

Innovation in Value-Added Development of Liquid Waste in the Fish and Surimi Processing Industry Case Study at PT Starfood International Lamongan and PT Kirana Food International Tuban

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Abstract:- Solid and liquid waste has not been widely utilised by the fishing industry in Indonesia. Waste treatment becomes the company's *cost centre* by building a Waste Water Treatment Plant so that the water meets the proper water quality standards so as not to pollute the waters around the factory. In the seafood production process uses a lot of water for various purposes. The more water used, the more potential for pollution. Reducing waste contamination will be one of the important steps for business and environmental sustainability so that innovation is needed to implement waste management. This research aims to analyse the potential of waste into circular business potential with the *Business Model Canvas* concept approach. The results of this research are expected to be useful for fishing industry companies, namely technical production from liquid waste which was originally a *cost centre* to fish oil as a *profit centre*. The test results of crude fish oil processed from fish processing waste showed good results and were within the *Food Grade* standard based on SNI, Codex and IFOSS criteria. These test results confirm that there is potential for processing fishery industry waste into consumer fish oil. Furthermore, this potential can be improved into a product innovation towards commercialisation and potential positive financial benefits. Furthermore, the innovation of increasing the added value of Surimi industrial waste and fish processing also has a positive impact on the environment and business sustainability through reducing the final waste contamination towards the concept of *zero waste*.

Keywords:- Innovation, Environmental Sustainability, Fishing Industry Waste, Sustainable Development Goal (SDG), Circular Economy, Zero Waste, Business Model Canvas, Fish Oil.

I. INTRODUCTION

➤ Background

According to a report by the *Boston Consulting Group* (BCG), globally 1.6 billion tonnes of food, worth around \$1.2 trillion, is lost or wasted every year. Food loss occurs along the value chain, and as much as 32% is wasted in the production process. *Food loss* is when food is lost unintentionally e.g. due to spoilage, which mostly occurs at the farm and logistics level. *Waste* is when food is fit for human consumption but is discarded, mostly at the retail and consumer level. Food waste is a global problem with environmental, social and economic consequences. Waste reduction will be one of the important steps towards a more sustainable society thus urging new solutions to implement sustainable waste management practices.

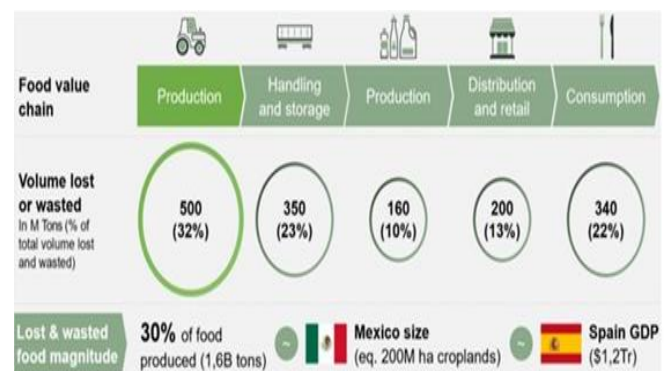


Fig 1 Food Loss in the Food Chain (Hegnsholt et al, BCG, 2018)

One of the products that can be developed from fish processing waste is fish oil production. Suseno (2021) stated that the potential of Indonesian fish oil is very large, which is above 12,000 tonnes/year. By increasing the added value of fish processing results for tuna alone, it is predicted that profits can reach 3.8 billion per month with a production capacity of 20 tonnes of tuna per day. This capacity can produce 96 tonnes of crude oil, which is equivalent to 76 kilograms (kg) of refined oil. Through refining, the price of

crude oil which was previously Rp 20,000 per kg will double to Rp 4 million per kg in the form of softgels.

Indonesian fish oil, such as sardine oil, has entered the high-trade category with a production capacity of 10,000 tonnes per year. Its omega 3 content is even higher than salmon oil. The existence of a good national fish oil research laboratory, finding and supporting innovations, and being able to be implemented in the form of fish oil refining technology must be supported by all parties with the right policies. There are many positive impacts both economically and socially that will be obtained by the country if the fisheries industry continues to grow through the utilisation of fish processing industry waste into fish oil, given the great potential of the Indonesian fisheries sector.

In the domestic fisheries industry, not many parties have conducted research and plan to develop fish waste into fish oil. Domestic companies that have conducted research and will develop innovations with the main raw material of waste from fish processing into fish oil are PT Starfood International (SFI) and PT Kirana Food International (KFI). Innovation with the main raw material of waste from fish processing into fish oil is expected to grow. This is a consideration for making this fisheries industry company the object of research and is expected to contribute to improving the sustainability of the company through innovations to increase the added value of surimi and fish processing waste.

➤ *Problem Formulation*

Food waste must be reduced globally to meet sustainable development goals, as well as supply nutrients. Innovations in the food industry, including the fish processing industry, can reduce waste to the environment while adding economic value.

Innovation in the fishery product processing industry in the form of fish oil production has not been widely developed in Indonesia. Even though the waste from fish processing such as the head, fins, intestines, bones and thorns are wasted due to the lack of innovation in processing them. Based on previous research, fishery waste can still be processed and has high economic value. Suseno (2021) revealed that the omega 3 content in tuna tails, which are often discarded as waste, is extraordinarily high, reaching 29.44 per cent. Innovation is needed to maximally obtain added value from the fish processing chain, by utilising fish waste to be processed into fish oil. This innovation is important considering the omega 3 content in fish oil has an important role in human health and nutrition. On the other hand, the government has yet to establish fish oil production as one of its main programmes. This is despite the high omega-3 content in marine fish such as sardines, tuna and snapper in Indonesia.

By looking at the promising prospects of the fisheries business in the future and the potential benefits of fish waste, an innovation solution is needed, namely by developing the *invention of the potential benefits of waste from fish processing into a business model that can be*

developed commercially. Fishing industry companies do not know the potential that can be utilised from fish processing waste in the fishing industry. The research aims to propose innovation in waste utilisation into a business model that provides economic value and has an impact on environmental *sustainability*.

➤ *Research Objectives*

Based on the background and problem formulation above, this research focuses on aiming to find out and analyse the following things, namely:

- *Identify and analyse the potential for innovation through processing fish processing waste and surimi production into fish oil.*
- *Knowing the economic added value of fish waste utilisation innovation*
- *Analyse the potential added value of fish waste innovation for Environmental*
- *Sustainability.*
- *Developing a business model for innovative fish oil production from fish processing industry waste and surimi.*
- *Develop comparative and competitive strategies of fish oil business for business innovation development.*

➤ *Research Benefits*

The results of the research are expected to be useful for various parties, namely:

- *The results of this study are expected to be initial research that can be continued in subsequent studies to find things that have not been studied in this study.*
- *The results of the study are expected to be useful for policy makers and stakeholders in the fisheries sector in Indonesia.*
- *The research results are expected to provide insights to business actors, fisheries practitioners, research institutions, business management consulting institutions, fisheries training institutions, environmental activists and communities interested in developing fish processing waste into fish oil.*

➤ *Scope of Research*

The research was conducted by going to the field by conducting surveys and discussions with directors and employees at PT SFI and PT KFI who are members of the Kelola Mina Laut Group (Kelola Group). PT SFI is a *seafood processing* company established in 2010 which is located in Paciran District, Lamongan, East Java. Meanwhile, PT KFI is a PMA (Foreign Investment) company located in Tuban, East Java, which is a business collaboration between Kelola Group and a Japanese company. The main products of PT SFI are frozen Surimi, frozen *Demersal* fish, frozen *Pelagic* fish, frozen *Cephalopods* and fishmeal and fish oil (*feed standard*). While PT KFI's main product is frozen mackerel. The scope of the study is limited to liquid waste generated from processing surimi derived from small demersal fish at PT SFI, as well as solid waste generated from processing mackerel at PT KFI.

Data collection was conducted from October 2022 to November 2022 and *expert interviews* were conducted with fisheries and fish oil experts.

II. LITERATURE REVIEW

➤ *Innovation*

Innovation is a necessary factor for an enterprise to find a way to survive. Only through continuous innovation can enterprises seek long-term development. If an enterprise does not know how to innovate and pursue improvement, the life of the enterprise will soon stop and it will risk dying. The essence of innovation is the need for enterprises to break through their own limitations and create more new systems and initiatives to meet the needs of the economic market under the only available conditions, so as to stay at the forefront of the trend of the times, provide a solid foundation for enterprises, win fierce market competition, and bring new growth points for enterprises (Zhuang, 2022). Enterprises that face high innovation costs, feel uncertainty in demand and markets for new goods and services and exhibit a shortage of qualified personnel to carry out innovation activities and a lack of market information are less likely to innovate than enterprises that do not experience these difficulties, the lack of external financing also affects the tendency of enterprises to engage in product innovation and creates barriers to innovation. (Madeira, Moreira, Carvalho, & Duarte, 2017). Corporate culture innovation largely affects corporate management innovation, and corporate culture innovation can continuously enhance the centripetal force and cohesion of the enterprise, reflect the core values of the enterprise, play a positive guiding role in corporate innovation management. Through corporate culture innovation, corporate management innovation can be realised, corporate operating efficiency can be improved, and corporate maximum value can be realised, so as to complete the long-term strategic development goal of the enterprise. (Yuan & Chen, 2022)

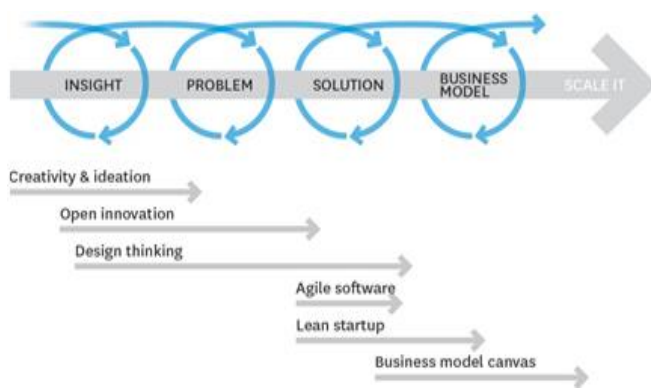


Fig 2 Innovation Process (Furr, Dyer, 2014)

The modern concept of innovation implies both institutional and technical innovation, hence the combination or integration of the two dimensions of innovation requires cross-cutting and interdisciplinary studies. Some false dichotomies that can undermine the debate on innovation need to be addressed, including: i) innovation focussed on technical or technological progress vs. institutional change; and ii) pragmatic market and technological innovation vs.

idealistic systems innovation. These dichotomies, which reveal simplistic approaches, are often part of the same system and therefore do not allow the development of a truly innovative research agenda (Boochi et All, 2012).

➤ *Fish Waste Management for Environmental Sustainability*

Waste management techniques have an order of application known as the waste hierarchy. The order of techniques in the hierarchy is as follows: 1. strict waste avoidance, 2. reduction at source, 3. product reuse, 4. recycling/composting, 5. energy recovery and, 6. disposal (Huhtinen, 2009).

Fish scraps and processing by-products represent a large proportion of indigenous fish, and their disposal has a high environmental as well as economic impact. The utilisation of waste as feedstock for the production of different classes of *biofuels* and high-value chemicals, a concept known as "*biorefinery*", can be part of the circular economy vision and *zero waste* policies. In this context, a valorisation route that attracts attention is the extraction of omega-3 fatty acids (ω -3 FAs). These fatty acids, such as *icosapentaenoic acid (EPA)* and *docosahexaenoic acid (DHA)* exert their beneficial effects on human health. The high resale value of the product makes this waste a powerful tool that simultaneously protects the environment and benefits the global economy (Afio, Manzo & Micillo, 2021). These discards, bycatch and wastes are a rich source of nutrients, essential industrial materials and also bioenergy. Green processing can promote zero-waste seafood processing, environmental protection, blue economy and potentially realise the United Nations Sustainable Development Goals (SDGs), particularly SDG #12.3. (Venugopa, 2022)

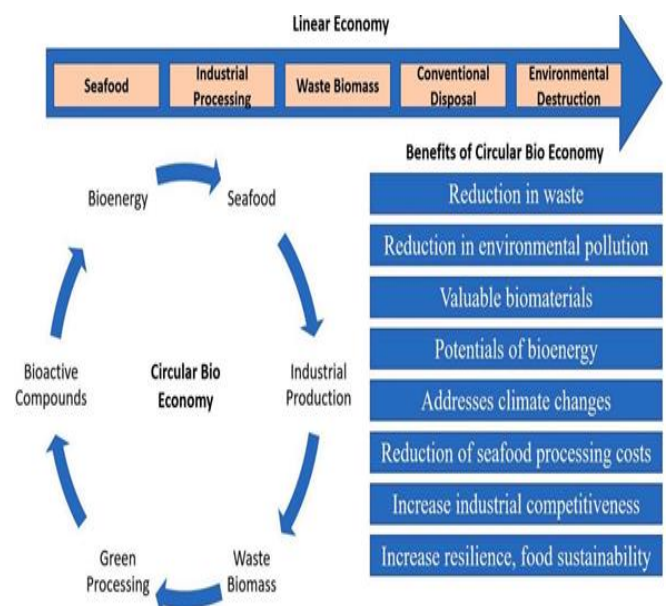


Fig 3 Blue Economy Gains Through Green Processing of SWB in a Circular Bioeconomy Model Compared to Linear Economy-based Waste Management (Venugopa, 2022).

➤ Previous Research

Table 1 Previous Research

S No.	Topik	Nama Jurnal	Penulis	Tahun	Temuan
1	Inovasi	The Ways of Corporate Innovation: A Review Analysis	Jingyao Zhuang	2022	Inovasi telah menjadi suatu bagian yang tidak terpisahkan dari masyarakat. Inovasi adalah inti dari sebuah perusahaan. Tanpa inovasi, perusahaan akan kehilangannya daya saing inti. Perkembangan perusahaan tidak dapat meninggalkan dukungan inovasi. Demikian pula, inovasi tergantung pada pengembangan perusahaan. Keduanya saling melengkapi.
2	Inovasi Hijau & Keberlanjutan	From Fish Waste to Value: An Overview of the Sustainable Recovery of Omega-3 for Food Supplements	Vincenzo Gabriele Alfio; Cosimo Manzo; Dr. Raffaella Micillo	2021	Limbah merupakan sumber daya yang berharga dan menguntungkan yang mampu membawa kesehatan, sosial, ekonomi, dan manfaat lingkungan. Ekstraksi asam lemak omega-3 (ω -3 FAs) untuk aplikasi nutraceutical. Asam lemak ini, seperti eicosapentaenoic acid (EPA) dan docosahexaenoic acid (DHA) memiliki efek menguntungkan mereka pada kesehatan manusia. Produksi berkelanjutan adalah proses kunci untuk mengimbangi peningkatan permintaan pasar sambil mengurangi tekanan pada ekosistem laut dan mengurangi dampak produksi limbah. Tingginya nilai jual produk membuat limbah ini menjadi alat ampuh yang secara bersamaan melindungi lingkungan dan menguntungkan ekonomi global.
3	Pengolahan Limbah Ikan	Potential utilization of fish waste for the sustainable production of microalgae rich in renewable protein and phycocyanin- <i>Arthrospira platensis</i> /Spirulina	G. Shanthi; M. Premalatha; N. Anantharaman	2021	Hasil menunjukkan bahwa limbah ikan berupa FPH bisa menjadi nitrogen organik yang potensial untuk budidaya Spirulina dengan pigmen berkualitas tinggi, meningkatkan berat sel keringnya, dan produktifitas biomassa meningkat, peningkatan senyawa seperti phycocyanin dapat digunakan sebagai pewarna makanan alami untuk industri makanan, tidak ada polutan sekunder yang dihasilkan dari pasokan nutrisi. Pemanfaatan limbah ikan untuk budidaya Spirulina mengurangi pencemaran lingkungan sekaligus meningkatkan ekonomi dari proses secara keseluruhan.
		Fish Oil and Fish Meal Production From Urban Fisheries Biomass In Japan	Atsushi Ido;Mika Kaneta	2020	Nutrisi dan kualitas FO dan FM dari UFB sebanding dengan yang dari ikan utuh.

III. RESEARCH METHODS

The data collected in this study consists of two types of data, namely primary data and secondary data. Primary data includes laboratory test data related to the content of elements in many fish, as well as information, opinions, policies and considerations derived from factory visits at PT KFI and PT SFI and interviews with experts. Meanwhile, secondary data was obtained through literature studies related to the fish oil industry.

This research focused on creating an innovation model for the utilisation of fish processing waste. Researchers conducted a literature study on the innovation potential of fish processing industry waste utilisation and business model development for new *inventions*. The *expert judgement* method was used to confirm the innovation potential and develop the business model. This method is the most widely used method in the initiation and idea development stages of the business innovation process (Gilsing R, et al, 2022).

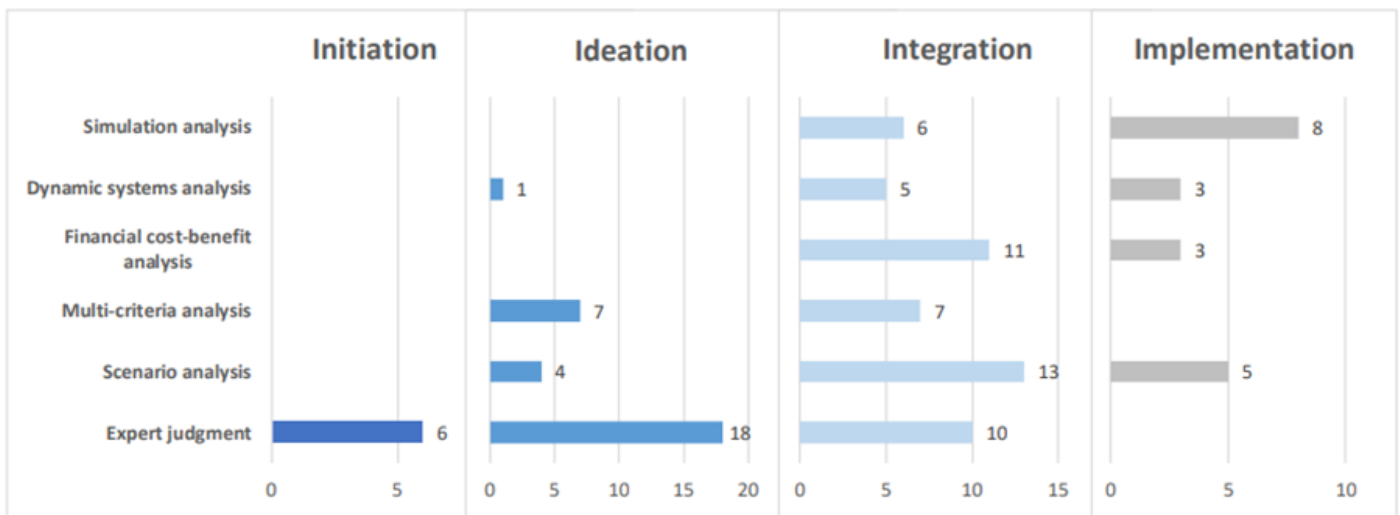


Fig 4 Evaluation method at the stage of business model innovation process (Gilsing R, et al, 2022)

Business model identification begins with a literature study, mapping the company's current business model and mapping the business ecosystem based on the results of fieldsurveys, interviews with the company and interviews with *experts* in the field of businessinnovation and fisheries.

The data obtained was then used as a reference and analysed qualitatively to explain the condition of each business model element. The analytical tools used were SWOT analysis and the *Business Model Canvas* method (Osterwalder and Pigneur, 2010). A Business Ecosystem is a dynamic and interdependent

structure of inter-organisational relationships for sustainability, in this case sustainable business activities (Townsend 2012a). In Moore's business ecosystem mapping model, the business ecosystem is the relationship between actors in a business that is grouped into 3 layers, namely the *Core Business*, which maps the core activities in a business, *the Extended Enterprise*, which maps business actors who directly interact in core business activities, and the *Business Ecosystem*, which includes actors who can influence business dynamics, both directly and indirectly (Figure 5).

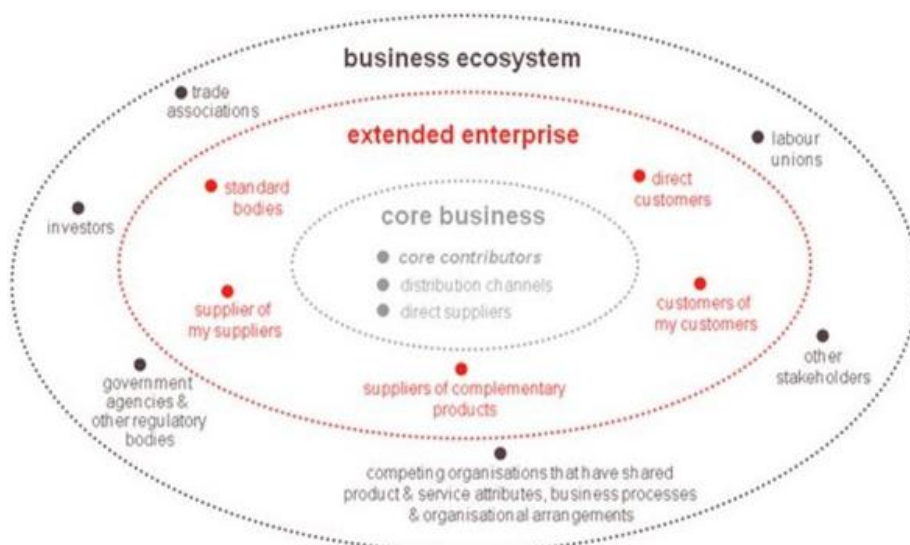


Fig 5 James F. Moore's Business Ecosystem Actor Model (Townsend 2012).

Furthermore, the business innovation model was developed based on the results of business ecosystem mapping, SWOT analysis at PT SFI and KFI, and the results of *expert judgement* on the proposed innovation. The business model used as a guideline in this research is the *Business Model Canvas* (BMC), which was first introduced by Osterwalder and Pigneur (2010). BMC looks at the company through nine elements, namely: (1) *Customer segmentations*, (2) *Value Propositions*, (3) *Channels*, (4) *Customer relationships*, (5) *Revenue streams*, (6) *Key Resources*, (7) *Key Activities*, (8) *Key Partnerships*, and (9)

Cost Structure.

Finally, the *Value Proposition of the fish oil business* in Indonesia is analysed, so as to produce the right strategy for the sustainability of the fish oil business.

• *Expert Panel:*

Prof Dr Sugeng Heri Suseno Prof Dr Ir Nurjanah, MS Sidrotun Naim S.Si., M.Mart.St., M.S., M.P.A., Ph.D. Budiman, R,A (Practitioner) Ikrom, H (Practitioner)

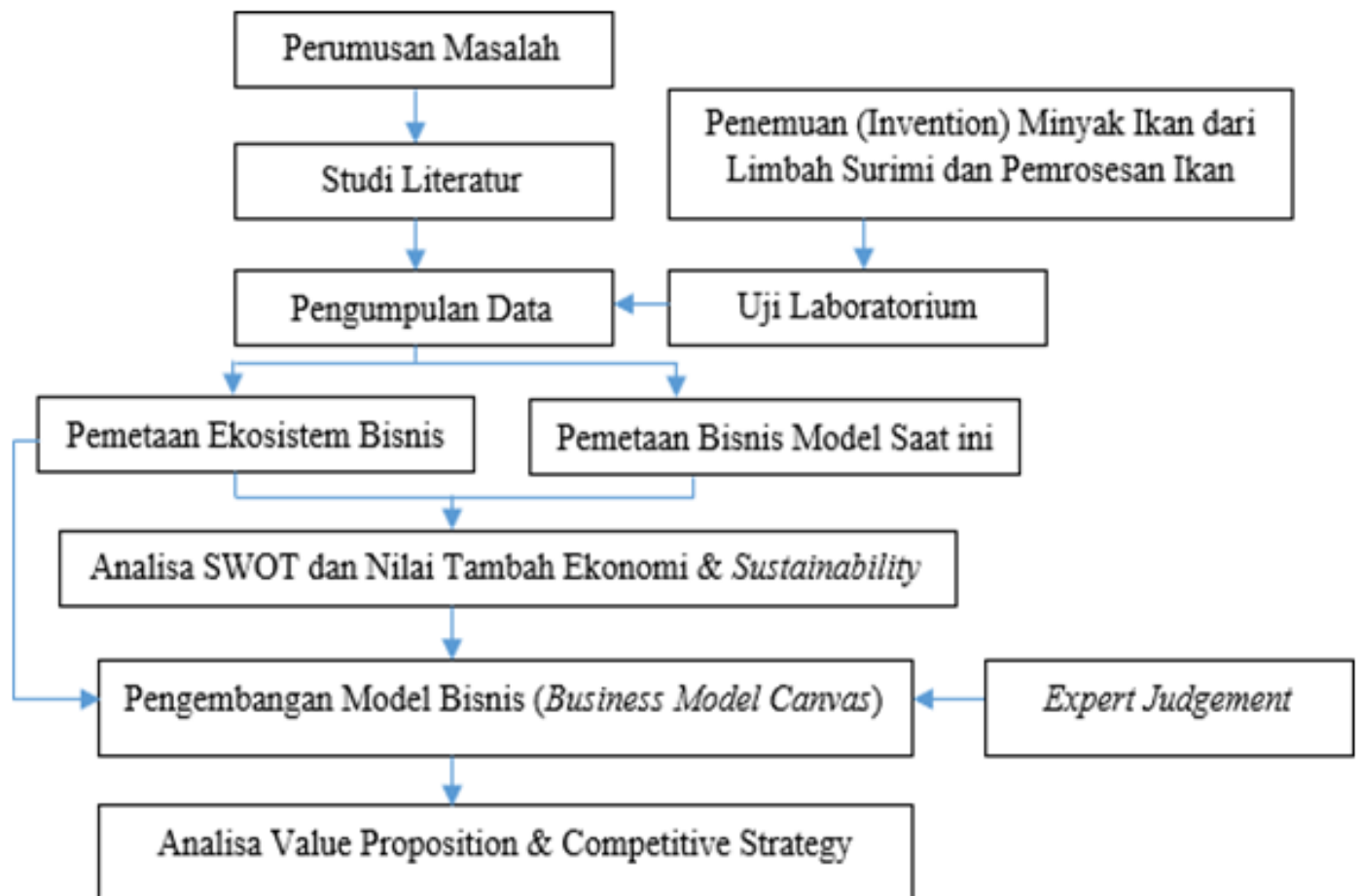


Fig 6 Research Framework

IV. RESULTS AND DISCUSSION

➤ *Processing Surimi Waste Into Fish Oil*

The main products of PT SFI are frozen Surimi, frozen Demersal Fish, frozen Pelagic, frozen Cephalopods and fishmeal and fish oil (*feed standard*). The export destination countries for the company's products are Taiwan, Malaysia, Singapore and China. The fish raw materials used are the Small Demersal fish group, namely Kurisi fish (*Nenimperus virgatus*), Kuniran fish (*Upeneus sulphureus*), Kapasan fish (*Penthaprion longimanus*). The yield of these three fish species into Surimi is around 27-28%. Meanwhile, wide-eyed fish (*Priacanthus macracantus*) and Coklatan fish (*Nemipterus japonicas*) produce yields of around 20% only. These fish are caught from the Java Sea or WPP NRI 712 with bag nets.

In the fish *leaching* process at PT SFI, a liquid containing fat is obtained floating on the surface of the fish *leaching* basin. This fatty liquid is cooked at 70-80°C for 30 minutes, cooled and filtered to obtain *crude fish oil*.

MODEL RECYCLE PENGOLAHAN LIMBAH CAIRAN BERMINYAK SURIMI MENJADI MINYAK IKAN "CRUDE OIL" KOMERSIAL

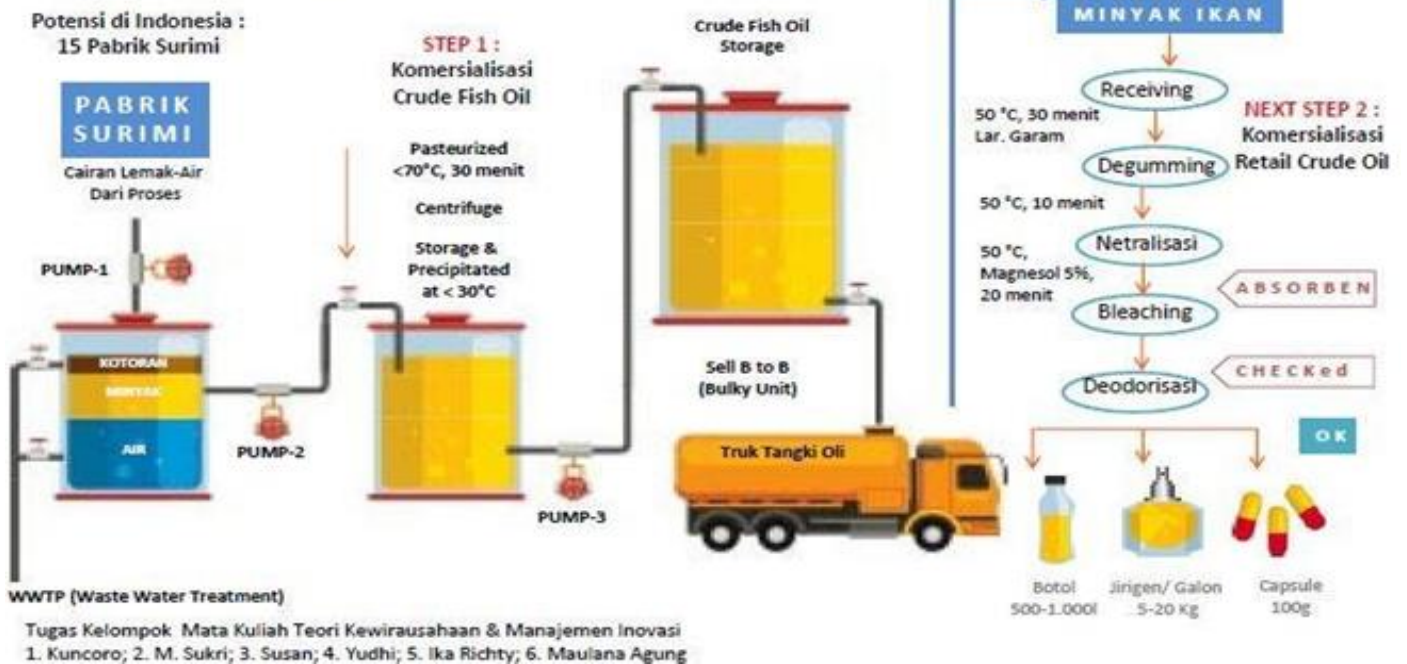


Fig 7 Fish Oil Production Process from Surimi Waste

The results of laboratory-scale experiments of fish meat washing liquid in *leaching* tanks with a composition of the amount of water 5 times the amount of meat at a temperature of 5 ° C in the form of cold water with a stirring device. This condition makes the fat or oil float to the top and enter the collection funnel. The resulting liquid, which contains a lot of fish oil, is collected in a large tub. Fish oil collectors collect the oil at any time and take it to the cooking area. The temperature used is around 70-80°C for 30 minutes. The observation result of the crude fish oil content as a by-product of demersal fish surimi processing at PT Starfood International Lamongan is 0.5% of the raw material. This crude fish oil is taken from the fat contained in the surimi wash water. Test results at Angler and Saraswanti's external laboratories show that fish oil from this wash is in accordance with SNI (Indonesian National Standard), Codex and IFOS standards, especially for the Acid Value test (1.47 mg KOH/g); Anisidin Value (9.71); Peroxide Value <math><1\text{ meq O}_2/\text{Kg}</math> and ToTox (11.1). Currently in the process of testing the content of Omega 3, 6 and 9. From the literature, kurisi fish contains EPA 3.05-4.68% and DHA 7.68-13.35%.

On an experimental scale, the results of crude fish oil at PT SFI meet the criteria of SNI, Codex and IFOSS standards conducted by Angler and Saraswanti Laboratories.

In addition to PT SFI, potential raw materials can be obtained from solid waste in the form of mackerel heads and fins processed by PT KFI located in Tuban. The main processed fish are frozen *Atlantic mackerel (Scomber scombrus)* and *Atlantic salmon (Salmon salar)* imported from Sweden, Norway, the UK and the Netherlands. PT KFI does not produce surimi, but rather *processes* frozen fish, namely the process of fileting fish, *trimming* and marinating

some of the fish or soaking in 3% salt water, and then freezing it with an IQF (*Individual Quick Freezing*) machine. Last year's data imports 998 tonnes of mackerel (2019), 3,300 tonnes (2020) and 4,655 (2021). The amount of solid waste inventory (*by product*) in the form of mackerel heads is 900 tonnes and 100 tonnes of mackerel fin pieces which currently have the potential to become fish oil. PT KFI is a company in a Bonded Zone (KB) so that both processes, assets, raw materials, finished goods and waste are under customs control. Solid waste inventories are not exported but sold to domestic buyers. Waste buyers state that this material is used for animal feed.

➤ *Economic Value Added on Fish Waste Utilisation Innovation*

Literature studies indicate the potential utilisation of by-products from the fish processing industry. The edible portion of fish is 50%-70% of the whole body (Kaneniwa, 2009), and the other parts of the fish, namely the head, bones, intestines, and blood, are *by-products* of fish processing. From 40 to 60 million tonnes of fisheries by-products are estimated to come from wild caught and farmed fish (Stevens et al, 2018, Jacksons et al, 2016). *Fish Meal (FM)* from by-products contains a balanced amino acid composition, and *fish oil (FO)* from by-products is rich in omega-3 polyunsaturated fatty acids, namely eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Ghaly et al, 2013). Currently, 1.5 million tonnes of by-product is used globally for fish oil and animal feed production; although it accounts for 33% of total animal feed production and 23% of total EPA and DHA in fish oil production in the world, there is a potential of 35,837,000 tonnes of unused biomass (86.3% of total by-product by calculation) (Jackson et al, 2016).

The research was conducted to determine the economic added value of fish waste utilisation at PT KFI and PT SFI. At PT SFI, the raw material for small demersal fish processed in 2019 was 11,538,694 Kg. The calculation of fish meat that is included in Surimi processing in the form of fish meat is 7,843,444 Kg while the raw material for processing fishmeal and fish oil (*by product*) is 3,695,250 Kg. So the raw material for the surimi process is 68% meat while the raw material for fishmeal & fish oil is 32%. While the number of finished Surimi products is 2,424,910 Kg and fishmeal is 1,157,775 Kg. When calculated from the initial *raw material (raw material)* into surimi, the percentage value = $(2,424,910 / 11,538,694) \times 100\% = 21\%$ and the fishmeal is $(1,157,775 / 11,538,694) \times 100\% = 10\%$. From the processing of fishmeal, the *crude* fish oil with *feed grade* quality is about 0.1%. Or in other words, the yield of fishmeal is 9.9% while fish oil is 0.1%. The raw materials processed in 2020 increased to a total of 12,448,053 Kg. Frozen Surimi yields 2,393,231 Kg (19.22%) and fishmeal 1,428,481 Kg (11.47%). Fishmeal and crude fish oil are sold at a price of Rp. 12,000/Kg.

The calculation of the potential for *crude* fish oil (crude oil) from the company with reference to 2020 raw material data, which is processed in the amount of 12,000,000 Kg, it is estimated that $0.5\% \times 12,000,000 \text{ Kg} / \text{year} = 60,000 \text{ Kg} / \text{year}$ will be obtained. If the selling price is valued at Rp.300,000/Kg, it is estimated that a sales value of up to Rp. 18 billion rupiah/year will be obtained. If 10 out of 15 Surimi companies in Indonesia can collect the fatty washing liquid and process it into fish oil, the potential is 10 companies \times 18 billion = Rp. 180 billion/year.

According to SFI technicians, if the oily laundry liquid is collected and does not enter the WWTP (*Waste Water Treatment Plant*), it can reduce wastewater treatment costs by around Rp. 170 million / year. The waste treatment process becomes more quickly decomposed by bacteria in the treatment basin.

Apart from PT Starfood International Lamongan, potential raw materials can be obtained from solid waste in the form of mackerel heads and fins processed by PT Kirana Food International located in Tuban. An additional process is required, namely grinding and squeezing the solid waste. The oily liquid results can also be obtained at PT Starfood International lamongan. The potential of mackerel solid waste is 900,000 Kg/year mackerel head will become 1% crude fish oil = 9,000 Kg. While 100,000 Kg mackerel fins become crude fish oil 6% = 6,000 Kg. Total crude mackerel oil = 15,000 Kg/year. If the selling price is Rp. 300,000/Kg, the sales value is estimated at Rp. 4.5 billion a year.

Based on the results of the above analysis, innovation in the utilisation of fish waste can provide additional income potential for PT SFI of up to Rp. 18 billion/year from the sale of fish oil and a reduction in wastewater treatment costs from increased waste treatment efficiency of around Rp. 170 million/year. For PT KFI, the potential additional revenue is smaller, at Rp. 4.5 billion/year. If PT SFI can increase its capacity by producing fish oil from the waste of the 10

surimi companies in the Kelola Group, the potential revenue could increase to Rp.180 billion/year.

➤ *Innovation Value-Added Potential for Environmental Sustainability*

The results of the study using data collected from 223 Slovenian firms on the adoption of eco-innovation processes concluded that there are benefits of green business. The eco-innovation process is beneficial in terms of company profitability, growth, and competitive benefits. (Hojnik & Ruzzier, 2016) Implementation and process innovation of green products are linked to business strategy and performance as well as environmental success. (Chiou, 2011). Green products, including process innovation, have been shown to influence the competitiveness and performance of companies through strong environmental culture and values (Li et al., 2018; Wang, 2019). Green organisational practices are referred to as actions that contribute to preserving the environment and creating a sustainable future. Green innovation practices also influence the way things are done within the company, resulting in profitability (Perez-Valls, Cohen et al., 2018; Wang, 2019). (Perez-Valls, Cespedes-Lorente, & Moreno-Garcia, 2016). Research has shown that green innovation is critical to achieving long-term performance (Cloud et al., 2019; Imran et al., 2021). The adoption of green innovation is positively related to environmental performance (Wang, 2019).

According to the calculation of technicians from PT SFI, if the oily liquid from the fish washing process is taken and does not enter the WWTP (*Waste Water Treatment*), the waste treatment process will be decomposed faster by bacteria in the treatment basin. In the expert interview process, the biologist in this study revealed that the selection of the right bacteria in the waste treatment will also improve the quality of the final effluent water from the waste treatment discharged into the sea. Faster effluent treatment processing, less volume of final effluent due to fish oil production, and the use of appropriate bacteria will reduce pressure on the marine ecosystem and reduce the impact of waste production. Thus, the utilisation of waste into value-added products can protect the environment and support business sustainability.

Future prospects, if studied further, it is estimated that this industry will continue to grow forward in fulfilling food needs based on cultivation and catches of local fishermen. Economically and socially, it will have a positive impact on local communities. The central government also benefits through the products produced, which are generally export-oriented. Business models with innovation and the right strategy will be a solution to several social problems in the company's operating area such as providing new jobs, increasing local and central government revenues. According to Rappa (2000), a business model is a method used by a company to make money in its business environment, which allows the company to survive. According to Wheelen and Hunger (2010), a business model is a method used by a company to make money where the company operates.

➤ *Business Model Development*

● *Fish Oil Business Ecosystem*

The ecosystem of the fish oil business in Indonesia can be described through grouping the scope of interaction according to James F. Moore's model:

✓ *Scope 1 - Core Business*

Within the scope of the core business, activities in the fish oil industry can be mapped into 3, namely: production, distribution, and consumption. However, when examined further, there are some more detailed specifications of each role, namely:

- Fishing Entrepreneur, is a person who owns fishing facilities such as ships or boats, nets, and other fishing gear used to catch fish as raw material for fish oil.
- Supplier, is a company that collects fish caught and conducts the process of receiving fish at the fish auction site, then sorting and immediately sent to the company.
- Fish and surimi processing companies. Fish and surimi processing companies are suppliers of fish/surimi processing wastewater, which is the raw material for fish oil.
- Fish oil producer companies, which are companies that process fish oil raw materials, including crude fish oil into fish oil products that are ready for public consumption.
- Distribution and logistics companies, which are companies engaged in product transport, including exporters and freight forwarders.
- Health supplement manufacturers, i.e. companies that purchase bulk fish oil.

✓ *Scope 2 - Extended Enterprise*

In scope 2, for business continuity in the medium term, the fish oil industry needs several parties that can expand business communication, networking and product

consumption. The scope of 2 - *Extended Enterprise* in the fish oil industry is as follows.

- Overseas Agents, or *buyers* for the export market.
- Supermarkets. Overseas agents can directly distribute to supermarkets or reprocess the purchased products.
- Consumers. The consumer is the last actor in the supply chain.

✓ *Scope 3 - Business Ecosystem*

Industry scope 3 is required for the industry to be sustainable in the long term. In the fishoil industry, industry players in scope 3 are as follows.

- Investors as providers of funds for business development.
- *Media Hub*, media hubs are industry players who have media or access to media that communicate developments in the industry. Media can be a driver for a product to be more acceptable to the public.
- The government as a regulator has an interest in macro aspects, especially in developing opportunities for fish oil industry players to be more competitive with certain facilities or bureaucracy.
- Business associations, in this case the Indonesian Fisheries Companies Association (Gappindo), act as a counterweight for fish fisheries industry players in communication with the government or other large-scale parties. This business association can also be a regulator for industry players in building healthy and conducive industry interactions.
- Workers' Union, an organisation of workers in a company.

● *SWOT Analysis*

✓ *PT Kirana Food Industries (KFI) - Tuban*

Key Partner	Key Activities	Value Propositions	Customer Relationships	Customer Segments
✓ JV Partner Perusahaan Jepang ✓ <i>Buyer</i> : Negara importir dari Taiwan, Malaysia, Singapura, dan China. ✓ <i>Supplier</i> : Negara eksportir bahan baku dari Swedia, Norway, Inggris dan Belanda	✓ <u>Pengolahan ikan</u> Atlantic Mackerel (<i>Scomber scombrus</i>) dan Atlantic salmon (<i>Salmo salar</i>) beku yang diimpor dari negara Swedia, Norway, Inggris dan Belanda ✓ Ekspor produk perusahaan ke Negara Taiwan, Malaysia, Singapura, dan China. ✓ Penjualan limbah padat ke pembeli domestik	✓ Harga jual limbah padat relatif murah. ✓ Sertifikasi HACCP, certified sustainable seafood, BPOM dan Halal MUI ✓ Pengolahan produk dengan energy saving dan environmentally friendly.	✓ Penjualan konvensional melalui tim marketing & penjualan	✓ Negara importir dari Taiwan, Malaysia, Singapura, dan China. ✓ Perusahaan domestik untuk limbah padat
	Key Resources		Channels	
	✓ Bahan baku untuk pembuatan minyak ikan. ✓ Alat dan fasilitas untuk pembuatan produk ✓ Sumberdaya manusia mulai dari pimpinan, teknisi, pengendalian kualitas dan tenaga kerja ✓ Akses pendanaan		Pemasaran secara nasional dan internasional (Asia) dengan ekspor tidak langsung namun melalui perantara dari negara asal	
Cost Structure		Revenues Streams		
✓ Biaya Pokok Produksi (biaya pembelian bahan baku, biaya listrik, biaya tenaga kerja, biaya depresiasi mesin dan peralatan) ✓ Biaya operasional lainnya (biaya bunga, biaya, biaya pemasaran, biaya operasional usaha lainnya, serta biaya pajak)		✓ Penjualan Ikan Mackerel dan Salmon yang telah diproses ✓ Penjualan limbah padat		

Fig 8 Business model of PT Kirana Food International

• *SWOT Analysis of PT Kirana Food International*

✓ *S (Strength)*

- Imports of mackerel raw materials increase every year so that the amount of solid waste (*by-product*) in the form of mackerel heads and fins will increase.
- The quality of the solid waste is still relatively good because even though the solid waste is stored in frozen form.
- The selling price of this solid waste is relatively cheap, namely for the price of mackerel heads Rp. 1,410, -/Kg and mackerel fins Rp. 3,300, -/Kg.
- The yield of mackerel heads was 2% while mackerel fins were 6%.
- The results of the crude fish oil test at Angler and Saraswanti Laboratories in Surabaya obtained good results in *Food Grade* standards based on SNI, Codex and IFOSS criteria.
- The distance between PT Kirana Food Industries and PT Starfood International is close to about 36 Km which can be travelled in 1 hour if KFI's solid waste is taken to SFI to be processed into fish oil.

✓ *W (Weakness)*

- Solid waste is not processed into fish oil within the facility because the company owner has other business developments.

- If a fish oil business unit is created, it requires a lot of complicated legal permits in addition to the legality of customs, ministries, the addition of a Business Identification Number (NIB), and others.
- If solid waste is not immediately sold to outside parties, it will become a cost in storing the material in *cold storage*. Domestic buyers are not able to buy on a large scale, which can be a problem in the future.

✓ *O (Opportunity)*

- Opportunities for buying and selling co-operation between KFI and SFI will be easier.
- Coordination is easier.
- There are opportunities with the addition of other imported fish raw materials such as Salmon and Pollock.

✓ *T (Threat)*

- If there are obstacles due to import regulations, it will disrupt business supply and demand.
- If other competitor countries are more competitive such as Vietnam, India and Phillipines, the supply of imported fish raw materials will decrease.

• *PT Starfood International (SFI) – Lamongan*

Key Partner	Key Activities	Value Propositions	Customer Relationships	Customer Segments
<ul style="list-style-type: none"> ✓ Perusahaan-perusahaan di negara tujuan ekspor di Asia ✓ Suplier dari TPI ✓ Jasa Transport ✓ Perusahaan perantara di negara tujuan ekspor 	<ul style="list-style-type: none"> ✓ Kegiatan memperoleh bahan baku ✓ Kegiatan pengolahan ikan demersal kecil menjadi produk Surimi beku. ✓ Kegiatan pemasaran ✓ Kegiatan distribusi ✓ Kegiatan R&D ✓ Ekspor produk perusahaan ke negara-negara di Asia. ✓ Promosi melalui website 	<ul style="list-style-type: none"> ✓ Produksi Surimi berkualitas dalam partai besar ✓ Mencapai kinerja perusahaan di atas rata-rata pelaku bisnis perikanan yang didasari fundamental bisnis yang kuat 	<ul style="list-style-type: none"> ✓ Penjualan konvensional melalui tim marketing & penjualan 	<ul style="list-style-type: none"> ✓ Negara importir dari Cina, Taiwan, Vietnam, Malaysia, Singapura, Thailand dan Hongkong
	Key Resources		Channels	
	<ul style="list-style-type: none"> ✓ Bahan baku untuk pembuatan minyak ikan. ✓ Alat dan fasilitas untuk pembuatan produk ✓ Sumberdaya manusia mulai dari pimpinan, teknisi, pengendalian kualitas dan tenaga kerja ✓ Akses pendanaan 		<ul style="list-style-type: none"> Pemasaran secara nasional dan internasional (Asia) dengan ekspor tidak langsung namun melalui perantara dari negara asal 	
Cost Structure		Revenues Streams		
<ul style="list-style-type: none"> ✓ Biaya Pokok Produksi (biaya pembelian bahan baku, biaya listrik, biaya tenaga kerja, biaya depresiasi mesin dan peralatan) ✓ Biaya operasional lainnya (biaya bunga, biaya, biaya pemasaran, biaya operasional usaha lainnya, serta biaya pajak) 		<ul style="list-style-type: none"> ✓ Penjualan Surimi ✓ Penjualan Tepung Ikan. 		

Fig 9 Business Model of PT Starfood International

- *Analysis of PT Starfood International (SFI) – Lamongan*

- ✓ *S (Strength)*

- The amount of oily wash liquid is estimated to be considerable. In the experimental scale, it is estimated that crude oil is obtained about 0.5% of the total fish raw materials processed. The average raw material processed per day is 50,000 kg, so the estimated crude fish oil yield is about 250 kg/day or about 6,260 kg/month.
- The quality of the crude fish oil is good because the washing water temperature is about 5°C and can be directly processed.
- The number of active Surimi companies in 2022 is 15 companies. The solid waste of PT KFI can be processed at PT SFI so that the potential for developing fish oil innovation is great.
- According to SFI technicians, if the oily laundry liquid is collected and does not enter the WWTP (*Waste Water Treatment*), it can reduce wastewater treatment costs by around 170 million / year. The waste treatment process becomes more quickly decomposed by bacteria in the treatment basin.
- There is infrastructure in the form of a building or space that can be used for the crude fish oil *refining* process within the existing fishmeal processing unit building site. Adequate electrical installations are available.
- Leaders, technicians, quality control and labour are available for fish oil processing.

- ✓ *W (Weakness)*

- The technology of refining crude fish oil has not been mastered by the personnel in the company.
- The machine used for refining crude fish oil has not yet been bid for and the business feasibility study has not yet been calculated. It will take time to procure the machine.
- Manuals, procedures, SOPs (Standard Operating Procedures) and Process Control Forms have not been created.

- There is no place for refining crude fish oil, which needs to be certified by the Ministry of Maritime Affairs and Fisheries as a legal requirement. Once certified, the product can be sold to factories that require the fish oil. The estimated certification takes at least 4-6 months.
- If the purpose is to be sold in retail, MD registration is required at BPOM. The audit to obtain a distribution licence takes about 3 months at most.

- ✓ *O (Opportunity)*

- Market opportunities for both fish oil speciality factories and retail markets are considerable.
- As an alternative to import substitution of fish oil.
- If the domestic market is maximised, the fish oil produced has the opportunity to be exported, of course, provided that it meets the Codex and IFOSS quality standards and competitive prices.
- The behaviour of consumers who like *healthy food* will increase the sales potential of fish oil. Today's lifestyle behaviour is interested in healthy foods including fish oil.

- ✓ *T (Threat)*

- Strict fish oil competition from producers who provide low prices and who pay less attention to fish oil quality standards or indicate the presence of other fish oil mixtures.
- Decreased availability of captured fish will lead to a decrease in the amount of fish oil produced.

- *Proposed Business Model*

Business development to the fish oil industry is planned at PT SFI while PT KFI will act as a supplier of waste raw materials. Thus, a business model was developed based on the results of literature studies and interviews with 5 experts consisting of; (1) three academics as well as researchers in the fisheries and aquaculture industry, of which two are also business innovation practitioners, and (2) two practitioners in the fish processing industry. Using the *Business Model Canvas* method, the research results resulted in the following proposed business model components:

Key Partner	Key Activities	Value Propositions	Customer Relationships	Customer Segments
<ul style="list-style-type: none"> ✓KFI as a provider of raw materials for fish oil. Suppliers (Fishing Companies, Collectors, and TPIs) ✓Fish processing companies as suppliers of fish oil raw materials ✓Health supplement company as fish oil buyer ✓Angler and Saraswanti laboratories for checking SNI, Codex and IFOSS standard criteria ✓Distribution and logistics companies ✓Companies in export destination countries in Asia ✓Overseas agents in export destination countries 	<ul style="list-style-type: none"> ✓Activities to obtain raw materials The activity of processing small demersal fish into frozen Surimi products. ✓Marketing activities ✓Distribution activities ✓Fish oil product R&D activities ✓Export the company's products to countries in Asia. Promotion through website ✓Processing of distribution licences and MD registration at BPOM. 	<ul style="list-style-type: none"> ✓Technological innovation with the main raw material of waste from fish processing into fish oil (circular economy) High quality fish oil because it is included in the Food Grade standard based on SNI, Codex and IFOSS criteria (<i>Food and pharmaceutical grade</i>) ✓Products that support sustainability ✓Consumer fish oil in bulk form and can be packaged according to the buyer's brand ✓The purification process is carried out several times ✓The material sourcing system is open within the 	<ul style="list-style-type: none"> ✓Excellent service to achieve customer satisfaction ✓Adequate information and sales service facilities ✓In the long term, specialised service staff for large long-term clients 	<ul style="list-style-type: none"> ✓Importing countries from China, Taiwan, Vietnam, Malaysia, Singapore, Thailand and Hong Kong ✓Health supplement companies as target buyers of bulk fish oil End consumers from the middle to upper economic class
BPOM for Fish Oil registration ✓Regulator		scope of the holding and outside the holding (with certain material spec requirements). ✓Local fish oil as an alternative substitution for imported fish oil ✓Achieving above-average company performance in the fisheries business based on strong business fundamentals		Fish oil speciality factory ✓Consumers who favour healthy food
	Key Resources		Channels	
	<ul style="list-style-type: none"> ✓Raw materials for the manufacture of fish oil. ✓Tools and facilities for product manufacturing ✓Human resources ranging from leaders, technicians, quality control and labour. ✓Crude fish oil refining process site that needs to be certified for processing feasibility and HACCP (<i>Hazard Analysis Critical Control Point</i>) certification ✓Access to funding 		<ul style="list-style-type: none"> ✓Marketing nationally and internationally (Asia) by exporting indirectly but through intermediaries from the country of origin is carried out through the website ✓Digital platform Marketing in online and offline retail 	
Cost Structure		Revenues Streams		
<ul style="list-style-type: none"> ✓Cost of production (raw material purchase cost, electricity cost, labour cost, depreciation cost of machinery and equipment) Other operating costs (interest costs, fees, marketing costs, other business operating costs, and tax costs) ✓Investment Costs 		<ul style="list-style-type: none"> ✓Surimi Sales ✓Fishmeal Sales. ✓Bulk Fish Oil Sales 		

Fig 10 Business Model Canvas of Fish Oil Product Innovation

✓ Value Proposition (Advantages Offered):

The advantage offered is fish oil as a food supplement (*food and pharmaceutical grade*), with a purification process that is safe for consumption. Products are sold in bulk to reduce selling prices. To reduce costs, raw material procurement uses an open system, either from associated companies or third parties. The products also offer a

qualitative advantage, namely the status as a local product in the country that offers a 'sense of belonging' to local products. The product is also a form of support for environmental sustainability as the product is processed from industrial waste that can contribute to the development of a circular economy and strengthen environmental resilience.

✓ *Customer Segmentation (Market Segments):*

Based on research conducted by PT Talenta Data Indonesia (2022a, 2022b, 2022c), it can be concluded that the Indonesian population aged over 25 years with middle to upper socio-economic conditions is the largest consumer every month for the fish oil supplement industry. The content of Omega 3, EPA and DHA in fish oil is very beneficial for heart health. The adult population is the main segment of the product because it has a higher level of health awareness and has sufficient financial capacity.

In the early stages of innovation development, the product will be sold in bulk form, so the market segments in the early stages are health supplement companies, fish oil distributors and *retailers*. In the long term, the innovation is expected to continue to grow and reach the final market segment, namely the individual segment.

✓ *Channel (Sales Channel):*

Channel is the medium used to reach the target market segment, either in the form of communication channels or distribution and sales channels. In the early stages of product sales, products are sold in bulk so that the sales channels used are traditional channels in the form of business negotiations between companies (b to b), as well as bulk commodity markets, including exhibition activities and sales of fishery products. To increase sales and customer awareness of the developed products, traditional media such as advertising as well as digital platforms such as websites, sales through market places and the use of *search optimisation engines* (SOE) can be used.

✓ *Customer Relationship:*

Customer relationship in the BMC concept is a way of maintaining good relationships with buyers who are motivated to acquire customers, retain customers or increase sales. Currently, PT SFI and PT KFI do not have a special *customer relationship* concept. To overcome this, it is proposed to provide adequate information and service facilities, both in conventional and digital forms, so that customers can be independent in conducting transactions. For the long term, it is proposed to provide service officers specifically for long-term individual clients.

✓ *Key Partnerships*

Key partnerships describe relationships with key partners that are important for the business model to run smoothly. In the fish oil business model, key partners include parties mapped in scopes 1, 2 and 3 of the fish oil business ecosystem that are closely related to the business model, namely fish and surimi processing companies as suppliers of waste raw materials, fish auction sites (TPI) as one of the suppliers, health supplement companies as product buyers, distribution and logistics companies, sales agents and related government institutions (regulators). Waste processing is closely related to environmental sustainability, so another important partner outside the core business ecosystem is the regulator (BPOM and the marine and fisheries agency).

✓ *Key Activities*

These are the key activities required to run the business, create an edge and deliver *value propositions*, reach the market, maintain good customer relationships and generate revenue. The key activities in this business model are the treatment of surimi liquid waste and the processing of mackerel waste into fish oil and the production of fish feed from the same industrial solid waste. Research and development of innovations are also needed to continue reducing waste to achieve zero waste, including through research on the potential development of liquid fertiliser from liquid waste that cannot be processed into fish oil, research on improving the use of bacteria in the *waste water treatment plant* process to improve environmental sustainability, developing fish oil production technology, market development, human resource development, and forming business partnerships.

✓ *Key Resources*

Key resources describe the main assets required for a business model to function. The key resources in this fish oil business model consist of physical assets (buildings and waste treatment facilities), financial assets (initial funding support from PT SFI and PT KFI), human resource assets (labour). The resources are owned by PT SFI and PT KFI, but can be utilised for innovation development.

✓ *Cost Structure*

The cost structure describes all the costs incurred to operate the business model, namely the cost of purchasing raw materials, labour costs, electricity and business operation costs, machinery and equipment depreciation costs, licensing costs, marketing costs and tax costs.

✓ *Revenue Stream*

The source of revenue from the development of the business model comes from the sale of crude oil. In addition, PT SFI still has the main revenue from the sale of Surimi and fishmeal.

➤ *Analysis of Fish Oil Value Proposition Strategy*

Based on research that has been conducted by PT Talenta Data Indonesia (2022a, 2022b, 2022c) regarding the consumption level, *awareness*, and market share of fish oil in Indonesia. It can be concluded that the largest end consumers are Indonesian women with an age range of 25 to 34 years, residing in DKI Jakarta, working as office workers, and have middle to upper socio-economic conditions.

If examined in more depth by using this information as a proxy for mapping the *value proposition* of bulk fish oil producers, and with the *value proposition canvas* method introduced by (Osterwalder et al., 2015). Then, a profiling can be done, that the female persona above encourages herself to work 40 hours every week, with her office activities being non-physical, and with high intensity in looking at monitor screens, televisions, and mobile phones as a form of her main activity.

In addition, as a benefit, fish oil products for women should be able to be used anywhere and anytime. If it runs out, it can be obtained anywhere. However, the potential for physical and mental health problems, as well as not having much time to rest can also be a disadvantage for consumers.

Therefore, the fish oil supplement as a product needs to be safe for regular consumption, small in size, and able to be stored at room temperature. In addition, it needs to be sold generally, under the category of supplements and minerals, but not hard drugs. As a *pain reliever*, we focus on antioxidant, immune, and dental bone health functions, as

well as preventing premature aging. Aside from how to use this supplement, it should be easy and quick.

From the above, a profile of fish oil supplement manufacturers as consumers of bulk fish oil producers can be constructed (Table 2). It can be seen that the main activity as a consumer of bulk oil is for the production of fish oil supplements in the context of supplements that are safe for consumption. In addition, values such as certification and large quantities at reduced prices are benefits that fish oil supplement manufacturers such as Scott's Emulsion expect to receive.

Table 2 Manufacturing Profile of Supplements from Fish Oil as a Consumer

Profile Parameters		Consumer Profile
Main Activities		Production of safe-to-consume supplements
Consumer Gain	1)	Certified
	2)	Large quantity with decreasing price
Consumer Pain	1)	The quality of the goods does not match
	2)	Material supply quantity fluctuates

However, non-conforming quality of goods, as well as fluctuating quantity of material supply, leads to losses for consumers. This is the profile of fish oil supplement manufacturers such as Scott's Emulsion, and the basis for the value proposition for bulk fish oil producers.

Table 3 Proposition Value of Bulk Fish Oil Producing Industries

Proposition Value Parameter		Proposition Value
Products		Wholesales and bulk fish oil
Gain Creator	1)	Food and Pharmaceutical Grade
	2)	Large party and bulk form
Pain Reliever	1)	Sustainability in terms of environment and production materials
	2)	Domestic production

If based on table 3, the proposition values of this bulk fish oil product are: 1) *food and pharmaceutical grade*, 2) wholesales and bulk, 3) the refining process is carried out several times, 4) the *material sourcing* system is open within the scope of the holding and outside the holding (with certain material spec requirements).

The four propositioned values are both the foundation and the targets that need to be achieved for the company to be competitive and dominate the bulk fish oil market in Indonesia. Because, credibility, efficiency, competitive price, and quality are certainly some of the indicators in successful market penetration, and these four proposition values already represent these values.

➤ *Company Comparative Analysis*

Through the information summarised earlier. So, it can be comparatively synthesised several things in table 4 below, namely, 1) SFI as a company engaged in the upstream and downstream fisheries industry in Indonesia is superior in terms of product availability, pharmaceutical and food standards, logistics, selling prices, efficiency and production technology; 2) Meanwhile, foreign competitors are allegedly the main competitors, with quality and COGS that are also quite efficient, but not all fish processing companies abroad have the availability of production materials such as SFI-KFI and competitors in Indonesia, this also affects the efficiency of selling prices; 3) On the other hand, domestic competitors have abundant amounts of production materials, but do not necessarily have market access, nor production technology that can reduce COGS.

Table 4 Comparative Analysis of SFI-KFI with Domestic and Foreign Competitors

Comparative Variable	SFI & KFI	Domestic Competitors	Foreign Competitors (Import)
Food & Pharmaceutical Grade	★ ★ ★	★	★ ★ ★
Availability of production materials	★ ★ ★	★ ★ ★	★
Production technology	★ ★ ★	★	★ ★ ★
Cost of goods manufactured (COGS) efficiency	★ ★ ★	★	★ ★ ★
Market penetration (marketing) efficiency	★ ★ ★	★ ★	★ ★ ★
Selling price efficiency	★ ★ ★	★ ★ ★	★

➤ *Company Competitive Analysis*

Through the mapping of the comparative advantages of SFI and KFI above, something can be concluded through the *McKinsey 9 Box Matrix* competitive strategy analysis presented in Figure 11 below. (Kim, 2020; McKinsey, 2008).

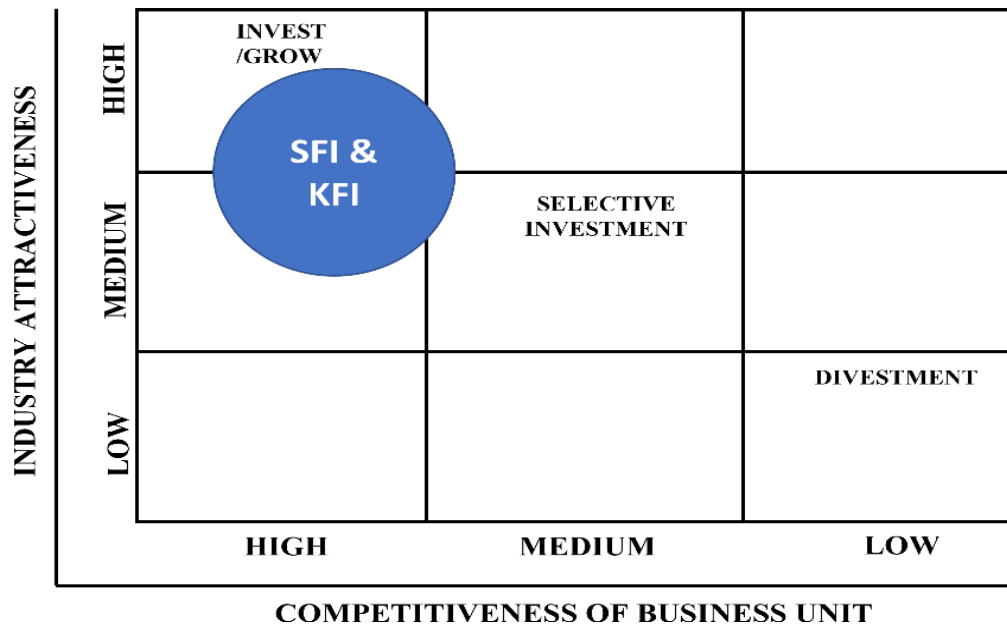


Fig 11 Competitive analysis of SFI & KFI through McKinsey 9 Box Matrix

Firstly, the figure above provides a synthesis that the fish oil industry is growing. Secondly, from an internal perspective, it can also be synthesised that from comparative identification it can be concluded that the competitive power of SFI and KFI is very high, whether it is related to production technology, price, or market penetration. So, it will enter the third synthesis, that strategically, this moment and niche oil is the most appropriate in investing in production equipment and growing in fish oil market share in the upstream sector. So, it will enter the fourth conclusion, namely the demand for fish oil will certainly be high and attractive. This can be seen through the mapping of the comparative advantages of SFI and KFI in Table 4, and also in Figure 11 above, which uses the *McKinsey 9 Box Matrix* competitive strategy analysis. (Kim, 2020; McKinsey, 2008).

V. CONCLUSIONS

Waste reduction will be one of the important steps for business and environmental sustainability so that innovation is needed to implement sustainable waste management. This research uses the concept of modern innovation which implies the integration of institutional and technical innovations where technical innovations in fish oil production are applied to the scope of the company so that it is expected to further bring up the culture of *corporate innovation* in the company under study.

The test results of *crude* fish oil processed from fish processing waste showed good results and were within the *Food Grade* standard based on SNI, Codex and IFOSS criteria. This data confirms the potential of processing fishery industry waste into consumer fish oil. The discovery of the potential of this fish oil can be upgraded into an

innovation with commercial aspects and positive financial benefits. The research resulted in an estimation of the financial benefits that PT SFI and PT KFI can obtain through the innovation. Furthermore, the innovation to increase the added value of Surimi and fish processing industry waste also has a positive impact on the environment and business sustainability through the reduction of final waste and towards the concept of *zero waste*.

The potential for waste management in the fisheries sector in Indonesia will continue to grow in fulfilling sustainable food needs, supporting the development of a circular economy, and having a positive impact on the environment and surrounding communities.

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