

VALUE CREATION IN FISHERIES SUPPLY CHAIN AS A ROLE MODEL FOR FISH PROTEIN HYDROLYZATE CLUSTER DEVELOPMENT

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To increase the level of competitiveness in the maritime and fisheries industry in Indonesia, the creation of added value products, such as Fish Protein Hydrolyzate (FHP) would be essential to accelerate this mission. This value creation occurs along the fisheries supply chain, including fishermen, shippers, fish processing units, and industry. To assess the innovation maturity, the FHP machine was assessed with the Technology Readiness Level (TRL) and Innovation Readiness Level (IRL). The TLR was carried out by TRL-Meter and IRL was carried out by IRL-Meter. The data was collected by interviews and questionnaires with related stakeholders. The data assessed that the machine met the requirement for TRL level 9 and IRL Level 3. The recommendation for TRL 9 and IRL 3 has been conducted through a strategic partnership with a related state-owned enterprise. Because the FHP shows product competitiveness, gives value-added, and generates value creation in the fisheries supply chain, it could be a role model for the development of the FHP cluster in another location. However, the involvement of local and central governments still needs to be improved significantly. Furthermore, the government should build a conducive ecosystem for technology-based innovation in the country.

Keywords: Fish Protein Hydrolyzate, Added Value, Value Creation, Technology Readiness Level, Innovation Readiness Level

1. INTRODUCTION

Indonesia is a maritime country with the largest sea area in the world. However, with a total of more than 17,000 islands spread throughout the archipelago, the maritime sector currently only contributes 7.86% to the national economy [1]. The development of aquaculture has a huge opportunity to increase gross domestic product (GDP) of the country. The aquaculture subsector contributed 1.41 percent to the nation's GDP [2]. As the 4th largest aquaculture producer in the world, the production of the country reached 3,067,660 tons or 4.6% of world fisheries production in 2012 [3]. Although there has been a decrease in demand and supply in the country due to the outbreak of corona virus (COVID – 19), the Ministry of Marine and Fishery Affairs stated that the export value of Indonesian fishery products in March 2020 reached US\$ 427.71 million, it increased 3.92% compared to March 2019 [4]. After the pandemic is finished, the demand for fish and fishery-based staples is predicted to increase [5].

To improve the competitiveness of Indonesian fishery products at the global level, the development of technology and innovation in marine and fisheries sector is strongly required. The innovation capability indicator of Indonesia ranked 74 from 141 countries in 2019 [6]. The marine and fisheries sector developments are not only focused on efforts to increase production, but also provide added value and competitiveness. Consequently, it would be able to improve the diversification of export commodities and branding of the national fisheries products. In Porter's Diamond Model, the advanced factors include scientific knowledge and technological innovation are regarded as the significant factors for national's competitive advantage. These factors can be created through research and innovation that produce a diversification of product [7].

Porter argues that value chain generic is composed of primary activities and secondary activities. The primary activities consist of inbound logistics, operations, outbound logistics, marketing and sales, and

service. There is a component of technological innovation in secondary activities to support the primary ones [8]. The development in technology is the basis for the nation's economic growth since today's competition is based on innovation or knowledge [9]. Therefore, technological innovation in the fisheries sector is also essential as the development of fisheries commodities that provide added value can support the nation's economic growth and improvement of people's welfare in the coastal area. Besides, the selection of fisheries commodities, as well as effective and efficient technology is also necessary to develop the marine sector [10].

In increasing the competitiveness in maritime affairs and fisheries sector, the Government of Indonesia has stipulated national policy in the sector for 2020 – 2024 that the authority is committed to strengthening human resources, marine and fisheries research innovation, generating the marine and fisheries industry through fulfilment the industrial raw materials, improvement of product quality and added value, and increasing the investment and exports of fishery products. Furthermore, the aquaculture sector will be optimized and strengthened to keep the availability of animal protein sources for society [11].

The high value-added fisheries products can be developed through diversification and fisheries distribution network improvement to fulfill the needs of nutrition in the community. The objectives of the research are to discuss the value-added creation in the business processing of fisheries products, especially in production and supply chain. In the current research, business process is discussed at the post-harvest stage that the fish processing activity is intended not to extend the life of fish, but to produce into hydrolyzate to increase the economic value of product, particularly in food clusters. Moreover, the research would evaluate the business actors involved in increasing the value chain of fisheries products. This research would also examine the Innovation Readiness Level (IRL) and Technological Readiness Level (TRL) to ensure the technology application is ready to enter the market for commercialization.

2. RESEARCH METHOD

This research is a type of qualitative participatory that involves active participation among members of the community who become the targeted group. The research was conducted to provide policy recommendations for value creation in the fisheries supply chain as a role model for Fish Protein Hydrolyzate (FHP) cluster development. The method used in this research is triangulation through survey, questionnaire, and in-dept interviews with related stakeholders, Focused Group Discussion (FGD), and assessment of IRL and TRL of FHP machine, owned by PT. XYZ. The purposive sampling technique was chosen as the sampling method in this study. The research was conducted in Bintan, Riau Islands province; Indramayu, West Java province; and Jakarta. The collected data was analysed using IRL-Meter and TRL-Meter developed by the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia.

The steps taken in this study are as follows:

1. Conducting Triangulation or Data Testing
This stage is intended to construct a coherent justification from multiple source, such as: business actors, central and local government and experts. They provide inputs in reports as well as in informal conversations.
2. Data Collection
Primary Data is obtained through field study, questionnaires, in-dept interviews, and FGD with partners and related stakeholders regarding to the Management of the Fisheries Sector, the Protection and Recovery Program for Micro, Small and Medium Enterprises, Management of the Creative Economy Sector, Innovation and Business Ecosystem Development. Secondary Data is done to find information from reference books, journals, theses, internet, or other sources related to the issues.
3. TRL and IRL Measurement
TRL is a systematic measurement system that supports the assessment of the maturity or readiness of a particular technology and comparison of maturity or readiness between different types of technology. The TRL was examined by TRL-Meter while IRL was measured by IRL-Meter.
4. Data Analysis
At this stage, the analysis is done through data obtained from field study, questionnaires, interviews and FGD recommendations.
5. Conclusions
The final step of the research is to provide policy recommendation to related stakeholders regarding how to increase value in the fisheries supply chain as a model for developing FHP cluster.

3. RESULT AND DISCUSSION

3.1 Fish Farming Management

Based on the Decree Minister of Marine and Fishery Affairs No. KEP.02/MEN/2007 [12] on Good Fish Farming Method that fish farming is defined as an activity to maintain, raise, and/or breed fish and harvest in a controlled environment, including activities that use ships to load, transport, store, refrigerate, handle, process and/or preserve them. The fishing industry can cover a scale ranging from a small scale with dozens of square meters to large scale. Generally, management of this industry consists of seed acquisition, harvest and post-harvest.

For the method of fish enlargement, in general there are three methods used namely extensive, semi-intensive and intensive. Management plays a role in determining the methods to be used and how to manage fish in the pool according to the amount [13]. Maintenance and monitoring need to be done periodically to ensure fish grow in optimal condition and avoid illness, indicators that are examined generally are water quality (pH, oxygen content, odor, color, turbidity, and temperature). Harvesting is done when the fish are large and can be consumed (generally after five to six months). At the post-harvest stage, fish must be sold immediately or processed to increase durability. Preservation methods can generally be dried and smoked, where it is low cost. It can also be very expensive if it is into cold storage [13].

3.2 Challenges in Fisheries Supply Chain Sector

Fishing industry in Indonesia has significant role for national economic growth. However, this industry needs improvement due to supply chain issues [14]. There are many unique challenges in managing the national's fishery supply chains [15]. Suadi and Kusano [16] reported that there are some aspects to be paid attention by related stakeholders in improving this sector. For instance, many fisheries products were rejected by targeted market because of quality and safety issues. It is clearly related to the lack of cold chain systems where cooling and refrigeration [17] are really essential to secure the quality and safety aspects of the products along the supply chain, from handling to processing units up to consumers. The limitations of supporting infrastructure in the fish production centers have led to a high cost economy in the fisheries industry [15] Low quality of seafood products and high disparity of prices are the effects of these limitations. Even logistics costs, mainly the price of fuel represents about 60 % of the total cost of putting a vessel to the sea [17].

The Economist [18] stated that underinvestment had sent Indonesia's logistics costs soaring, averaging 27% of GDP in 2004–2011, compared with 25% in Viet Nam, 20% in Thailand, 13% in Malaysia, and 8% in Singapore. As the President's instruction that infrastructure development is one of the national top priority, thus the establishment of maritime and fisheries infrastructure would tackle the high cost logistic issue in the country. Even 2 from 3 major projects in the Ministry for Maritime Affairs and Fisheries are related to infrastructure development which is revitalization of ponds in shrimp and milkfish production center areas and integration of international standard fishery and fish market port. These projects are projected to increase the production of aquaculture sector and export of fishery products [19].

3.3 Development of Innovation-Based Ecosystem

Increasing the growth in the fishing firm will impact to economic contribution in Indonesia [15]. However, the lack of innovation reduces the overall value of the supply chain in the industry. Innovation has basic purpose to produce new value propositions in the systems [20 – 23]. Various researchers [24 – 26] stated that innovation is the most crucial part of every industry.

Utilization of technology and innovation are required to increase the added value in the supply chain management. It takes a lot of start-ups development in leading sectors to accelerate the utilization of technology and stimulate sustainability. To set up the establishment of an ecosystem, there should be involvement from related agency, such as research and education institutions, business, government, non-governmental organization, funding institutions, and networking. The research and education institutions should conduct research, education and training while business actors consist of start-up entrepreneurs, small medium enterprises, mid-sized businessmen to large business people. The government should stipulate the related supporting policies and Non-governmental organization which covers from community-based institutions and non-profit organizations should be partners with the government to accelerate the ecosystem. The funding institutions could also play a role in providing funds, such as grants, loans, equities and other financial products including funding from angel investors and venture capital. Building networking between scientific community, business alliances, and community networks are also extremely important.

The development of sustainable small medium enterprises ecosystem is expected to advance the efforts of the creative economy and the success of business start-ups. The conducive climate in the ecosystem is expected to be one of the supporters to increase the contribution of the creative economy to the Indonesian economy largely. Creative businesses and start-ups can grow and use productive capital adequately since the

creative industry becomes one of the profitable investment choices while regulators could support the integrated infrastructure and stimulate the economy with the right policies.

3.4 Development of Supply Chains for Small and Medium Enterprise

To overcome challenges and obstacles in the small and medium enterprise (SMEs) business supply chain, integrated solutions are needed by utilizing technology. Digital platforms are required that integrate all components of the supply chain. Through digital technology, integration with SME business processes both offline (conventional) and online in various channels can be conducted. Implementation of the concept of a single view of the supply of raw materials, products, orders, promotions and customers can build high business process efficiency.

Besides, customers can buy from anywhere, both online and offline marketing channels, such as point of sales, customer service, 3rd party online marketplaces, as well as brand owned online stores. Delivery of goods can be done from the location closest to the customer. Many SMEs find it difficult to carry out digital transformation because the core business of SMEs is production only. Therefore, it is proposed to establish business partner services units in each sub-district, especially the sub-districts which are the center of SMEs. Business Service Partners are operated as professional digital trading units at the sub-district level.

Based on interviews and questionnaire answers from respondents that SMEs competitiveness could be increased through increasing domestic market access in the national retail network, expanding market access for SMEs products to e-commerce platforms, increasing market access for export, and simplifying SMEs licensing. The effectiveness of the SMEs development program carried out by local and central governments need to be improved by synchronizing the regulations.

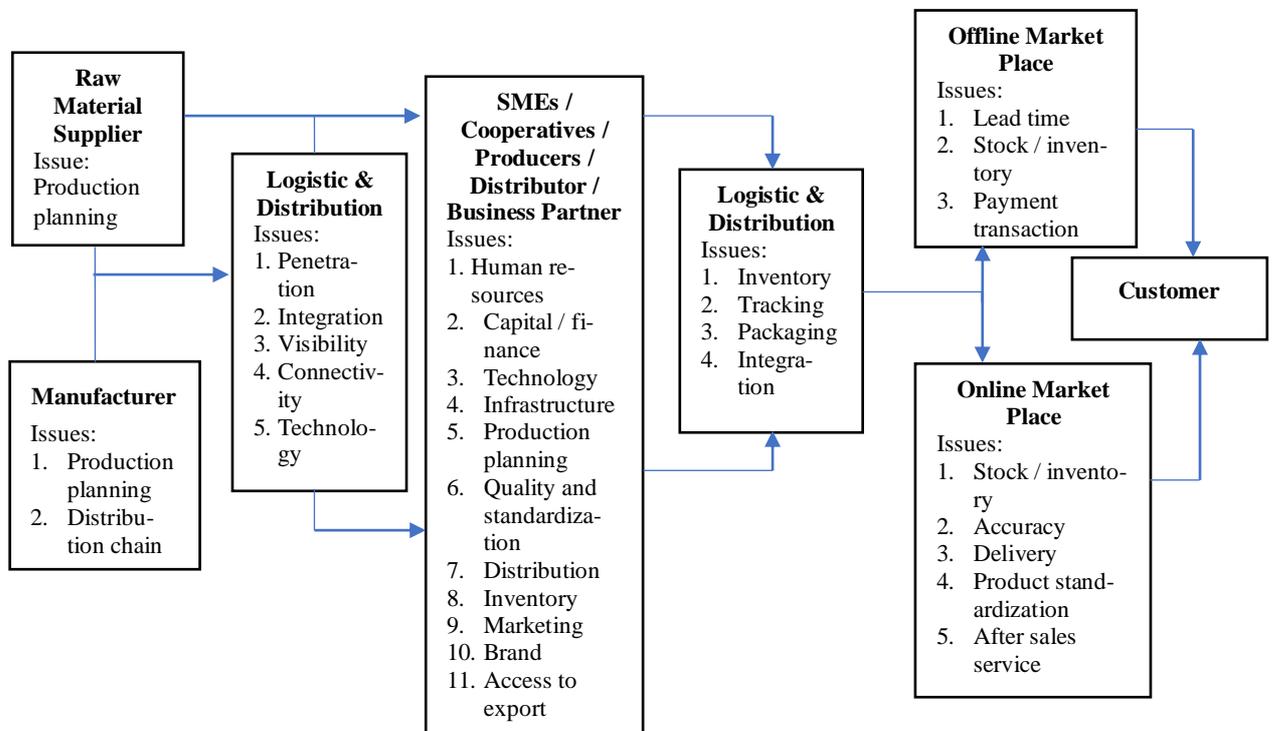


Figure 1. Issues Identification in Supply Chain of Small Medium Enterprises (SMEs) Business [27].

3.5 Establishment of Value Creation in Fisheries Supply Chain

From the scope of Fish Hydrolyzate Protein (FHP) logistics, the movement of goods is handled by the logistics value chain between fish carriers (shipper), fish carriers to processing places (carriers) and fish processing into extracts that facilitate the provision of logistics services in the logistics value chain [28]. The implementation in FHP products can be exemplified by processing trash fish that is almost worthless in the market into a fish-shaped flour extract that has a higher economic value.

The participation of all actors in the supply chain is needed to create a value creation [29]. In the implementation of the value creation in the supply chain involves fish suppliers which consist of (1) fishermen and fishing vessels that have access and resources in the form of fishing tools. Assets that generally must be owned by fish suppliers, namely storage space on ships, containers for loading fish and required documentation related to the role of suppliers; (2) the processing unit can be consist of Union and then selling it to the

buyer who is processing the fish into HPI; (3) the intermediate industry can be Union or companies which create value by combining technology, knowledge and expertise to produce the high valuable product of FHP. The extract of FHP can be processed into various consumer products and also then marketed by related state-owned enterprise.

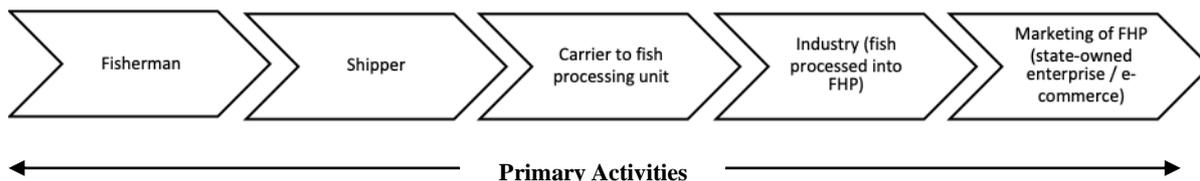


Figure 2. Logistic Network of FHP Products that Allows Value Creation at Each Stage

The logistics value chain which includes the management of goods flow that has a significant influence on the value creation logistics. Santoso and Rahman [30] demonstrated that collaboration among related actors can make supply chain management running well. The integration of actors involved in the fish supply chain is very important to support the flow of fishery products to consumers. Each actor gets added value from the fisheries supply chain. If there is one actor who gets added value due to innovation, then the actor before and after would also be affected. In this stage, the value of creation depends on the continuity of fish supply from fisherman to the processing unit. Therefore, it is very essential to keep the supply chain smoothly.

3.6 Assessment of Technology Readiness Level dan Innovation Readiness Level

TRL is a framework that is widely used in various industries to provide a measure of technological maturity from concepts that are adapted to develop technology to be commercialized. The added value of the assessment of FHP technology using the Level of Innovation Preparedness (IRL) is as a measure of the readiness of investment technology that is more directed in human resource development that includes aspects of markets, organizations, partnerships, manufacturing, investment and risk as well as the continuation of technological maturity used with the completeness of process data, materials used, product variations resulting from the production process, system applications and company identification and products produced to get more benefits as technological innovations. So that the product innovation results from technological maturity ready to enter the market share, survive and continue to be sustainable.

In the logistics value chain, an important role in providing value added products by integrating the flow of materials, products, information through the creation of place value, time utility and quantity utility values in supply chain management. That Innovation Readiness Level (IRL) is understood as a lifecycle of innovation consisting of two phases: technology development and market evolution. While the innovation process management explicitly contains 5 key aspects: technology, market, organization, partnership and risk.

TRL Measurement of the level of technological readiness is carried out using a TRL-Meter. TRL-Meter is a spreadsheet-based software from Microsoft Excel that collects some standard questions for each level and displays TRL graphically. This software is quite helpful in the TRL measurement process which can be done repeatedly. TRL-Meter can provide a snapshot of the technology's maturity at a particular time. Besides, it is also possible to evaluate the historical process of achieving technological readiness of the development program carried out in technology. Measurement of the level of technological readiness can be done independently (self-assessment) intended to map the capacity and capability of technology.

IRL-Meter is a tool used to measure the level of readiness or maturity of innovation. Besides, IRL provides direction for management in implementing the innovation process taking into account 7 key aspects, namely technology, market, organization, manufacturing, investment, partnership and risk. Measurement of IRL is very important not only to describe the development of innovation but also anticipate the market competition and to accelerate the technological life cycle.

3.7 Levels of TRL and IRL Measurement

From the data processed in the form of questionnaire answers from respondents that the FHP machine has met the TRL criteria on level 9. It was obtained since the technology has been applied, and there are no significant design changes. Moreover, the technology has been tested on actual conditions, productivity has stabilized, and all documentation is complete. The estimated price of production has been compared to competitors, and thus technology investment has been conducted. At this stage, a research result has entered and reached a proven technological condition.

Activities that have been carried out at the TRL on level 9 including the integrated system test is already in high accuracy (High Fidelity). Measurements have given rise to fabrication readiness, Investment estimates have also been raised, the design has no change significant. At level 7 there is readiness for production initial (Low Rate Initial Product - LRIP), while at level 8 the technology is ready for full production and at level 9 productivity is stable.

The results of the research that has reached level of TRL 9 can be said that the developed technology is ready to be commercialized. Within the framework of the concept of innovation TRL, then at this level has passed the technology development phase. Where the next phase is market evolution. Hence it can be understood that at the TRL level 9, basically it has passed the technology development phase, therefore the next stage is how to enter the commercialization phase and how to maintain its sustainability. In the concept of TRL is ready to enter the market evolution phase. The FHP result has reached TRL level 9, the next step is expected to have collaboration with Commercialization Institutions or Investors, such as incubators, accelerators, intermediary institutions, and governments. The FHP should maintain product sustainability by conducting or seeking new research (according to market needs).

In this assessment towards IRL has been identified that the external tests have been carried out to meet the technical requirements and regulatory compliance. The technology risk control plan at the engineering and operation stages has also been validated. At the initial stage, the current production of FHP machine is two tons per month. However, it will be increased gradually at a large scale. The partnership pattern has been agreed in the form of an agreement, hence that the legal partnership has formally bound the two partners between PT. XYZ and state-owned enterprise have made Memorandum of Understanding (MoU) to market the product. Besides, the cooperation has been built through this company and Union “ABC” with a turnover of around 90 billion rupiahs in 2017. The Union consisted of around 300 fishermen and has seven business units. PT. XYZ has made a financial feasibility analysis of its business. The government also puts high attention to the development of the FHP product and suggests to make partnerships with government and private agencies. Even the Coordinating Ministry for Maritime Affairs and Investment, as well as Ministry of Cooperatives and Small and Medium Enterprises, has stated that the development of FHP products has been one of the national flagship programs.

4. CONCLUSION

Value creation along the fisheries supply chain has been done by providing value added in the actors involved, including fishermen, shipper, fish processing unit, and industry. Fish Hydrolyzate Protein (FHP) contains an added value in the fisheries supply chain. Regarding the innovation maturity, technology to produce FHP is classified into Technology Readiness Level (TRL) on Level 9 and the Innovation Readiness Level (IRL) on Level 3 meaning that the technological risk is close to zero. The recommendation for TRL 9 and IRL 3 has been followed up by conducting strategic partnership with related state-owned enterprise which could be a role model for the development of FHP cluster in another location. The role of local and central government should be improved since the authority's responsibility is to develop a conducive innovation-based ecosystem. Therefore, it would be beneficial to support the related stakeholders.

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