female b) Male

2) Age

a) Between 20 and 30 years b) Between 31 and 40 years

c) Between 41 and 60 years d) More than 60 years of age

3) Household size (including you) ………..

**ii. Socio-economic information**

4) Education level

a) High school or less than high school b) College or higher professional school

c) University and above

5) Household income

a) Less than $29,999 b)Between $30,000 and $49,999

c) Between $50,000 and $79,999 d) $80,000 or more

**iii. Product attributes**

6) Which kind of Atlantic salmon do you prefer to purchase?

a)Wild b) Farm-raised

7) Which type of salmon do you prefer more?

a) Fresh c) Frozen

8) How much you or your households consume salmon per month?

a) Less than one pound b) Between one and two pounds

c) Between three and four pounds    d) More than four pounds

9) Do you have any idea about traceability systems of Atlantic salmon fish?

a) Yes    b) No

10) Do you read the label on the packet of salmon?

a) Yes    b) No

11) Do you consider food price is important during purchase?

a) Not important    b) Important

c) Somewhat somehow important    d) Very important

12) How much more price do you ready to pay for traceable salmon?

a) 2.5% to 5% more    b) 6% to 10% more

c) 2.5% to 5% less    d) Same price

13) Do you know what polychlorinated biphenyls are?

a) Yes    b) No

14) Which come first to you in case of buying farm-raised Atlantic salmon?

a) Quality    b) Safety

15) How do you measure the quality of farm-raised Atlantic salmon?

a) Quality through certification    b) Quality through labeling/branding

c) Quality through origin    d) Quality not assured

16) How do you measure the safety of farm-raised Atlantic salmon?

a) Safety through certification    b) Safety through labeling/branding

c) Safety through the place of purchase    d) Safety not guaranteed

e) No safety Knowledge

17) How frequent you search for food-safety information?

a) Always  b) Sometimes

c) Seldom  d) Never

18) Do you agree that traceable food is safer?

a) Strongly agree  b) Agree

c) Somewhat agree with  d) Disagree