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Original Article



## Promoting 4.0 Supply Chain Innovation for Fisheries Bioecoregion: A Case Study in West Java Province, Indonesia

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### Abstract

The industrialization of marine and fisheries is the integration of production systems from upstream and downstream, to increase the scale and quality of production, productivity, competitiveness, and value added of fishery products. Bio-ecoregion-based fisheries and marine resources from each region, especially in West Java, which is one of the producers of fisheries and marine production through the development of industrialization innovations 4.0. This study aims to analyze how to promote 4.0 industrial innovations for Fisheries Bioecoregion, case study in West Java Province, Indonesia. The method used in this research is quantitative description, using primary and secondary data. Data analysis tools use SWOT to systematically analyze various factors based on logic that can maximize strengths and opportunities, but simultaneously can minimize weaknesses and threats. Based on the research results, the strength that is owned is to create a transformation of the potential of fishery resources to the exploitation of fishery resources based on Bioecoregion. Opportunities faced by the transformation of open market access management and high competitiveness in fisheries and marine products. The challenges faced must be able to create a digital bio-ecoregion-based fishing industry system. The threat faced by the transformation of the workforce towards digitalization. Based on the SWOT analysis being in quadrant 2 it means it is in a diversification strategy. Promoting 4.0 Industrial Innovations For a Fisheries Bioecoregion, based on: increasing the added value of fisheries industrialization, increasing the competitiveness of fishery products; strengthening of marine and fisheries industry players; commodity-based, regional, and regional management systems with a concentration on leading commodities, modernization of upstream and downstream production systems; balance between the use of natural resources and sustainable environmental protection; and changes in the mindset and behavior of modern society.



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## 1. Introduction

Indonesia is a country that has the potential for the production and marketing of fisheries and marine products. Fishery production in Indonesia in 2017 is 23,186,442.49 (Kementerian Kelautan dan Perikanan, 2017). One province that produces fisheries and marine products is West Java Province. per capita fish consumption needs / in 2014 amounted to 38.14, in 2015 amounted to 41.11, in 2015 amounted to 43, 94 and in 2017 amounted to 46.49 increased from year to year (Kementerian Kelautan dan Perikanan, 2018). Fisheries are all activities related to the management

and utilization of fish resources and the environment starting from preproduction, production, processing to marketing carried out in a fisheries business system (Ministry of Law Republic of Indonesia, 2009). Fish resources are the potential of all types of fish. The environment of fish resources depends on the bio-ecoregion concession of each region. Bio-ecoregion is a landscape that is within a stretch of ecological unity determined by natural boundaries, such as watersheds, bays, and currents (Ministry of Law Republic of Indonesia, 2019). Bio-ecoregion conditions will determine the type of fish caught or the types of fish

produced where fish are all types of organisms who's entire or part of their life cycle is in the aquatic environment.

The fisheries business is carried out in the fisheries business system, including preproduction, production, processing, and marketing. Fisheries business in implementing the fishing business should pay attention to the quality standards of the fishery, particularly the processing of fisheries products marketing chain (A Nurhayati, Aisah, & Supriatna, 2018).

Industrialization of fishery product processing must be the main object of activity in the fisheries sector in its handling and development. Fishery products have the characteristics of perishable, voluminous and are seasonal, so it is necessary to process fishery products and supply chain management systems that process starting from processing activities, marketing distribution, to the desired products reach the consumers. The long product flow process in the supply chain of fishery products from the production center to the end consumer, will increase marketing costs, so it is necessary to study the promotion of the supply chain of fishery products in the industrial era 4.0 (A Nurhayati et al., 2018; Suryaningrat, 2016).

Therefore, a strategy is needed in the design of the most effective and efficient supply chain process in order to prevent the occurrence of concentrated distribution at one point (Benassi, Chirco, & Colombo, 2017). Mapping the distribution network promotion and matters relating to technical distribution promotion along with its operational costs within a certain period also needs to be examined because there are changes in the price patterns in each supply chain to reach the hands of consumers (Lee, Yang, Kim, & Kim, 2018).

In the era of the industrial revolution 4.0, the role of technology in the supply chain between individuals is growing and has a variety of ways and methods, especially promotion in marketing fishery products based on bioecoregion. The easiness of the public in purchasing products has changed with the presence of a variety of communication technologies, both text-based, voice-based, and video-based. Internet-based digital smartphone applications contribute to developing marketing promotions for fisheries and marine products (Ministry of Law Republic of Indonesia, 2009).

## 2. Literature review

The relationship between 4.0 industrial era and the promotion of marketing fishery products with the principle of being integrated. Industrial Revolution 4.0 including (Hasmaidi.com, 2018): Industrial Revolution 1, the first time occurred after the discovery of steam engines, resulting in the development and great growth in industrial machinery in England in 1764. This revolution affected the agricultural and manufacturing sectors / industries, especially the textile industry and its decline. The 2nd Industrial Revolution was at the beginning of the 19th century, where improvements were

made to the process side, where large-scale processes were also known thanks to innovations from Ford. The inventions at this time were more towards electricity and transportation, this combination of production methods and developments influenced technology especially for the iron, machinery, oil, chemical, vehicle and other industries. The 3rd Industrial Revolution, known as the automation period, after world war, was marked using high-tech automatic, using electronics and information technology. This is what continues to this day. where machines and increased production capacity and software are the main supporters of the manufacturing process. The 4th Industrial Revolution which is currently confronted explains that machines and production capacity alone are not enough to make growth for a country. Along with that the development of current information technology, software and hardware as well as the rapid development of internet usage.

The industrial revolution 4.0 has four principles that enable each company to identify and implement a variety of industry 4.0 scenarios, among them are : (1) Interoperability is ability of machines, devices, sensors, and humans to connect and communicate with each other through the internet of Things (IoT) or the internet for audiences (IoT); (2) Information transparency is ability of information systems to create a virtual copy of the physical world by enriching digital factory models with sensor data; (3) Technical support is the first is the ability of an aid system to help people collect data and make visualizations in order to make wise decisions. Second, the ability of the cyber-physical system to help humans perform a variety of heavy, unpleasant, or unsafe tasks for humans; (4) Independent Decree is the ability of the cyber-physical system to make decisions and perform tasks as independently as possible (Manyika et al., 2017).

This research in conjunction with the fisheries and marine commodities are also faced with various challenges, including in the era of global competition, namely the era of the 4th Industrial Revolution a. Where the main issues raised in this era are competitiveness and productivity of fisheries. This research in conjunction with the fisheries and marine commodities are also faced with various challenges, including in the era of global competition, namely the era of the 4th Industrial Revolution a. Where the main issues raised in this era are competitiveness and productivity of fisheries (Manyika et al., 2017).

Challenges of increasingly fierce global trade competition, fisheries and marine products must be highly competitive, with the availability of efficient technology inputs, guaranteed product quality, efficient production system chains from upstream to downstream and the promotion of fisheries and marine products (A Nurhayati et al., 2018).

The Ministry of Maritime Affairs and Fisheries continues to encourage digital e-commerce based fisheries and marine products that aim to: (1) shorten

inefficient distribution chains because fish producers are closer to the retail market; (2) providing price certainty in fish farmers and consumers; (3) increase connectivity and eliminate distance, space and time limits to provide input and market facilities in the development of aquaculture industry; and (4) presenting an efficient aquaculture business model in the midst of the community.

The transformation of fisheries and marine industrialization era 4.0 towards automation and digitalization includes: (1) the transformation of exploitation of natural resources leads to the efficiency of natural resources, services and the increase in added value and productivity, (2) the transformation of the use of unskilled labor towards the creation of employment opportunities that really intended for trained human resources while employment for unskilled labor can be reduced, and (3) transformation from conditions of limited market access and low product competitiveness towards broad open market access, high competitiveness and efficient management .

Information technology through promotion can streamline the marketing chain of fisheries and marine products. Supply chain analysis needs to be done in order to support the competitive advantage of the fishing industry to produce products in accordance with consumer desires in terms of quality, quantity, price, time and place right research needs to be done based on the bioecoregion (Atikah Nurhayati & Purnomo, 2018; Pertiwi & Saputri, 2020). The supply chain has a dynamic nature but involves three constant streams which are product flow, financial flow and information flow. But the main purpose of the supply chain is still to meet consumer needs (Chopra & Meindl, 2007).

Horizontally, there are five main components or actors in the supply chain, namely suppliers, manufacturers, distributors, retailers, costumer. Vertically there are five main components of the supply chain, namely buyers, transporter, warehouses, sellers and so on. The characteristics of perishable fish commodities have a significant impact on losses, which is around 35%. From that number, the distribution process contributed quite a lot, which is around 10%. Supply chain analysis needs to be done in order to support the competitive advantage of the fishing industry and the fisheries business to be able to produce products in accordance with consumer desires in terms of quality, quantity, price, time and place right (Pertiwi & Saputri, 2020).

Supply chain management is a concept of the right approach to overcome the problem of meeting consumer demand. When delivering products to end consumers is demanded as efficiently as possible while maintaining product quality. In the supply chain there are regulatory systems related to product flow, information flow, and financial flow (Tompodung, Worang, & Roring, 2016). Supply chain management is a set of activities and related decisions to integrate suppliers, manufactures,

warehouses, transportation services, retailers and consumers efficiently. Thus, goods and services can be distributed in the right amount, time and location to minimize costs to meet consumer needs (Li, 2007).

The decision-making process, consumers will go through the stages first before finally deciding to buy the product. There are many factors that influence consumer decision making, for example the level of consumer confidence in the product, price, and quality of services provided by the company. The purchasing decision making process is influenced by the company's stimulation which includes the product, price, and place. In addition to these stimuli there are also factors driving purchasing decisions, namely service quality and trust. (Kotler & Armstrong, 2010).

Every supply chain activity certainly does not always run well, there are conditions where the supply chain experiences one or several obstacles that make a risk that must be borne by the actors of the supply chain. Business actors who run their businesses or businesses can be sure to know what the risks in the business are, as well as new risks that will be borne by the supply chain network.

Supply chain risk can be defined as a loss that is assessed in terms of the likelihood of it occurring. If one of the actor's experiences problems in the supply chain, it will affect both directly and indirectly the partners in the supply chain network (Mariman & Magfiroh, 2010). Supply chain development can be analyzed using network structure, chain objectives, chain management, chain resources, chain business processes.

Supply chain risk does not only lie in activities within the business community but can cause disruption of product flow to the next consumer or suppliers of raw materials to be processed into a product that has added value. This situation is certainly very detrimental to all parties involved with the flow of goods and the flow of money in the supply chain so that there will be times when consumers suffer from the scarcity of desired products (Antarbangsa, Nurhayati, & Harahap, 2014).

One of the supply chain risks of fishery products is caused by the length of marketing channels from production to consumers. One solution is to shorten marketing channels, through product promotion using online media. Online promotion is also known as digital marketing. Types of digital marketing can be categorized as marketing via email, social media marketing such as Istanbul, Facebook, WhatsApp and many types of display advertisements including web banner ads, and mobile advertising (Pawar, 2014). Digital marketing is considered the most appropriate to be applied to micro small and medium business, especially the promotion of processed fishery products. One of the supporting factors that must be owned by small and medium micro business is mastery of information technology.

### 3. Materials and Methods

The method used in this research is descriptive qualitative and quantitative. The data used are primary and secondary data. The respondent used was chosen by the snowball sampling method, which is taking respondents based on recommendations from the first respondent. The number of respondents was 46 people consisting of fishermen, fish auction place traders, collector traders, small traders, consumers.

Analysis of supply chain management conditions. The product flow approach includes marketing objectives, implementation of supply chain management, demand and supply. The financial flow approach includes capital and payments (Neureuther & Kenyon, 2009). In abnormal supply chain conditions, there are risks that can threaten the sustainability of the supply chain, both those that are easy to replace and those that are not easy to replace quickly within their management timeframe (Sugiyono, 2010).

$$a = \frac{\delta \text{ replace}}{\delta \text{ Collapse}} \quad (1)$$

Descriptions:

$\alpha$	:	The consequences of the risk of a product in the supply chain.
$\delta$ replace	:	The time it takes for a supply chain to replace a sub-product or time needed to handle interruption of a product flow and returns to normal scheduling conditions with the same quality level.
$\delta$ collapse	:	The time of the sub-product failed to be completed before the supply chain experience a loss at a critical point in service the market.

The assessment indicators for promoting 4.0 supply chain innovations for a fisheries bio-ecoregion as seen in Table 1.

**Table 1.** Value of risk consequences

Consequences	Descriptions	$\alpha$
Important	Irreplaceable	1.0
Necessary	Not easy to replace	0.6
Needs	Easily replaced	0.3
Wanted	Easily replaced	0.1

#### 2.1. Validity test data

Validity test is used to determine the level of validity of the questionnaire instrument used in data collection. Using valid and reliable instruments in data collection it is expected that research results will be valid and reliable. Reliability testing in this study was conducted by calculating the value of Cronbach's Alpha instruments from each of the research variables tested (Freddy, 2014).

#### 2.2. SWOT analysis

SWOT analysis compares between factors external opportunities and threats with factors internal strengths

and weaknesses. Internal factors are entered into the matrix called Internal Strategic Factor Analysis Summary (IFAS). External factors are entered into the matrix which is called External Strategic Factor Analysis Summary (EFAS) (West Java Regional Development Planning Agency, 2019).

S-O Strategy (Strength-Opportunities). This strategy is based on thinking company, namely by utilizing all power to seize and take advantage of the biggest opportunities. S-T Strategy (Strengths-Threats) Is a strategy to use the power that companies have for overcome threats. W-O Strategy (Weaknesses-Opportunities). This strategy is applied based on utilization opportunities that exist by the way minimize existing weaknesses. W-T Strategy (Weaknesses-Threats). This strategy is based on activities that are defensive and trying to minimize existing weaknesses as well as avoiding threat.

### 4. Results and Discussion

#### 4.1. Research location based on bio-ecoregion aspect

This research was conducted in the coastal area of West Java Province. The Province of West Java is geographically located between 5°50' - 7°50' South Latitude and 104°48' - 108°48' East Longitude, with territorial boundaries, north with java sea and DKI Jakarta, east with central java province, south with Indonesian ocean, west with Banten province. West Java Province has natural conditions with complex geological structures with mountainous regions in the middle and south and lowlands in the north. The southern coastal region of West Java includes the districts of Sukabumi, Cianjur, Garut, Tasikmalaya, Ciamis and Pangandaran (The Minister of Marine and Fishereies of The Republic of Indonesia, 2014).

Coastal waters are seas bordering land, covering waters as far as 12 nautical miles measured from the coastline, waters connecting the coast and islands, estuaries, bays, shallow waters, brackish marshes and lagoons. Coastal areas are transitional areas between terrestrial and marine ecosystems that are affected by changes in land and sea. The condition of bio ecoregion from physiographic aspects, the southern coast of West Java is part of the Southern Java Mountain Range extending from Ujung Kulon in the west to Segara Anak in the east. The condition of bio ecoregion from the geographical aspect of the southern coast bordering the waters in the Indian Ocean, has a coastal condition located opposite the shallow waters of the Java Sea, with coastal conditions varying between sandy, rocky or reefed.



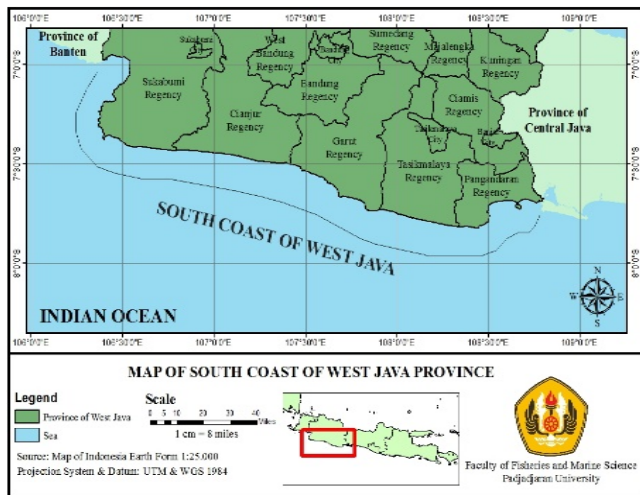


Figure 1. Research Location

The southern coastal region of West Java produces capture fisheries production. Fisheries are all activities related to the management and utilization of fish resources and the environment starting from preproduction, production, processing to marketing, which are carried out in a fisheries business system

#### 4.2. Characteristic of respondents

Respondents in this research includes fishermen, fish auction employees, large traders, small traders, consumers

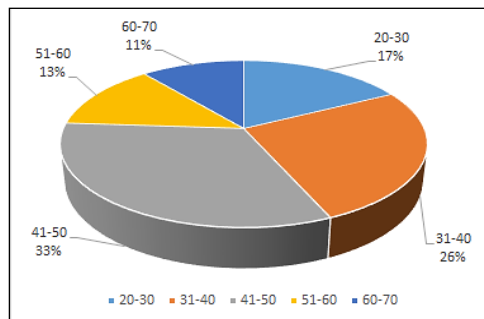


Figure 2. Respondent characteristic by age

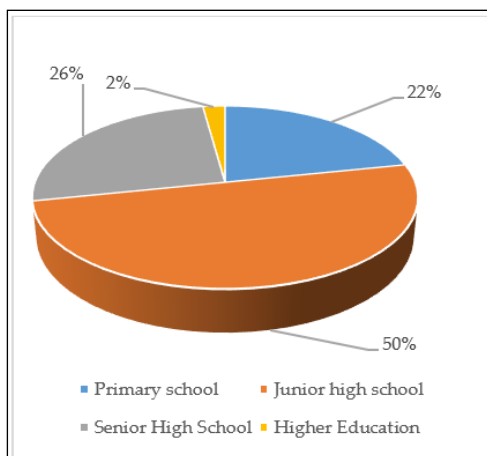


Figure 3. Education level of respondent

On the basis of the results of research the level of education of respondents has an influence on decision making in running their business.

Table 2. Total Respondent

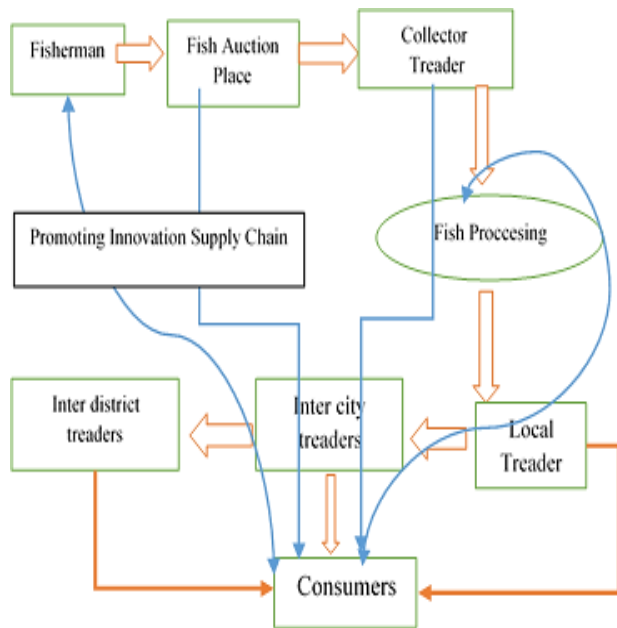
No	Category		Freq.
1	Raw Material Provider	Fisherman	6
		Fish auction manager	3
		Collector trader	1
2	Fish Processing		7
3	Trader	Local trader	15
		Inter-city traders	4
		Inter-district traders	4
		Inter-provincial traders	6
Total			46

#### 4.3. Promoting 4.0 supply chain innovations for a fishery

Fishery Products are any form of food products in the form of whole fish or products containing parts of fish, including products that have been processed in any way with the main raw material of fish. The National Fish Logistics System (SLIN) is a management system of fish and fishery product supply chains, materials and production equipment, as well as information ranging from procurement, storage, to distribution, as a unity of policies to increase capacity and stabilize the rural fisheries production system, control price disparity, and to meet domestic consumption needs.

The national fish logistics system aims to: (1) increase capacity and stabilizing the national fisheries production and marketing system; (2) strengthen and expand connectivity between upstream production centres, downstream production and marketing efficiently : (3) improve the efficiency of management of fish supply chains, materials and production equipment, as well as information from upstream to downstream.

The application of digital technology in the fisheries sector has shown a positive trend for Indonesia. Through collaboration with international institutions, Indonesia has succeeded in increasing the productivity of capture fisheries from 6.54 million tons in 2016 to 9.45 million tons in 2018 (data as of October 2018).



**Figure 4.** Promoting 4.0 supply chain innovations for a fishery

Figure 4 captures the supply chain of fishery products. Supply Chain of captured fishery products enter the fish auction place, then to collecting traders and processed so that it has product value added. After the product has been processed, it will be marketed through local traders, inter-city traders and inter-provincial traders, then to consumers. After done promoting innovation supply chain marketing channels can be done directly between fishermen and consumers, fisheries product processors and consumers, using internet marketing applications. Internet use applications for marketing fishery products have several strengths and weaknesses, which are as follows:

**Table 3.** Matrix Internal Strategic Factor Analysis Summary (IFAS) promoting 4.0 supply chain innovations for fisheries.

No	Internal Strategy Factors	Weight	Ranting	Score
<b>Strength</b>				
1	Increasing trends in fisheries productivity	0.18	4	0.36
2	The comparative and competitive advantage of Bioecoregion-based fishery products	0.25	3	0.75
3	National fisheries company performance improvement using Android-based digital technology	0.12	4	0.48
	<b>Total</b>	<b>0.55</b>		<b>1.56</b>
<b>Weakness</b>				
1	Transshipment prohibition as outlined in KKP Minister Regulation No. 57/2014.	0.2	4	0.6

No	Internal Strategy Factors	Weight	Ranting	Score
2	Education on the use of fisheries technology to fishermen and fishery product processors is still low	0.15	3	0.45
3	Vertical integration has not been focused on the integration of information technology systems at various levels of production, processing fishery products to consumers	0.1	3	0.3
<b>Total</b>		<b>0.45</b>		<b>1.35</b>

**Table 4.** Matrix external strategic factor analysis summary (EFAS) promoting 4.0 supply chain innovations for fisheries.

No	External Strategy Factors	Weight	Ranting	Score
<b>Opportunity</b>				
1	Increasing and high demand for fish	0.16	3	0.48
2	Increasing the added value of the national fishing industry	0.19	4	0.76
3	Time efficiency and marketing costs for fishery products	0.14	4	0.56
	<b>Total</b>	<b>0.49</b>		<b>1.8</b>
<b>Threat</b>				
1	Illegal, Unreported dan Unregulated (IUU) Fishing	0.21	4	0.84
2	Decreasing the number of workers in the fisheries sector, due to being replaced by machine automation	0.18	4	0.72
3	Competitiveness of domestic and foreign fishery products	0.12	3	0.36
	<b>Total</b>	<b>0.51</b>		<b>1.92</b>

#### Internal Analysis Coordinate:

Total strength score - total weakness score/ 2 is 0.21.

#### External Analysis Coordinates:

Total opportunity score - total threat score/ 2 is -0.06.

So, the coordinates are located at (0.21; - 0.06). On the basis of SWOT analysis of Promoting 4.0 Supply Chain Innovations for a Fisheries is in quadrant 2 in the

diversified position, this shows that despite facing various threats faced in industrial technology 4.0, the fisheries sector still has internal strength. This strategy utilizes the strength of the fisheries sector which can reduce threats to the industrial revolution 4.0.

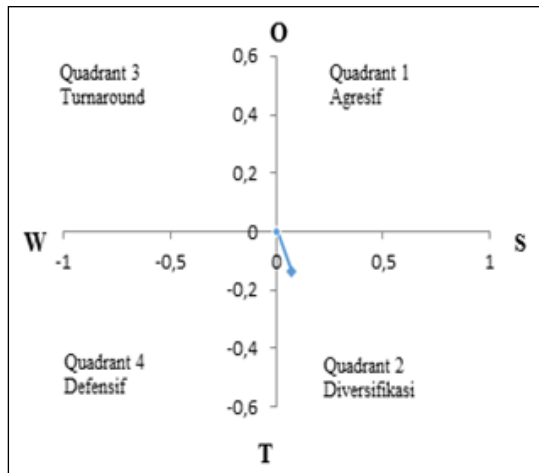


Figure 5. SWOT Analysis Diagram

Internal factors have a total score for strength of 1.56, total score for weakness of 1.35 so strengths are more dominant than weaknesses in determining development strategies promoting 4.0 supply chain innovations for a fishery. External factors have a total score for opportunity of 1.80, total score for so that external opportunities more dominating than the factor of the threats facing. The Cartesian diagram above shows the position in quadrant 2. This position has the power that can be utilized to seize the opportunities that exist. Alternative strategies that used all the power they must take advantage of opportunities that exist.

Table 5. Result of SWOT matrix

<div>O</div> <div>S</div>	O1. Increasing and high demand for fish O2. Increasing the added value of the national fishing industry O3. Time efficiency and marketing costs for fishery products
	S1. Increasing trends in fisheries productivity S2. The comparative and competitive advantage of bioecoregion-based fishery products
	Increasing trends in fisheries productivity through diversification and value added processing of fishery products, so that it has high economic value (S1-O1, O2, O3) The comparative and competitive advantage of bioecoregion-based fishery products through the development of fisheries production that is local specific based on bio ecotone conditions in a particular bioecoregion (S2-O1, O2, O3)

S3 National fisheries company performance improvement using Android-based digital technology	The use of the internet of things in marketing fishery products (S3-O1, O2, O3).
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Strategies promoting 4.0 supply chain in innovations fisheries through product flow, finance, supply chain risk. The product flow in the form of raw Materials for fishery products before processing the product. Supply chains which include fishermen, fish auction places, traders, fishery product processors, local marketers, inter-city marketers and inter-provincial marketers, with prices received from each different supply chain channel, based on fish species, length of type of subscription fish and travel time.

The financial flow in the supply chain of fishery products is the same as the financial flow in the supply chain of commodities or other goods where the financial flow moves from the bottom up where consumers make payments to processors and processors make payments to suppliers of raw materials. The flow of finance will not be stopped but there will be obstacles when the method of payment is not done in cash, but all methods of payment are based on agreements made previously.

Supply chain management of fishery products has not been going well as a whole starting from the procurement of raw materials to the hands of consumers. As there are conditions that are not normal at some time, for example, influenced by natural conditions and other unexpected conditions that cause disruption in the supply chain. This situation can cause losses ranging from irreplaceable to irreplaceable.

## 5. Conclusions

Consequence risk promoting 4.0 supply chain innovations for a fisheries used comparative between the time it takes for a supply chain to replace a sub-product or time needed to handle interruption of a product flow, and returns to normal scheduling conditions with the same quality level with the time of the sub-product failed to be completed before the supply chain experience a loss at a critical point in service the market. In conclusions, the consequence risk promoting 4.0 supply chain innovations for a fishery including Bio ecotone conditions suitable for the fisheries sector, Handling of fishery products after catching and processing, Sales system with a consignment pattern, to reduce the risk of payment systems between distributors, Avoiding the risk of fraud in the marketing supply chain with consequence is important.

Types of supply chain risks is Availability of fishery products, Availability of fishery products, Handling of products when transporting fishery products from each distributor with consequence is necessary, while handling of unsold Fresh fish products for fish feed ingredients and Handling of unsold processing fish products for fish feed ingredients with consequence is needs. Consequence risk promoting 4.0 supply chain

innovations for fisheries based on travel time in units of days in the supply chain of fishery products. Promoting 4.0 supply chain innovations for fisheries including procurement of fishery products, handling of fishery products, fisheries product transportation systems and distribution channels of fishery products are a unified whole to increase the added value of fishery products.

**Author Contributions:** Conceptualization, A.N. and I.N.; methodology, A.N.; software, A.N.; validation, I.N., T.H., I.R and I.A.; formal analysis, A.N., I.N.; investigation, A.N., I.N.; resources, X.X.; data curation, I.N., T.H., I.R and I.A.; writing—original draft preparation, A.N.; writing—review and editing, A.N., I.N., T.H., I.R and I.A.; visualization, A.N.; supervision, I.N.; project administration, I.N.; funding acquisition, A.N. All authors have read and agreed to the published version of the manuscript.

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