A study on the food supply chain traceability of agricultural produce in Ireland

Research dissertation presented in partial fulfilment of the requirements
for the degree of
MSc in International Procurement and Supply Management

Griffith College Dublin

Dissertation Supervisor: **Ronan Gallagher**

Student Name: Bharadwaj Ramesh

29/05/2020

Candidate Declaration

Candidate Name: Bharadwaj Ramesh

I declare to the best of my knowledge that the current research : **A Study on food supply chain traceability of agriculture in Ireland** submitted towards the degree of **MSc in International Procurement and Supply Management** is solely my own work and does not correspond to any other research in this area. The ideas presented in the research have been developed from a combined analysis of my supervisor, academic references and my own perceptions. I ensure to submit the research exclusively on the University portal and not for any other use. Additionally, I ensure to admit zero tolerance on plagiarism and malfeasance on the work.

Candidate's Signature:

Date: 29/05/2020

Supervisor Signature:

Date:

Acknowledgement

The given research has helped me developing my knowledge on the food supply chain traceability on the production of agriculture in Ireland. Focusing on traceability in food supply chain process of agriculture production, the research has upgraded my knowledge and skills regarding the effectiveness of the same in improving agriculture development research in the global context. I would like to thank my academic guide who had helped me in completing the project through sharing their knowledge and other relevant information. Such guidance has led to produce source of inspiration. I would like to thank the managers present in food supply chain process in Ireland, to be a great part of this project to provide such information and support. They have shared valuable time and knowledge to complete tasks. Finally, I would also wish to state my thankfulness to my parents and associates for being supportive to me both economically and honourably while collecting data in the form of primary resources. I have successfully complete the project, after getting the support of all these people.

Yours truly,

Bharadwaj Ramesh

Abstract

The agricultural food industry in Ireland is facing unprecedented challenges due to the rapid population growth in the emerging markets by putting a strain on the global food supply. Ireland has a growth in the natural food production techniques that has driven the quality appeal of the food produced with its low environmental footprints, strict traceability and the effective supply chain management. Traceability in the Supply Chain Management process for the agricultural food produce is a growing concern among the farmers, manufacturers and suppliers of the food industry in Ireland. The research study has focused on Ireland's reputation in the food and agricultural production and effective management of the SCM traceability. In order to provide a safe, traceable and sustainable food product through a modern and upgraded supply chain system, Ireland is focused on its agro food industry through adoption of new initiatives and modern technological systems.

The initial part of the research study sets the significance and specific purpose of the research study along with developing research objectives and questions. The second part of the study gathers the information that is based on food supply chain traceability in the Irish food produce sector and its effective implementation within the research paper. The methodology part of the research study identifies the specific research technique and the philosophy that is set for the research process. In order to carry out the study the application, a qualitative form of primary data collection method has been taken into consideration. Through the help of the interviews that are being conducted by the researcher, the findings of the data analysis have been presented. Based on the interview responses the primary data is collected and critically elaborated in the discussion part of the study. Finally, the concluding part of the study has justified if the research objectives are successfully linked with the research paper or not by stating a future scope of the study along with the limitations of the research.

Table of contents

Candidate Declaration ..... **II**
Acknowledgement ..... **III**
Abstract ..... **IV**
Table of contents ..... **V**
Chapter 1: Introduction **8**
1.1 Overview of the research 8
1.2 Purpose of the research 10
1.3 Significance of the study 11
1.4 Research aims and objectives 12
1.5 Structure of the research 13
Chapter 2: Literature Review **15**
2.1 Overview of the literature review 15
2.2 Food Supply chain traceability in Ireland 15
2.3 Supply chain management theories 16
2.4 Irish agricultural Practices related to supply chain management 18
2.5 Innovative Supply chain traceability system 19
2.6 Impact of climatic changes on food supply chain system in Ireland 20
2.7 Food security and high food prices in the agricultural produce 21
2.8 Identification of various methods to trace the supply chain process of the Irish agri-food produce. 22
2.9 Initiatives of traceability of livestock farming in Ireland 23
2.10 Identification of the impact of climate change on risk management 24
2.11 Analysis of the traceability systems that are currently used by the producers, distributors, suppliers and wholesalers to supply foods to the consumers 25
2.12 Impact of climate change in the agriculture system and the informational reliability 26
2.13 Analysis of the procedures of reducing climate change risk on the agriculture procedures 27
2.14 The relation between Traceability and food supply chain 28
2.15 The important of the digital platform in Ireland 28
2.16 Conceptual Framework 29
2.17 Conclusion 30
Chapter 3: Research methodology **31**

3.1 Introduction....31
3.2 Research philosophy....31
3.2.1 Justification....31
3.3 Research Approach....32
3.3.1 Justification....32
3.4 Research strategy....32
3.4.1 Justification....33
3.5 Collection of primary data....33
3.6 Sampling population....34
3.7 Sampling technique....35
3.8 Sources....35
3.9 Validation of the interview questions....36
3.10 Collection of secondary data....36
3.11 Access and Ethical issues....36
3.12 Approach to data analysis....37
3.13 Summary....37
Chapter 4: Data Analysis....38
4.1 Overview....38
4.2 Findings....38
4.3 Discussion....49
4.4 Conclusion....52
Chapter 5: Conclusions and Recommendations....53
5.1 Conclusion....53
5.2 Limitations to the study....54
5.3 Linking with objectives....54
5.3.1 Linking with objectives 1: Diverse methods that are used in tracing the supply chain process of the Irish agri-food produce....54
5.3.2 Linking with objectives 2: To emphasize on explaining the adoption of innovative supply chain traceability systems considered by the producers, suppliers, distributors, and wholesalers in regards to the agri-food production of Ireland....55
5.3.3 Linking with objectives 3: How to recognize and assess the impact of climatic changes along with the creation of a compact networking system about the food supply chain system of Irish agriculture?....55
Reference List....56

Appendices.....A

Appendix A: Participation Invite – Linkedin .....A

Appendix B: Participant Interview Mail.....B

List of Figures

Figure 1: Agri-food sector of Ireland.....8
Figure 2 : Irish agricultural sector 9
Figure 3:UK market for Irish agri-food production exportation 11
Figure 4: WSN System Model.....18
Figure 5: Traceability Information Flow 22
Figure 6: The dependent and independent framework 28

Chapter 1: Introduction

1.1 Overview of the research

This research paper sets out to establish quintessential facts about the aspects of inventory stress and food supply chain traceability practices in the Irish agri-food sector. Considering the participation of the private sector entities of the Irish agricultural sector on food supplies and governmental interventions, current research focuses on addressing the intrinsic factors related to the supply chain management framework. The background of the research is explained in the overview section along with justifying the purpose behind conducting the study. The significance of the study is established through the vital components, contained within the research in place of fixing the aims and objectives. The structure of the research depicts the way the research has been conducted and presented on paper. Considering the current topic to be "*A Study on the Food Supply Chain Traceability of Agricultural Produce in Ireland*" the research begins with a focused trajectory.

According to the findings of BORD BIA, the Irish Food Board, it has been noted that the agri-food industry of Ireland remains as one of the vital components of the country's economy. It accounts for as much as 8% of the total national GDP with a probability of as many as more than 160,000 jobs. Additionally, this sector accounts for a significant portion of the exports conducted by Irish-owned enterprises with access to over 170 markets across global locations.

Specifically focusing on the food and drink sector of the agriculture sector of Ireland, it has been found that the agri-food and drink sector accounts for 7.6% of the total revenue generation of Ireland with 10% of the productions made for exportation. The export percentages are increasing leaps and bounds, and 2019 witnessed a profit of €13 bn, generated from the export exclusively (Bordbia, 2020). Thus, looking at the figures, it is needful to state that the agriculture produce of the Irish agri-food sector must rely on sustainability and a comprehensive traceability system of the supply chain process, ensuring the safety, quality and informational possibilities of the entire process.

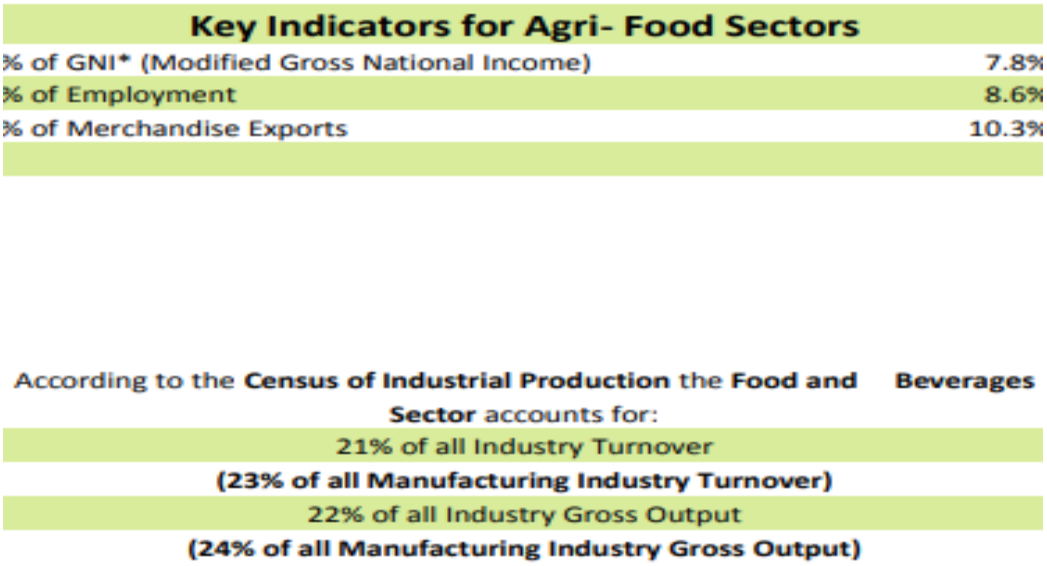

Figure 1: Agri-food sector of Ireland

(Source: Bord Bia, 2020)

Having a compact and no-frills supply chain process certainly contributes to better traceability by allowing the concerned professionals to develop networked contact, marking the suitability and accountability of each process. Additionally, there is a need to comply with the regulatory framework of the nation concerned and engage in assurance for secured data transmission and higher visibility on the supply chain process. This new system of supply chain traceability is observed to be incorporated in different nations, concerning their respective supply chain process in both private and public sectors with the use of systematic and innovative technologies to support the entire process.

The new system of supply chain traceability can be seen in Ireland as well, marking the rapid growth and acceptance of technology among the agri-food sector, apart from the private companies, involved in industrial businesses. The supply chain traceability in the agri-food sector of Ireland focuses on ensuring the supply of freshly farm-produced fruits, vegetables and dry foods along with adequate production levels (Tian, 2016). Due to the climatic changes, affecting the global temperature, agricultural production seems to undergo difficulties to cope up with the unprecedented changes.

Output, Input and Income in Agriculture, 2016				
Main Aggregates	Value €m	Main Commodities	Value €m	% of G/O
Goods Output @ Producer Prices [1]	7,961.1	Goods Output (excl forage)	6,911.7	100%
⊦ Contract Work	361.5	*of which*		
⊦ Subsidies - Taxes (Products)	1.8	Cattle	2,424.8	35.1%
Agricultural Output @ Basic Prices	8,324.4	Milk	2,492.5	36.1%
· Intermediate Consumption	5,181.8	Pigs	520.3	7.5%
Gross Value Added @ Basic Prices	3,142.6	Sheep	264.5	3.8%
· Fixed Capital Consumption	812.7	Cereals	229.8	3.3%
⊦ Subsidies - Taxes (Production)	1,645.8	Others	979.8	14.2%
· Compensation of Employees	514.8	Forage Plants	1,049.4	
Operating Surplus	3,460.8	Goods Output at Producer Prices [1]	7,961.1	

Figure 2 : Irish agricultural sector

(Source: Agriculture.gov.ie, 2020)

Hence, developing comprehensive traceability of the supply chain system ensures secure delivery of the raw materials and the finished products along with creating wider visibility and trust. Considering several factors to affect agricultural produce in Ireland, the facet of climatic changes is marked as the biggest threat. Framed upon the axioms of climatic change impacts on the agri-food sector of Ireland, the research draws on relevant literature justifying on the subject of assessing the present status of food supply chain traceability in Ireland. The research provides an accomplished structure, using both the primary and the secondary methods of data collection to render a more replenished outlook, justifying on the significance of the study.

1.2 Purpose of the research

The purpose of the research is to provide an interpretation into the core aspects of supply chain traceability within the food production in Irish agriculture. Following establishing a better explanation of the subject, the research dissects into the aspects of safety networking in supply chain management and higher demands for organic and farm-fresh food products. According to the studies conducted by the Department of Agriculture, Ireland, the Irish are more concerned with consuming farm-fresh agri-foods that are organic and harmless (Agriculture.gov.ie, 2020). Owing to the rapid growth in the demand, the Irish agricultural association decides to deploy an innovative

and systemized random assessment supply chain traceability system to evaluate and draw information on the capability of the supply chain system to fulfill the needs of the public demands.

Considering the design and structure of the food supply chain of Ireland to be dependent on a sole distribution system, there is a need to have a properly mixed model to be followed to consider the supply in multiple locations. Additionally, the changes in the climatic conditions call for unpredictable circumstances, challenging the process of the supply chain network. Also, it has been found that even if the supply chain system used all these while lacking the touch of sustainability, leading towards possibilities of greater damages in the long haul. Hence, it is needed to associate new-age technologies with the supply chain framework to ensure the traceability and better visibility of the entire process.

Therefore, looking at all these factors, the study has justified its purposes of finding measures to incorporate sustainability within the supply chain system of the Irish agri-food sector along with evaluating the rationale for selecting either a digital platform or an architecture-integrated platform that will have global connectivity and networking.

1.3 Significance of the study

The research signifies it focus on assessing one of the most important aspects of the Irish economy with special reference to the agri-food sector. The year 2019, witnessed the biggest profit generation for the agri-food sector of Ireland accounting for a 7% rise from the previous sectors. Having the UK as the biggest single market for the exportation, the Irish agri-food accounted for 37% of the total exportations. However, owing to the final execution of Brexit on 1 February 2020, and additional climatic changes, the agri-food sector of Ireland seemed to face challenges in this regard (Bordbia.ie, 2020).

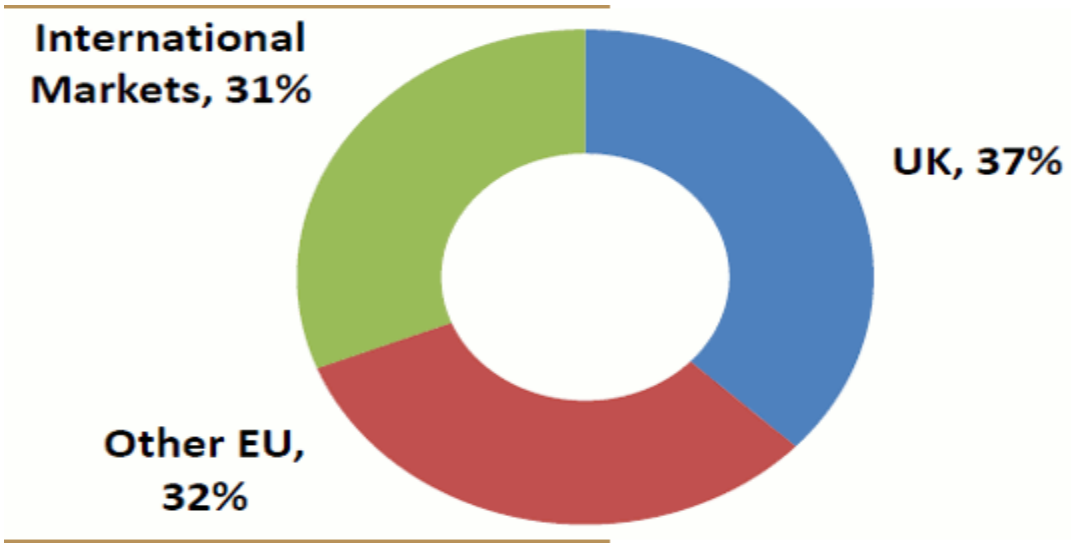

Figure 3:UK market for Irish agri-food production exportation

(Source: Agriculture.gov.ie, 2020)

The recent outbreak of COVID 19 has even added on to the recent troubles in the industrial and agricultural sectors of all nations, including Ireland, with limited or no access to proper supplies, imports, and exports. Thus, the significance of the research lies in addressing all the challenges of the recent setbacks on the political and environmental sphere and developing a more sustainable and durable supply chain framework that will be customized to sail through the crisis. Through the information shared in the research on aligning mechanisms for supply chain management along with coordination between the suppliers and the buyers, the Irish agri-food sector can plan out of improving the supply chain traceability.

1.4 Research aims and objectives

The aims and objectives of the research are based on the core variables addressing the vital points of the study. Following the explanation of the subject, considering the reformation in the supply chain traceability of the agri-food sector in Ireland, in tandem with the impacts of climatic changes, the below given are the aims and objectives of the study:

- To find out the diverse methods that are used in tracing the supply chain process of the Irish agri-food produce

- To emphasize on explaining the adoption of innovative supply chain traceability systems considered by the producers, suppliers, distributors, and wholesalers in regards to the agri-food production of Ireland
- To associate the impact of climatic changes along with the creation of a compact networking system about the food supply chain system of Irish agriculture

Research questions

The research questions are based on the research objectives and assist in finding the relevant answers to the same, via the contents shared in the Literature Review section.

- What are the diverse methods used in tracing the supply chain process of the Irish agri-food produce?
- How is innovative supply chain traceability adopted by producers, suppliers, distributors, and wholesalers in regards to the agri-food production of Ireland?
- How to recognize and assess the impact of climatic changes along with the creation of a compact networking system about the food supply chain system of Irish agriculture?

1.5 Structure of the research

The research is presented using a standardized structure, dividing it into 5 separate sections. The first section presents the introduction, followed by a literature review in the second section. The third section of the research explains the methodology and design of the research, followed by the presentation and discussion of the findings in section 4 and finally ends up with section including the conclusion, limitation, and contribution of the research.

Chapter 1: Introduction

- Research aim, objectives, question and hypotheses were identified that guided rest of the research.

Chapter 2: Literature review

- Theories, concepts and models were evaluated for gaining clear understanding of the research issue

Chapter 3: Research design and methodology

- Research design, strategies and data collection methods were identified along with sampling method and data analysis plan

Chapter 4: Presentation and discussion of the findings

- Both qualitative and quantitative data are presented in systematic manner and compared and analysed with the help of secondary literature

Chapter 5: Conclusion , limitations and contribution for further research

- Conclusions are drawn from analysis through linking the findings with objectives and recommendations are availed

Chapter 2: Literature Review

2.1 Overview of the literature review

The literature review draws on an array of authentic and reliable academic resources that have been assiduously selected to address the needs of the subject. The relativity of the discourse has been developed in place of the Irish agri-food context and presents the study with a unique reflection on the core points. Identifying the dependent and independent variables, the study aspires to develop a connection, by creating a conceptual framework to rationalize on the hypothetical aspects of the study. Based on the literary findings, the Literature Review section is prepared to keep the core subject intact in the research.

2.2 Food Supply chain traceability in Ireland

According to Caro *et al.* (2018), food supply chain traceability refers to the ability to trace the supply of foods including the raw materials and the finished products. Additionally, the process of traceability widens its functions on tracing feed, food-producing animal or substance via all the stages of production and distribution. This stage of production and distribution refers to the diverse set of activities that are interconnected with the primary production of food along with importation and exportation of the food produces (Handayati *et al.*2015).

The ***Irish & EU Food Law*** refers to the policy of supply chain traceability of food produces as an integral part of assessing the amount of stock storage along with production on a mass scale and distribution of the same in different locations. It has been noted that the majority of the private manufacturing and distribution companies depend on accreditation with ISO 9001 Quality Standards to ensure the quality of the food supply chain production and distribution (Dania *et al.*2018).

According to the findings of the British Standards Institute, it has been noted that traceability of food supply chain operates as in primary and secondary phases, the primary phase being the ability to trace the history of the primary product, including the raw materials and the second phase being the ability to trace the iterations of the supply chain process (Akhtar *et al.*2016). The recent incorporation of the traceability of the food supply chain in Ireland comprises of the processes to connect all the primary and sub-chains to develop into a single control panel. Based on the legislative regulations of the ***Irish & EU Food Law,*** the agri-food sector of Ireland focuses on

recognizing the abilities for conducting investments about troubleshooting processes (Utomo *et al.*2018).

The access to proper information relates to the procurement of processes that will be powerful enough to connect to all the processes of the supply chain and develop a compact understanding of each of the phases. However, it has been found that often it becomes difficult for the agricultural farmers to track the supply chain process due to lack of proper visibility and confusion due to lack of information (Saitone and Sexton, 2017). This can be seen in the case of the Irish agri-food sector. Despite having operated with the UK as the single market for exportation and importation, the recent changes in the climatic conditions and political tensions after the Brexit phenomenon, the conventional paradigm of supply chain traceability seemed to be inappropriate for the current competitive changes.

Due to the uncontrolled and unprecedented changes in temperature variations and extreme pattern of weather conditions, which might destroy the fertility of the crops, leading to lesser food production. There is a need to develop a compatible platform to deal with the issues, reflect in the creation of a systemized supply chain traceability framework (Nyamah *et al.*2017). The Irish agri-food sector needs to deploy innovative technologies likely RFID mechanisms to fulfill the requisites. Radio Frequency Identification(RFID) is a contactless digital information system that uses radio frequency to find various items and tag them concurrently thereby saving the information in the system without any manual work being necessary. The use of RFID technology in the form of assessing through remote sensing techniques can be beneficial for the Irish agri-food sector.

2.3 Supply chain management theories

It is essential to develop a comprehensive understanding of the networks while analyzing the criticality of supply chain management. A proper supply chain management framework including the sub-processes of the entire process catering to the essential aspects contributes to the formation of an effective paradigm of production and distribution (Aggarwal and Srivastava, 2016). Considering the current research to be based on critically evaluating the traceability of the food supply chain system of the agri-food sector of Ireland, three theories have been taken into consideration. The three theories are associated with the traceability factor for the supply chain network correlating the same with the agri-food sector of Ireland.

- ✓ *Agency theory:* This specific theory relates to the problems associated with agents and principles of business operations. In simpler terms, this theory relates to the development of a compatible relationship between the stakeholders and the executives of the company. There could be opposing opinions about both groups. An opinion from the stakeholders might be disrespectful for the executives of the company regarding business operations (Ganesh Kumar *et al*.2017). Thus, there is a need to develop a proper framework to resolve these conflicts, by looking at the core interest of the subject. Associating the theory with the traceability of the supply chain framework for the agri-food sector of Ireland, it can be stated that there could be a conflict of interest among the farmers of this sector with the executive level of stakeholders in this sector. There could be conflicts between the two groups about the adoption of innovative mechanisms serving the traceability need for the supply chain process of the agri-food sector (Mangla *et al*.2018).
- ✓ *Resource-based theory:* This theory relates to the maximum utilization of resources to gain a competitive advantage. This theory has been exponentially used in diverse areas of operation to ensure that the respective business sectors sustain in this competitive landscape. Considering this to be the practical application of theory, it needs to be stated that several aspects relate to addressing the contingencies of situations related to the use of resources (Tasca *et al*.2017). In regards to the Irish agri-food sector, it needs to be stated that this sector might apply this theory to aid the production process and quantity by using maximum resources and generate valuable information, about the production level and sustain the credibility and maintain the transparency of the entire system. Practically, applying this theory on the agri-food sector of Ireland, it needs to be stated that there is a need to use technical resources to the maximum percentage to ensure traceability on the production and visibility of the supply chain process (Septiani *et al*.2017).
- ✓ *Network theory:* According to this theory, there is a need to use a varied set of tools and techniques to critically evaluate the graphs. The application of this theory suggests the complexities of networking systems that exhibit the depiction of the networked framework concerning the supply chain framework. By applying this theory, the use of a graph-theoretic representation helps in following the connections between the two poles of the pathway and contributes to the growth of the firm (Galal and El-Kilany, 2016). Applying this theory to the agri-food sector of Ireland, it needs to be stated that through this the

visibility of the supply chain network projects growth of the firm and assess the inclination of the Irish customers towards consumption of organic and farm-fresh products.

2.4 Irish agricultural Practices related to supply chain management

In response to the explanations about checking the traceability of food supply chain processes within the Irish agri-food sector, it has been noted that along with the conventional practices for ensuring the quality of services, the use of performance management mechanisms were used. The performance management mechanism involved measuring the supplier's delivery status, along with quality, site and product certification of the supplier production and supplies (Dania *et al.*2016). Additionally, the Irish agricultural firms also focus on paying sufficient heed to the responsive speed of supply chain management that involves the supplier network and logistic processes to cater to customer demands.

With the ability to share information through the performance management mechanism, it can be stated that this process leads to effective communication and sustaining greater visibility and transparency for the entire supply process. The findings of the Rural Development Program for Ireland outlines the priority of using an amount of €3.92 billion of the public money to continue with sustainable practices within the agricultural system (Cagliano *et al.*2016). The Department of Agriculture, Food and the Marine's national strategy demonstrate the adoption of activities that need to be involved in conducting Smart and Competitive Supply Chains for the agri-food sector.

The Food Wise Strategy committee is a board comprising 35 investors from the Agri Food Sector that formulate strategies that are designed to attract quality concerned consumers from globally and locally and to award Irish farmers for their sustainable efforts and production of high quality products. Following the clauses of the 2025 Agri-Food Strategy Committee, the focus has led to the adoption of strategies that are smarter and greener in approach. The report of the committee emphasized on developing a sustainable and competent blueprint for improving the traceability of the supply chain framework in the agri-food sector (Garofalo *et al.*2017). From the assessment of the Food Wise 2025 target on enhancing the traceability of the food of the Irish agricultural sector, the key aims relate to the following:

- Increasing the value of agri-food exports by 85% to €19 billion by the end of 2025

- Enhance the added value in the agri-food sector along with fisheries and wood products by 70% or an excess amount of €13 billion by 2025 (Mor *et al.*2015)
- Augment the value of primary production by a percentage of 65% or to an amount of €10 billion by 2025
- Adopt the most innovative technologies, likely RFID sensors and automation to support the traceability of the agri-food supply chain production of Ireland (Ghezavati *et al.*2017)

2.5 Innovative Supply chain traceability system

According to Kim and Shin (2019), in terms of innovation the producers, suppliers, and distributors of the food agricultural products in Ireland are largely dependent on innovation and technological development for increasing the number of efficiencies and meeting the new customer demands. The Government of Ireland has lowered down the incentives on the agricultural food supply that has led to the innovation and technological development for increasing global food production. Amer *et al.* (2018) have stated for tracing the food supply of the agricultural products and the cross, there are innovative systems and mechanisms like ICT, RFID, wireless technology, and document-based instruments that are being installed in the farming fields for tracking the advancement of the crops. Moreover, to fasten up the process of the food supply chain the progressive farmers, producers, and the wholesalers of Ireland have invested in crop field trials and breeding programs for developing greater transparency in the supply chain process.

Wireless Network and RFID

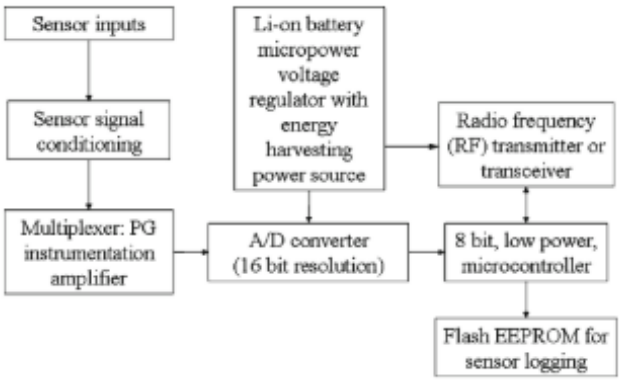

Figure 4: ***WSN System Model***

(Source: Zhao *et al.* 2020)

Stančová and Cavicchi (2019) have explained that WSN represents a range of the network of sensors that are being used together for the transmission of different types of information in the

agricultural field and the surrounding environment. The sensors of the WSN network can exchange the data together with the other external users for a specific software application for tracing and processing large volumes of crops in the SCM process. Finnegan *et al.* (2017) have argued to develop greater collaboration and communication with the manufacturers of the fertilizers of the agro-food products and smoothen the process of the SCM, WSN implementation is considered as an effective innovative system by the Irish agri-food sector.

ICT traceability system

Regan *et al*. (2018) have stated in recent years ICT and its application in the supply chain traceability system in Ireland is becoming popular. The farmers, wholesalers, producers of the crops are getting reliable on the ICT's fast and efficient services in terms of quality and quantity of the marketing of the agricultural products. Cagliano *et al*. (2016) have stated to increase the agro-food productivity and fulfill the demand of the global population in the SCM process, the adaptation of ICT has evolved the consumer demands and has been successful in being able to change the product line, supply chain, and the distributional channels. The application of ICT based innovation systems can easily solve the problem that passes on information about the food supply chain and this GPS and GIS-related traceability helps in enhancing the efficiency of high-quality agricultural goods.

2.6 Impact of climatic changes on food supply chain system in Ireland

Wang *et al*. (2017) have stated that global climatic change has largely affected the food SC system in Ireland. The ecological and social impacts of a warming planet have adversely affected the decision-making process of the SCM process in Ireland. The rapid change in the climatic condition, the temperature of the country, heavy rainfall, and floods in some of the years affects the agricultural products largely and this directly creates an impact on the SCM process. Murphy *et al*. (2016) have stated that the difficulties in predicting climatic changes from continental to global climatic changes adversely affect food safety and security in the SCM process. In the case of the SC transportation and process, the climatic changes in the atmosphere due to temperature conditions and the storage conditions of the food especially the packed products and the dairy goods are badly affected. Due to the change in the climatic conditions and the temperature control of the storage and the warehouses of the food producers in the SCM process, the foods often get damaged while trading and transporting, and this largely decreases the level of the consumer's demands for the quality of the product. Stančová and Cavicchi (2019) have stated that the changing

climatic conditions have affected the water supply system in some parts of Ireland and in the agricultural fields, thus creating soil degradation of the products.

Due to the extreme climatic conditions and changes in the temperature because of global warming the food security for the nutritious food and dairy products comes under scrutiny by the Food Safety Authority in Ireland. The damage of the food products and the risk of liability due to the poor and changing climatic conditions disrupt the demand and supply management of the Irish agri-food sector. Amer *et al.* (2018) have further argued, due to heavy rainfall or snowfall, most often the roadways, airways, and other transportation routes are being blocked in many parts of the country, thus hampering the effective supply of the food items to the respective suppliers or the wholesalers. This directly affects the growth and productivity of the agricultural firm thus reducing the profit margin of the goods, due to irregular supply. Mahfouz *et al.* (2019) explained, the changing temperature of the oceanic climate in the northwestern part of the country affects the food safety and public health of the population. In order to fulfill the demand of the products with the stored and packed foods that have already breached the expiry date of the product from that of its manufacturing date, the Irish SCM system manages to mitigate the loss in the trading facilities.

2.7 Food security and high food prices in the agricultural produce

According to Tian (2016), the food prices for the agriculture products and the organic foods will continue to rise high with the increasing demand for the agro-based products in the country as well as in the global market. The limited availability of land and shortage of water resources and the climate-related poor harvesting technique often damages the food safety and production and therefore, maintaining the security of the crops has become a rising concern for the Irish Food and Safety Organization. Adamashvili *et al.* (2018) explained, the growing demands for biofuel production and the rise in the cost of implementing innovative machinery and technologies in the firm for ensuring food safety and security have parallelly increased the demand for the farmers to charge more for the agro-based and organic food products. As a result of this, the SCM automatically increase their costing price for the trading and transportation to meet the increasing price demand of the farmers. The shift of the suppliers and the farmers to resource-intensive high supplied food products have increased the price of the manufacturing and fertilization process, thus creating heavy demand for the food producers in Ireland.

Ganesh Kumar *et al.* (2017) have also argued that the rising prices of the energy resources have increased the cost of production and transportation, thus ensuring greater protection for food safety

and security. Moreover, the implementation of innovative tracking systems and machinery in the agricultural fields allows the farmers as well as the SCM to identify any harmful chemicals and pesticides within the crops immediately. Zhao *et al*. (2020) have stated this helps in proper maintenance of food safety and security during its manufacturing and production time, thus allowing a safe and secure supply chain system for the food products. As the food supply chain of Ireland becomes increasingly global, the risk of contamination in the SC also rises. In order to ensure the consumer's concern about food safety and security, the food handling process and the pesticides that are used in the crops are properly traced by the Food Safety Authority, and then it is sent for delivery and marketing. The traceability of the agricultural products thus has ensured proper food security with a high price rise in global food products.

2.8 Identification of various methods to trace the supply chain process of the Irish agri-food produce

Saberi *et al*. (2019) have stated according to the Grocery manufacturers association report, most of the agricultural producers in Ireland lack the product-related information ambiguity, which makes the suppliers and the wholesalers to trace the product authenticity and liability properly. Due to the age-old traditional system in the SCM process to track and monitor the data for the foods packed and supplied daily by a manual record-keeping system, the traceability is not effectively conducted within the supply chain process. Therefore, the Irish Food Safety Association have developed and proposed various methods for improving the traceability of the supply chain for the Irish agro-food produce. Corrigan and Nieuwenhuis (2017) have explained in the food SCM process end-to-end traceability is a challenging task and due to the limited use of the digital records and standardization process, implementation of modern technologies and advanced computerized methods are essential for the suppliers and the traders. The introduction of ***Blockchain technology*** is a new identified method that is used by the agricultural supply chain system of Ireland to trace and track the data of the food supply in a new type of system. Finnegan *et al*. (2017) stated the blockchain technology not only helps in maintaining and monitoring the data of multiple stakeholders but it also allows the SCM system to confidently share the access of the data and other information with reliable sources.

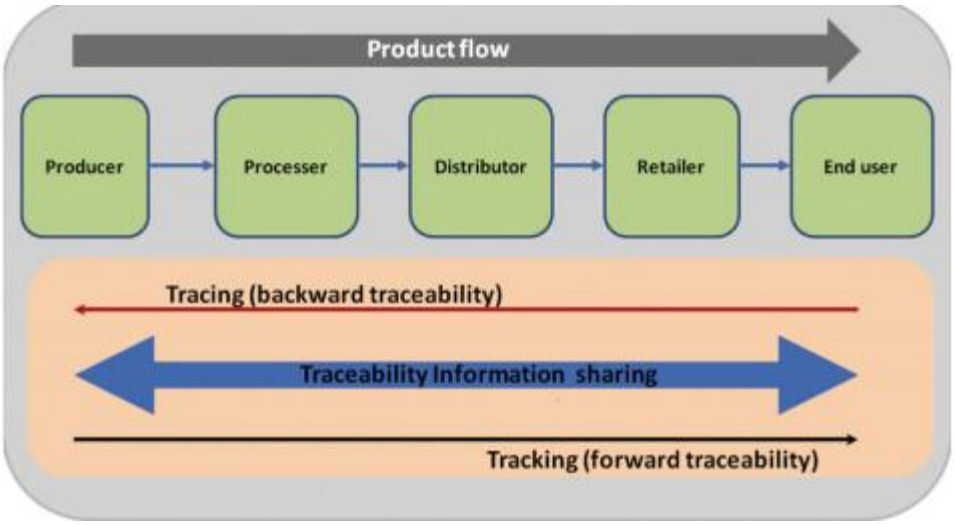

Figure 5: Traceability Information Flow

(Source: Adamashvili *et al.* 2018)

Barrett *et al.* (2017) have argued while blockchain methods alone cannot solve the existing failure of the manual record keeping process, the dependency of digital transformation through the introduction of ***GPS enabled smartbook*** is also a method worth mentioning. The application of these smart ***IoT devices*** helps in digitalization of the entire SCM process starting from smart packaging to the labelling system by tampering with an evident sealed or a security sticker. This can help the suppliers as well as the manufacturers to easily trace the agricultural food produce, thus enhancing the SCM process of the Irish food sector. Adamashvili *et al*. (2018) have explained that the digital technology-based traceability method helps in developing basic infrastructure of the supply chain system in the Irish agricultural food produce. On the other hand, a better access can be created between the farmers with the direct retailers as well as the customers, thus improving the transparency of the agricultural food produce and the supply.

2.9 Initiatives of traceability of livestock farming in Ireland

Mahfouz *et al.* (2019) have specified in his article that Irish Government has planned to double the global footprint of the country by the year 2030 by focusing on greater investment in agriculture and livestock farming, tourism and various other technological industries. Ireland recently introduced cattle ***tagging system*** by the help of RFID in the traceability of dairy farming and livestock trading that includes some of the biggest dairy units in the country like 'United Dairy', 'Draynes Farms' and 'Glenilen firm'. Through the improvement of the new traceability initiative that is being applied in livestock farming by the RFID process, the SCM process for the agro and

dairy food products is effectively handled. Mezquita *et al*. (2019) have further explained that the livestock sector is an important aspect of the agricultural food produced in Ireland that contributes half of the economic growth within the country's food supply chain system. The improved management of the food processing software helps the SCM of the food producers in Ireland to trace the real-time data and the current information about the location of the product once it is being packed and dispatched from the respective farms (Antonucci *et al.* 2019). On the other hand, a ***Brexit Act On Initiative*** aims at helping the Livestock enterprises in Ireland, to create a strong action plan for identifying the opportunities through the SCM process in the food produce business and mitigating the risks of the transportation and other supply chain related problems through the traceability process.

Kim and Shin (2019) have stated that the importance of research and innovation in the livestock traceability sector have created a high-level innovation team that helps in the effective management and tracing of the supply chain goods and services with the current agro-food sector. The utilization of the innovation capacity and the livestock trading have created a better market for the Irish agro-food sector thus producing greater quality of dairy products by maintaining the sustainable health perspectives of the Irish as well as global people. Tian (2016) have argued that based on the new food processing strategies that have been adopted by livestock farming the shelf-life of the food in a non-destructive way has been increased and a better traceability system is being created. The industry-led initiatives have generated greater collaboration with the end users of the supply chain system, thus creating new opportunities for the farmers as well as the Irish based dairy food companies.

2.10 Identification of the impact of climate change on risk management

Risk management can be affected by climate change in Ireland. The heavy rainfall, flood and different changes in the temperature impact on the risk management. This damage the assets and the manufacturing process. Climate change increases the risk factors and affects the production line of the company (Shelman*et al.* 2016). The increase rate of waste energy can influence the maintenance of the firm. This hampers the growth and profit in the agriculture firms. This affects the transport system and the employees are not able to sell their products. This will enhance many difficulties within the agriculture firm. This hamper the risks management process (Kamilaris *et al*. 2019). The employees are not the analysis in different factor affecting the production of the agriculture organization. This will reduce the quality of the products. Monitoring the risks is an

important part of the risk management although the climatic change affects in their aspects. This will negatively impact on the different factors of the company. The organization needs to focus on improving the storage management of the company. This can protect the products during climate change (Dandage *et al.* 2017). This will affect the different sector of the firm. Recycling the products can reduce the financial loss in the firm. The different types of chemicals can enhance changes in the firm. This increases the risk factors and the risk management process cannot handle this situation. Due to climate change affects the supply chain management of the firm (Sangeetha and Vijayalakshmi, 2020).

Heavy snowfall affects the growth of the company and this affects the whole management of the company (Tian, 2017). The organization needs to improve its risk management for improving its current position. Due to the high-temperature condition, the qualities of the product decrease the different factors of commercial state in the firm. Climate change undertakes the controls of the employees are not able to use the risks management tools and this will enhance many problems (Shelman*et al.* 2016). In the case of the SC transportation and process, climate change is the changing condition of the climate which badly affects the production and the suitability of the company. The employees need to understand the risk, and then take the appropriate steps to reduce the impact of climate change on the company (Ling and Wahab, 2020).

2.11 Analysis of the traceability systems that are currently used by the producers, distributors, suppliers and wholesalers to supply foods to the consumers

The traceability systems are maintaining the desired information about the agriculture products and its component in the different parts of the products. The system assists to collect and record the appropriate information about the products. This can improve the whole situation of the company (Zhong *et al.* 2017). Thus, has the ability in which the system can identify the raw materials, production and processing system of the products. This will enhance success within the firm. The system is currently used by the:

Producers

The producers are proving appropriate finance to the company in which this system can improve the production of the firm. The producers are using this system to analyze the raw material used in production. This can assist to estimate the appropriate commercial condition of the firm. The producers are trying to mitigate all the different issues of the entity (Kallas *et al.* 2019). The

producer can provide the requirements to the employees which can improve the quality of the products.

Distributors

The traceability systems increase the supply chain visibility which is beneficial for the firm. This can improve the distribution process of the firm. The appropriate supply chain can improve the logistics and distribute the products to the customers in a proper way. This can enhance long term success in the firm (Saberi *et al.* 2019). This can help to improve the brand reputation of the firm and maintain the quality of the products during the distribution system. The products can maintain specific attributes and bring success in the agriculture firm.

Suppliers

The suppliers are using the traceability systems for delivering the appropriate raw material to the company. This can maintain the quality of the raw material which improve the services of the firm (Sellitto *et al.* 2018). This can improve the customers base and increases the brand reputation of the company. The suppliers are using this system for maintaining the commercial condition of the company.

Wholesalers

The wholesalers are using this system to reduce the wastage of the firm. This can maintain the brand image of the company.

The traceability systems help to improve the decision-making process. The appropriate decisions can increase the commercial state of the company and deliver high-quality services to the customers (Sangeetha and Vijayalakshmi, 2020). The inventory management system can be developed with the help of the traceability systems and this reduces the wastage and improving the product tracking system.

2.12 Impact of climate change in the agriculture system and the informational reliability

Climate has made the most effective changes in the agriculture system. This can destroy the production of the product. The climate change such as the high rainfall, snowfall and flood can change the whole system of the agriculture. Thus, affects the stability of the company and reduces its financial standings. Climate change affects the logistics system and the production of the company. The whole supply chain management of the firm can hamper from climate change. This affects information reliability and therefore cannot gather the appropriate information because of

climate change. Climate change cannot collect the relevant information which will improve the condition of the company. This hampers the logistics system and decreases the productivity of the firm (Auler *et al.* 2016). This can destroy all types of reliable sources of gathering information and thus can increase the weakness of the firm. The firm would not able to improve the safety factors to protect the products. This can reduce the brand image of the firm (Shelman *et al.* 2016). Ireland has faced different types of issues during this climate change. This can reduce the control from the food chain. Supportive tools and effective strategies can improve the situation of the firm. This will enhance success in the firm (Eksoz *et al*. 2019).

2.13 Analysis of the procedures of reducing climate change risk on the agriculture procedures

The organization needs to use advanced technologies which can improve the whole agriculture procedures. The technologies help to reduce the risks of climate change by developing the risks management process. The employees can gather relevant information for improving the condition of the company. This will improve the productivity of the firm and increases economic condition. The technologies can boost up the performance of the employees and they will deliver high-quality agriculture products to the clients (Montet and Ray, 2017). The risks management process can identify the risks and monitor the performance of the employees. Proper water resources can improve the whole system of the company and this can be possible with the help of the innovative technologies. The Irish Food and Safety Organization is trying to provide effective services to the clients (Shelman *et al.* 2016). The appropriate water resources can help to grow the agriculture system and improve its quality. The technologies can mitigate the different types of risks factors within the firm. This can improve the poor harvesting technique and improve the food safety process. They can improve the logistics of the firm and the suppliers are able to deliver effective services. The technologies can improve the land and water resources (Bucci *et al.* 2018). This can influence the performance of employees and they are trying to deliver the high-quality services to the customers. Irish Food can easily improve their brand image (Shelman *et al.* 2016). This process can refuse the impact of climate change affecting the production in the firm. This can reduce the risks factors of the firm. The technologies improve the fertilization process in increasing the productivity of the firm. The utilization of the innovative process can improve the management system of the entity (Yu *et al.* 2018).

2.14 The relation between Traceability and food supply chain

There is a difference between the traceability and food supply chain such as, the traceability system can monitor the different aspects and performance of the employees. This can help to make the proper decisions for the company. The organization can take proper decisions for improving the productivity and profit of the firm (Shelman *et al.* 2016). This can follow the challenges of the food supply chain (Yu *et al.* 2018). This can gather the relevant information for improving the food system of the company. Thus, it allows for retention of the emergencies in the supply chain. The food supply chain is maintaining the distribution system of the company while offering quality services. The traceability system properly tracks the products and improve this supply chain system (Sangeetha and Vijayalakshmi, 2020). This can improve the economic condition of the entity. This is important for food safety and food safety can improve the reputation of the company. This can trace the flow of foods and products. The prices and distribution stages of the firm will be improved for increasing the system (Shelman *et al.* 2016). The entity is trying to improve the status of the company. The organization can fulfill the requirements of the supply chain. The organization can implement the different types of strategies to improve its management system (Sangeetha and Vijayalakshmi, 2020).

2.15 The important of the digital platform in Ireland

The digital platform has provided the appropriate logistics system globally for Ireland. The digital platform can develop the agriculture food process and supply to every region in Ireland. The digital platform can increase the recognition of the products (Shelman *et al.* 2016). This can cover the food holding the storage and delivery changes with the stable approaches. The firm has decided to improve the whole section of the form to improve the sectors. The digital platform helps to improve the brand reputation and increases the profundity of the firm. The clients can get the appropriate products within the proper time limit. Digital platforms are important for maintaining the distribution system of the firm. This can maintain the raw materials (Sangeetha and Vijayalakshmi, 2020). This can improve the supply chain system in all the region of the company. The appropriate food handling food process will increase the financial condition of the entity and increased its brand image. This can enhance long term success in the firm. The organization can provide the products in different countries through digital platforms and this can increase the customer base (Sangeetha and Vijayalakshmi, 2020).

2.16 Conceptual Framework

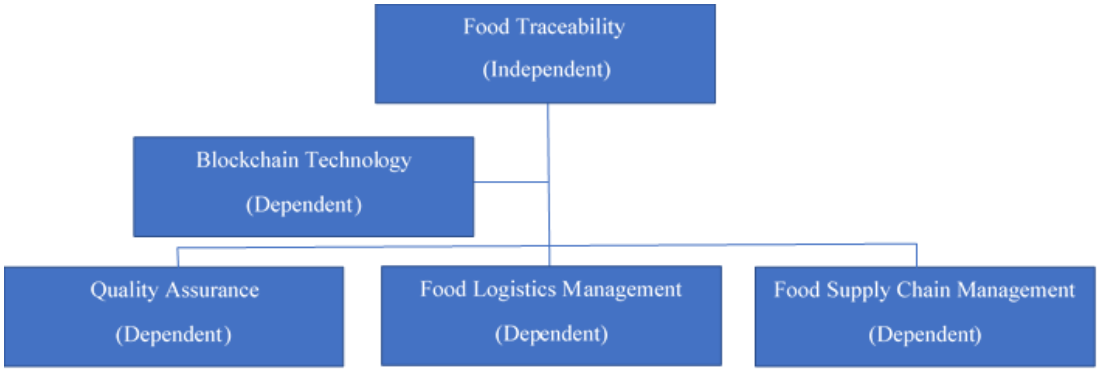

Figure 6: The dependent and independent framework

Source: (Self-created)

Food traceability is an independent variable as it can be influenced by the incorporation of the dependent variables. Food traceability requires operational efficiency to be effectively tracked and for food safety (Tian, June). Blockchain technology, quality assurance, food logistics management, and food supply chain assimilated management are such variables that are mandatory to achieve effective food traceability. The dependent variables determined are crucial as it leads to effective and accurate traceability of the food. The integration of technology expands the scope of effective tracking of food-related stages. It provides a clear insight into production, distribution, and processing. The traceability is crucial as it enhances the chances of visibility and improves quality assurance (Shelman *et al.* 2016). It is a better control system that reduces the risk related to food wastage and suppliers can take actions accordingly. The effective management by the food supply chain management and food logistics management of the foods are preserved safely. The chances of food contamination are reduced, and chances of harmful bacteria, parasites, chemicals, and toxins are eliminated by integrating tracking. Traceability assesses and establishes the sources that are required to verify and test food safety. A timely improvement can be traced based on which the supply chain can be made effective (King*et al.* 2017). It is a modern technique that implements modern technologies enabling tracking and software usage. An alert system integrated technique that alerts and secures food safety specifically. The tracing of the food on a regular basis reduces the risk of food contamination that can have adverse effects on individual health.

The food traceability that is an independent variable is dependent on the variables such as blockchain technology and effective management by logistics and the management team to test and trace food in a timely manner. The quality assurance is automatically gained by following these measures. This reflects the interrelationship among the independent and dependent variables. The attainment of the dependent variables automatically leads to the attainment of the independent variable that is effective food traceability.

2.17 Conclusion

The paper concludes with the appropriate food supply chain traceability of the production of agriculture in Ireland. The innovation in the supply chain traceability system has been concluded in this paper. The climate changes affect the risk management of the production of the company. This can hamper the supply chain management for the firm. The Entity is trying to deliver high-quality services to the clients to improve the whole situation of the firm. The innovative system and technologies help to reduce the stress of the company. The effective system will improve the production of the company. Climate change impacts on the agriculture system which affects sustainability.

Chapter 3: Research methodology

3.1 Introduction

The purpose of this chapter of the dissertation is to lay focus on the use of a diverse set of methods that are taken into consideration to render a realistic version to the study. The chapter initiates with the selection of the research philosophy along with the approach and strategy followed by a justification for each of the selected methods. This chapter validates based on the facts that ability to derive at reliable conclusions and valid results, by accomplishing the objectives of the study and application of the apt data analysis methods. The chapter concludes with a brief summary of all the contents included within the study and thereby enables the researcher to come to meaningful findings.

3.2 Research philosophy

The current research construes episodes of explanations pertaining to the recognition of the core variables of the study. Assessing the variables of the study, it needs to be stated that the study centres on the concepts of evaluating the impact of supply chain operations to mark the traceability of agricultural produce in Ireland. Hence, it needs to be stated that the research tends to be more realistic and interpretive and does not rely on developing theories. Considering the new innovations in the supply chain operations to be a never-ending phenomenon, the use of the interpretive research philosophy would mark the aptness of the study. The use of the interpretive philosophy helps in coming to generalised conditions and thereby locating the key interpretations and findings based on a qualitative format. Conventionally, the interpretivism philosophy is connected with a qualitative research strategy, however, the use of quantitative prospects equally contribute to adding on more precision to the study content , making the core phenomenon clear and appropriate (Mackey and Gass, 2015).

3.2.1 Justification

The justification behind the selection of the interpretivism research philosophy lies in finding the rationale for addressing the research using the interpretive way. It allows the researchers to come to generalised findings as provides room for continuous updation and input. As it has been stated that the research subject debriefs the aspects of supply chain traceability in the agricultural production of Ireland, the application of the interpretivism philosophy helps in adding on to the

validity of the research by coming to conclusions that generalise on the subject of the study and contributes to the formation of a clear view and space for more research in the long run.

3.3 Research Approach

In regards to the use of the research approach, it needs to be stated that a research can either develop findings using the inductive or the deductive approach. The use of the deductive approach helps coming straight on to the core point of the study. The study hedges around the concept of evaluating the feasibility of supply chain traceability in agricultural sector of Ireland. Hence, the use of the deductive approach seems to be apt in this regard as the subject generates a two-dimensional study format, indicating on the aspects of explaining multiple subjective notions procured from the primary and secondary data (Fletcher, 2017). The study is not much formal in content as it is based on the understandings of the researcher and tries to render a realistic view to the subject. Despite being a realistic study, one of the limitations of the subject is that it develops a one-way communication and thereby the readers do not have much to share unless the researchers wants them to.

3.3.1 Justification

The justification behind the selection of the deductive approach for the study lies in delivering generalised interpretations on the subject and thereby allows the researcher to have adequate time and space for further research. The subject of the research is more realistic and continuous in approach making the approach more phenomenal and thereby investing the applications of some of the best concepts and theories to suffice the content of the research. The researcher is able to create a separate space for coming to useful conclusions on the study pertaining to the continued development of supply chain operations in the agricultural sector of Ireland. This allows the researcher to shed more time on focusing on the practical implications of the study along with deriving at general conclusions.

3.4 Research strategy

According to Mohajan, (2018), a research strategy refers to the step-wise process that helps a researcher to create a proper form of a dissertation paper. The research strategy focuses on mentioning the research topic focus area along with diverse aspects of the research design , approach, philosophy and the different modes of data collection and analysis. The beginning of the research strategy deals in finding the research topic, followed by developing the thesis

statements and the possible interrogative areas that might crop up while conducting the study. A research strategy can either be of 4 basic types, based on which the questions of the research are fixed. The 4 basic types are case study, qualitative study, quantitative study and action-oriented research (Taherdoost, 2016). The use of the qualitative research strategy suits best with the interpretivism philosophy and thereby indicates use of structured or semi-structured interviews. Adding on the qualitative research strategy helps the researcher to render precision to the study and enhance the realistic purview. Keeping into mind all the research strategies along with their implications, the current research shall follow exclusively a qualitative strategy, complemented by a primary research to add on to the precision.

3.4.1 Justification

The justification behind the use of the qualitative research strategy has been conducted based on the selection of the right number of samples, using the semi-structured interviews to procure maximum information on the subject. While conducting the research, the researcher had kept in mind the use of the deductive approach as it allows for more space to investigate on the matter and understand the practical implications of the study. The current research follows a deductive approach and thereby the use of the interpretive philosophy suits the application of the qualitative research strategy. It has allowed more time to the researcher to conduct extensive planning concerning the selection of the right structure for the study. This has allowed the researcher to look onto the essential aspects of the study by engaging in taking decisions about whom to interview and on what grounds the interview must be taken. The use of the qualitative strategy has also helped in enabling the researcher to decide on the aspects as to whether the study shall be conducted as individual interviews or group interviews and finding on the right methods to analyse the same. Therefore, it has been evident that the researcher has been able to focus on the aspects of developing the basic outline of the study and thereby take effective decisions in selecting the right strategies to derive at meaningful conclusions avoiding any biases of partiality.

3.5 Collection of primary data

While conducting researches, a researcher primarily depends on the use of two methods likely, the primary and the secondary method. The primary data collection method indicates the use of practical instruments in developing quantitative data and deriving at numerical (Quantitative) as well as non-numerical (Qualitative) data in the same platform. According to Attia and Edge (2017),

the process of primary data collection refers to the aspects of finding the practical resources of data collection and allows the researcher to gather first hand information on the subject. Accessing primary data can be difficult in a number of ways; however, the primary data can be collected using multiple methods, including individual interviews, self-administered surveys, focus group interviews, experiments and field observations. Critically assessing the feasibility of primary data, it needs to be stated that the process is quite expensive and tedious as consumes a lot of time (Ulmer, 2017). However, in order to render a practical input to the research study, the researcher often uses the primary data. In regards to the current study, the researcher has used the primary data for conducting the qualitative analysis. The use of qualitative approach has added on to the conceptual and practical aspects of the study. In order to collect the primary data, the below mentioned aspects have been taken into consideration with highest priority.

3.6 Sampling population

In regards to conducting some of the researches, it needs to be stated that if the entire population considered to be the possible sample for the research is so small then all the members of the population can be included for conducting the survey. However, in certain aspects, the study may have a bigger compass of operation and entail a larger population, all of whom cannot be included within the study. This is where the sampling technique is selected and based on the sampling technique the number of samples are allocated to conduct the study (Gray and Malins, 2016). Thus, it can be stated that a sample for a specific research refers to the selected group of individuals who are shortlisted to be included for conducting the data collection process. In consideration to the current study, it needs to be stated the use of the probability sampling method has been taken into consideration. Considering the researcher focus exclusively on the supply chain and agricultural sector of Ireland, it needs to be stated that the researcher finds the best exposure in using the random probability sampling method. The sampled population is considered to be all the professionals involved in the food supply chain operations in Ireland and only a selective number of respondents have been marked as the sample for conducting the study. Simple random sampling has been used to choose the participants of the study. The researcher focuses on only considering the participation of respondents within Ireland for the study. The participants were selected randomly through business networking site “Linkedin”. They were chosen on the criteria of work experience and position in the food supply chain industry. The population of respondents included those working in senior level roles at food supply chain sector of Ireland and had connections with

food producers, suppliers and distributors. Both genders were used to conduct the study. The study participants included people from various roles in supply chain like warehouse supervisor, supply chain managers, logistics coordinator and all the respondents had 3-10 years of experience working in the supply chain sector. The rationale for using a semi-structured interview was to elucidate the interviewees' opinion about the various operations in food SCM that assist in the traceability of agricultural produce in Ireland.

3.7 Sampling technique

The researcher has intelligently used the probability sampling technique as it has allowed the researcher to prevent occurrence of errors and develop an impartial approach to collecting data. The use of the probability sampling method is considered to be appropriate for the current study as it has enabled the researcher to abstain from any kind of biased approaches and developing higher levels of reliability for the study (Sessler and Imrey, 2015). As it was suggested in the proposal, the researcher wanted to interview 50 employees from the supply chain sector of Ireland but due to the impact of Covid-19, made it difficult for the researcher to get face to face interview responses from the sample. As a result the number of respondents were limited. The current use of the random probability sampling technique goes well with the selection of the samples as it has helped the researcher to come to practical conclusions along with increasing the accuracy level of study by prior estimating possibilities of errors found in the later part of data collection process. Additionally, it has helped the researcher to come to generalised conclusions by making meaningful inferences about the population. A open ended questionnaire was prepared and shared with the respondents to evaluate the present status of food supply chain traceability in Ireland. Common questionnaire has been shared with all the participants to maintain coherence in the questionnaire.

3.8 Sources

To satisfy the objectives of the research, the researcher makes complete efforts to obtain the best available information from important senior level executives and members from the food supply chain sector of Ireland. Apart from the selected samples, the researcher has also used the secondary method of data collection by procuring information from an array of literary sources that have been selected based on the dates and the main keywords of research study. The primary data has been

collected using semi structured online interview format by including a questionnaire of 15 Open ended questions.

3.9 Validation of the interview questions

The validation of the Interview questions serves as one the most important aspects of data collection in research and contributes to the truthfulness and reliability of the findings (Hadi and Closs, 2016). The current research uses a total of 15 questions to suffice the content of the study and derive at effective conclusions. While validating the use of data collection instruments, the researcher either follows the face validity process or the content validity process. In regards to the current study, the researcher has used the content validity method. The current set of interview questions were shown to the Supply Chain Management professionals and were asked to share their opinions on the validity and appropriateness of the interview questions. The experts went through the research questions and assured on the adequacy of them. Thereby the validity of the interview questions has been established.

3.10 Collection of secondary data

The secondary data has been collected from the existing literary and academic sources. The researcher had used the information databases like, Google Scholar, EBSCO, Science Direct and the website of the agricultural boards of Ireland. Based on the selected key word search, the researcher had been able to find relevant information on the subject and also narrow down the search criteria. The secondary literature sources have been segregated based on the recent years of the publication of the most recent articles on the subject keeping a maximum range between 2015 and 2020.

3.11 Access and Ethical issues

Ethical consideration is an integral part of research to ensure that the study has been conducted on secured and compliant terms. The current research faces few issues in regards to accessing information from the samples (Goldberg *et al*.2017). All the relevant data collection and responses are bound to the capacity of profession network. Additionally, it was difficult to get in touch with them and convince them for an interview due to the Coronavirus Pandemic . Each of the respondents needed to validate the researcher's background and purpose of the study, Therefore,

permissions for collecting data were only granted based on maintaining the anonymity of some of the respondent.

3.12 Approach to data analysis

Corresponding, the above explanations on the research methodology used for the study, it needs to be stated that following the use of the qualitative research strategy, the researcher has focused on using the content analysis process for analysing the collected data. The use of the content analysis has helped the researcher to directly examine the research subject , complemented by a rational evaluation (Aithal, 2017). Additionally, the research reflects development of valid information based on following an unobtrusive means for collecting and assessing the required information.

3.13 Summary

The primary purpose of this chapter was to delineate the apt methodologies expected to complete the study. The chapter successfully outlined the application of the diverse research methods to collect the data along with meaningful justifications behind the use of each of the methods. Considering the nature of the research, the researcher opted for the use of the interpretive and deductive approaches to justify the implementation of the qualitative strategy. The key research tools used to conduct the study were primarily interview questions that complemented the selection of the right number of samples targeted from the right sample population. The results of the findings were analysed using deductions based on the interview finding. Considering the use of the included methods in the study, the researcher has successfully derived at valid conclusions to support evidentiary information procured from the study and the findings are discussed on the next chapter of the research.

Chapter 4: Data Analysis

4.1 Overview

The given chapter has presented the findings in the form of a transcript along with the discussion on the different data that has been gathered from the research. The given chapter has been effectively successful in integrating the identification of the results obtained and the overall demonstration of the results obtained considering the research questions and objectives identified.

4.2 Findings

The researcher draws upon the findings based on the responses given by the 5 research participants from different retail and food supply organisations in Ireland. The participants come from various functional roles in food supply chain like warehousing, packaging, supply chain management, logistics. The responses given by the candidate is used as a benchmark to verify and gather opinion regarding the research questions and objective. The purpose of the finding is to evaluate the responses of the respondents and analyse the content and summarize the findings based on best practise deductions made during the literature review.

4.2.1: In which part of the supply chain department is your job role involved in the organisation and what is your working tenure?

This question introduces the research candidate and reflects on the research methodology where the criteria for selection of the sample is identified. The research candidates work in companies like Keelings FarmFresh, Lidl and Tesco.

Respondent 1: I am currently working in the packaging department of the company by means of monitoring the control over the packaging process, sometimes I do take care of the storage and the stocking process in the warehouse. I have been currency working in the company for the past three years. However, I have working experience in the supply chain department for the past ten years.

Respondent 2: I have been currently employed in the distribution department in the current company where I have been working for the past 2 years. However, I have been involved in the supply chain development process for four years before the current company in the warehouse processes.

Respondent 3: It has been 6 years; I am employed in the current company and I mostly administer the distribution system along with the supervision in the food packaging and safety deliverance.

Respondent 4: I am currently employed in the warehouse management and stocking process for the last four years in the current company.

Respondent 5: I work as a supervisor in the current company in terms of ensuring food quality and development of safety measures while packaging the food items and tracking them at the same time.

4.2.2 According to you, what factors of the supply chain are required to be incorporated within the traceability of food agriculture in Ireland?

The purpose of this question is to evaluate the candidate's opinion regarding the supply chain factors that help drive traceability in Ireland.

Respondent 1: As per my review in terms of the incorporation of the factors that are required to be included is the productivity of the products in terms of the smooth flow of the goods and services across the nation. Ireland in terms of supply chain management is required of the incorporation of the factors that may lead to the major evaluation of the process of food agriculture in terms of the process of traceability.

Respondent 2: In my review, I think that the incorporation of factors such as the management of the quality and parts of the products is required to be managed by the entrepreneurs of the supply chain management. As one of the managers in the supply chain management, I would have incorporated the factors as the safety of the goods and services. The safety of the products and services of the agricultural companies that have been operating with the supply chain management is the essential factor of the management.

Respondent 3: According to the experience that I have gathered over the management of the supply chain in Ireland the quick tracking of the products and services that are being delivered to the different companies across the Ireland country play a key role in determining supply chain influence on food traceability. The tracking of the products produces safety to the producing and operating services.

Respondent 4: The process of the productivity of the products and services of the organization is the best process that needs to be processed within the management of the supply chain market. The productivity of the products and services helps in the effectively attracting of the customers and clients across the operative companies of Ireland.

Respondent 5: The quality of the products and services that are being delivered and served to the users and clients of the company is required to be controlled. I think that the process of controlling over the products and services of the company may help in the management of the supply chain of Ireland in the most successful ways.

4.2.3: What is your opinion in terms of incorporating supply chain management within the functions of Ireland's agricultural organizations?

This question seeks to analyze the answers of the subject whether SCM activities are necessary within Ireland agro companies.

Respondent 1: According to my knowledge that has been helping me to be more operative within the organization in terms of the managing the products and offering with the help of the activities of supply chain management, the flow of the organization services and goods will be recommended to be more successful.

Respondent 2: In reference to the incorporation of the supply chain management within the organization is the best idea as it helps to achieve timely and accurate verifiability of products and services.

Respondent 3: According to my point of view, all the operating agricultural organization of Ireland should adopt and follow the factors and the effects of the supply chain management in order to be effective, competitive across the nation with the production and flow of the unique and different quality of goods and services.

Respondent 4: The process of the incorporation of the supply chain within all the operating agricultural organizations of Ireland in the effective processing of the provision of the goods and services to the different operating companies as well as to the users. In order to increase the efficiency of the flow of the products and services of the company the incorporation of the supply chain management is the best idea.

Respondent 5: In order to keep the users and clients of the agricultural organization connected, the incorporation of the factors and policies of the supply chain management are essential.

4.2.4: According to you what practices and methods need to be followed in order to maintain the supply chain management within Ireland?

The researcher is gaining insights to the best practices followed in the respective organizations within Ireland. Trying to evaluate whether those practices are sufficient to address issues in food supply chain.

Respondent 1: In reference to the practices being followed by the operating agricultural organization, I would recommend that the mountain of the relationship of the customers with the company is the basic practices that need to be operated by several and almost most of the companies of Ireland.

Respondent 2: The maintaining of a relationship between the firm and users of the company is the major success that is required to be created over the region of the Ireland. As the users or the clients of the company are the biggest factors if the firm that has been helping the business of the agricultural organization to be effectively operating.

Respondent 3: The relationship between the buyer and the supplier needs to be cordial.

Respondent 4: The best practices and methods of Supply Chain should not just apply for Ireland but Globally. There must be a common traceability method based on common sets of goals, data and methodology.

Respondent 5: The process of the planning and segregation of the products and services of the company is another practice that I think needed to be noted within the agricultural organization in terms of the supply chain management.

4.2.5: In your opinion what more policies are required to be created in order to increase the efficiency of supply chain traceability in Ireland?

The purpose of this question is to understand whether the policies laid out by the FSAI and other food board are carefully practiced in the Industry. Are these policies effective or is there a need to strengthen the policies?

Respondent 1: In reference to the supply chain management of the traceability, I must recommend that the safety of the food products and services that are being delivered are required to be manned over all the operating companies of Ireland. In reference, the Island is required of allying with the lawful policies in order to maintain and operate the supply chain management in the most effective and efficient ways.

Respondent 2: As the information and knowledge that I have regarding the law of the Ireland in terms of the agricultural supply chain the setting and evaluation of the law and relation in terms

of the safety of the food products that are being produced and delivered to the other region of the nation are followed strictly.

Respondent 3: The policies that are required are incorporated within the management of the supply chain of Ireland in respect to the food agriculture is the safety and health issues of the customers. The safety of the foods must include the health safety of the customers and clients of the nation and firm.

Respondent 4: The process of the following of the transparency issues within the operations of the development of the law based on the issues of the food agriculture is to be incorporated according to many points of views and experience.

Respondent 5: -

4.2.6: Is the evaluation of the risk management important to you to incorporate within the overall process of the supply chain management of the country?

In this the researcher tries to find out whether risk management is necessary in the supply chain management process. This relates to the literature review whether risk management can help mitigate problems associated with Supply Chain.

Respondent 1: In reference to the incorporation of the process of the risk management is being referred to as one of the most essential process to be maintained within the supply chain of Ireland.

Respondent 2: As per the information that I have with the incorporation of the risk management, the risks involved within the operations are being decreased.

Respondent 3: There is always risk involved through misuse of information, technological change, through interactions and cultural differences. There can be misuse at functional and across the supply chain.

Respondent 4: In reference to my point of view, the evaluation of the risk management is not much effectively essential to be incorporated as the operation of the function of the company depends on the efficiency of the employees.

Respondent 5: According to the experience that I have inquired of that the employees of the company are required to be effective with the operations that may help the organization is decreasing the rate of risk into the function of the company.

4.2.7: According to your views is the change in climate hindering the supply chain process of agriculture within Ireland?

This question is based on the third objective of the study whether climate change is impacting the network structure in agricultural processes within Ireland.

Respondent 1: According to my experience that I have gathered while working as the supply chain management of the organization over the food agriculture company climate change is hindering the supply chain process.

Respondent 2: The change in the climate leads to affecting the whole process and the functions of the organization in terms of the of the product and service to the other agricultural organization across the nation of Ireland.

Respondent 3: The whole selling of the products and offering of the organization of Ireland in terms of the food agriculture is being affected by the process of the random and vigorous change in the climate.

Respondent 4: No, I don't think so, the development and the growth of both should happen together.

Respondent 5: This is too broad a question to answer.

4.2.8: In your views, what strategies are required to be implemented for the traceability frameworks for supply chain management?

In this the researcher is trying to understand the strategies that are incorporated in the food industry to improve traceability in their organization. This seeks to gain information as to whether all the strategies in the organization are aligned with each other.

Respondent 1: In my opinion, the implication of the strategies is being successful implemented within the organization in terms of the effective management of the process. The strategy that is required to be incorporated within the organization is the utilization of the technologies.

Respondent 2: The effective incorporation of the utilization of the resources helps in maintaining the whole process of the supply chain management within the food agriculture process of the Ireland country.

Respondent 3: According to my experience that I have inquired about, the incorporation of the utilization of the traceability of the software that needs to be incorporated will help the organization to be successful.

Respondent 4: In reference to my statements the strategies that need to be incorporated within the operation of the food agriculture companies in reference to the supply chain management is the incorporation of the communication channels.

Respondent 5: The overall business strategy, sales strategy, operational strategy all needs to be aligned with the agro-supply chain network from farm to fork.

4.2.9: What is your view on applying mobile technologies and devices in developing the management of supply chain systems?

This question is again linked back to second objective trying to determine the respondents input regarding the effectiveness of usage of innovative supply chain systems using mobile technology.

Respondent 1: I think the use of mobile technologies would be highly beneficial out of the process of tracking the food items and locating them during the different stages in the supply chain activities.

Respondent 2: I think mobile technology usage would be highly effective and efficient, as it would allow easy recording of the current location of the vehicle or the current location of the food items that are being distributed after packaging. GPS and GIS can be enabled through mobile devices.

Respondent 3: Mobile technology is going to be one of the most prominent features of developing the supply chain management process. In my view it should implemented at the earliest.

Respondent 4: In my view, mobile technology would be highly beneficial in improving the real-time reporting process in the company's supply chain management system that would help in tracking down the location of the food service.

Respondent 5: IT infrastructure usage can be more effective by the presence of mobile technology, as it would help developing and involving the IoT processes.

4.2.10: Do you think the development of mobile technologies would be effective in maintaining traceability in the food supply chain management process?

Seeks to understand the candidate’s response on whether mobile technology is linked with food traceability.

Respondent 1: Yes, I do believe that will help in managing the traceability of the food items that are being transported through the different stages in the supply chain department through mobile technologies.

Respondent 2: The development of new technologies is beneficial, but it would be consuming more time to implement the process and the investment that would be carried out is high.

Respondent 3: I think it is convenient enough to use the mobile technologies in ordering the traceability of the food supply chain management system, as there would be proper storage of the data using IoT leading to easy data revival of the whereabouts of the food items being transported.

Respondent 4: I do not think it would be convenient enough to develop the supply chain department of the food industry in terms of managing the traceability by using mobile technologies.

Respondent 5: RFID is a great tool in Mobile Technology and has been used for several years in agricultural industry. Animal tagging has been followed to collect data from the animals like sheep and cows to observe better breeding. Wheat, corn and grain growth can be monitored through RFID.

4.2.11: Does your company hold enough productiveness in maintaining the safety of the food during the packaging process?

Question to understand the safety measures that are being observed in several organisations during the packaging process.

Respondent 1: Yes, food safety has been the major priority in my company by ensuring that the government food safety acts are being entitled in the company and processed during the supply chain management activities that are carried out in the company.

Respondent 2: Yes, there is the provision of effectiveness in maintaining food safety regulations in the company, as it has been the primary concern in the company to develop the corporate governance policies and regulations. These regulations thus include the food safety acts of Ireland.

Respondent 3: During the packaging process that is carried out in my company, I, being the supervisors in such activities ensure that the food items are being packaged with regularity maintained in the overall food safety regulations, through checking of the notable possibilities of risks is maintained.

Respondent 4: I think the company has been effective using the food safety regulations, as I am not much aware of the process of packaging as I am involved in the warehouse mostly.

Respondent 5: Yes, there is proper food safety regulations provided to every employee in the supply chain activities, irrespective the job role that is being carried out by them to ensure that the products are being delivered with proper quality maintenance.

4.2.12: What is your view on using blockchain technology in improving the processing of the food supply chain in Ireland?

The purpose of this question is to know the candidate's response regarding the implementation of innovative blockchain technology in the food supply chain sector. This technology is a dependent variable and views of respondents regarding the use of such device is collected.

Respondent 1: I think blockchain would be highly technical usage and would allow effective storage of information processing being carried out which is highly important as retrieval of information during inspection and supervision becomes chaotic without such intelligence technology availability.

Respondent 2: It is important for the supply chain management companies to ensure that they are using blockchain technology as it usually benefits the production process by enhancing the overall processes of data migration and retrieval based on the inspection carried out and the food packaging details along with distribution information.

Respondent 3: I do not think blockchain technology would be effective in improving the processing food supply chain in Ireland, as there is the requirement of huge investment and there might be increased in the usage of environmental degradation-based technologies to utilize blockchain.

Respondent 4: The use of blockchain would effectively increase in the processing of the IT infrastructure it would be requiring heavy investments to be carried to maintain such processes.

Respondent 5: According to me, blockchain would be highly efficient but it would be requiring huge amount of time and would involve additional investments in the form of training and other aspects. Blockchain usage in food supply chain will decentralize the food network.

4.2.13: Why do you think safety regulations are important to be present in the food supply chain for increased traceability?

Researcher has framed this question based on Literature Review that relates to find Irish agricultural practices related to supply chain management. It seeks to understand how these safety measures are incorporated by suppliers, manufacturers, retailers, wholesalers and others in the food supply chain.

Respondent 1: The development of traceability by means of applying effective food safety regulation would help in developing instance on the different types of products with the operational standard ensuring that the products are being obtain by the consumers and consumed with high quality.

Respondent 2: Safety regulations are important to represent in the supply chain management process ensuring traceability, as the major cause of concern for traceability development helps in the effective monitoring of the food safety procedures occurring in the company.

Respondent 3: Considering the challenges based on climatic condition and movement of the food products, food safety regulations ensures that there is effective demonstration and presence of traceability in the supply chain management process.

Respondent 4: Safety regulations ensure that the motto of the traceability process is carried out by initiating transparency on the overall development of food safety purposes that is to be tracked among the several stages that the food items passes through after the production process has been completed till the consumption process occurs.

Respondent 5: It is the key for buyer's confidence and building relationships to achieve global food security. It enhances visibility, improves operational efficiency.

4.2.14: What is your view on the need for effective communication to develop the traceability of the food supply chain system in Ireland?

The researcher is trying to understand the importance of communication involved by the various members in the supply chain to improve the traceability of food.

Respondent 1: I think communication is the most important factor which helps in maintaining the tracking of the different food items though its phases in supply chain management. It is essential to track down the different metrics of the supply chain and to be transparent about the information with all the departments present.

Respondent 2: Yes, I do agree that traceability can be further obtained through productive development of the supply chain management strategies only if there is effective development of communication and using various mediums of it.

Respondent 3: Communication is not only important in the supply chain to maintain traceability; it is the core element in managing any business process irrespective of its importance and the need in the company.

Respondent 4: Yes, I do think communication is highly important in overall development and processing of traceability in the supply chain department as it would involve effective sharing of information among the team members.

Respondent 5: Communication is the key to hold different project processes and maintain the basic development of the traceability in supply chain management considering the production and selling of food supplies.

4.2.15: What is your view on using IT infrastructure to maintain traceability in the food supply chain of Ireland?

This seeks to emphasize on the second objective of adoption of innovative traceability solutions by the different members of the supply chain.

Respondent 1: Information technology usage in the development and maintenance of traceability in the food supply chain in Ireland would help in increasing the productive analysis and development of the different types of measures that would uplift the overall control, maintenance in the supply chain management.

Respondent 2: IT is the main source of improving traceability in the current food supply chain as there has been the development of different types of technology -based traceability processes.

Respondent 3: The involvement of information technology effectively dominates the improvisation of the tracking system of the supply chain.

Respondent 4: I think technology would help in reducing the challenges based on climatic conditions that are being faced by different companies in managing the applied chain in the food production industry.

Respondent 5: Hardware and software used through the Supply chain to assimilate and analyze information will enable good decision making. It can have a significant impact on the Supply

Chain Performance. It will improve Supplier Relationship Management, Customer Relationship Management, Internal Supply Chain Management.

4.3 Discussion

In reference to the study of the factors of the supply chain that are required to be effectively incorporated within the process of traceability of the food agriculture in Ireland. The process of the supply chain that has been followed within the country of Ireland is required for the effective processing of traceability of agriculture in order to increase the awareness of the process across other nation. The factors are supposed to be incorporated in terms of the effective management of the quality and efficiency of the products and offerings and the tracking of the foods that are getting grown within Ireland. The process and the functions that are being laid over the evaluation of the food supply chain organization of Ireland is being required to be incorporated within supply chain management. The process of supply chain management is being referred to be effectively utilized with the operations and function of Ireland's supply chain across the organization of the nation. The involvement of the process helps in the success and the easy flow of the goods and services of the organization. In reference to the following of the policies and the methods for the effective management of the supply chain within Ireland, the nation has a successful management of the supply chain process of the agricultural organization. The practices and the methods that need to be incorporated within the process of the traceability in agriculture is to maintain relationship with the customers, satisfying the customers of the firm with the best goods and services and quick demand and supply of the company's products.

The functions that are being laid over the platform of the supply chain management of the food sector are being required of the incorporation and the evaluation of the policies. The entrepreneurs of the organization according to the nature of the supply chain management that are being operated within the organization are setting the policies. The process of the supply chain of the food agriculture within Ireland includes the processing of the development of the food law and accessing the information related to the food items that are being grown and serving the different organizations. The process of the incorporation and the effective utilization of risk management into the management of the supply chain of the food agriculture is the first -priority or responsibility to be obtained by the agricultural organizations of Ireland. Most of the operations of the organization includes higher risk that may cause disruptions in the success of the company.

The risk management includes the measuring of the region that is being involved within the individual functions and activities of the Ireland Organizations.

The random change in the climate has been hindering the process of the supply chain management of the agricultural food organization process. The change in the climate leads to the change in the production pattern of the agricultural process in order to keep the customers and clients of the organization connected and satisfied over the goods and services. The decision-making processes of the supply chain, as well as the agricultural products, are being affected by the change in the climate of Ireland. The incorporation of the strategies helps in the effective management of the process of the supply chain that is required to be in the form of traceability of the agriculture of Ireland. The incorporation of the strategies may help in the effective evaluation and processing of the supply chain market of Ireland to be more successful across the nation of Ireland.

The responses that have been obtained from question one indicates that the participants in the interview process have been involved in the supply chain management activities for the past two to ten years. According to their opinion, it has been noted that there are various factors that can act as the drivers of developing and maintaining traceability in food supply chain management processes. These factors are IT infrastructure, mobile technologies, communication processes, and safety regulations, which are based on the food safety acts in Ireland. According to the respondents, it is important to ensure the increased development of technology in the supply chain management process in the food production units, as it would help in carrying out successful inspection of the various processes that the food products undergo while they are passing through the stages present in between the production unit and the consumption.

It has been understood that the use of mobile technologies has been highly recommended by the subjects. It has been noted that there are various firms that have been using mobile technology successfully in order to track the products and the services while they are proceeding through the supply chain development processes. It is important to note that the overall prospects of mobile technology are to ensure that there is enough flexibility maintained in the development of the supply chain processes. It is also important to note that the overall identification of the exact location and the immediate consciousness of the products can be easily scanned through mobile technologies in the form of Smartphone and other scanners. These technologies have the ability to increase the rate of information sharing which is again a part of the communication process to be carried out among the different departments. The use of mobile technology has been considered

the most innovative method after the use of block chain technology and strong IT infrastructure forming the base and foundation of the entire supply chain management processes. In various agriculture production processes, it has been relatively noted that the traditional methods are time consuming and reduce the productivity level of the processes. This reduction in productivity level can be enhanced by the use of innovation through mobile technology and IT infrastructure development. This would further entail the process of sustainability that is another major factor that has been indicated by explaining the importance of technology in the traceability system of supply chain.

The focus on the technological department has initiated the understanding that the agro-food production business is highly impacted by the climatic condition in Ireland even though the country is focused on environmental protection. There has been various instances of crop destruction due to the changing climatic condition as a result of global warming which has led to the development and the initiation to be taken on the use of innovative approaches that are sustain and help in tracing down the food products while passing from the producers, suppliers, distributors and wholesalers.

Food traceability is an integral part of the logistics management system in the agricultural food produced in Ireland. The information that is collected from the interview responses of the primary data analysis specifies the effective role of communication for developing the traceability in the food and supply chain system in Ireland. The evaluation of the responses signifies that most of the respondents agreed with the fact that effective communication between the suppliers and the food manufacturers helps in tracking the order of the packed products and the transported goods in a systematic manner. Therefore, communication helps to strengthen the collaboration and bond between the suppliers, producers and the manufacturers of the agro food producers in Ireland (Shelman *et al*. 2016). On the other hand, the limited information and communication in the food production and processing system affects the internal and external chain traceability where the strategic information flow at the various stages of operational flow becomes difficult. The respondents have also identified that communication and collaboration between the different supply chain systems and logistics managers not only helps in superior tracking of the food supply and the processing unit, but it helps the food manufacturers to create an effective bond between the customers and the suppliers. On the other hand, the respondents have also said that a reliable

traceability system helps in enhancing customer service experience with the Irish agro food produced in the global market as well (Mohammed *et al.* 2017). Further, from the findings of the primary data gathering it can be also stated that communication flow helps in creating awareness among the supply chain workers and the customers about the safety and security of the food processing technology, thus raising the trust of the consumers in large.

The analysis that has been evaluated from the findings of the primary data clearly demonstrates that apart from the significant use of IT based technology, blockchain food traceability infrastructure system is another significant one that helps in improving the traceability of food SCM in Ireland. The blockchain IT based infrastructure system is gaining momentum in the global agrifood sector as it helps in instantly tracing the entire lifecycle of the food products with full efficiency and safety measurements (Ling and Wahab, 2020). Moreover, one of the interviewees has stated that RFID in the agriculture food process helps to track the pesticides and harmful chemical in the farming land through GPS enabled tracker that helps in maintaining the quality of the agro food products in the generic food supplements. Moreover, along with the IT based infrastructure, blockchain and RFID technology helps in quickly recognizing the potential sources of contamination in the food products so that it can be removed before the food is being packed or shipped for marketing and supply on the global market. The usefulness of the current IT based infrastructure and the technological innovation have also helped the food supply chain system to keep a track of the record in an ethical and systematic manner in a secured database. It has been observed from the findings of the primary data, that Irish Food supply chain organizations are largely dependent on the IT based solutions and technical innovations for calculating their stock variety and optimizing the food distribution system.

4.4 Conclusion

The given chapter has been effective in producing knowledge on the various openings that has been presented by senior professionals that are working in the supply chain management departments in the agriculture-based food companies in Ireland. These responses have been highly indicative in maintaining innovative approaches considering the rate of development important to be carried out to maintain traceability supply chain management processes. There responses in the findings benchmark the best practices that are being observed in Ireland food supply chain organisations.

Chapter 5: Conclusions and Recommendations

5.1 Conclusion

In concluding this specific study of research, the researcher has gained a clear understanding of the benefits of food traceability that can be acquired to engage supply chain management. The study mainly strains on the diverse methods that are inserted in the tracking of the food stages that is part of the supply chain process of the Irish agricultural food production. The study looks at various practices that are integrated into effectively track the food various stages assimilated to food production, distribution, and processing. The conventional practices are an effective technique to secure the food sector efficiently. The strain on the adoption of innovative supply chain traceability assimilated systems to enhance the various aspects of wholesalers, production, producers, and processes. An effective system that tracks down the food different stages from which the Irish agricultural firms can benefit from the system. The effective delivery system is attained by the food traceability, a modern technique. Technologies such as blockchain are an appropriate way to achieve effective food supply management. The inert fated effective steps and practices can attain the quality assurance. The capability of the Irish agricultural procedure has increased coordination of the buyers and suppliers. Strenuous attempts are made that reflect the benefits that can be gained by Irish agricultural firms due to integrating innovative supply chain assimilated traceability systems.

More scientific and calculated steps can be taken to preserve the food. The food traceability system has indulged in better production and reduced the chances of food contamination that leads to food wastage. The various theories provide a clear understanding of the management of the various stages of the food supply chain. The evaluation of the traceability system that correlates with the food network. The scope of performance management and development is increased by the traceability system. This has been beneficial for the suppliers to take effective measures to reduce food contamination and food wastage. A smarter and scientific approach that has been benefiting for the Irish agricultural food producers. An effective integral process that includes software and technological integration for better control and administration over the food-producing system. This way the cost can be saved that is incurred in the food production that was getting wasted due to the traditional form of agriculture. Rural development progress is achieved through the traceability system that is revolutionary and ensures advanced measures in the food production

field of Ireland. Thus, the study is successful in understanding the viewpoints of the best practices followed by professionals working in the Irish food sector.

5.2 Limitations to the study

The main limiting factor for the dissertation is that the study was conducted at a time when everything was stand still due to the impact of the Coronavirus Pandemic. This affected the researcher's efforts of reaching out to higher number of respondents and also the time frame. The researcher initially wanted to conduct direct interviews of more than 50 respondents. But due to the impact of the virus the researcher was limited to conduct semi structured interview online. The researcher was able to only contact respondents through professional networking site and email which was a major drawback in the research. Another limiting factor was the sample size. Invitations were sent to more than 20 out of which only 5 responded. This weakened the efforts of data collection by the researcher.

5.3 Linking with objectives

In these specific sections, the efforts will be made on the research and the key findings that are extracted from the conducted research. The section identified the interrelationship and whether the research conducted was successful in attaining the research objectives successfully. It is a significant step to determine the objectives are met to effectively evaluate the facets related to success.

5.3.1 Linking with objectives 1: Diverse methods that are used in tracing the supply chain process of the Irish agri-food produce

The conventional practices are integrated for assuring the quality assurance of the food produced by the Irish agriculture food producer. An effective performance management process that secures the effective tracking and measuring of the food at various stages. This way the food contamination and wastage chances have reduced to an extent. A scientific approach that is taken to take effective measures to enhance the form of agriculture procedures. The increased scope of sharing information among irrespirable bodies and performance management has increased the food sustainability as a significant result. The investment is saved that is incurred in the ineffective practices and a chance of sustainability is enhanced. A smarter approach is taken into consideration to develop the traceability system and enhance the food supply chain assimilated framework. The significant results were an increase that is accounted for in the agri-food exports to a rate of 85%

in recent years. The researcher has studied the facets that influence traceability systems. A strenuous attempt to determine the steps that are integrated and supported the findings with accurate evidence. The specific identification of the diverse methods to determine the ways the tracing system is bringing a positive change in agricultural food production practices.

The facets that are integrated are determined that specifically reflect the changes and the advancement and enhancement that is attained by the integration of the food traceability system. A modern approach is contemplated that has brought a revolutionary change in which agriculture was previously practiced.

5.3.2 Linking with objectives 2: To emphasize on explaining the adoption of innovative supply chain traceability systems considered by the producers, suppliers, distributors, and wholesalers in regards to the agri-food production of Ireland

The findings and the literature review specify that the adoption of innovative traceability systems like RFID, Blockchain and WSN are necessary for traceability by SCM network. The findings suggest that the Blockchain technology is gaining momentum and would be very useful for improving efficiency in the supply chain.

5.3.3 Linking with objectives 3: How to recognize and assess the impact of climatic changes along with the creation of a compact networking system about the food supply chain system of Irish agriculture?

The findings and the literature review both suggest that a technological change in agricultural food supply chain organisation would decrease the impact of climate change and assist in building an efficient system to monitor production and distribution damages that might be caused by climatic change.

Reference List

Aggarwal, S. and Srivastava, M.K., 2016. Towards a grounded view of collaboration in Indian agri-food supply chains. *British Food Journal*, *118*(5), pp.1085-1106.

Agriculture.gov.ie.2020.[online] Available at: <https://www.agriculture.gov.ie/media/migration/publications/2018/January2018Factsheet120118.pdf> [Accessed 15 April 2020].

Aithal, P.S., 2017. ABCD Analysis as Research Methodology in Company Case Studies. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *2*(2), pp.40-54.

Akhtar, P., Tse, Y.K., Khan, Z. and Rao-Nicholson, R., 2016. Data-driven and adaptive leadership contributing to sustainability: Global agri-food supply chains connected with emerging markets. *International Journal of Production Economics*, *181*, pp.392-401.

Attia, M. and Edge, J., 2017. Be (com) ing a reflexive researcher: a developmental approach to research methodology. *Open Review of Educational Research*, *4*(1), pp.33-45.

Auler, D., Teixeira, R. and NARDI, V., 2016. Food safety as a field in supply chain management studies: a systematic literature review. Embrapa Uva e Vinho-Artigo em periódico indexado (ALICE).

Bordbia.ie. 2020. *Irish Horticulture Industry - Bord Bia | Irish Food Board*. [online] Available at: <https://www.bordbia.ie/industry/irish-sector-profiles/irish-agriculture-food-drink-sector/> [Accessed 15 April 2020].

Bucci, G., Bentivoglio, D. and Finco, A., 2018. Precision agriculture as a driver for sustainable farming systems: state of art in litterature and research. Calitatea, 19(S1), pp.114-121.

Cagliano, R., Worley, C.G. and Caniato, F.F., 2016. The challenge of sustainable innovation in agri-food supply chains. *Organizing for Sustainable Effectiveness*, *5*, pp.1-30.

Caro, M.P., Ali, M.S., Vecchio, M. and Giaffreda, R., 2018, May. Blockchain-based traceability in Agri-Food supply chain management: A practical implementation. In *2018 IoT Vertical and Topical Summit on Agriculture-Tuscany (IOT Tuscany)* (pp. 1-4). IEEE.

Dandage, K., Badia-Melis, R. and Ruiz-García, L., 2017. Indian perspective in food traceability: A review. Food Control, 71, pp.217-227.

Dania, W.A.P., Xing, K. and Amer, Y., 2016. Collaboration and sustainable agri-food suply chain: a literature review. In *MATEC Web of Conferences* (Vol. 58, p. 02004). EDP Sciences.

Dania, W.A.P., Xing, K. and Amer, Y., 2018. Collaboration behavioural factors for sustainable agri-food supply chains: A systematic review. *Journal of cleaner production*, *186*, pp.851-864.

Eksoz, C., Mansouri, S.A., Bourlakis, M. and Önkal, D., 2019. Judgmental adjustments through supply integration for strategic partnerships in food chains. Omega, 87, pp.20-33.

Fletcher, A.J., 2017. Applying critical realism in qualitative research: methodology meets method. *International journal of social research methodology*, *20*(2), pp.181-194.

Galal, N.M. and El-Kilany, K.S., 2016. Sustainable agri-food supply chain with uncertain demand and lead time. *International Journal of Simulation Modelling*, *15*(3), pp.485-496.

Ganesh Kumar, C., Murugaiyan, P. and Madanmohan, G., 2017. Agri-food supply chain management: literature review. *Intelligent Information Management*, *9*, pp.68-96.

Garofalo, P., D'Andrea, L., Tomaiuolo, M., Venezia, A. and Castrignanò, A., 2017. Environmental sustainability of agri-food supply chains in Italy: The case of the whole-peeled tomato production under life cycle assessment methodology. *Journal of food engineering*, *200*, pp.1-12.

Ghezavati, V.R., Hooshyar, S. and Tavakkoli-Moghaddam, R., 2017. A Benders' decomposition algorithm for optimizing distribution of perishable products considering postharvest biological behavior in agri-food supply chain: a case study of tomato. *Central European Journal of Operations Research*, *25*(1), pp.29-54.

Goldberg, S.B., Tucker, R.P., Greene, P.A., Simpson, T.L., Kearney, D.J. and Davidson, R.J., 2017. Is mindfulness research methodology improving over time? A systematic review. *PloS one*, *12*(10).

Gray, C. and Malins, J., 2016. *Visualizing research: A guide to the research process in art and design*. Routledge.

Hadi, M.A. and Closs, S.J., 2016. Ensuring rigour and trustworthiness of qualitative research in clinical pharmacy. *International journal of clinical pharmacy*, *38*(3), pp.641-646.

Handayati, Y., Simatupang, T.M. and Perdana, T., 2015. Agri-food supply chain coordination: the state-of-the-art and recent developments. *Logistics Research*, *8*(1), p.5.

Kallas, Z., Alba, M.F., Casellas, K., Berges, M., Degreef, G. and Gil, J.M., 2019. The development of short food supply chain for locally produced honey. British Food Journal.

Kamilaris, A., Fonts, A. and Prenafeta-Boldύ, F.X., 2019. The rise of blockchain technology in agriculture and food supply chains. Trends in Food Science & Technology, 91, pp.640-652.\

King, T., Cole, M., Farber, J.M., Eisenbrand, G., Zabaras, D., Fox, E.M. and Hill, J.P., 2017. Food safety for food security: Relationship between global megatrends and developments in food safety. *Trends in Food Science & Technology*, *68*, pp.160-175.

Ling, E.K. and Wahab, S.N., 2020. Integrity of food supply chain: going beyond food safety and food quality. International Journal of Productivity and Quality Management, 29(2), pp.216-232.

Mackey, A. and Gass, S.M., 2015. *Second language research: Methodology and design*. Routledge.

Mangla, S.K., Luthra, S., Rich, N., Kumar, D., Rana, N.P. and Dwivedi, Y.K., 2018. Enablers to implement sustainable initiatives in agri-food supply chains. *International Journal of Production Economics*, *203*, pp.379-393.

Mohajan, H.K., 2018. Qualitative research methodology in social sciences and related subjects. *Journal of Economic Development, Environment and People*, *7*(1), pp.23-48.

Montet, D. and Ray, R.C. eds., 2017. Food traceability and authenticity: analytical techniques. CRC Press.

Mor, R.S., Singh, S., Bhardwaj, A. and Singh, L.P., 2015. Technological implications of supply chain practices in agri-food sector-a review. *International Journal of Supply and Operations Management*, *2*(2), p.720.

Nyamah, E.Y., Jiang, Y., Feng, Y. and Enchill, E., 2017. Agri-food supply chain performance: an empirical impact of risk. *Management Decision*.

Saberi, S., Kouhizadeh, M., Sarkis, J. and Shen, L., 2019. Blockchain technology and its relationships to sustainable supply chain management. International Journal of Production Research, 57(7), pp.2117-2135.

Saitone, T.L. and Sexton, R.J., 2017. Agri-food supply chain: evolution and performance with conflicting consumer and societal demands. *European Review of Agricultural Economics*, *44*(4), pp.634-657.

Sangeetha, G. and Vijayalakshmi, M., 2020. Role of Smart Sensors in Minimizing Food Deficit by Prediction of Shelf-Life in Agricultural Supply Chain. In Principles of Internet of Things (IoT) Ecosystem: Insight Paradigm (pp. 153-175). Springer, Cham.

Sellitto, M.A., Vial, L.A.M. and Viegas, C.V., 2018. Critical success factors in Short Food Supply Chains: Case studies with milk and dairy producers from Italy and Brazil. Journal of Cleaner Production, 170, pp.1361-1368.

Septiani, W., Marimin, M., Herdiyeni, Y. and Haditjaroko, L., 2016. Method and approach mapping for agri-food supply chain risk management: a literature review. *International Journal of Supply Chain Management*, *5*(2), pp.51-64.

Sessler, D.I. and Imrey, P.B., 2015. Clinical research methodology 2: observational clinical research. *Anesthesia & Analgesia*, *121*(4), pp.1043-1051.

Shelman, M., McLoughlin, D. and Pagell, M., 2016. Origin Green: When Your Brand is Your Supply Chain', Organizing Supply Chain Processes for Sustainable Innovation in the Agri-Food Industry (Organizing for Sustainable Effectiveness, Volume 5).

Taherdoost, H., 2016. Sampling methods in research methodology; how to choose a sampling technique for research. *How to Choose a Sampling Technique for Research (April 10, 2016)*.

Tasca, A.L., Nessi, S. and Rigamonti, L., 2017. Environmental sustainability of agri-food supply chains: An LCA comparison between two alternative forms of production and distribution of endive in northern Italy. *Journal of Cleaner Production*, *140*, pp.725-741.

Tian, F., 2016, June. An agri-food supply chain traceability system for China based on RFID & blockchain technology. In *2016 13th international conference on service systems and service management (ICSSSM)* (pp. 1-6). IEEE.

Tian, F., 2017, June. A supply chain traceability system for food safety based on HACCP, blockchain & Internet of things. In *2017 International conference on service systems and service management* (pp. 1-6). IEEE.

Tian, F., 2017, June. A supply chain traceability system for food safety based on HACCP, blockchain & Internet of things. In 2017 International conference on service systems and service management (pp. 1-6). IEEE.\

Ulmer, J.B., 2017. Posthumanism as research methodology: Inquiry in the Anthropocene. *International Journal of Qualitative Studies in Education*, *30*(9), pp.832-848.

Utomo, D.S., Onggo, B.S. and Eldridge, S., 2018. Applications of agent-based modelling and simulation in the agri-food supply chains. *European Journal of Operational Research*, *269*(3), pp.794-805.

Yu, K., Luo, B.N., Feng, X. and Liu, J., 2018. Supply chain information integration, flexibility, and operational performance. The International Journal of Logistics Management.

Zhong, R., Xu, X. and Wang, L., 2017. Food supply chain management: systems, implementations, and future research. Industrial Management & Data Systems.

Appendices

Appendix A: Participation Invite – Linkedin

Dear Participant,

I am a student at Griffith College Dublin conducting a study on food supply chain traceability of agricultural produce in Ireland and since you are from the food supply chain background, I would like to know your feedback regarding the same.

Looking forward to hearing from you.

Sincerely,

Bharadwaj Ramesh

Appendix B: Participant Interview Mail

Dear Participant,

As per our conversation, I am writing to request your participation with a study I am undertaking as part of my (MSc) in Procurement & Supply Chain Management at Griffith College Dublin.

I am conducting a research on the study of Food Supply Chain Traceability of Agricultural Produce in Ireland.

I would greatly appreciate and be interested to know your views you have experienced & understand the use of technology like traceability systems and other food supply chain systems.

I am especially interested regarding the use of such technologies and the impact they have on carrying out supply chain decisions.

Any further insights you have would be greatly welcomed.

There are few questions in this email which are requested to be answered & same will be used purely for my research purpose.

The answers shared by you or any specific information revealed during this process will be treated in strict confidence. Also, use of the information obtained in the interview will be such that your company or any of the persons interviewed will not be individually identifiable.

If you have any questions about the interview, or about being in this study, you may contact me at bharadwaj.ramesh@student.griffith.ie or by mobile (0899 638246).

My project has been approved by Griffith College Graduate School and they would be able to assist you in case of any privacy concerns.

Looking forward to hearing from you.

Questions – There are 15 questions in total. Please answer them at the best of your knowledge.

1. According to you, what factors of the supply chain are required to be incorporated within the traceability of food agriculture in Ireland?

2. What is your opinion in terms of incorporating supply chain management within the functions of Ireland's agricultural organizations?

3. According to you, what practices and measures need to be followed in order to maintain the supply chain management within Ireland?

4. In your opinion what policies are required to be created in order to increase the efficiency of supply chain traceability in Ireland?

5. Is the evaluation of the risk management important to you to incorporate within the overall process of the supply chain management of the country?

6. According to your views is the climate change hindering the supply chain process of agriculture within Ireland?

7. In your views, what strategies are required to be implemented for the traceability frameworks for supply chain management?

8. In which part of the supply chain department is your job role involved in the organisation and what is your working tenure?

9. What is our view on applying mobile technologies and devices in developing the management of supply chain systems?

10. Do you think the development of mobile technologies would be effective in maintaining traceability in the food supply chain management process?

11. Does your company hold enough productiveness in maintaining the safety of the food during the packaging process?

12. What is your view on using blockchain technology in improving the processing of the food supply chain in Ireland?

13. Why safety regulations do you think are important to be present in the food supply chain for increased traceability?

14. What is your view on the need for effective communication to develop the traceability of the food supply chain system in Ireland?

15. What is your view on using IT infrastructure to maintain traceability in the food supply chain of Ireland?

Feel free to reach out to me if needed.

Thank you,

Bharadwaj Ramesh