

MSc Thesis Research

Food loss and waste management in the tuna processing industry in Thailand

A case of Sea Value Public Limited Company



Student name: Marisa Thamavit
Student number: 940308827120
Educational institution: Wageningen University
Chair group: Management studies chair group
MSc Program: Food Technology
Thesis code: MST-80436
First academic supervisor: dr. WJJ (Jos) Bijman
Second academic supervisor: Prof. dr. JH (Jacques) Trienekens
Date: 05 July 2019

Table of Contents

Executive summary	1
1. Introduction	2
1.1 SEA VALUE PUBLIC LIMITED COMPANY.....	2
1.2 PROBLEM STATEMENT	3
1.3 SCIENTIFIC OBJECTIVE AND RESEARCH QUESTIONS	4
2. Literature review	5
2.1 INTRODUCTION	5
2.2 TUNA VALUE CHAIN	5
2.3 TUNA VALUE PROCESSING STEPS.....	7
2.4 FOOD LOSS AND WASTE	9
2.4.1 Food loss and waste characteristics	9
2.4.2. Environmental, economic and social implications of FLW	9
2.5 MOTIVATIONS AND CONSTRAINTS OF FLW MANAGEMENT	11
2.5.1 Motivations to the adoption of FLW management	11
2.5.2 Constraints to the adoption of FLW management	11
2.6 CIRCULAR ECONOMY	12
2.7 CONCEPTUAL FRAMEWORK.....	14
3. Methods.....	15
3.1 RESEARCH STRATEGY.....	15
3.2 THE STUDY AREA AND SAMPLE	15
3.3 DATA COLLECTIONS.....	16
3.4 DATA ANALYSIS.....	17
3.5 THE CHALLENGES/LIMITATIONS OF THE STUDY	17
4. Results.....	18
4.1 INTRODUCTION.....	18
4.2 CAUSES OF FLW	18
4.3 FLW IMPACTS	21
4.4 MOTIVES AND CONSTRAINTS FOR SUSTAINABLE MANAGEMENT	23
4.5 THE OPPORTUNITIES TO IMPLEMENT FLW MANAGEMENT	24
5. Conclusions & Discussion	26
5.1 ANSWERS TO THE RESEARCH QUESTIONS	26
5.2 SPECIFIC RECOMMENDATIONS FOR SEA VALUE PLC	29
5.3 PROPOSALS FOR FUTURE RESEARCH	30
References	31

Appendices	34
------------------	----

Table of Figures

Figure 1. Sea value group structure.....	2
Figure 2. Yellowfin tuna value chain actors.....	5
Figure 3. Canned tuna production and wastes generated in some steps of the process.....	7
Figure 4. Circular economy model for tuna industry.....	13
Figure 5. Conceptual framework.....	14
Figure 6. A research framework.....	15
Figure 7. Canned tuna production and wastes generated in some steps of the process.....	19

Table of Tables

Table 1. Overview of Demographics of interviewees.....	16
Table 2. Causes of food loss and waste in the tuna industry.....	21
Table 3. Impacts of food loss and waste in the tuna industry.....	22
Table 4. The motivations for sustainable management.....	23
Table 5. Constraints for sustainable management.....	24
Table 6. The opportunities framework to engage in FLW management.....	25

Executive summary

Thailand is the world's leading importer of frozen tuna and exporter of canned tuna with a world market share of 41 percent which is four times higher than other exporters (Globefish, 2010; Kuldilok et al., 2013). According to the FAO, fish and seafood are the second most food losses and wastes globally (FAO, 2012). During the entire processing process of canned tuna, food losses and wastes occur. Food loss and waste problem is one of the sustainability challenges that need to be addressed as it has negative implications for environment, economic and social. Although there are numerous studies (Arvanitoyannis & Kassaveti, 2007; Salihoglu et al., 2017; Yano & Sakai, 2016) on food loss and waste management, the FLW handlings are still not being addressed in a practical way for the tuna industry. Food loss and waste minimization bring economic benefits to a company by lowering the costs for business that results in an increasing of the competitiveness. However, few studies have been carried out on the factors for managing food loss and waste, and managerial implications of food loss and waste in the tuna processing industry. By focusing on a tuna cannery industry in Thailand, the research will be a case study of the Sea Value public limited company which is tuna canning company in Thailand. By conducting in-depth interviews, this research focuses on data collection at different levels of management within the company, but also from tuna industry experts, governments and NGOs. The research aims to explore factors that affect the management of food loss and waste in the tuna processing industry and provide managerial recommendations to the company. By conclusion, the support from top management team, reputation, and pressure from stakeholders and governments contribute to the improvement of FLW management. However, there is evidence throughout the study that internal resources and financial constraints are the barriers for a company to implement FLW management in the tuna industry.

1. Introduction

1.1 SEA VALUE PUBLIC LIMITED COMPANY

In 2010, the global catch of tuna market species (albacore, bigeye, bluefin, skipjack and yellowfin) was 4.3 million tonnes, which contribute to about 8 percent of global fish exports (FAO, 2013). Tuna is marketed in the form of fresh, chilled, frozen, and canned. Nevertheless, it has been found that a tuna canning industry generates a significant number of by-products, or so called 'waste'. Thailand is one of the largest producers and exporters of canned tuna in the world (FAO, 2013). Reporting by FAO (2013), there are 26 tuna canning factories with a total capacity of 770,000 tonnes in Thailand. Skipjack was the major species imported with 79.67 percent, follow by yellowfin at 13.63 percent, albacore at 5.99 percent, and others amounting for the rest.

Sea Value Plc, one of the large tuna canneries in Thailand, began operating in 2004 to produce canned tuna and seafood business (www.seavaluegroup.com). In 2001, the large-scale tuna cannery of the 'Chicken of the Sea' on the US mainland closed, giving the opportunity for Thailand to become the largest tuna producer and exporter in the world (FAO, 2013). Sea Value Plc has been partnering with Thai seafood processors (Wales Group and PTN Group), the raw material traders (Itochu Group and F.C.F. Group) (see Figure 1). Sea Value Plc subsidiaries comprise of Sea Value Netherlands Cooperatief U.A., manufacturer and logistic. The manufacturer consists of Unicord Plc, I.S.A Value Co., Ltd, Siam International foods and T.C. Union Agrotech Co., Ltd. In the study, the research is taking place at Unicord Plc which located in Samutsakorn province, Thailand. The total operating capacity of this factory is 1,000 tonnes/day. The product varieties range from industrial standard to highly customized specifications co-developed and tailored made to customer requirements to meet consumers' demand worldwide.

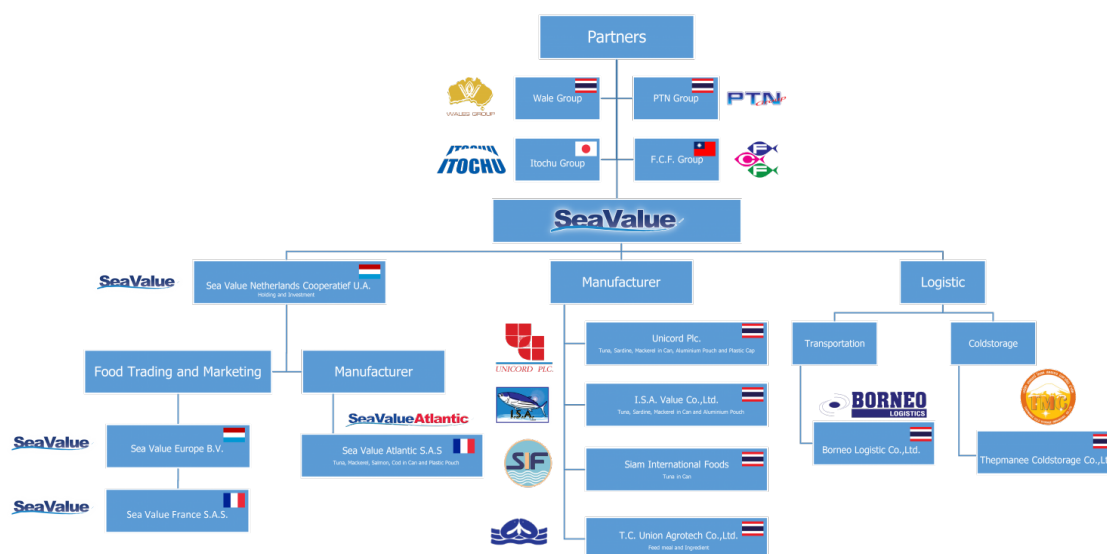


Figure 1. Sea Value Public Limited Company group structure

Tuna, sardine, mackerel and other fishes as value-added and ready-to-eat products in the form of can, Aluminum pouch, and plastic cap are their products for selling in domestic and export market. The research will focus on food loss and waste management in the tuna canning process.

1.2 PROBLEM STATEMENT

An increased demand for recycling has prompted the food industry to become more efficient in its handling of waste (Riley, 2016). Food loss and waste (FLW) is among the priority streams for waste prevention worldwide in both developed and developing countries. In recent years, FLW is receiving increased attention on both academic and societal levels such as food producers, processors, consumers, etc. It is considered to be one of the sustainability issues that needs to be addressed since it has been causing negative environmental, economic and social impacts. From an environmental point of view, Food and Agriculture Organization (FAO) estimates that one-third of all food produced today goes to landfills and causes greenhouse gas emissions (FAO, 2012). Economic impacts are related to the costs of dealing with wastes (EPA, 2012). And social impact may be ascribed to ethical and moral issues within the concept of food security - the ability of the world to provide food for the entire population, safely and nutritiously. All in all, these three impacts underline the significance of the waste problem. In order to minimize FLW, it is necessary to have a comprehensive understanding of the causes, consequences and an effective management of FLW. Thus, industry, consumers, governments and other related organizations could work collaboratively to achieve FLW prevention at all levels.

During the entire tuna canning process, production losses and wastes occur. These losses consist of food ingredients or products which cannot be sold or used as food products. In the research, food loss and waste together with other side streams (e.g. water) will be defined as 'food loss and waste (FLW)'. However, few studies have been carried out on the FLW reduction and/or management in the tuna processing industry. Therefore, this study aims to explore the possible factors affecting FLW management in the tuna industry and provide the managerial recommendations for Sea Value Plc. By the aim of the research, food loss and waste management will be discovered in every management level in a company and circular economy will be represented to the company as a long-term planning for FLW management in the tuna canning industry.

1.3 SCIENTIFIC OBJECTIVE AND RESEARCH QUESTIONS

- *Objective:*
To explore the possible factors of managing food loss and waste for the tuna processing industry in Thailand in order to mitigate food loss and waste problems
- *Central research questions:*
Which factors affect food loss and waste management in the tuna processing industry?
- *Sub research questions:*
 - 1) What are causes of FLW during tuna processing?
 - 2) What are the impacts from FLW during tuna processing in terms of environment, economic, and social?
 - 3) What are the motivations and constraints for sustainable management of FLW during tuna processing?
 - 4) What are the opportunities for sustainable management of FLW during tuna processing?

2. Literature review

2.1 INTRODUCTION

In order to achieve the objective of the study and to identify the knowledge gap, the articles have been reviewed and was structured in the following topics: (2.2) Tuna value chain, (2.3) Tuna value processing steps, (2.4) Food loss and waste, (2.5) Motivations and constraints of FLW management, (2.6) Circular economy, and the last one is (2.7) Conceptual framework which will describe the main concepts and the relationship among the concepts used in the research.

2.2 TUNA VALUE CHAIN

Value chain can be defined as interlinked value adding activities that convert inputs into outputs which in turn help to create the competitive advantages (Porter, 1985). The tuna value chain which can be seen from Figure 2 represents the relationships among the different actors (Bailey et al., 2016). Fishermen are responsible to preliminary clean and trim tuna at sea which is the first stage of the chain. When the fishing day is over, the fishers return to the landing site. Fish quality as expected by the processing industry is based on a selection of the quality of fish at the receiving point during this stage (Schuurhurizen et al., 2006). Next, the middle men hold an important position in the value chain through facilitating production, processing, controlling flows of commodities, and moving raw product from fishers to processors (Bailey et al., 2016). They can be trader, exporter, importer, etc. At middlemen's facility, the fish is lightly processed by rinsing, bagging, and in other cases cleaning bones, skin, and brown meat. In this stage, fish is also graded which is selectively distinguishing between good and poor quality, based on color, firmness, and texture of the meat. Common features of the developing country suppliers such as insufficient quality control in the upstream part of the channel, insufficient use of ice and long-waiting times of the trucks, can lead to the inefficiency of fish quality through the whole chain (Schuurhurizen et al., 2006). Those fish might not meet the quality requirement and eventually causing wastes during processing.

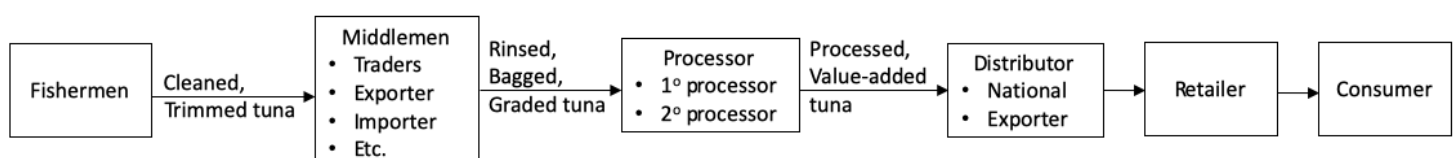


Figure 2. Yellowfin tuna value chain actors (Bailey et al., 2016)

Almost 95% of the raw material used in canning factories in Thailand has been imported in the form of frozen whole tuna (Laowapong, 2010) before passing to the processing step. The processor can be varied depending on the company. The duties of primary processor are cleaning, freezing, packaging, and export, while the secondary processor unfreezes the incoming products and then process by means of smoking, salting or other value-added process and preservation techniques (Fox et al., 2018). Following processing, the fish products are distributed to customers for national consumption or exported to foreign markets or the further-stepped processors. The export markets commonly include brokers, traders, wholesalers, distributors and other middlemen. Of the total processed tuna from Sea Value Plc, about 99% is exported and the remaining is sold and consumed in the domestic market (www.seavaluegroup.com). Then the next actors in the value chain are the retailers, for instance, supermarkets who store and domestically sell products to the consumers. Finally, consumers mark the end of the value chain. The consumer segment consists of the end consumers who purchase fishery products from those in the retailer segment (Dubay et al., 2010).

Since the problems of food loss and waste have a consequence to not only the actors in the chain, but also the external actors like non-governmental organizations (NGOs) or the governments. Hence, problems could have been well-managed and solved with the collaborations both from the key actors within the chain, as well as the externalities such as NGOs, governments, tuna industry experts, etc. From a study of van Marrewijk & Hardjono (2003), NGOs and government can build up impacts and politics by acting more responsibly and operating in a more sustainable way which would influence the business owner to be more energetic and engaged in sustainability management. In general, environmental NGOs are working with actors across the value chain to reduce the ecological consequence of processing practices while the government is responsible for creating and maintaining legislation to control people in more sustainable way (Dubay et al., 2010).

Sea Value Plc is a founder and a member of the International Seafood Sustainability Foundation (ISSF) (www.seavaluegroup.com). As part of the involvement in ISSF, Sea Value Plc has made a commitment to the better business practices by adopting sustainable procurement and processing policy in the company. Regardless a proper FLW management and there has been a significant amount of FLW generated during manufacturing, Sea Value Plc put FLW as one of their sustainability issues since they got pressure from the stakeholders for sustainability impact from food loss and waste that could have been managed in some direction. The research will explore the factors that affect food loss and waste management in the tuna industry through the different perspectives from the different management levels in the Sea Value Plc, as well as NGOs, government, and tuna expert industry.

2.3 TUNA VALUE PROCESSING STEPS

Prior to have FLW management, the overview of the canned tuna production will be initially examined and understood. According to FAO (2013), the tuna canning production and wastes generated was preliminary studied, as can be seen from Figure 3. The tuna processing consists of thawing, gutting, pre-cooking, cooling, trimming, packing, retorting, labelling and packaging.

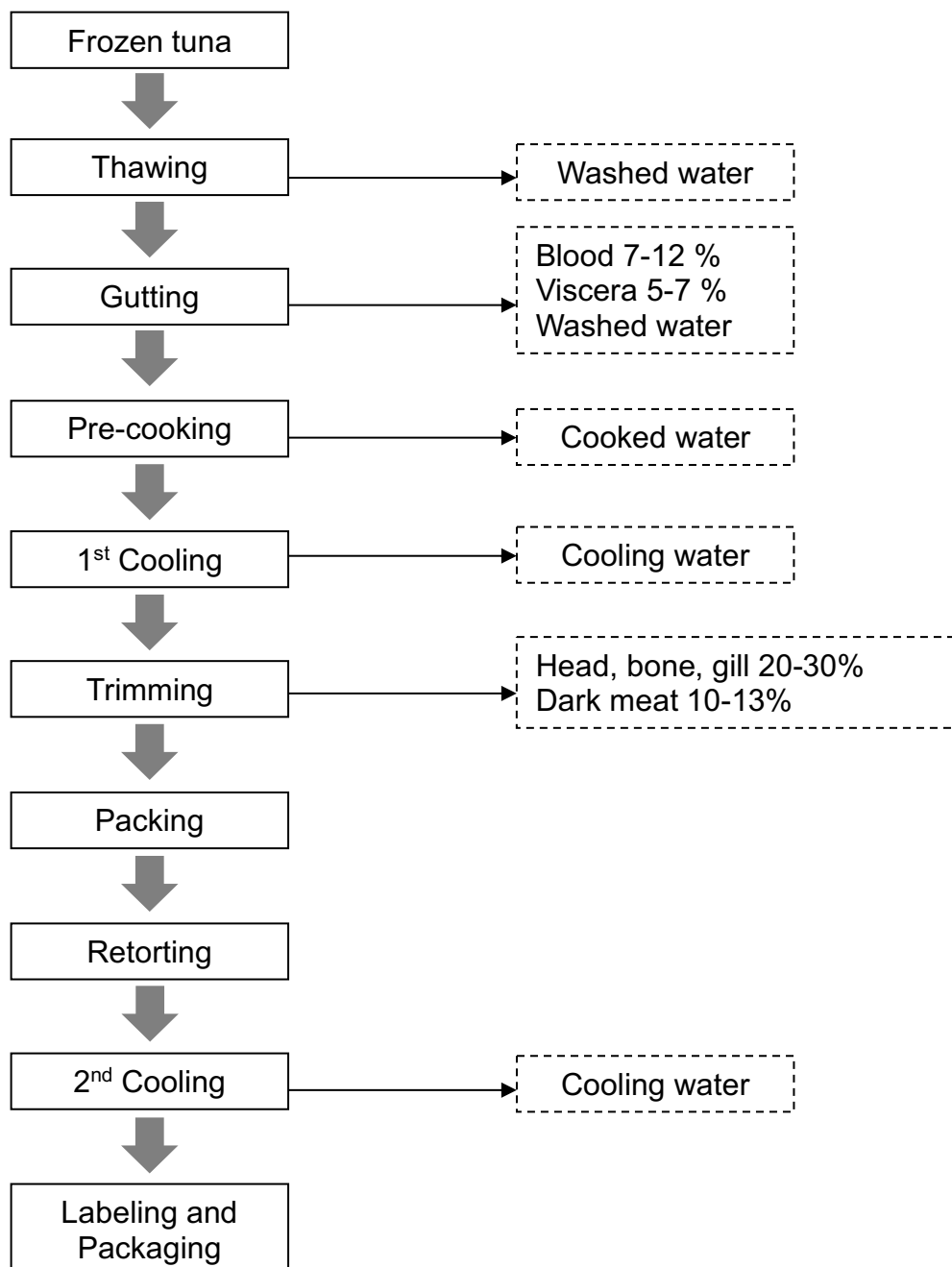


Figure 3. Tuna processing chain and the wastes generated in some steps of the process

- 1) Raw material receiving
Upon receiving the frozen fish, the quality of raw materials is examined by checking the physical properties of gills, eyes, skin, and texture of the fish as well as the histamine contents.
- 2) Thawing
After the inspection, frozen tuna is thawed at room temperature by using water. It usually takes about 2-3 hours to raise the temperature up to 5°C, meanwhile the temperature of tuna should be kept as low as possible as high temperature will cause the fish to deteriorate as a result of the activity of microbes and enzymes.
- 3) Gutting
Next, thawed tuna is gutted in order to remove blood and viscera and then washed with water to reduce microbial growth and deterioration.
- 4) Pre-cooking
At pre-cooking or steaming process, gutted tuna is steamed at a temperature of about 95°C and sometimes pressured of about 1-2 bar, 60-90 minutes depending on size and species of tuna. The tuna skins and fish bones can be removed easier from tuna meat.
- 5) First cooling
After that, steamed tuna is taken to the first cooling in order to reduce the temperature to prevent overcooking.
- 6) Trimming
The purpose of this process is to remove fish skin. A study of FAO (2012) indicates that white meat which is used for human consumption in can and pouch yields at 32-40 percent of a tuna, while dark meat yield of about 10-13 percent which will be used for animal or pet food.
- 7) Packing
Tuna is packed in various sizes using machine and/or by hands, followed by the addition of solutions e.g. tomato sauce, vegetable oil, brine or other seasoning sauce for preserving fish quality and to meet customer's needs.
- 8) Retorting
After packing, a can will be retorted by heating up for the sterilization reason. The temperature will be controlled during retorting because if the temperature is too high, fish will lose its physical characteristics, smell, taste, nutritional value, etc.
- 9) Second cooling
After sterilization, the temperature is reduced as soon as possible to prevent heat accumulation making fish changing the color, taste and decreasing nutritional value. Additionally, it also prevents the growth of thermophilic microbes that maybe left after the heating process.
- 10) Labeling and packaging
Then the dried canned tuna is labeled and packed in cardboard boxes for storage and transportation.

In the research, the participant observation for FLW causes will be done according to the previous processing steps (Figure 3). Researcher will take the processing presented by FAO (2013) as a baseline for the tuna cannery process. After observation and the interviews, the overview of tuna cannery production of Sea Value Plc will be presented and discussed in the result chapter and discussion chapter, respectively.

2.4 FOOD LOSS AND WASTE

To answer the research question, the definition of food loss and waste as well as food loss and waste impact will be clarified in order to have the same understanding of the meaning and scope of the study along the research. Therefore, the topic of food loss and waste (2.4) will be divided into 2 subtopics: (2.4.1) Food loss and waste characteristics, and (2.4.2) Environmental, economic and social implications of FLW.

2.4.1 Food loss and waste characteristics

Despite a growing global recognition of the food loss and waste problem, there is no consensus within the literature on how food loss and food waste should be characterized (Garrone et al., 2014). From several studies, food loss and food waste are different in the content. Food losses take place at production, postharvest and processing steps, while food waste occurs during distribution, sale, and final consumption (FAO, 2011). However, there are a number of studies define food waste differently. By including losses that arise before food reaches the end-user (pre-consumer food losses), together with food that is discarded by consumers (post-consumer food waste), Nahman & de Lange (2013) defined food waste as waste that arise during production, storage, transportation, processing, retailers and in the kitchens of restaurants and households. Until this point, there are no exact and agreed definition of the word 'Food loss' and 'Food waste'. Therefore, this research defines waste during the processing process as 'Food loss and waste (FLW)'. Based on the previous study (Porat et al., 2018) the term 'FLW' refers to any decrease in edible food mass that available for human consumption through the various segments of the food supply chain. For the tuna industry, food loss refers to white tuna meat that can be consumed by human but lost during processing step and food waste refers to dark tuna meat, gills, head, bone, and viscera, which are processed into low market value products, such as fish meal and fertilizer, not for human consumption.

2.4.2. Environmental, economic and social implications of FLW

The main environmental impact of food waste is related to the final disposal in the landfills (Papargyropoulou et al., 2014). Disposed food waste in landfills produce greenhouse gases (GHGs); methane and carbon dioxide which will contribute to climate change. Food waste is the cause of approximately 22% of the global warming in the Europe. Therefore, food sector is possibly one of the significant areas to reduce GHG emissions.

One of the studies of fish waste management reported that fish waste problem has great impact on the environment (Arvanitoyannis & Kassaveti, 2007). Processing of large bulk of fish or other aquatic organisms produces a great number of by-products and wastes. A report shows that fish effluents have high value of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids, fat oil grease, pathogenic and other microflora and organic matters (Islam et al., 2004). BOD and COD are indicators of water quality, high values of BOD and COD mean high accumulation of soluble in water which is not a good quality of water and not in a good condition to the environment (Boziaris, 2014). While manufacturing, wastes generated will be discharged into the nearby coastal water that are potentially hazardous to the receiving environment. However, the impacts of seafood processing wastes may range differently depending on the amount of waste output.

For economic perspective, food loss and waste are also being one of the crucial topics to the global economic. As can be seen from a study of Papargyropoulou et al. (2014), almost USD 750 billion was estimated by FAO as global food wastage in 2007. This substantial amount of money can have a consequence on the livelihood of ones who live on the margins of food insecurity. Having heard of this incident, there is the encouragement of food producers to reduce food waste so as to minimize purchasing cost and waste disposal costs (EPA, 2012).

Some of the manufacturers come up with the idea of a cleaner production. The utilization of aquatic by-products is a cleaner production opportunity for the manufacturers since an additional revenue can be potentially generated and disposal costs for the wastage can be reduced (Arvanitoyannis & Kassaveti, 2007). This result is in line with the study of Ghisellini et al. (2016) that the prevention of loss of valuable materials during processing allows a reduction of the costs for the companies. Some large companies gain benefits through waste reduction, productivity increasing and product development (Boziaris, 2014).

In addition to the environmental and economic aspects, food waste also has social implication. The ethical and moral issues of wasting food tend to be focused, particularly in the inequality between wasteful practices and food poverty (Papargyropoulou et al., 2014). The social benefit after amending wasted food management is to create skilled employment. However, there is not much literature on the social impact regarding fishery or tuna industry.

All in all, FLW is one of the global challenges which affect environment, economic and social. Any relevant practices to alleviate a problem would be helpful. This research will examine environment, economic, and social implications from the point of view of Sea Value Plc employees, tuna experts, NGOs, and the governments in order to see the importance of the reduction of FLW and FLW management.

2.5 MOTIVATIONS AND CONSTRAINTS OF FLW MANAGEMENT

Before discovering the factors that will affect food loss and waste management, the study of the motivations and constraints of FLW management is carried out. In this topic, 2 subtopics are divided into (2.4.1) Motivations and (2.4.2) Barriers to the adoption of FLW management as below.

2.5.1 Motivations to the adoption of FLW management

The concept of motivation can be referred into two factors: internal and external factors (Locke & Latham, 2004). Motivation can refer to internal factors that impel the action, while refer to external factors that can act as inducements to the action. In this research, the motivations for adopting FLW management will be discovered and discussed. From various studies (EPA, 2012; Ghisellini et al., 2016; Arvanitoyannis & Kassaveti, 2007) cost reduction for handling waste, cost reduction of products (due to the utilization of by-products as raw materials), and the additional revenue are the motivating examples for company to implement FLW management. Financial savings were referred to as primary driver for adopting the food waste mitigation practices alongside reputation gains (Filimonau & Gherbin, 2017). This is in line with findings from the other contexts, such as hospitality, where the economic and corporate image factors were found to drive managerial engagement in sustainability initiatives (Graci & Dodds, 2008). However, even though providing economic incentives to increase recycling rates by abandoned the housing fee price, a study of Hage et al. (2009) shows that waste pricing schemes can be quite ineffective but a moral norm and attitude rather play an important role.

In addition to economic motives, company may also care for sustainability for ethical and social reasons. Problem awareness and description of responsibility are necessary to influence behavior (Hage et al., 2009). A moral behavior could be adopted by each of us on a personal level. Therefore, environmental and social drivers for reducing waste are initially build from self-enforcement. The individual must also feel a personal responsibility to reduce waste, they should not believe that it is some other actors' responsibility to solve waste problems.

2.5.2 Constraints to the adoption of FLW management

By exploring managerial attitudes and their first-hand approaches to food waste mitigation, Gustavsson et al. (2011) noted that managerial attitudes often represent a significant barrier towards the adoption of more effective food waste management practices in many food manufacturing. If the managers have no awareness of FLW problem, the employees are not likely to be aware of such problem. Larsen (2015) shows that employees are considered as an under-utilized resource in a company's development and implementation of sustainability. In addition to this, the barriers for implementing FLW management by a company or an industry are a combination of financial, technical and management issues (Boziaris, 2014). Financial

considerations include the high initial capital of new technology, which should be compensated by lower operating costs. Although sustainable technologies are well developed, there is still uncertainty attached to them in some areas, which could be better by the introduction of validation and certification schemes and the development of a service and maintenance sector in the support of the technology. The barriers are not only the new technology cost and maintenance cost but also cost for the additional know-how from expertise, training, human resource. In addition to this, a study of Filimonau & Gherbin (2017) shows that irresponsible suppliers and their disinterest in pro-actively engaging in environmental initiatives were acknowledged as inhibitors of food waste mitigation.

2.6 CIRCULAR ECONOMY

The prevention and recycling of food loss and waste contribute to a circular economy due to the improvements in resource efficiency and energy recovery (Fujii & Kondo, 2018). The concept of Circular Economy (CE) appears to be new. However, in this research it will be used for the long-term planning for a company in order to create no waste. In the study of Linder & Williander (2017), CE proves helpful for the company for profitable achievement. The reason to study the CE is to gain more insights about CE concepts to help setting zero waste strategy for long term management. The specific suggestion and/or recommendation for Sea Value Plc could be drawn from the concept of CE. In addition to this, the cleaner production (CP) is chosen to study since it is the primary strategy of CE and can enhance environmental performance during processing for a company.

In order to achieve long-term sustainability, businesses will have to manage not only economic capital, but also their natural capital and their social capital (Dyllick & Hockerts, 2002). There are three different definitions for corporate sustainability, regarding in economic, environment and social. Economically sustainable companies guarantee at any time cash flow sufficient to ensure liquidity while producing a persistent above average return to their shareholders. Environmentally sustainable companies use natural resources that are consumed at lower rate than the natural reproduction. They do not cause emissions that accumulate in the environment and do not engage in activity that degrades eco-system services. Socially sustainable companies add value to the communities. They manage social capital in such a way that stakeholders can understand its motivations and can broadly agree with the company's value system.

The Circular Economy imitates natural life cycle where dead organic material decomposes become a nutrient for the next generation of living organisms that does not create waste. This is in line with Walter Stahel who proposed that CE is a model that materials are being processed in a closed loop in which keeping resources in use as long as possible, extract the maximum value from it and eventually waste becomes a resource (Andrews, 2015). CE aims to increase the efficiency of resource use and achieve a better balance and harmony of

environment, economic and society (Ghisellini et al., 2016). In the use of resources, CE emphasizes the efficient utilization of resources and waste recycling of resources to achieve a reduction in natural resource consumption. It is preferable use to the linear approach that the outcome is being a cleaner environment. Waste management is recognized as a recovery of resources and environmental prevention (Ghisellini et al., 2016). In company level for example, it becomes an important sub-sector of CE that companies are capable to extract resources out of waste by applying innovative recovery technologies.

The circular economy concept was applied considering tuna cannery industry. The model is adapted from Andrews (2015) see Figure 4. Fishermen are the primary sector involved in tuna canning industry. Sustainable practices for fishers are based on the wise use of raw materials which is during tuna fishing.

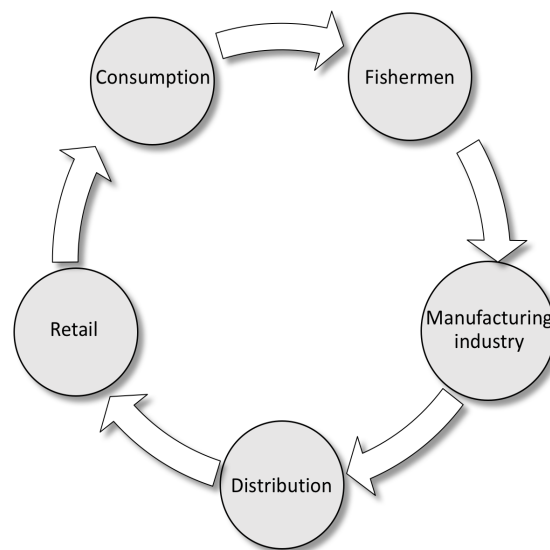


Figure 4. Circular economy model for tuna industry (Adapted from Andrews, 2015)

During canning process, the valorization of the tuna residues can be amended by the manufacturing site. These residues were used to produce, for instance, fish oil, fishmeal, etc. (Marnis et al., 2016). The use of side stream will also taken into account. For machinery, the consideration on maximizing the length of material life cycle and improving renewable use can contribute to circular economy concept for the firm. Next, sustainable enhancement for distribution can be, for instance, the coordination between sectors, fossil fuel-free or renewable fuel transportation, etc. Retailers can take charge for implementing sustainability by telling consumers about the environmental impacts, raising the sustainability policy, and promoting eco-label for the consumer goods, etc. So far consumers demand on creating or having sustainable commodities and use of green goods can stimulate the retailers to be more concerned as such, and consequently affect the manufacturing company to be more focused on sustainable practices during tuna canning processing.

In the research, the attempts have been made to cope with the problem of FLW using 'Circular Economy' model for the least amount of wasted food generation. According to the recent studies, applying CE within the process of remanufacturing and/or reusing is the potential way for industries or companies to profitably achieve an increase resource productivity and significant cost savings associated with reductions in the environmental impact (Linder & Willander, 2017). A holistic approach of FLW considering circular economic model might provide win-win solutions that is being able to minimize wastage, promote income growth, job creation, and prompt sustainable management.

Cleaner production (CP) is the main strategy to be considered as preparatory towards CE (Ghisellini et al., 2016). A design for environment and CP is in relation among each other. Marnis et al. (2016) study the utilization of fish processing waste, they find out that CP can be used as an environmental management model by promoting high efficiency in an industry, so that the generation of fish effluents and waste can be prevented and reduced. They also state that prevention method must be done in the early process of production by reducing the formation of waste. The success of these effort result in substantial savings for significant minimization in production costs so that this approach can be a source of income and enhance an environmental performance for the industry to be better.

2.7 CONCEPTUAL FRAMEWORK

In this research, the conceptual framework, shown in Figure 5, illustrates the interconnection of each main concepts that was discussed in the theoretical framework. The framework begins with understanding the causes of FLW before moving to current impact of FLW in the tuna processing industry. Then after defining FLW causes, current impact, motivations, constrains and opportunities for adoption of FLW management, there will be the improvement of FLW management. And lastly, FLW management itself is followed by potential impacts, which constitute of environmental, economic, and social implications.

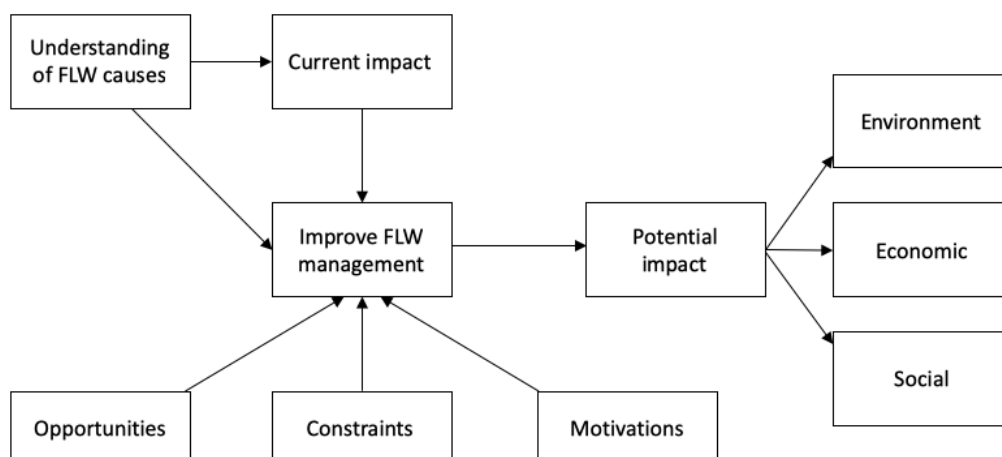


Figure 5. Conceptual framework

3. Methods

A method or a research design is a detailed plan for how the research is to be completed. The elements of research design consist of research strategy, study area, sample, methods of data collection, and data analysis. Starts with the strategy of this research (3.1), it is a case study which is a qualitative research of a company. Then, the study area and sample are discussed (3.2). Followed by methods of data collection which are observation and interviews (3.3). Next, the method of data analysis is identified (3.4). And lastly, the challenges encountered during the research period are also highlighted at the end of this chapter (3.5).

3.1 RESEARCH STRATEGY

By the aim of the research, the study will be completed by doing a case study of a company (namely Sea Value Public company Limited) and literature research. The qualitative research strategy is selected for both primary data collection. An inductive approach (theory developing) is chose, which will start with the observations, then theory will be formulated towards the end of the research. A schematic representation that describes the sequence of the activities taken in the research is shown in Figure 6.

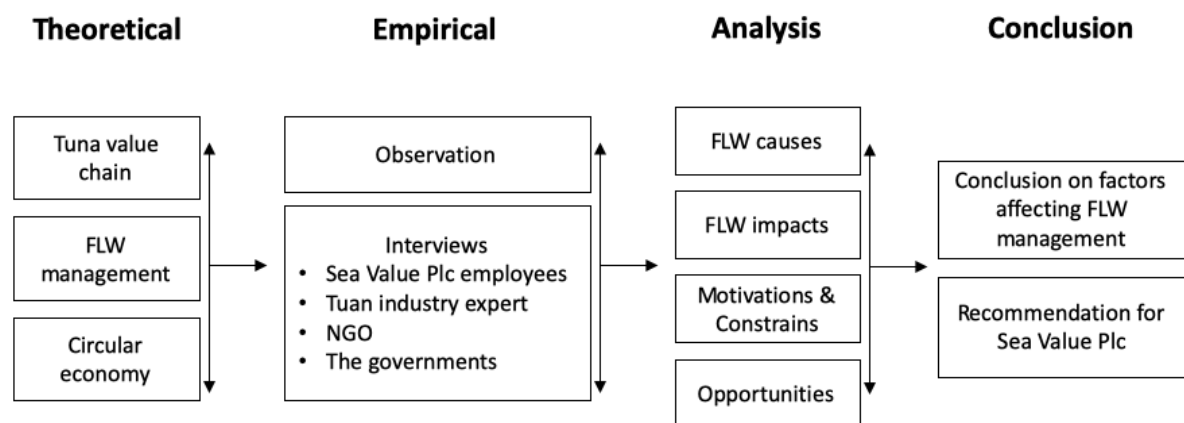


Figure 6. A research framework

3.2 THE STUDY AREA AND SAMPLE

The study area for this research is taking place at Sea Value Plc manufacturer, located in Samutsakorn province, Thailand. Prior to the time of the interview the researcher planned to conduct a total of 12 in-depth interviews, therefore 12 samples/interviewees planned. However, during the period of time the target aim was lowered to a total of 7 interviewees due to the inaccessibility together with time constraints. When asking permission for audiotaping the interviews, all the interviewee responded positively. Some interviewees preferred to stay anonymous in the thesis report. Recording was done by the researcher's mobile voice tracer as well as laptop in order to guarantee a backup in case either one would not function properly. An overview of some of the interviewees' demographics is shown in Table 1.

Table 1. Overview of Demographics of interviewees

Interview	Name	Gender	Position	Organization name
1	Anonymous	Female	Anonymous	Sea Value Plc.
2	Songpol Panikorn	Male	Processing line supervisor	Sea Value Plc.
3	Navapol Chaopaknam	Male	Warehousing assistant manager	Sea Value Plc.
4	Chidpong Pradistsuwana	Male	Assistant professor	Chulalongkorn university
5	Benjamas Chotthong	Female	Director	Thailand Environment Institute Foundation (TEI)
6	Tanirat Tanawat	Female	Project manager/ Researcher	Thailand Environment Institute Foundation (TEI)
7	Supatra Rewpairoj	Female	Executive director	Thai Tuna Industry Association

3.3 DATA COLLECTIONS

Data collections of this study are mainly from primary sources which are observation and interview. Participant observation is being done. A researcher presented as an observer during the activities of the group with their knowing that they are being observed. However, Hawthorne effect will be taken into account because when observants become aware that they are being observed, they might change their behavior. The observation was conducted in order to answer the first sub research question (food loss and waste causes). Therefore, the activities along the processing lines are observed (see Appendix 1). The observation and interviews were conducted within the period of November 5th and December 10th 2018.

For the interviews, it is a commonly used method of collecting information from people. The semi structured interviews were conducted in the research. The general structure of the interview will be planned beforehand to make sure that key questions are being covered as well as offered the flexibility by allowing the introduction of new questions. The insight information about the company in which such information can only be obtained from the internal source (for example; company's production line, current practice in relation of food waste, competitive advantage, etc.) require the judgmental sampling which is managers and people working in a company. The reason behind this is that people working in a company is the one who know the required information of a company. Moreover, tuna fishery experts, representatives from NGOs and the governments were the judgmental sampling whom are the ones that fall in the related field of this study. An overview of the interview questions can be found in the Appendix 2.

3.4 DATA ANALYSIS

After conducting the interviews all recorded audio material from the interviews was transcribed (see Appendix 3) word by word to make sure that no important data was left out in the analysis. All the interviews were written out in a Word document. Although time consuming, this was very manageable due to the good quality of the recordings. After all interviews were transcribed, a technique of coding (Saldana, 2009) was used in order to select relevant data from the text. Specifically, open coding was used as this technique encourages a thematic approach which was most fitting to this kind of qualitative research because it encourages one to categorize the data into relevant themes. It took several drafts of the coding before the definite coding was designed as some codes had to be added, deleted or rephrased and combined. Links were established between some of the codes and several data were found and grouped by the following themes: Causes of FLW, FLW impacts, Motives and constraints for sustainable management, Opportunities to implement FLW management. Each theme is supported by fragments from the interviews. It is important to note here that some of the fragments have been rephrased in order to make them easier to read. In doing so, the researcher has stayed close to the original data by making as little alterations as possible. Further analysis of the themes is done in the following chapter in order to provide answers to the research objective and research questions. Finally, conclusions were drawn based on the provided answers to the research questions.

3.5 THE CHALLENGES/LIMITATIONS OF THE STUDY

Once contacted the interviewee before arriving the research destination, some challenges occurred. Firstly, the accessibility of Thai government turned out to be quite challenged. It is decided to be the communication limitation across the country when the only access is to send an e-mail. A researcher tried to solve the problem by asking for the help from Thai friends to contact the governments. Contrary to the expectations, no any reply and a case is holding for a month with a reason that there's no officer responsible in the research topic. Because of this, the planned research sample of 10-12 interviewees had to be reduced to a total of 7 interviews. Secondly, many organizations had to be visited and a lot of contact had to be made in order to successfully complete within the 4-week frame. Due to the limited timeframe and the availability of the interviewees that mostly meant it was nearly impossible to conduct multiple interviews in a single day. However, this was done in a timeframe with a total amount of 7 interviews which is the highest amount that can be done within the mentioned time frame. With the limitation of access of the interviewee, a researcher also aware that there could be a high risk of a bias from interviewees since most of them are having the same and/or relevant background. Because of this, they could provide only similar direction of answers to the research question. So, a literature research is also done by comparing and analyzing to the ones provided by the interviewees to have more perspective and cover all the relevant elements to the central research question.

4. Results

4.1 INTRODUCTION

The main objective for this research is to understand the various factors that affect FLW management in the tuna processing industry. In order to provide answers to the research questions, the researcher presents the results of the qualitative in-depth interviews conducted in Thailand. Based on the research questions, the following topics will be presented: (4.2) Causes of FLW, (4.3) FLW impacts, (4.4) Motives and constraints for sustainable management, and (4.5) The opportunities to implement FLW management.

4.2 CAUSES OF FLW

According to the observation and the interviews, certain causes of food loss and waste were addressed. The result of the observation is shown in Figure 7 which represents tuna production and wastes generated in all steps of the process. FLW causes were collected and analyzed from both the observation and the interviewees who are working in the company.

During the interviews, some elements were found to be core concept amongst the interviewees as they kept coming up within almost every interview. The interviews turned out that human, specifically in operation level, is the important determinant conducting to FLW while production. The other elements such as machine and equipment will also be shown below (see Table 2). Some examples by the interviewees will be given in order to illustrate.

Considering the tuna production (see Figure 7) since raw material receiving until the outbound logistics, the human involvement in butchering, trimming and storing resulted in a substantial amount of FLW. As discussed by interviewee 1, a lot of FLW emerges in these three activities since the tuna canning industry employs numerous people and is largely exposed to hands of human. When workers utilized raw materials inefficiently by speeding up or scraping intensely, there will be a number of fish residue spattering on the floor. This is aligned with interviewee 3 when high speed and intensity of butchering and trimming are the two main causes of FLW by human. Further explanation by this interviewee revealed that once residue fall on the floor, it would not account as product anymore but rather sell to other industry in the lower price.

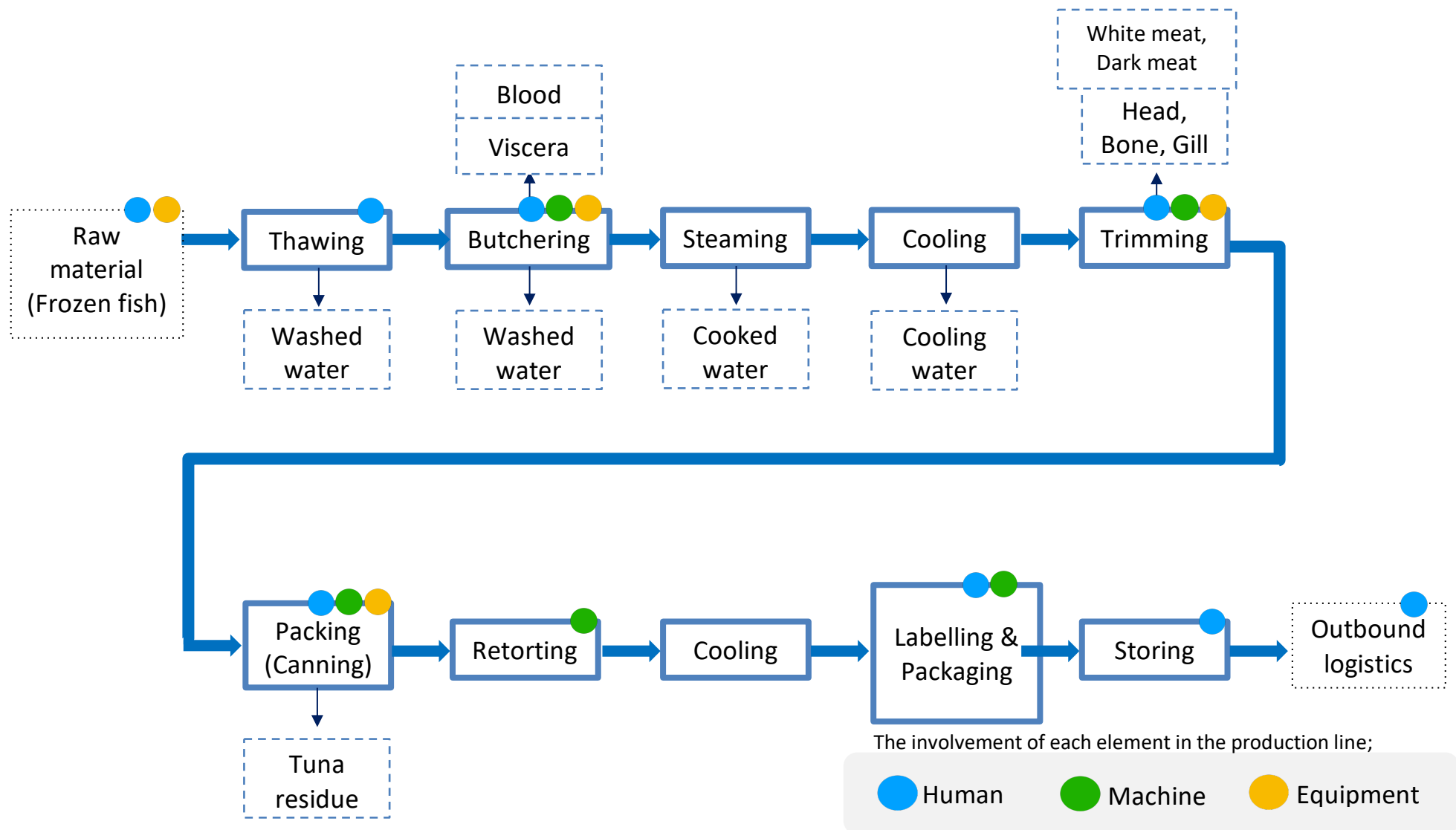


Figure 7. Canned tuna production and wastes generated in some steps of the process

According to the interviews, this was the main issue for the factory to discover solutions for food loss and waste. While human factor was being seen as the main FLW cause, inaccurate storage and movement of finished goods were also considered as another cause for FLW. The example of improper storage shows below.

“Storage problem is caused by workers who store the product in the wrong way. For example, they will sometimes, both intentionally and unintentionally, overlap the first load that has not been full by the second load. And as a consequence, the first one will be damaged and has to re-processed again.” – Interviewee 3

Apart from storage, the movement of final products from one to another location (in warehouse) by human with high speed can subsequently be a cause of the damage as well and these products will be re-processed at the end. Of all the causes happened during production, some problems are being solved by the company. However, it is not the real cause so the better loss and waste management is required.

As from the interviews, ‘Machine’ turned out as the other cause of waste. The only interviewee mentioned this is the interviewee 4 as in his view it seemed as the important cause for food waste during processing. Those causes from the machine can be subcategorized into two issues. First, the machine setting is not right adjusted in which the machine user might set it in the wrong condition and subsequently making a defect.

“This issue affects quite a lot to the whole production line. For instance, when machine is running through the wrong condition, some cans will become unfilled, overfilled, or a can is even ripped away. Thus, tuna that is already been filled and/or passed the thermal process has to be brought back to warm up again. Or else, the product need to be re-packed or re-processed. The total production costs in this batch will be higher than normal. I think this is not worth the cost.”- Interviewee 4

Another reason behind this is that during the initial setting of the machine (after shifting the production condition from one to another), the first processing product could be unusable, that means some of the processed tuna has to be disposed of. The example given by the interviewee 4 is when there was alteration of product specification, tuna size, can size.

“...when company had to try the process during the first time after the machine change the conditions such as different fish size, can size from A to B. Imagine that it is not the same product every day. The product had been torn, unusable, and become waste at the end. I think it is quite manual and a practical problem.” - Interviewee 4

Secondly, due to the machine structure, there may be some of tuna adhered and remained in the blade, gap, or hole in the machine, particularly when the tuna is too moist. However, this was pointed out as the machine error that the company cannot refuse.

Aside from human and machine, equipment was another consideration as a cause for food waste during processing. The knives for scraping tuna, for instance, are being seen by interviewee 2 as a factor for food loss and waste during butchering. Once the sharpness is not enough, the intensity of cutting will rise, causing some amount of food waste.

Table 2. Causes of food loss and waste in the tuna industry

Causes of FLW	Explanation
Human (Operation level)	<ul style="list-style-type: none"> ● Raw material utilization during butchering and trimming; intensity, high speed to compete against time ● Inaccurate storage and movement of finished goods
Machine	<ul style="list-style-type: none"> ● The setting is not right adjusted ● Machine error; moist tuna adheres to the blade, gap and/or hole in the machine
Equipment	<ul style="list-style-type: none"> ● Knife sharpness

4.3 FLW IMPACTS

After interviewing, the data was analyzed and then three themes were captured relatively to the impacts of food loss and waste for the tuna industry; Economic, Environmental, and Social impacts (see Table 3). Economic impact is the most frequently mentioned by the interviewees. The statement that ‘FLW contributes to higher production cost’ can be seen in every interview. This is further supported by the interviewee 1.

“Food loss and waste can affect the production cost in some way. Certainly, the cost will become higher if food loss and waste is not well-managed but it’s not going to affect the overall profit of a company.” – Interviewee 1

By sorting and summarizing from the interviews, it can be seen that the production cost includes re-processing, re-packing, disposal, treatment, labelling, and storing costs. Some interviewees were seeing this as the most crucial impact to the company.

“In my opinion, the economy of the company may affect the most by food waste, then environment and society since the re-process of defect products will increase the cost of production. The cost of re-working is rather high, depending on the amount of loss.” – Interviewee 3

Looking broader to the country level by the interviewee 7 who works closely to the various tuna companies, Thailand is the large country who imports and exports tuna worldwide with the amount of about 43 million import, and 70 million export Thai baht per year both in 2017. With the large difference between import and export, the interviewee highlighted that economic impact is likely to play an important role for the tuna industry compare to the other twos. In term of one company, it might not have an effect, but this can compile into a significant amount of food loss and waste for the tuna industry.

Within the company, the Sea Value Plc employees thought that environmental impact from FLW has affected less than that of the economic impact. Interviewee 1 stated that the environmental impact occurs only when disposing unusable waste to the landfills. However, that is not a big case since the amount of waste left to landfill is quite low. To be aligned with interviewee 1, the interviewee 3 said that there is no environmental impact since all of FLW has been reprocessed. Due to the fact that tuna can be totally re-processed or else it is becoming disposable organic waste, tuna waste has no impact to environment which is in line with interviewee 6 when there would be no environmental impact if organic waste can be treated effectively. In addition to this, one interviewee from a company mentioned that waste during processing can be distinguished into two forms; solid and liquid. The solid waste can be managed by re-processing, repacking, or selling to other industry while liquid waste that cannot be treated anymore will be released out of the factory and subsequently affect the environment of the factory's surrounding e.g. canal, river, etc.

Only two interviewees can think about the social impact from food loss and waste. Interviewee 2 pointed out that untreated waste could affect people who is living surrounding the factory. As of the way as interviewee 6 explained, these wastes can be smelly and subsequently disturb and annoy the society around the factory.

Table 3. Impacts of food loss and waste in the tuna industry

Impacts	Explanation
Economic	<ul style="list-style-type: none"> • Higher production cost; re-processing, re-packing, disposal, treatment, labelling, and storing costs • Difference between import and export amount
Environment	<ul style="list-style-type: none"> • Waste left to landfill is quite low • Affect water source surrounding the factory i.e. canal, river, etc. • No environmental impact since FLW has been totally reprocessed and/or organic waste will be well-treated
Social	<ul style="list-style-type: none"> • Affect people who is surrounding the factory i.e. smelly waste

4.4 MOTIVES AND CONSTRAINTS FOR SUSTAINABLE MANAGEMENT

Interviews revealed a number of motives (see Table 4) and constraints for sustainable management (see Table 5). The motivations are dominated by the profit and reputational gain of a company. The company could have the reputational gains by promoting their sustainability issue. For instance, by being the sustainable company from having the environmentally friendly label could help the company to pursue a better company's image. This could eventually contribute to a better stock market price in an eye of the investors. Aside from that, a self-consciousness of the business owner was also seen as another incentive for food loss and waste mitigation. Self-consciousness of the business owners when trying to balance economic, environmental, and social concerns can be assigned to the food waste minimization. The motivation is that the social responsibility and care for the planet are important for them. In the sense of management thinking, the tuna expert emphasized that increasing the opportunity of having higher profit or competitive advantage can be an incentive for a business owner to reduce food waste. This was also in agreement with interviewee 6 if there's someone who can point out to the company that the implementation of sustainable management in the production line can reduce cost of food loss and waste, the top management is likely to engage in FLW management.

Table 4. The motivations for sustainable management

Motives	Explanation
Profit	<ul style="list-style-type: none">• Higher profit• Higher competitive advantage• After having reputational gains, this can encourage stock market
Reputation	<ul style="list-style-type: none">• More reputation after promoting the sustainability issue• Better image; environmentally friendly product label
Self-consciousness	<ul style="list-style-type: none">• The intention of the entrepreneur/top manger to reduce FLW

For the constraints of food waste management, budget, internal resources, and unconsciousness considerations represented as the constraint factors for the tuna industry to engage food loss and waste management (Table 5). Indeed, the involvement of initiative in a company requires the investment and so does food waste mitigation. Although some of the interviewee interpreted a budget as a major disincentive, other argued that it is not always a case as long as it is reasonable and worth the investment. This was reflected by the interviewee 1:

"As can be seen from the upper management level, they are considering about the minimization of waste during production process and are now taking the efforts to reduce the waste. I personally think that if the payback period can be calculated and presented in a reasonable way to our executives, they will be ready to invest in order to minimize the waste. So, I'm quite sure that the budget or money to invest is not a big deal for our company." – Interviewee 1

Aside from the budgetary constraint, the majority of interviewees stated that lack of internal resources (technology, staff, and time) and poor in-house expertise are being seen as barriers to adopting more effective food waste management. This was supported by the Interviewee 3:

“As from what I see, it’s sometimes lack of resources as well as lack of knowledge. For example, when you need to be rush in order to compete with the time, you simply need to concentrate on making money rather than concern about the waste. For technology, due to the inconsistency between some technology and the production process, loss and waste can occur anywhere at any time. And then lack of knowledge is another problem. I believe that there’s not all of the machine users who know correctly about technology. And as a consequence, they might end up with food loss and waste. In this case, it requires the expertise who knows and understands the technology know-how that could be used for the maximum efficiency and effectiveness. If we can hire the right people working in the right job, it would be a good think and can solve the problem.” – Interviewee 3

Apart from the budget and internal resources, the unconscious behavior of the entrepreneur is a contributor to the occurrence of food waste in their enterprise. Meaning that the ignorance to reducing food waste as well as unawareness to the environment and society can also be the disincentives for the company to implement food waste management.

Table 5. Constraints for sustainable management

Constraints	Explanation
Budget	<ul style="list-style-type: none"> ● High cost to implement food loss and waste management ● Money is not a case for Sea Value Plc if it’s reasonable and worth the investment
Internal resources	<ul style="list-style-type: none"> ● Technology ● Staff ● Time ● Poor in-house expertise
Unconsciousness	<ul style="list-style-type: none"> ● Unconscious behavior of the entrepreneur ● Business owner’s ignorance and irresponsibility

4.5 THE OPPORTUNITIES TO IMPLEMENT FLW MANAGEMENT

The opportunities in this case refer to the external factors that an organization can use to reduce food loss and waste (see Table 6). The desire to see the collaboration between tuna processor and other organization of being more closely and proactively engaged in food loss and waste management was reflected as one theme across all the interviews. The so called ‘tuna big brother’ project runs by all big tuna factories as well as Thai government to sharing knowledge, technology know-how, waste management methods etc. This project underlines importantly that Thai tuna industry as a whole will achieve the goal of successfully being the largest tuna canning exporter in the world. Recently, the Office of Natural Resources and

Environmental Policy and Planning (ONEP) has taken sustainability issue into account and decided that the policy should be formulated, targeting at food loss and waste. The company can turn this case to be their opportunity, for example, being the spokesperson in order to accelerate this project and eventually getting an eye from the public by being a sustainable enterprise. The last one is the collaboration between the tuna industry and the educational institution when the company can save the budgetary cost for giving the opportunity for students to experience the real production line by solving the food waste problem instead of hiring the expertise. And this has been already applied by a university in Thailand.

The government is attributed to the two key roles to play for the opportunities of food loss and waste mitigation. The first is seen in optimizing the food loss and waste regulatory framework. The second is asked in the design of educational and public awareness raising campaigns. The integrated governmental support was viewed by interviewee 5 as the paramount for business to more effectively tackle the food waste generation in the country. The governmental involvement has been identified as a major success factor for better public recognition of environmental claims made on food labels as well as food packaging to minimize food waste.

“For the domestic market mechanism, if the government is stricter about food waste and provide support for it, for example, encouraging entrepreneurs to have the environmental conservative or green label, lowering tax, or supporting financial, then business would definitely rethink about managing food waste broader.” – Interviewee 5

Table 6. The opportunities framework to engage in FLW management

The opportunities	Explanation
Collaboration with other organizations	<ul style="list-style-type: none"> ● Collaborations across the tuna processing companies ● Collaboration with ONEP ● Collaboration with institution and/or university
Government	<ul style="list-style-type: none"> ● Government regulation; regulatory framework ● Public awareness ● Tax reduction
New consumer/Market	<ul style="list-style-type: none"> ● End consumer’s consciousness ● The regulation of destination country i.e. EU

In addition to this, new consumer and/or market can be seen as another opportunity for the company as well. The tuna canning manufacturer can export its products into a new pool of consumer who has the environment awareness. Moreover, to be able to reach the new market in another country such as EU, the business has to adapt itself and abide by the regulation of such countries.

5. Conclusions & Discussion

The main objective of the research is to identify the factors that affect food loss and waste management in the tuna processing industry in Thailand. In order to provide answers to the research questions, several sub research questions have been drawn as discussed in the introduction chapter. Based on the analysis of the data, answers to the research questions are provided in the conclusion, and then the findings are discussed. Additionally, specific recommendations for Sea Value Plc. as well as proposals for future research are suggested.

5.1 ANSWERS TO THE RESEARCH QUESTIONS

As discussed in the result chapter, several data were found in the analysis of gathered interview data. The data are grouped according to the sub research questions (SRQs): causes of FLW, FLW impacts, motives and constraints for sustainable management, and the opportunities to implement FLW management. The findings will be discussed and concluded below.

SRQ1: What are causes of FLW during tuna processing?

Human at operational level turned out as the vital determinant resulting in FLW, especially during raw material utilizations (butchering, trimming, packing) and storage. This is partly in line with FAO (2013) which study on the causes of FLW from tuna canning processing. Waste is mostly generated in the step that human is involved, for example, head bone, gill, dark meat are created during trimming and blood, internal organ, washed water are created during gutting or butchering. However, a study of FAO (2013) shows that there has no food waste generated during labelling and packing, which conflicts with a result from this research. The reason why FAO has not taken FLW from packing into account is because the amount of tuna residue that has been observed during this step is insignificant if compare to trimming and butchering steps. Regarding human involvement, the argument is the workers have a lack of concern and awareness about food loss and waste. They think that food loss and waste management are not important point for them to be concerned. This is also confirmed by the observation of the production line that most of the operation workers do not appear to be concerned about food loss and wastage during processing. The reason behind this is that Sea Value Plc still does not have the exact operating procedure and management for FLW. This could link to the top management since they are the base for decision making in a company. A top management team consists of key executives within an organization who have responsibility to plan, execute the organizational strategies and reflect in the major decision of many organizations (Wu et al., 2017). So, the argument here is to address that operating workers may not be the root cause for FLW but the main decision makers which are the top managers in an enterprise. For instance, if there are the support, exact operating procedure, or KPI regarding to the FLW management from the top management team, the first and middle management will likely to take actions in order to fulfill the organizational objectives and vice

versa. The understanding of FLW management and the support from the top management team lead to the improvement of FLW management.

SRQ 2: What are the impacts from FLW during tuna processing?

For the current impacts of FLW, economic impact was seemed as the highest frequent mentioned by the interviewees. FLW results in higher production cost due to re-processing, re-packing, disposal, treatment, labelling, storing, etc. However, no investigations have been found to study on economic impacts of FLW in the tuna processing industry. Most of the study focused on the large scale (e.g. country, world) of the food waste from household, retailer, or wholesale sector (Gustavsson et al., 2011; Venkat, 2011). For the factory, the environment was also being seen as another effect from FLW but it was affected less than the economics because of the low amount of waste from the factory to the landfills. Nevertheless, it cannot be concluded that a tuna industry creates no environment problem as the interviewee's interpretation may base on their own understandings. In contrast to previous study (Gamarro et al., 2013.) that the tuna plant creates a high protein waste and a very high COD value (Chemical Oxygen Demand) in waste water during the processing which will cause problems in managing waste water discharge and affect the surrounding ecology. However, it also depends to the factory if there is proper waste water treatment, they would not face the problem from waste and could not affect the society outside accordingly.

SRQ 3: What are the motivations and constraints for sustainable management?

When it comes to the motivations for sustainable management, profit turned out as the important driver for interviewees in a company. From a research, economic benefits could motivate the managers and employee to implement FLW management in a company level. The business operations and decision-making should contribute to the financial bottom line to promote FLW management in a company, for instance, higher profit, higher competitive advantage in various markets. This is in line with various of the previous studies (Arvanitoyannis & Kassaveti, 2007; Ghisellini et al., 2016), the evidence showed that fish waste management can contribute to the cost reduction of products and the additional revenue, which could motivate a decision maker to achieve sustainable management in fishery industry. The argument from Filimonau & Gherbin (2017), financial savings alongside with the reputational gains were a primary driver for adopting food waste mitigation practices, supports the previously mentioned statement that economic benefits are a motivation for sustainable management in the tuna industry. The above statement is also aligned with an interview that the company reputation is also perceived as another driver for a company to implement food loss and waste management, which includes a better image, an attractiveness to the customers and the market share improvement. Next, self-consciousness of the top management was mentioned as another potential driver during the interview. When top managers or the entrepreneur perceive demand from stakeholder and/or from outside for the management, they would participate in and support the initiatives. There is also an evidence from one study to confirm that pressure is also proposed as an important driver of

management implementation (Delmas, 2001). This argument is in line with the exiting studies that societal pressure and market requirements affect the decision of top management to invest in eco-innovation (Wagner, 2008). Considering in the same way, it is stated that one of the drivers for a company to apply for a sustainable innovation is the need to respond to the external pressures coming from the intermediate customers (e.g. retailers) as well as final consumers (Iraldo & Barberio, 2017). However, it is important to note that there has no evidence showing that the top management can be pressured by the external entity for the sustainable management particularly in tuna or seafood industry. In conclusion, economic benefits, company reputation, and stakeholder pressure are the main motivations for a tuna industry enterprise to adopt and improve the FLW management.

For the barriers, unconsciousness of the top management and budgetary constraints prevent a company from engaging in food waste management more actively. In comparison between the unconcern of top management and a study of Gustavsson et al. (2011), the attitude of the top management represented as a significant barrier to the adoption of food waste management practices. Meaning that if there is no awareness to the problem among the top managers, there will be no action for the management. Therefore, a consciousness of top managers also plays an important role for adopting sustainability practices. Additionally, financial is considered as another constraint for implementing the sustainable initiatives (Boziarias, 2014), for example high capital to invest for the new technology because some of management requires technology to handle waste during and after processing. However, this issue seems not to be the barrier for Sea Value Plc as some of the managers stated that if the investment is worth the compensation and reasonable, there would be no refusal from the top management. Apparently, this is only a personal decision from one group, it cannot be concluded that all company will end up in the same decision. Although a company declared that these costs are not the barrier for them, it is important to quantify the overall cost of implementation and to indicate the costs that need to make change to the production process, hire consultants (particularly in sea food industry), and train employees. The argument here is also supported by a study of Boziaris (2014) that a combination of financial, technical, and management issues are potential constraints to implement FLW management in seafood processing industry. Financial considerations include not only the capital of new technology, but also costs for the additional know-how from expertise, training, human resources, and other indirect costs.

SRQ 4: What are the opportunities for sustainable management?

There is a project runs by several tuna companies in Thailand. It was created for big companies to sharing knowledge, technology, and waste management methods to the small ones. The collaboration among tuna processors is a chance for Sea Value Plc to engage food loss and waste management. While collaboration, the existence of this cluster could also enable research and development, innovation, as well as the improvement of yield, capacity, productivity or a new niche market access by networking and cooperation in certain

companies in a tuna industry. A research proposed that a company might support research and development who can contribute to innovations which may reduce food wastage, for instance, improved technology, improvements during storage and transportation. Aside from this, boarder engagement with other organizations would reduce the pressure on internal resources that were identified as another barrier towards the application of more effective food loss and waste management practices. Moreover, governmental support is necessary to facilitate this change regarding food waste reduction. The governmental interventions could lead to the revision of corporate policies in the tuna or other food industries. The government could streamline food loss and waste legislation and support the public and consumer awareness. This argument is in line with a study of Yan & Chen (2015), they studied on the sustainability of seafood industry. It is revealed that the development of a processing takes the strong cooperation of governments, research institutes, policy makers, funders and the public. They agreed in the same way that the opportunity for seafood industry to engage sustainability practices should be supported by governments for financial issue, executed by researchers with expertise, covering food science and food engineering.

5.2 SPECIFIC RECOMMENDATIONS FOR SEA VALUE PLC

As for the earlier discussion, recommendations specifically for Sea Value Plc can be addressed here into **four** points. First, providing training to help the workers and employee better understand food waste management may be essential for food waste prevention. Additionally, the issue of food waste, quantities generated, and why it is an environmental, economic, and social concern could mechanize the prevention to the lack of awareness about wasting food. A company could launch the program or training to educate employee in different management level regarding FLW management so that they will be more concerned and aware of the importance of food waste. The recommendation to the factory manager is to have a talk with supervisor, worker once a week and having equipment maintenance regularly every month.

Secondly, understanding the economic costs of waste may encourage behavioral could change to prevent waste. If the amount of food loss and waste in tuna industry is quantified correctly, this could provide a unique incentive to save money through waste reduction. Third, the factory should be put into effort on designing and implementing appropriate measures to dispose of the waste generated during processing in order to minimize the environmental impact from FLW during processing. Recently, there are recovery programs typically aim to divert food waste from disposal (landfill) and treat it with biological treatment; composting or anaerobic digestion to capture nutrients and energy. The digestion of organic waste can seal environment of the process preventing exit of methane into the atmosphere. In addition to this, the tuna processing industry would have to look for the possibility of utilizing waste for the production of value-added products. Meaning that value addition and proper utilization of fish processing waste can make a major contribution to minimizing food loss and waste

which contribute to the less environmental impact. Fourth, a researcher suggests a company to concur with particular organizations who have knowledge of waste management such as academic agency, NGO, and government. In the future, hiring an advisor for a particular reason could be a choice for a company to reduce waste. And lastly, a recommendation for Sea Value Plc to valorize tuna residues by producing fish oil and fishmeal for the lower quality meal such as animal feed in order to create no waste.

5.3 PROPOSALS FOR FUTURE RESEARCH

Several propositions can be made for the future research on the topic of food loss and waste in the tuna industry in Thailand. It would be beneficial for the tuna industry to encourage further research on the quantification of loss and waste during processing and through the whole production as a follow up to this research. This thesis research could be improved in many ways.

Firstly, as the sample of this research was limited to 7 interviewees, it is proposed to use a bigger sample size in future research on this topic in order to have as many as perspectives from the interviews in many level of management. Second, it is suggested to involve different organization into one whole big interview group to drive into the collaboration and a final agreement among the groups. Thirdly, as this research is restricted to only the area of Bangkok and nearby provinces, it is suggested to increase the research area by including different factories around the country of Thailand or by significantly increasing the research area through the inclusion of other countries like the Philippines, Indonesia or India in order to ascertain differences insight of tuna industry all over the world and after all the research could be generalizable for the tuna industry as a whole. Fourth, conducting a similar study in particular company several years later, or conducting a study over a wider timeframe will show how food loss and waste management change over time as a result of development and/or technology. And lastly, it is recommended to include multiple methods in future research on this topic like quantitative methods or additional qualitative methods like survey or focus groups. It is expected that this will provide a more detailed of causes and ways to handling loss and waste.

References

Articles:

- Andrews, D. (2015). The Circular Economy, Design Thinking and Education for Sustainability. *Local Economy* 30 (3), 305-315.
- Bailey, M., Bush, S., Oosterveer, P. & Larastiti. (2016). Fisheries, Fair Trade, and finding middle ground. *Fisheries Research* (182), 59-68.
- Bozias, I. S. (2014). Seafood Processing, Technology, Quality and Safety. Wiley Blackwell, UK.
- Delmas, M.A. (2001). Stakeholders and Competitive Advantage: the case of ISO 14001. *Production and Operation Management* 10 (3), 343-358.
- Dubay, K., Tokunaga, S., & Gereffi, G. (2010). A Value Chain Analysis of the Sinaloa, Mexico Shrimp Fishery. Center on Globalization, Governance and Competitiveness. Duke University, United States. Retrieved from: www.fao.org/3/a-at203e.pdf
- Dyllick, T. & Hockerts, K. (2002). Beyond the Business Case for Corporate Sustainability. *Business Strategy and the Environment* (11), 130-141.
- FAO. (2012). The State of World Fisheries and Aquaculture 2012. Rome. 209pp.
- Filimonau, G. & Gherbin, A. (2017). An Exploratory study of Food Waste Management Practices in the UK Grocery Retail Sector. *Journal of Cleaner Production* (167), 1184-1194.
- Fox, M., Mitchell, M., Dean, M. Elliott, C. & Campbell, K. (2018). The Seafood Supply Chain from a Fraudulent perspective. *Food Security* (10), 939-963.
- Fujii, H. & Kondo, Y. (2018). Decomposition Analysis of Food Waste Management with Explicit Consideration of Priority of Alternative Management options and its application to the Japanese Food Industry from 2008 to 2015. *Journal of Cleaner Production* (188), 568-574.
- Garrone, P., Melacini, M. & Perego, A. (2014). Opening the Black Box of Food Waste Reduction. *Food Policy*. 46, 129-139.
- Ghisellini, P., Cialani, C. & Ulgiati, S. (2016). A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems. *Journal of Cleaner Production*. 114, 11-32.
- Graci, S. & Dodds, R. (2008). Why go Green? The Business Case for Environmental Commitment in the Canadian Hotel Industry Anatolia. 19, 251-270.
- Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R. & Meybeck, A. (2011). Global Food Losses and Food Waste. Food and Agriculture Organization of the United Nations, Rome. Retrieved from: www.fao.org/docrep/014/mb060e/mb060e00.pdf
- Hage, O., Soderholm, P. & Berglund, C. (2009). Norms and Economic Motivation in Household Recycling: Empirical evidence from Sweden. *Resources, Conservation and Recycling*. 53, 155-165.
- Iraldo, F., Barberio, M. (2017). Drivers, Barriers and Benefits of the EU Ecolabel in European Companies' Perception. *Sustainability Journal*. 9 (5).
- Islam, S., Khan, S. & Tanaka, M. (2004). Waste Loading in Shrimp and Fish Processing Effluents: Potential Source of Hazards to the Coastal and Nearshore Environments. *Marine Pollution Bulletin*. 49, 103-110.
- Kuldilok, K. S., Dawson, P. J. & Lingard, J. (2013). The Export Competitiveness of the Tuna Industry in Thailand. *British Food Journal*. 115 (3), 328-341.

- Laowapong, A. (2010). Fisheries Value Chain: Kingdom of Thailand. A Report submitted to Food and Agriculture Organization for the project entitled A Value-chain Analysis of International Fish Trade and Food Security with an Impact Assessment of the Small-scale Sector.
- Larsen, K. (2015). Why Engaging Employees on Sustainability Really Isn't about Money. GreenBiz, Oakland. Retrieved from: [www.greenbiz.com/article/ why-engaging-employees-sustainability-really-isnt-about-money](http://www.greenbiz.com/article/why-engaging-employees-sustainability-really-isnt-about-money).
- Linder, M. & Williander, M. (2017). Circular Business Model Innovation: Inherent Uncertainties. *Business Strategy Environment*. 26, 182–196.
- Locke, E.A. & Latham, G.P. (2004). What should we do about Motivation theory? Six recommendations for the Twenty-first century. *Academy of Management Review*. 29(3), 388-403.
- Marnis, Syahrul, Fitri & Mardayulis. (2016). Valuation of Economic Utilization of Fish Processing Waste as an Added Value for Fish Processing Industry Players in the District Kampar, Riau. *International Journal of Economics and Finance*. 8, 104-116.
- Nahman, A. & de Lange, W. (2013). Costs of Food Waste along the Value Chain: Evidence from South Africa. *Waste Management* (33), 2493-2500.
- Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N. & Ujang, Z. B. (2014). The Food Waste Hierarchy as a Framework for the Management of Food Surplus and Food Waste. *Journal of Cleaner Production* (76), 106-115.
- Porat, R., Lichter, A., Terry, L. A., Harket, R. & Buzby, J. (2018). Postharvest losses of Fruit and Vegetables during Retail and in Consumers' Homes: Quantifications, Causes, and Means of Prevention. *Postharvest Biology and Technology* (139), 135-149.
- Porter, M. E. (1985). *Competitive Advantage, Creating and Sustaining Superior Performance*. Free Press, New York.
- Riley, G. L. (2016). *Food Waste: Practices, Management and Challenges*. Waste and Waste management. Nova publishers, New York.
- Salihoglu, G., Salihoglu, N. K., Ucaroglu, S. & Banar, M. (2017). Food Loss and Waste Management in Turkey. *Bioresource Technology*. 248, 88-99.
- Schuurhurizen, R., van Tilburg, A. & Kambewa, E. (2006). *Fish in Kenya: The Nile-Perch Chain. Agro-food Chains and Networks for Development*. Springer, The Netherlands.
- van Marrewijk, M. & Hardjono, T. W. (2003). European Corporate Sustainability Framework for Managing Complexity and Corporate Change. *Journal of Business Ethics*. 44, 121-132.
- Venkat, K. (2011). The Climate Change and Economic Impacts of Food Waste in the United States. *International Journal on Food System Dynamics*. 2(4), 431-446.
- Wagner, M. (2008). Empirical Influence of Environmental Management on Innovation: Evidence from Europe. *Ecological Economics*. 66, 392–402.
- Wu, T., Wu, Y. J., Tsai, H. & Li, Y. (2017). Top Management Teams' Characteristics and Strategic Decision-Making: A Mediation of Risk Perceptions and Mental Models. *Sustainability*. 9(12), 2265.
- Yan, N. & Chen, X. (2015). Sustainability: Don't waste seafood waste. *Nature Journal*. 524 (7564), 155-157.
- Yano, J. & Sakai, S. (2016). Waste Prevention Indicators and Their Implications from a Life Cycle Perspective: a review. *Journal of Material Cycles and Waste Management*. 18, 38-56.

Books:

Arvanitoyannis, I. S. & Kassaveti, A. (2007). Fish Waste Management: Treatment Methods and Potential Uses of Treated Waste. In *Waste Management for the Food Industries. Academic Press (1)*, 861-937.

FAO. (2011). Global food losses and waste: Extent, Causes and Prevention

FAO. (2013). Fishery and Aquaculture Statistics. Global Production Statistics 1950-2010. In FAO Fisheries and Aquaculture Department, Rome, Italy.

Gamarro, E. G., Orawattanamateekul, W., Sentina, J. & Gopal, T. K. S. (2013). By-products of Tuna Processing. GLOBEFISH Research Programme (112). In: Food and Agriculture Organization of the United Nations, Rome, Italy.

Saldana, J. (2009). The Coding Manual for Qualitative Researchers. SAGE publications Ltd, London, UK.

Website:

FAO, 2010: www.fao.org

FAO, 2012: <http://www.fao.org/save-food/en/>

Globefish, 2010: www.fao.org/in-action/globefish/market-reports/resource-detail/en/c/337491/

EPA, 2012: www.epa.gov

www.seavaluegroup.com

Appendices

Appendix 1. Preliminary observation scheme on causes of FLW in Sea Value Plc

		Criteria of interest	Point of interest	Explanation
Inbound logistics	Raw material	Raw material	Raw material receiving and/or handling	At shore, QC receives raw materials from the traders and evaluates core temperature, flavor, chemical components. The raw material received at a factory will be separated by weighing.
			Raw material storing	Store raw materials in the freezing room under -10°C. Receive 500 ton/day. Room capacity is 3,000 ton/day.
			Raw material disseminating	Depending on the planning.
	Equipment	Equipment	Equipment handling	n/a
			Equipment maintenance	n/a
	People	People	Activities and behaviors	3-4 people involved in one truck with supervisor
			Repetition and/or noticeable activities and behaviors	n/a
	Technology	Technology	Machinery utilization	n/a
			Know-how/expertise of the workforce level	n/a
	Transportation	Transportation	Temperature control	Not exceed -18 °C
			Vehicle scheduling/vehicle return to suppliers	n/a
Operations/Processing	Frozen fish receiving	Raw material	Frozen fish receiving and/or handling	Receive from storage room. Thawing frozen tuna in a room by just still standing. No waste.
			Frozen fish storing/temperature control	Keep at room temperature
		Equipment	Equipment handling	n/a
			Equipment maintenance	n/a
		People	Activities and behaviors	Only 2 people involved
			Repetition and/or noticeable activities and behaviors	n/a
		Technology	Machinery utilization	n/a
			Know-how/expertise of the workforce level	n/a
			Machine maintenance	n/a
	Butchering	Raw material	Soft fish receiving and/or handling	When frozen fish is becoming soften. It will be handling to butchering room.
			Soft fish butchering in different steps	Soft fish is butchered into 2 pieces. Some of tuna white meat is falling down on the butchering table and floor. Ones in a table can still be used, and ones on the floor is collected to be discharged.
		Equipment	Equipment handling	n/a

		People	Equipment maintenance	Equipment used until it cannot be used/broken.
			Activities and behaviors	Speed and strength of scratching are different depending on each person
			Repetition and/or noticeable activities and behaviors	White and dark tuna meat are separated in this step. Can be different depending on a person
		Technology	Machinery utilization	Fish meat sometimes stuck in a conveyor and a tray
			Know-how/expertise of the workforce level	Workforce level is lower than Bachelor degree. Most of them learnt by the experiences.
			Machine maintenance	Regularly every 1-2 months. Or whenever there's an issue

Operations/Processing	Canning	Criteria of interest	Point of interest	Explanation
		Raw material	Fish receiving /or handling	n/a
			Fish canning	n/a
			Ingredient mixing	n/a
		Equipment	Equipment handling	n/a
			Equipment maintenance	n/a
		People	Activities and behaviors	Fish meat is being put in a can. Size and grade of fish are as a requirement from various customers. Therefore, every can has to have the same standard and quality. So most of fish residue is abandoned.
			Repetition and/or noticeable activities and behaviors	Significant amount of fish residue is discharged because it’s not in a prefer shape and size.
		Technology	Machinery utilization	Filling and canning machine, conveyor
			Know-how/expertise of the workforce level	n/a
	Machine maintenance		Regularly every month	
	Retorting	Product	Product receiving/handling	Receive in a big basket
			Product pasteurization	n/a
		Equipment	Equipment handling	n/a
			Equipment maintenance	n/a
		People	Activities and behaviors	In this step, people are not directly contact to fish.
			Repetition and/or noticeable activities and behaviors	n/a
		Technology	Machinery utilization	Pasteurizer
			Know-how/expertise of the workforce level	Trained before using the machine
			Machine maintenance	n/a
Incubating		Product	Product receiving/handling	Products are still in the same basket as it is in a pasteurizer. It is kept in an incubating room.
	Equipment	Equipment handling	n/a	
		Equipment maintenance	n/a	
	People	Activities and behaviors	n/a	

			Repetition and/or noticeable activities and behaviors	n/a
		Technology	Machinery utilization	n/a
			Know-how/expertise of the workforce level	n/a
	Labelling	Technology	Machine maintenance	n/a
		Product	Product receiving/handling	Receive in a big basket.
			Product labelling	n/a
		Equipment	Equipment handling	n/a
			Equipment maintenance	n/a
		People	Activities and behaviors	People unload the products tray by tray to the conveyor in order to label a product by using laser technology.
			Repetition and/or noticeable activities and behaviors	Some of product is going out of its way so people is the one to look after in order not to check and make sure that every piece of a product is in line and labelled.
		Technology	Machinery utilization	Laser technology labelling machine
			Know-how/expertise of the workforce level	n/a
			Machine maintenance	n/a
Outbound logistics		Criteria of interest	Point of interest	Explanation
	Finished good		Finished good receiving and/or handling	After labelling, products are packed and wrapped in a pallet.
			Finished good storing/warehousing	The products are stored in a warehouse waiting for shipment order.
			Finished good disseminating	n/a
	Equipment		Equipment handling	n/a
			Equipment maintenance	n/a
	People		Activities and behaviors	People use folk lift to transfer the product from one to another places. Speed is considered as one of the careless factors among the workers, so products sometimes fall and wasted during this step. Some that can still be used will be reprocessed again.
			Repetition and/or noticeable activities and behaviors	n/a
	Transportation		Temperature control	n/a
			Vehicle scheduling/vehicle return to suppliers	n/a

Appendix 2. Interview question lists

Causes of FLW

1. Does Sea Value Plc have any possible FLW causes along the production line?
2. In your opinion, what is the most important FLW causes? Why?
3. What are the criteria used for Sea Value Plc to discarding FLW?
4. How does Sea Value Plc dispose by-products?
5. Does Sea Value Plc have systems for monitoring input usage, workforce? Which and how?
6. How does Sea Value Plc deal with human resources?
7. Does Sea Value Plc provide any human resource training through the raw material/product handlings? Which and how?
8. Does Sea Value Plc have information sharing/coordination among different departments regarding FLW? How? Frequency?
9. What is an average distance from suppliers, type and costs of transport? Who is responsible for transport, supplier or buyer?
10. How is the efficiency of transport system?
11. Does Sea Value Plc have monitoring/technical assistance programs for suppliers?
12. Does Sea Value Plc have managerial systems for FLW control? Which one? And does the company satisfied with the systems in place?

FLW impacts

13. Do you agree that FLW has the impact to all of three implications? Why?
14. What is the expected impact of FLW in terms of environment, economic, and social? How?
15. In your opinion, which one do you think is the most crucial impact for Sea Value Plc? And why?
16. How can Sea Value Plc control tuna effluent before discarding?

Motivations & Constraints

17. Does Sea Value Plc have incentive programs/scheme for FLW control? And how?
18. What could be the barriers for Sea Value Plc to hinder FLW management?

Opportunities

19. What could be the opportunities for Sea Value Plc to manage FLW?
20. Does Sea Value Plc have any existing FLW improvement? What do think of these initiatives? Under what conditions would you participate in such programs?

Demographical questions

1. Name
2. Position and responsibility
3. Consent of confidentiality: Yes/No

Questions for Sea Value Plc

1. Number of years in business
2. Number of years of the main industrial plant
3. Area occupied by plant

4. Production capacity (ton/month)
5. Number of employees
6. Turnover rate (people)
7. Turnover rate (profit)

Appendix 3. Transcription of the interviews

1. Sea Value Plc. - Anonymous

Q1: What are causes of FLW during tuna processing?

Interviewer: Does Sea Value have any possible FLW causes along the production line?

1: There are 2 causes of wastages. The first cause is that the raw materials (tuna) will be used and then thrown away. Another cause is caused by mishandlings of canning. In the corners, the wasted can can be handled more easily than the waste produced during the production process e.g. scraping fish. Since the staffs want to make speed, controlling of tuna residue is more difficult than that of canned waste by concerning staff intention and determination of working.

Interviewer: Then how can Sea Value control and manage such wastage?

1: As there are three main types of waste that are produced during the production process: fish residues (e.g. fish head, fishbone, etc.), fish steaming water, fat residues. We control these types of waste differently. The first one will be sold to animal food industry. The second is to make the fish steaming water concentrated and then sold to another factory. The last part is usually dumped at landfill. The company will not produce our own pet feed but will sell it to other industry because it is not worth the investment.

Interviewer: Does Sea Value have systems for monitoring input usage?

1: During this procedure, the raw material represents as the input. Raw materials are determined by the yield of each lot since they are calculated sufficiently by the dairy order from planning department. Hence, the input usage is monitoring by weighing raw fish both before and after scraping process. Above all, production department should be able to produce products as high as of the required order. To be summarized, loss of waste is controlled by the order. The amount of raw material as well as canned raw materials, labels, plans and orders is required enough to the order, it must be signed by the relevant supervisors with the statement of loss, and will be directly shown to the managerial level as well as board of directors.

Interviewer: Does SV provide the workforce training before working?

1: On the part of the staff receiving. There will be On Job Training (OJT) by the hiring supervisor.

Interviewer: How is the efficiency of SV transportation?

1: In terms of transportation, the company will be responsible for the fish receiving at piers, transfer to the cold rooms, process, until the unit closure and it then out of our responsibility but the transporting suppliers. Every single container will be insured.

Interviewer: Is there information sharing/coordination between different departments regarding FLW?

1: If it regards to FLW, there's only production and warehousing units that concern the most and have been shared the solutions to such problems only when

there's large number of FLW. Apart from that, the company will have a monthly meeting or called 'Task force' meeting. All units in the factory will be presented what they are going to reduce such as ones may reduce water, paper, employee number, etc. to the board of director.

Q2: What are the impacts from FLW during tuna processing in terms of environment, economic, social?

Interviewer: Do you agree that FLW has three impacts to SV?

1: I do agree with it but for SV, it seems that FLW impact exists obviously to the environment and economics. The environmental impact occurs when we dump unusable waste to the landfills but that's not the big deal since the amount of waste left to landfill is quite low. We just take a few pieces of vegetable, fish and other organic residues to the black bag, send it to the municipality, and eventually leave it to the landfill. For the economic side, if we can reduce the amount of food waste in the production process, it may affect the cost and/or profit. Surely that the cost will be reduced but it does not reduce the price of goods because the price is determined already at the first time. In order to reduce the amount of waste to increase %yield, it would not affect the price whether it will rise or fall.

Q3: What are the motivations and drivers for sustainable management of FLW during tuna processing?

Interviewer: What do you think could be the motivations to manage FLW for SV?

1: Looking deep through the motives for production processing, the staffs who are working might see the yield as the drivers for them. If there is a lot of waste, the supervisor has to look after it. If there's high amount of waste, it will be shown to the managerial level and board of directors. Therefore, the motivations and drivers are the attention of the supervisor by having an overview of the problems and look for the solutions of each cause.

Interviewer: Does SV have the program dealing with Thai governments in order to manage FLW? Or else, are there any offer from the governments to do as such?

1: Technically, we have no offer from the governments but what really drives us to do so is the good management in the factory as well as the reputation for a company.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: What could be the opportunities for FLW management for SV?

1: We believe that our company has the opportunity to reduce the waste from organizing activities in order to cultivate employees to reduce waste to environmental awareness. The factory has the opportunity to be organized regularly every month. And besides, I still have the idea that the factory should have a policy of waste management because it is a good idea. But at the same time, it must be seen how busy the activity is and can be done in the company. If it can be done without affecting work or people and motivated enough to get employees involved. That is really interesting to do. In addition, we have both internal and external CSR. The first is to create consciousness in various forms for the employees. The objective is to have employee awareness. However, the CSR project relevant to FLW is not much pronounced. At the same time, the company has a project called the 'clean canal' at which we have released the wasted waste. It will be done every month.

Q5: What are the constraints to sustainable management of FLW during tuna processing?

Interviewer: What could be the barriers to hinder FLW management? Do you think that technology cost or technical issue can be the constraints as well?

- 1: I personally think that if the reduction of waste will require the use of new technology. It would require a lot of capital but that won't be a barrier as if the payback period can be calculated and presented to executives and managers with the reasonable price, they will be ready to invest. As can be seen from the management level, there is a concern about the reduction of waste that occurs during the production process. They are now taking the efforts to reduce waste during processing in all three factories, for instance, by creating a curved table to reduce the amount of losses that may occur during production.

2. Sea Value Plc. - Processing line supervisor

Q1: What are causes of FLW during tuna processing?

Interviewer: Does Sea Value have any possible FLW causes along the production line?

- 2: The first cause is people or employees, we find that people are the main factors that cause waste to occur during the production process, particularly when scraping fish. However, we have improved and developed curved table to allow people to stand to reduce the fall of the fish. It is still falling somehow but the amount is less than before. The reason why we focus for this problem is that if fish meat falls to the floor, it would not account as product anymore and rather sell to other industry in the lower price since the value is downgraded. In addition, the scraping knives are also the cause of waste but it doesn't contribute as much as people. In my opinion, people is the most important cause to be concerned. I think the main cause is while people competing with speed in order to reach the required order. As such, it may cause the fish to splash. In my mind, I think that the money that the company determines will motivate him/her to do the work that the company has set. Consequently, the employees rushed and the fish splashed on the floor. In addition to this, the mechanic has to do something that the fish at the end of the rails so as to support the fish and that the fish can be used again.

Interviewer: If you conclude that people is the main cause of FLW, then how can SV train and manage that?

- 2: The company has to train people before starting work for about 1-2 weeks, we provide one extra row for the trainers to practice doing fish scraping process. After that, we will let him/herself do it themselves, but as long as they're new to the process, there will be a helper to teach and control particularly to that row as well. Above all, there is also annual training. The supervisors have a responsibility to write a table that what the staffs should practice in each month according to the work instruction.

Interviewer: Is there information sharing/coordination between different departments regarding FLW?

- 2: Talk about meeting with other parties. It is only the same level of supervisor and upper who're discussing with regards to a reduction or disposal of waste with two or three departments. There's no event that all the departments within the organization are having discuss with such problem.

Q2: What are the impacts from FLW during tuna processing in terms of environment, economic, social?

Interviewer: What is the expected impact of FLW in terms of environment, economic, and social? How?

2: For me, the economic impact would be the higher cost of products. If there is a fish falling and we couldn't utilize it to the most efficient way, the cost will be raised. As it would be sold to the animal industry, the value of fish is decreased. For example, canned tuna prices at around 130 baht per kilogram, fish residues are sold to chicken feed factory at 7 baht per kilogram. If the waste is reduced, the cost of disposal will be reduced. As a result, the revenue of the state of our organization's income may increase. For the environment, perhaps fish scraps will be stuck to the pipeline and could contaminate into the pipe. Out of the factory to the environment. It will affect the society as a whole.

Interviewer: In your opinion, which one do you think the most crucial impact? And why?

2: I think that money or that economic results are the most important. But management level may highlight the environment and society as the most crucial ones for the reputation and company image purposes.

Q3: What are the motivations and drivers for sustainable management of FLW during tuna processing?

Interviewer: What do you think could be more motives to minimize FLW for SV?

2: Think that money and the company's policy implementation could drives the staffs to the sustainable management for FLW. In case of the managers, the image of the organization could the motivations for them.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: What could be the opportunities for FLW management for SV?

2: The opportunity to reduce waste is likely to be that the organization has the internal seminars and workshops that empower employees to be aware and knowledgeable about waste reduction and management during the production process. Nonetheless, we still have to look at the workload whether it deserves to reduce waste or not. If the staffs cannot overcome with the extra workload then it doesn't work. At this time, the company has also concern on the reduction of our three factories. Because of the Kaizen, it is good because it will reduce the workload. For me, I have no condition to do so because it is the company's policy.

Q5: What are the constraints to sustainable management of FLW during tuna processing?

Interviewer: What could be the barriers to hinder FLW management?

2: If we reduce waste that means people might have the extra work. As a result, people cannot meet the set goals. In that case, we do not want to go to waste reduction.

3. Sea Value Plc. - Warehousing assistant manager

Q1: What are causes of FLW during tuna processing?

Interviewer: Does Sea Value have any possible FLW causes along the production line?

3: I would say I will focus on loss and waste during storage in the warehouse, especially canning wastage. There're two main reasons: from storage and moving. Storage is caused by employees who store it in the wrong way. For example, the second load will overlap to the first load that is not yet full, damaging the first load. The company solve the problem by support another layer of plywood in order for the weight of the second load to be spread and the cans at the bottom are not torn. The next thing is that people who drives folk lift is moving goods from one location to another with such as high speed with carelessness. These will consequently be the opportunity to damage the product. The cause of such high speed may that the folk lift people will have more time to rest. The company has solved the problem by adding the sheet of paper to the front and back of the carton in order to reduce the impact to can. Apart from that, we also added pads to the folk lift to reduce bumps. The speed issue is solved by talking to employees that they should distribute time to move goods. Do not hurry, but we will not go to force him much since we concern that don't want to pressure the employee. Hence, the main reason is caused by people.

Interviewer: If you conclude that people is the main cause of FLW, then how can SV train and manage that?

3: In general, we will basically train them 1-2 days. If they drive so fast, we will observe and warn them. Sometimes we have to stay but not all the time. We mostly have a talk with them as there's no KPI indicator pointed out directly to each staff. In order to recruiting new employees. There will be only 1-2 days as I told you. However, if some part that needs to be more detailed may take a little longer time. The training will be mostly based on the job training (OJT) that there is no clear schedule for what the training will be today. Nevertheless, the whole factory is planned for each month. But there is one disadvantage, for example, if we train for storage in November. But the staff came in December. Therefore, this employee will not be trained on storage. This may happen next December. The training in each subject is a loop.

Interviewer: How many level of damaged canning for SV?

3: There are many levels of damaged canning. QC will be the one who considered whether the finished goods can be sold or not, depending on the regulation of the destination. Warehouse will talk to the QC before the product go on. The initial level called 'minor' is a slight bump can.

Interviewer: Is there information sharing/coordination between different departments regarding FLW?

3: The warehouse will collaboratively work with production, such as communication between the warehouse and production, using paper, create plywood to reduce damage during transportation and storage. Both sides talked about the problem of canning. Warehouse also contacted Borneo or a supplier who transported goods from one warehouse to another. We talked to him about the need to be cautious because of the canned goods. After talking,

the amount of distorted can dropped. After QC, the product is shipped back to production to re-process the fish. The can is sold to other industry.

Q2: What are the impacts from FLW during tuna processing in terms of environment, economic, social?

Interviewer: What is the expected impact of FLW in terms of environment, economic, and social for SV? How?

3: In my opinion. It does not affect the environment as all wastes are re-process. The economy may be affected most, then environment and society since the re-process will increase the cost of production, the profit will decrease. But it may not affect the company's overall profit because the proportion of sales to the number of bumps is as large difference. Much Like a hundred million sales while only thirty-thousand-baht distortion. In addition, KPI is set at 0.25-0.27%. Ten thousand canned products have a maximum of 27 cans. Throughout the year, we were able to control the overwhelming, which we have reduced KPI at 0.20% was quite difficult to do so. This will lead to a discussion on the management level for the solutions. And the defense and KPI will set out every year. If asked what impact these three aspects are most important.

Interviewer: In your opinion, which one do you think the most crucial impact? And why?

3: I think the environment for the image of the company. But we can control this problem.

Q3: What are the motivations and drivers for sustainable management of FLW during tuna processing?

Interviewer: What do you think could be the motivations to manage FLW for SV?

3: In the employee's mind, there should be motivation or differentiation that they have engaged. Just like a little bonus. The staff will look at the main income, may not be money but something else, for instance, social welfare. I believe that employees will be more motivated to work. At the level of the elder I cannot imagine what motivates us to do.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: What could be the opportunities for FLW management for SV?

3: In addition to training and the additional equipment we made to staff. I do not think so. But if we look at the long term, we can cut out the person to the robot system, such as production. The storage process in the warehouse itself just has only 1-2 worker to monitor. But we have to consider the cost. The cost is very high.

Q5: What are the constraints to sustainable management of FLW during tuna processing?

Interviewer: What could be the barriers to hinder FLW management?

3: Personally, I think that finances are not very problematic. If things are going to work well in the long run with the factory. In addition, the executive level has a project to build a new warehouse. Or if the company has policy to reduce waste during the production process. I'm open to listen. The condition is unlikely to be. If it can actually fix the problem. If the payback period is reasonable. I think that the management does not stick to anything. We can proceed.

4. Tuna industry expert

Q1: What are causes of FLW during tuna processing?

Interviewer: Any possible causes along the production line, from inbound to outbound logistics?

4: There are four major causes of waste, namely the first setting of machines. Because of this step, we have to try the process before so the FLW can be caused by this process, such as different fish size or change the size of the can from A to B on a daily basis is quite manual. The first runner may be torn and unusable. At that point, it is a practical problem. The first part of the process run is about 1-2%. The second is run process in the wrong conditions, the defect causes because it is not the same product every day. Some can be totally filled but some is not. If this point is broken, it will affect quite a lot. It will affect each other, might lead to the thermal process, the fish has to brought back to warm up again. Or if it's not completely filled, we need to repack again and then cost would be higher. Fish will be brought to re-process, but canned is being disposed or sold. The third cause is the machine. During production, there may be some of the fish caught with the blade. Or track the machine, especially the very moist. If the fish is rehydrated, it will spoil the texture. If the re-pack is not useful. They have to sell to feed mills. Each day, the amount of waste is about several kilograms per day. The final cause of human error is that it is a work error from both the production and QC department may be due to the fact that they differently focused on each KPI, both parties misunderstand the spec or understand in the different way. But it is not often happened. These fish may be re-packaged, which means that the use of tools is the most important reason to fix. People who is dealing with the tools must have knowledge about what the machine is, how it works, how to deal with it. People who has no experience and knowledge with such machine should go through training first. Other choice could be that we could pay more for skilled people such as supervisor or team leader to work with the machine.

Interviewer: How can you think when people training will be helpful for not causing FLW?

4: Generally, companies are training their employees already. Normally it is every three months. Because we produce wild tuna, so the quality of each source may be different. This may have extra training by training from the bottom to the Supervisor level on how to manage the tuna received in each Lot, how to process, or pack effectively.

Interviewer: How is the efficiency of fish transportation could be?

4: For fish transport systems, the company will send QC to receive raw material at pier and measure core temperature (must be lower than -18 °C because the bacteria that produce histamine will not activate at temperatures below -18 °C), salt intake, histamine. After the fish is put on the car, it is time to determine how long it will take to transport the fish to the factory and the temperature. In addition, the factory has a system of food loss and waste management in the production process, such as if we found bacteria in fish. We will freeze the fish first and follow the managerial plan of the company.

Q2: What are the impacts from FLW during tuna processing in terms of environment, economic, social?

Interviewer: What is the expected impact of FLW in terms of environment, economic, and social? How?

4: For the can, the environmental impact is significant because of the energy lost in the manufacture of can is huge. And the amount of carbon dioxide used in the canning process is also very high. So, it would have a negative impact on the environment. For fish that can be decomposed. However, it must be taken into account that we should utilize fish to be the most effective since it comes from natural resources. For the economy will affect quite a lot. In terms of labeling, cost of marketing, rent, logistics, etc. Hence if there's a lot of waste rather than the expectation, it will affect the economy hugely. In summary, the production of waste may have the effect of supply chain. If one talks about the factory level, the cost of re-work is quite high. The loss of each day in the management of waste about a hundred thousand baht. I couldn't think of the social side.

Interviewer: In your opinion, which one do you think the most crucial impact? And why?

4: Of all these three effects. The most important one is the economic impact that should be realized in both private and national entity.

Q3: What are the motivations and drivers for sustainable management of FLW during tuna processing?

Interviewer: What do you think could be the motivations to manage FLW for tuna industry?

4: In the sense of management thinking. Increasing opportunity or competitive advantage can be an incentive to reduce waste, as lower losses are associated with lower costs. The motivation figure is that the level of management is level 4, as can be seen from the Dow Jones index; sustainability index.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: What could be the opportunities for FLW management for tuna industry?

4: Could be the policy. If the executives pay attention and are interested in reducing this waste. This will help to motivate all employees to become aware and pay attention to this matter. This is a policy setting for the importance of reducing the percentage of food loss and waste in order to increase profits and sustainability to the company. Management level also need to know the reason why they need to reduce FLW and what's the benefit to reduce? The last part corresponds to the operating level in the correct operation as planned which should follow the systematic management of raw materials. And always keep in mind that the management plan should be updated and developed.

Interviewer: Have you heard of a coordinating program between governments and tuna industries in order to overcome with FLW problem?

4: There is one project, so called a 'tuna big brother' project. This project has been worked collaboratively between Thai governments and big tuna factories in order to sharing knowledge with small tuna factories. By having the ultimate goal of helping smaller factories to produce better quality products which could drive Thai tuna industry as a whole country being successful in the world.

Interviewer: What is your opinion toward this project?

4: Personally, I think FLW should be managed because tuna comes from the natural source, so we need to use it to the maximum benefits. Management must be well organized to achieve the lowest FLW%, because what is lost in addition to the profit of the company is also a waste of natural resources.

Q5: What are the constraints to sustainable management of FLW during tuna processing?

Interviewer: What could be the barriers to hinder FLW management?

4: Technology, because some technologies are inconsistent with the production process, so FLW may occur consequently. Next, the machine user must have an understanding of the technology that should be used for maximum efficiency and effectiveness. The third part is the budget. If we have enough to use the technology properly and hire the right people to work here, it is a good thing.

5. TEI- Director

Q2: What are the impacts from FLW during tuna processing in terms of environment, economic, social?

Interviewer: What is the expected impact of FLW in terms of environment, economic, and social? How?

5: Think economically, it may affect the business owner. That is, the costs of waste management and the cost of waste treatment are incurred. The environmental aspect is that if the waste during the production process is very high. It may imply the use of inefficient and inexpensive natural resources, such as energy, transportation, etc. Environmental impacts in the surrounding area may affect the social impact. That is, the society around the factory. For canned tuna waste, most organic is quite stinky. And there are not many chemicals, so this waste is not difficult to manage. Because it can use biodegradable microorganisms. But must be in good control. If not, it can spoil the outside society itself.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: Is there any program/concern for improvement of FLW control by hands of your organization?

5: There are currently neither consumer advertising project nor the entrepreneur taking into account the importance of the environment. However, the Office of Natural Resources and Environmental Policy and Planning (ONEP) has taken this into account and decided that this policy should be formulated. SCT12 is the driving force behind this. It is targeted at food loss and waste. Another opportunity is that if the entrepreneur is knowledgeable about the technology and realizes that the reduction of waste will save the cost, this is likely to be a chance of reduction.

Q5: What are the constraints to sustainable management of FLW during tuna processing?

Interviewer: What could be the barriers to hinder FLW management?

5: Limitations could be technology, the ignorance of the entrepreneur on how to reduce the waste, include irresponsibility and unawareness of the society and the environment of the factory owner. The factory may secretly discharge waste during the rainy season.

6. TEI - Project Manager/Researcher

Q2: What are the impacts from FLW during tuna processing in terms of environment, economic, social?

Interviewer: What is the expected impact of FLW in terms of environment, economic, and social? How?

6: It can have a huge environmental impact if the environment is fragile and may affect the social or people around the factory. In case that the company removes the remaining fish from the production process, the responsible waste disposal unit has to have the standard. I think this does not have a serious environmental impact. However, most of Landfill's Pollution Control reports in Thailand are rarely standardized like foreign ones.

Q3: What are the motivations and drivers for sustainable management of FLW during tuna processing?

Interviewer: What do you think could be the motivations to manage FLW for tuna industry?

6: If the participating agencies can point out to the company or factory that the improvement of the production process is in line with the reduction of the waste generated by the production process, for instance, reducing costs or increasing revenue, this may result in the company's incentive to reduce FLW. We need to link entrepreneurs to see what's happening, there is still a value that can be produced manually or can be forwarded to other companies. For example, molasses can be converted into energy, then sell as electricity. Nonetheless, it must be seen that the capital to invest the company is reasonable or not. Another possible driver for a company is that the company also has the image of being environmentally friendly. And was promoted by the label. This will make the company more motivated. For the domestic marketing mechanism. If the government has a policy to encourage entrepreneurs to label environmental conservation or green label will be more stimulating. It is also the driving force for entrepreneurs to reduce and manage waste that is generated during the production process. For example, the government may have a policy of promoting tax deduction from the operators who have green label and/or carbon label. In addition to this, the international marketing mechanism can drive waste management as well, such as the exporting of canned fish to other countries in the EU requires FLW management, the entrepreneurs are struggling to adjust the production process to the prescribed rules. For consumers' consciousness, it is another part of defining the direction of waste management, as most people in the country are willing to buy environmentally-friendly products. The green label or the carbon label would be another factor that will make entrepreneurs adapt to the needs of consumers. In terms of the stock market, companies that want to get a sustainable reward or have a reputation for sustainability may need to manage the production process. If the company is very sustainable, it may be in a good ranking on the stock market. Therefore, the more the company want to have a better image in the environment and sustainability, the faster they need to manage FLW.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: Is there any program/concern for improvement of FLW control by hands of your organization?

- 6: The institute has the limited encouragement for the consumers to pay attention to environmentally conscious products by having public relations as we have a limited set of operations. Most are defensive rather than offensive. Our work will focus on coordinating with government agencies by pushing the government to set more policies like tax cuts or low interest loans. If the government set this as the law, entrepreneurs will be more responsive for FLW. But it must be taken into account the effects that can occur. There may be complaints if the law is too strong. At present, the government is motivating the industry rather than introducing the law. For the responsible state agencies, this is the Ministry of Industry who will oversee the production of controlled industries. And the Ministry of Natural Resources and Environment, which oversees the environmental impact, acts as a watchdog, coping, or warning, rather than seeking a matter of food and waste. So, the government should give incentives to entrepreneurs more than what it was.

7. TTIA - Executive director

Q1: What are causes of FLW during tuna processing?

Interviewer: What is the expected impact of FLW in terms of environment, economic, and social? How?

- 7: If you look at the economy, the tuna industry is quite driven by Thailand's GDP because Thailand imports and exports the most tuna in the world. In terms of exports, the major markets are America, 18%, Europe, 7%, Australia 5%, Japan 5%, Exports worth about 80 billion, 80 billion baht per year (2017 exports 70,000 million). Skip jack, Yellow fin is imported. In the country, it is Black Oat fish Pattani, but relatively little. Thailand will get into frozen form. The value of imports in 2017 is 43,000 million, with the advantage that we have a lot of factories. In terms of packaging, we have the advantage of being a major exporter of the world. The environment and society will come together. The economic impact is likely to be most significant, given the large import and export gap (2017 is 30,000 million baht), which can have a huge impact on the economy. Including hiring a factory supply chain, such as canned vegetable oil plant.

Q3: What are the motivations and drivers for sustainable management of FLW during tuna processing?

Interviewer: What do you think could be the motivations to manage FLW for tuna industry?

- 7: Reducing costs and increasing profits is likely to propel entrepreneurs.

Q4: What are the opportunities for sustainable management of FLW during tuna processing?

Interviewer: Is there any program/concern for improvement of FLW control by hands of your organization?

- 7: Other agencies that fund projects are listed below. To save energy or cost, the Federation of Industries may create opportunities to reduce waste from college, such as King Mongkut's University North to contact the factory directly.

The factory needs to solve the problem. Operators can offer their own problems.

Q5: What are the constraints to sustainable management of FLW during tuna processing?

Interviewer: What could be the barriers to hinder FLW management?

7: It is based on managerial level and board of director in the company. How do they listen and see? And at least management should have basic knowledge.