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Fisheries Development Strategies of
Biak Numfor Regency, Indonesia

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Abstract

The purpose of this research was to develop the fisheries development strategies of Biak Numfor Regency. This research used primary data and secondary data. Primary data were collected through field observations and indepth interviews with key stakeholders. Secondary data were collected from related publications and documents issued by the competent institutions. SWOT Analysis was used to inventory the strengths, weaknesses, o 22 tunities and threats. TOWS matrix was used to develop an alternative of fish 1 es development strategies. QSPM was used to determine a priority of strategies. Based on the research results, there are 22 alternative strategies that can be applied for optimization of fisheries development in Biak Numfor Regency. The s 1 egies priority is the development of 'Wadibu' ocean fishing port, 'Fandoi' fish landing place and 'Bosnik' fish landing place. Each alternative strategies can be synergized to optimize the fisheries development in Biak Numfor Regency

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1. Introduction

Biak Numfor regency has high potential of fisheries resources. Marine waters of Biak Numfor regency is relatively low pollution. Biak Numfor regency also has several protected waters where potential to be developed for marine fish farming, such as grouper fish, snapper fish and napoleon fish. Several marine waters of Biak Numfor

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regency also could be developed as an area for seaweed culture. Biak Numfor regency is bordered with the Pacific Ocean, so have a high potential to be developed fishing industry.

However, the fishing industry in Biak Numfor regency is not optimally be developed. Biak Numfor regency has not a ocean fishing port (PPS) yet. Biak Numfor regency still have a fish landing place (PPI) in Bosnik district and Fandoi district. Fisheries business in Biak Numfor regency is still dominated by artisanal fisheries (vessels without motors and outboard motor) that can be operated oneday fishing. Intensive fish farming has not developed in Biak Numfor regency yet. So, efforts to accelerate the fisheries development in Biak Numfor regency is needed to optimize the fisheries potential of Biak Numfor regency.

The purpose of this study was to develop the fisheries development strategies in Biak Numfor regency. The fisheries development strategy in Biak Numfor regency should take account to an internal and external factors. Internal factors include fisheries resources, human resources, and infrastructure as an input factor in the fisheries development. While the external factors include a markets, business competition and political support that can not be controlled by the stakeholders of fisheries development of Biak Numfor regency.

2. Material and methods

This research followed an applied research, that is to solve the problems, especially fisheries development in Biak Numfor regency.

2.1. Data collection

This research used a primary data and secondary data. Primary data was collected by field observations and in-depth interviews with the stakeholders. Respondents in this study included a regency government employee of marine and fisheries departement (three persons), employee of fish seed producer (one person), fisherman (five persons), fish traders (four persons), fish processors (four persons), fish farmers (three persons), employees of the state electricity company (one person) and employees of the regency water supply company (one person). While secondary data was collected from a publications and documents issued by the competent authority.

2.2. SWOT analysis

SWOT Analysis was used to inventory the strengths (S), weaknesses (W), opportunities (O) and threats (T). Strengths and weaknesses were derived from the internal environment, including an existing resources of stakeholders, both natural resources, human resources and infrastructure as an input factor in the fisheries development of Biak Numfor regency. The external environment was a source of opportunities and threats, including market, business competition and political support that can not be controlled by the stakeholders. Research used SWOT analysis to develop a strategies has been done by several researchers, both to business strategies (Abdi et al., 2013; Agarwal et al., 2012; Chan, 2011; Dyson, 2004; Ommani, 2011; Shojaei et al., 2010; Wang et al., 2014) and public policy strategies (Adepoju and Famade, 2010; Chen, 2014; Jamshidi et al., 2012; Kantawateera et al., 2013; Sayyed et al., 2013). Developing fisheries strategies used the TOWS matrix. In the TOWS matrix, there are four strategies types, i.e. SO strategy (integrating the strengths and opportunities), ST strategy (integrating the strengths and threats), WO (integrating the weaknesses and opportunities), and WT (integrating the weaknesses and threats).

2.3. QSPM

Quantitative Strategic Planning Matrix (QSPM) was used to determine the strategic priorities. In QSPM, each alternative strategy assessed for compliance with the key factors. Each of key factors have the weight of factors. Strategies rated of 1 if it has not related to the key factor, then the value of 2 if it has less relevance, the value of 3 if it has relevance to the key factor and value of 4 if it has a high relevance to the key factor. Several researchers also used QSPM to determine the strategic priorities, including Ommani (2011) and Shojaei et al. (2010). In this study, the key factors used natural resources, human resources, infrastructures, regulation, markets and technologies.

3. Result and discussiona

3.1. Overview

Biak Numfor regency is located in the northern of Papua island, on 0°55'-1°27' latitude and 136°134'47' east longitude. Biak Numfor regency has 2 602 km² and 19 districts. Biak Numfor regency has a north border with the Pacific ocean, south border with the Yapen strait, west Biak Numfor regency with Manokwari and east border with the Pacific ocean. Biak Numfor regency consists of two main islands, i.e. Biak island and Numfor island. Biak Numfor regency has more than 42 small islands, including the Padaido Islands. The population of Biak Numfor regency was 135 080 people in 2013 with a population density of 51.91 people per km² and a population growth rate of 2.03 % (BPS, 2015).

Table 1. General condition in 2014

Indicators	Note
Regional broadness	2 602 km ²
Districts	19 districts
Population	135 831 person
Population density	52 persons per km ²
Growth of population	0.56 %
Human development indexes (HDI)	70.32
Mean years schooling	9.61yr
Regional Income	IDR 23 094.40 × 10 ⁶
GRDP on nominal price	IDR 3 824 951.52 × 10 ⁶
GRDP on constant price	IDR 3 131 696.46 × 10 ⁶
GRDP per capita	IDR 28.16 × 10 ⁶ · yr ⁻¹
Economic growth	5.12 %
Expor	USD 0
Impor	USD 0
Length of roads	958.39 km
Inland fish production	901.3 t
Big pelagic fish capture production	12 950 t
Small pelagic fish capture production	15 900 t
Demercal fish capture production	21 500 t
Seaweeds culture production	16.2 t

Source: BPS Kabupaten Biak Numfor (2015)

Gross Regional Domestic Product (GRDP) of Biak Numfor regency continued to rise. GRDP based on nominal prices in was IDR 2 490 × 10⁹, and increased to IDR 3 825 × 10⁹ in 2014. While the contribution of the fisheries sub-sector was IDR 748 × 10⁶ n or approximately 19.5 % contribution to GRDP of Biak Numfor regency in 2014 and reached 81.0 % of GRDP on group of agriculture, forestry and fisheries (BPS, 2015). That was prove if fisheries sub-sector has a significant contribution to GRDP of Biak Numfor regency.

3.2. Strength

Stakeholders could use the strength to optimalize the Biak Numfor regency fisheries development. Biak Numfor regency bordering the Pacific ocean that has the potential of fisheries resources. Government of Indonesia set the seawaters of Biak Numfor regency as a part of the fisheries management area of 717 (WPP 717) which has potential resources in big pelagic fish of 13 921 t · yr⁻¹, swordfish of 9 243 t · yr⁻¹, small pelagic fish of 384 750 t · yr⁻¹, demercal fish of 97 800 t · yr⁻¹, reef fish of 3 854 t · yr⁻¹, shrimp of 8 656 t · yr⁻¹, lobster of 1 051 t · yr⁻¹, squid of 1 515 t · yr⁻¹ and the total amount reached of 520 790 t · yr⁻¹ as the research results of the National Commission for Stock Assessment of Fish Resources (Komnaskajiskan) in 2013 (P4KSI, 2014). However, the fishing business in Biak Numfor regency is still dominated by artisanal fishing use simple fishing gear, small vessels and operate oneday fishing.

At another side, there are several locations in Biak Numfor regency where should be developed as a center of marine aquaculture, including the Vendidori district for floating cage culture, and Padaido district for seaweeds culture. Seawaters area where could be used as location of marine culture is protected waters, and lower polluted.

At the present, there are fishing port (fish landing place) in Bosnik district and Fandoi district where could be developed as a center of micro and small-scale fisheries business. Ocean fishing port (PPS) could be developed in Wadibu as center of middle and large-scale fisheries business. The candidate sites of PPS Wadibu is feasible in technical aspects and environmental aspect. So, supporting of central government and province governments to realize the construction of PPS Wadibu is needed. PPS Wadibu as fishing base of fishing vessels above 60GT to exploit the fisheries resources in the Pacific ocean (WPP 717), including tuna and skipjack. Medium and large scale of fishing industry could be oriented for export purposes.

Frans Kaisiepo airport and Wapnor public port could be use to support the fisheries exports of Biak Numfor regency. Japan and South Korea is one of major importer of tuna in thr world. Exporter could distribute a fresh tuna from Jakarta or Bali, and then transit in Biak before continue to Japan or South Korea. Frans Kaisiepo airport was a military airport in World War II with a runway of 3 500 m. Exporter also could distribute a frozen tuna from Jakarta or Bali, and then transit in Biak before continue to Japan, South Korea or USA. 'Tol Laut' program (regional interconnectivity by regular vessels) could be optimized fish trade and logistics of Biak Numfor regency to other areas.

The electric supply of Biak Numfor regency also still surplus, with capacity is 13MW and peak load of 11MW. Moreover, the electricity producer corporation (PT. PLN) of Biak Numfor regency also has a plan to increase electricity supply and ready to supply additional electricity when PPS Wadibu be developed, including fish processing industry. The roads and bridges in Biak Numfor regency also sufficient to support fisheries industry. The supply of fresh water is also relatively sufficient. Freshwater producer corporation (PDAM) of Biak Numfor regency utilize several natural source of water to supply the fresh water demand of Biak Numfor regency people. PDAM of Biak Numfor regency also ready to supply fresh water to PPS Wadibu.

Based on the above, formulated several strengths that can be optimized for the fisheries development in Biak Numfor regency. Some of these strengths are as follows:

- Directly border to the Pacific ocean that has a highly fisheries resources (Code: S1).
- There are several locations that suitable with the technical requirements for marine culture (Code: S2).
- Frans Kaisiepo airport has a runway of 3 500 m and ready to become an international airport (Code: S3).
- There is location where technically feasible to be used as a PPS in Wadibu (Code: S4).
- There is PPI Bosnik as traditional capture fisheries center in East Biak district (Code: S5).
- There is PPI Fandoi as traditional capture fisheries center in Biak City district (Code: S6).
- The electricity supply from PLN is sufficient (Code: S7).
- Infrastructure of roads and bridges relative support (Code: S8).
- The availability of fresh water sources are sufficient (Code: S9).
- There is a public port facilities (Code: S10).

3.3. Weakness

Although WPP 717 has a high potential of fisheries resources, especially big pelagic fish resources (including tunas), but research of Komnaskajiskan in 2013 proved that several types of fish resources are overexploited, i.e: small pelagic fish, and lobster. Resources of coral reef fish, squid and tuna has been fully exploited (P4KSI, 2014). Therefore, the exploitation of certain type of fisheries resources must to be strictly controlled.

Moreover, the human resources (HR) competitiveness of fisheries businessman are still relatively weak in education, knowledge and networking. Fisheries capture of Biak Numfor regency is dominated by micro scale enterprises, using boats without motors and outboard (size below 5GT), operate oneday fishing, and fishing grounds in the coastal area. Fishermen of Biak Numfor regency have low level education. Meanyear schooling of Biak Numfor regency was 9.61 yr (BPS, 2015), it means that on average had graduated junior high school, but have not graduated senior high school.

Fish cultivation in Biak Numfor also underdeveloped. Although Biak Numfor regency has the potential locations for aquaculture, but marine culture in Biak Numfor regency still was not a mass harvesting yet. Aquaculturist in Biak Numfor regency start their business by the grant program of government projects. Beach fish seed center (BBIP) of Biak located near Bosnik fish market (coordinates of 01°10'12,46"S 136°13'29,85"E) also has not produce

marine fish (grouper fish) seed yet. Therefore, the supply of marine fish seed is still from other regions, i.e: Situbondo (East Java) and Gondol (Bali). Seaweed culture also undeveloped, whereas seaweed cultivation technology is relatively simple and there are several small islands in Biak Numfor regency has potential to be location of seaweed culture. That's because the coastal communities in Biak Numfor regency are still assessing that seaweed culture is unprospective business.

The government of Biak Numfor regency should develop fisheries vocational school and university/college where have fisheries major to supply a qualified human resource demand. At the present, there are Fisheries Academy of Kamasan-Biak and Marine and Fisheries Vocational Senior High School (SMK) of Biak. Fisheries Academy of Kamasan-Biak was founded in 1999. Fisheries Academy of Kamasan Biak have the diploma program (D3) of Fishery Products Processing Technologies (TPHP) that accredited of C and the lecturer-student ratio of 1:7. Fisheries Academy of Kamasan Biak also have the diploma program of Fisheries Resources Utilization (PSP) with accreditation status of C and the lecturer-student ratio of 1:8.

The fish post-harvest and marketing of in Biak Numfor regency still uses traditional technology and it is not in accordance with the hygiene and sanitation principles. The fish market in Fandoi District and Bosnik District as fish marketing center also still traditional, and incompatible to the hygiene and sanitation principles.

Transportation providers in Biak Numfor regency still insufficient and transportation still inefficient. Local transportation is relatively available, but still concentrate in certain area. The major transportation inter-region use marine transportation with limited schedule. The air transportation is still low in frequency and expensive. So, 'Tol Laut' (inter-regional regular marine transportation) program is expected to reduce transportation cost, both in marketing and logistic interest.

Biak Numfor regency has three passenger local terminals. Biak Numfor regency has several ferry port. i.e. Mokmer port in Biak Kota district (route of Biak-Manokwari), Yemburwo port in Poiru district, Numfor island (route of Numfor-Manokwari) dan several local port, i.e. Bromsi port (Aimando district), Numfor port (Orkeri district), Wardo port (West Biak district), Korem port (Nort Biak district), Bosnik port (East Biak district), Manggari port (Bruyadori district) and Tip-Top (City Biak district). Frans Kaisiepo airport serve several route interlink with Biak, i.e. (i) Jakarta, Makassar, Jayapura, Numfor, Manokwari; (ii) Jakarta, Makasar, Manado, Ambon, Tual, Wamena, Merauke; (iii) Serui, Nabire, Manokwari; (iv) Serui, Nabire, Kaimana, Fak-fak; and (v) Jakarta, Surabaya, Makasar, Timika. While Yemburwo in Numfor island is pioneering domestic airport where have route of Biak-Yemburwo (Pemkab Biak Numfor, 2011).

Based on the above reasons, there are several weaknesses need a solutions for the fisheries development of Biak Numfor regency, i.e.:

- The utilization rate of fish resources status of WPP 717 is partially overfishing (including lobster and pelagic fish), and fully exploited (including tuna, squid and reef fish) (Code: W1).
- Competitive rate of HR fishing operators is weak, especially in education, knowledge and networking (Code: W2).
- Enterprises of fisheries is still dominated by the artisanal fisheries business use boat without motor, and outboard boat (Code: W3).
- Technical skills of aquaculture businesses is still inadequate (Code: W4).
- Fish Seed Center Beach (BBIP) Bosnik has not managed to produce fish seeds in mass yet (Code: W5).
- The coastal communities is still assessing seaweed farming as a unfeasible business, although there are several potential locations for the seaweed culture (Code: W6).
- The fish market in Fandoi and Bosnik are still traditional and incompetent to the principles of hygiene and sanitation (Code: W7).
- The fish processing is still simple and incompetent to the principles of hygiene and sanitation (Code: W8).
- The transportation services are insufficient and inefficient (Code: W9).
- The fisheries educational institutions are still inadequate, especially in quality (Code: W10).

3.4. Opportunities

Biak Numfor fisheries development can take advantage of opportunities from the external environment progress, which is associated with the market, technology, and politic. The Indonesia population is ranked of fourth in the

world and continues to growth, so it is a big market for national fish products, including fish products from Biak Numfor regency. The population of Indonesia in 2014 was amounted of 253.60×10^6 people and the average population growth was $1.5 \% \cdot \text{yr}^{-1}$. Fish consumption per capita of Indonesia was 35.6 kg per person in 2013, and is estimated to be 54.5 kg per person in 2019. Similarly, the fish demand in the world is increased in progress. The fish consumption in the world reached 136.2×10^6 t (the world population of 7.1×10^9 people), so fish consumption per capita in the world of 19.2 kg per capita per year in 2012, and the fish consumption per capita in developed countries reached 27.4 kg per capita in 2012. Meanwhile, fish demand for not human consumption reached 21.7×10^6 t in 2012. Japan, the United States and China are major importer of fish in the world, while South Korea ranks of ninth, and Hong Kong rank of 10. The import volume of Japan, the United States, South Korea, Hong Kong and European countries (Spain, France, Italy, German and England) were increased in progress. Unfortunately, Indonesia has not been in the top 10 exporters of fish in the world, still under from Thailand and Vietnam (FAO, 2014).

The national fish price has also increased, its cause of inflation. The world fish price has rise trend. Projected world fish demand in 2030 will reach 186×10^6 t (World Bank, 2013). Trend of skipjack tuna price in the world is rise, although have a daily fluctuation. Similarly, the shrimp price in Japan is fluctuate with the trend increasing (FAO, 2014).

Seaweed demand, both in Indonesia and the world, are also increase. Seaweeds are needed by several industries, both for food and non food. Although the seaweed price in Indonesia has fluctuated, but the trend of seaweed price in the world tend to increase. In 2012, *Kappaphycus alvarezii* and *Eucheuma* spp. were the main production of seaweed in the world. *Eucheuma* spp. relatively abundant in the Indonesia seawaters, including in the Biak Numfor seawaters, and has been successfully cultivated in Indonesia. In 2005 to 2011, Indonesia was ranked two of major producers of seaweed culture in the world (27.4 % of the world production in 2012), and the first rank was China. The production of seaweed and other cultivated plants in the world also continued to increase, in 2005 reached 13.52 t to 20.98 t in 2011 (FAO, 2014).

Several fisheries commodities (including tuna, grouper, shrimp, and lobster) was produced from the Biak Numfor seawaters have potency to be exported to several countries around the Pacific ocean, i.e. Japan, South Korea and Hong Kong. The Biak Numfor seawaters also produce several ornamental fish, especially fish in coral reef ecosystems. Japan and South Korea have decreasing trend in fisheries production. Total tonnage of fishing vessels in South Korea was 917 603 GT (1 Gross Tonnage equal 2.83 m^3) in 2000, and became 607 887 GT in 2012. While the total tonnage of fishing vessels of Japan in 2000 amounted to $1\,447\,960 \times 10^6$ became 1 017 275 GT in 2012. In 2003 to 2012, Japan marine capture fisheries production fell of 21.9 %, while South Korea declined of 4.5 % in 2011 to 2012. Meanwhile, Indonesia fisheries production have continued to rise, amounting to 27 % in 2003 to 2012 and had increase of 1.7 % in 2011 to 2012 (FAO, 2014). Of course it is an opportunity for investment in the Biak Numfor fishing industry for export fishery products interest to Japan and South Korea.

Biak Numfor people relatively like to eat a fish, it becomes the prospective market for the traditional fishing businessman in Biak Numfor regency. Biak Numfor regency population tends to increase, in 2012 amounted to 132 392 people, in 2013 amounted to 135 080 people and in 2014 amounted to 135 831 people. RGDP (regional gross domestic product) of Biak Numfor regency also continued to increase, amounting to $\text{IDR } 23.01 \times 10^6 \cdot \text{yr}^{-1}$ in 2012 to $\text{IDR } 28.16 \times 10^6 \cdot \text{yr}^{-1}$ in 2014 (BPS Kabupaten Biak Numfor, 2015). The RGDP per capita is one of the indicators of people purchasing power, although it must take into account the distribution of income.

Technological developments in the world is relatively fast over time, especially computer and informatics technology. The computer and informatics technology progress are used by businessman for a several purposes, including marketing and promotion interest. Fisheries technology continues to develop, both in fishing technology, aquaculture and fish processing technology. The technology progress is an opportunity for the fisheries development in Biak Numfor regency.

Law enforcement on illegal fishing by the central government provide a positive impact to Indonesia fishing industry, including in Biak Numfor regency. Although it needs to be empirically proven, but several stakeholders have expressed that there are increase in production of the fishermen after the enforcement of illegal fishing. Foreign illegal fishing in Indonesia were a relatively large number of vessels and used big vessel (above 30 GT). So, law enforcement to illegal fishing have a positive impact in fish stock availability, including fish stock in the Pacific ocean that bordered with Biak Numfor regency. Moreover, political support for the fisheries development also

increase. Maritime center issues and also micro, small and medium enterprises (SME's) of fisheries issues make political support for the fisheries development become more intensified, including in Biak Numfor regency.

Based on the above, it can be formulated several opportunities that can be exploited for the fisheries development of Biak Numfor regency, i.e.:

- The national demand of fish and seaweed tends to increase (Code: O1).
- The world demand of fish and seaweed tends to increase (Code: O2).
- Capture fisheries production of Japan dan South Korea tended to decrease (Code: O3).
- The price progress of fish and seaweed in the world tends to increase (Code: O4).
- The awareness level of people to the sustainability of fish resources tends to increase (Code: O5).
- The population of Biak Numfor regency amounted to 135 831 (in 2014) and its people like to eat fish (Code: O6).
- The fisheries technology progress in the world is more sophisticated (Code: O7).
- The information technology progress is very fast (Code: O8).
- Law enforcement on illegal fishing which is getting stronger by the central government (Code: O9).
- Political support to the fisheries development tends to increase (Code: O10).

3.5. Threats

Biak Numfor regency also should face several threats from external environment. The fish importer want a high quality standards (for example: HACCP, ISO, etc.) and that be included a threat to the fisheries businessman in Biak Numfor regency if they are not able to fulfill. There are lack of capital and competencies, so fish quality could not be maintain, both fish handling on board, fish loading process and fish storage. Tradisional fisheries businessman are still insufficient in implementation of hygiene and sanitation principle. Thailand, Philippines, China and Vietnam also continued to increase its global competitiveness. If the fisheries businessman in Biak Numfor regency is not improve theirsself, so it will lose in the global competition.

The level of inter-regional fish trade competition is also high. Another areas are also the producer of fish in Indonesia, including Merauke, Maluku Islands, etc. If the fisheries businessman in Biak Numfor regency have insufficient competitiveness, it will lose, both in national, and local market. The public awareness level of food safety in fishery products are also tends to increase. Although the formaldehyde and other hazardous materials issue are not exist in Biak Numfor regency, but it does not mean Biak Numfor regency has not problem in food safety. Fish handling and processing in Biak Numfor regency still ignore the hygiene and sanitation principles and that can lead to decrease in fish demad, both fresh fish and fish preserved that produce of Biak Numfor regency.

Suppliers of materials and equipment for fisheries industry in Biak Numfor regency is still limited. Prices of materials and equipment for fisheries industry in Biak Numfor regency is also still relatively expensive compared with Java region. That's because the transportation cost is relatively expensive from Java (as the economic center in Indonesia) to Biak Numfor regency. Although the central government try to minimalize an illegal fishing, but the phenomenon of illegal fishing is still occurs. This was caused by very wide of the seawaters of Indonesia and the limited of supervision, budget quantity of personnel. Moreover, the phenomenon of robbing in floating cage culture have occurred in Biak Numfor regency.

The issue of labor globalization could also become the threat to Biak Numfor regency labor, especially the arrival of foreign workers in the fisheries sector from Thailand, Philippines, China and Vietnam. If local labor are not ready, so fisheries industrialization in Biak Numfor regency will be fullfiled by foreign labors. For profit-oriented entrepreneurs, the arrival of foreign labor is not a significant problem. However, for local government, if local labor is not fill in employment, it can result in a complex problem, such as unemployment, social jealous and social conflict. If the investment in Biak Numfor are not running optimally, there is the possibility of highly competent local workforce migrate to other areas. There are a high inter-region competition to invite the investors, both national and international investors.

Based on the above, it can be formulated several threats that should be anticipated by stakeholders of Biak Numfor regency fisheries development. Some of these threats are as follows:

- The fish high quality standards demanded by fish importers from Japan, Hong Kong and South Korea as the export target (Code: T1).
- International competition of fish trade is high (Code: T2).
- Inter-regions competition fish trade is high (Code: T3).
- The awareness level of local and national consumers to food safety of fisheries products tends to increase (Code: T4).
- The supplier of materials and equipment of fisheries production in Biak Numfor regency is limit (Code: T5).
- The phenomenon of illegal fishing is still occurs (Code: T6).
- The phenomenon of robbing in floating cage culture is still occurs (Code: T7).
- The threat of foreign workers increases competition fisheries labor for the local labor (Code: T8).
- The attractiveness of other areas for the competent local labor (Code: T9).
- High inter-regions competition to invite both national and international investors (Code: T10).

3.6. Alternative Strategies

The results of SWOT analysis can be used to develop an alternative strategies by use TOWS matrix. Alternative strategies can be divided into four groups of strategies, i.e. SO, ST, WO and WT strategies.

Table 2. Strategies Alternative

Strategies Alternative		Code
SO Strategies		
1.	The development of PPS Wadibu as the center of fisheries capture industry in middle and large scale (S1, S4, S7, S8, S9, S10, O1, O2, O3, O4, O7, O9, O10)	SO1
2.	The development of PPI Fandoi dan PPI Bosnik as the center of fisheries capture industry in micro and small scale (S5, S6, S7, S8, S9, S10, O1, O6, O7, O9, O10)	SO2
3.	The development of marine culture to high value fish commodities (including grouper fish, and napoleon) in protected seawaters in Venditori district (S2, S8, S10, O1, O2, O4, O5, O7, O10)	SO3
4.	The development of seaweed culture in small island in Padaido district (S2, S8, S10, O1, O2, O4, O7)	SO4
5.	Invite the foreign and national investors to invest in middle and large scale fisheries industry (S1, S2, S4, S7, S8, S9, S10, O1, O2, O4, O8)	SO5
6.	The promotion and marketing development of fisheries product use internet (S4, S5, S6, O1, O2, O4, O8)	SO6
7.	The development of Frans Kaisiepo airport as international airport to serve fisheries product export to Japan, South Korea and Hongkong (S3, S7, O2, O4, O1)	SO7
WO Strategies		
1.	Conservation of coral reef region, especially where still in a good condition (W1, W10, O5, O9, O10)	WO1
2.	Implementation of minimum size regulation (W1, O5, O7, O10)	WO2
3.	The competencies development in technical and managerial to fisheries capture businessman (W2, W3, W10, O7, O8)	WO3
4.	The competencies development in technical and managerial to aquaculture businessman (W4, W6, W10, O7)	WO4
5.	The competencies development in technical and managerial to fish processing businessman (W8, W10, O7, O8)	WO5
6.	The development of fish seeding technology (W5, W1, O1, O2, O4, O5, O7)	WO6
7.	The development of marine culture technology (W10, O1, O2, O4, O5, O7)	WO7
8.	The development of fish seeding center (W5, O1, O2, O4, O5, O7)	WO8
ST Strategies		
1.	The development of medium and large scale fish processing industry at area of PPS Wadibu (S1, S4, S7, S8, S9, S10, T1, T2, T3, T4, T5, T9, T10)	ST1
2.	The security raising at marine culture location (S2, T7, T10)	ST2
3.	The development of public port in Biak Numfor regency synergy with 'Tol Laut' programs (S7, S8, S9, S10, T3, T5, T10)	ST3
WT Strategies		
1.	The raising of MCS (monitoring, controlling and surveillance) in fisheries capture on WPP of 717 (W1, W10, T6, T7)	WT1
2.	The development of fisheries vocational senior high school and college (W2, W10, T8, T10).	WT2
3.	The development of Bosnik dan Fandoi fish market (W3, W7, W9, T3, T4, T5, T9)	WT3
4.	The development of micro and small scale fish processing at area of PPI Bosnik dan PPI Fandoi (W7, W8, W9, T3, T4, T5, T9)	WT4

The development of fish processing industry is also needed to increase the value added, both on PPS Wadibu, PPI Fandoi and PPI Bosnik. PPS Wadibu could be developed as the center of fish processing industry in medium and large scale, such as filet tuna processing, tuna frozen, shrimp frozen, etc. While PPI Bosnik and PPI Fandoi can be developed as the center of fish processing in micro and small scale, such as smoked fish and dried fish.

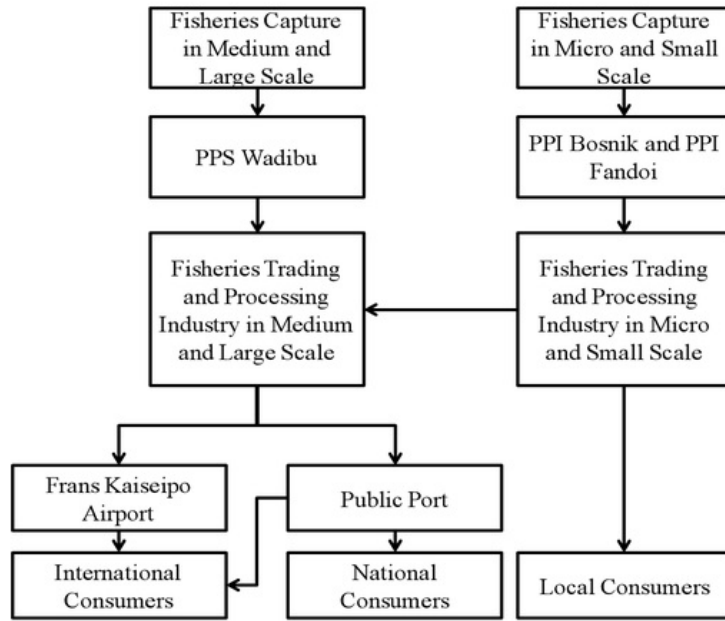


Fig 1. Recommendation of Fisheries Distribution

For the determination of strategic priorities, QSPM used to measure the relevance of each an alternative strategy to key factors. QSPM matrix can be seen in the following table.

Table 3. QSPM

Strategies	Key factors and weight												Sum of Value
	Natural Resources 15 %		Human Resources 20 %		Infrastructures 20 %		Regulation 15 %		Market 15 %		Technologies 15 %		
	V	V x W	V	V x W	V	V x W	V	V x W	V	V x W	V	V x W	
SO1	3	0.45	2	0.40	4	0.80	2	0.30	3	0.45	3	0.45	2.85
SO2	3	0.45	3	0.60	4	0.80	2	0.30	3	0.45	2	0.30	2.90
SO3	3	0.45	2	0.40	2	0.40	2	0.30	3	0.45	3	0.45	2.45
SO4	3	0.45	2	0.40	2	0.40	2	0.30	3	0.45	3	0.45	2.45
SO5	2	0.30	2	0.40	3	0.60	2	0.30	3	0.45	3	0.45	2.50
SO6	2	0.30	2	0.40	3	0.60	2	0.30	4	0.60	3	0.45	2.65
21	2	0.30	2	0.40	4	0.80	2	0.30	3	0.45	2	0.30	2.55
WO1	4	0.60	3	0.60	3	0.60	3	0.45	2	0.30	2	0.30	2.85
WO2	4	0.60	3	0.60	2	0.40	4	0.60	3	0.45	2	0.30	2.95
WO3	2	0.30	4	0.80	2	0.40	2	0.30	2	0.30	3	0.45	2.55
WO4	2	0.30	4	0.80	2	0.40	2	0.30	2	0.30	3	0.45	2.55
WO5	2	0.30	4	0.80	2	0.40	2	0.30	2	0.30	3	0.45	2.55
WO6	3	0.45	3	0.60	2	0.40	2	0.30	3	0.45	4	0.60	2.80
WO7	3	0.45	3	0.60	2	0.40	2	0.30	3	0.45	4	0.60	2.80
WO8	3	0.45	2	0.40	4	0.80	2	0.30	3	0.45	3	0.45	2.85
ST1	3	0.45	3	0.60	4	0.80	2	0.30	3	0.45	3	0.45	3.05
ST2	2	0.30	3	0.60	3	0.60	3	0.45	2	0.30	3	0.45	2.70
ST3	2	0.30	2	0.40	4	0.80	2	0.30	3	0.45	2	0.30	2.55
WT1	3	0.45	3	0.60	3	0.60	4	0.60	2	0.30	3	0.45	3.00
WT2	2	0.30	4	0.80	3	0.60	2	0.30	3	0.45	3	0.45	2.90
WT3	2	0.30	3	0.60	4	0.80	2	0.30	4	0.60	2	0.30	2.90
WT4	2	0.30	3	0.60	4	0.80	3	0.45	3	0.45	3	0.45	3.05

Note: V = value; W = weight

QSPM analysis results indicate that the development of PPS Wadibu needs to be a top priority as fisheries development strategy (ST1 and SO1), for the center of fisheries industry in medium and large scale. The development of PPI Fandoi and PPI Bosnik also be prioritized (WT4, WT3 and SO2), for strengthening the fisheries industry in micro and small scale. While other strategies can also support the development of PPS Wadibu, PPI Bosnik and PPI Fandoi, because each strategy can be complementary.

4. Conclusion

Based on the results of the analysis can be concluded that there are 22 alternative strategies that can be applied to the optimization of the development of fisheries in Biak Numfor regency. Each alternative strategy is not contradictory, but can be synergized. Area development of PPS Wadibu, PPI Fandoi and PPI Bosnik can be prioritized, where PPS Wadibu as the center of the fisheries industrialization in medium and large scale, while the PPI Fandoi and PPI Bosnik as the center of fisheries industry in micro and small scale.

5. Suggestion

The development of medium and large scale of fisheries industries do not sacrifice to the micro and small scale fisheries. Industrial micro and small scale fisheries in area of PPI Fandoi and PPI Bosnik should be protected, where fish are landed in PPS Wadibu is not distributed to the Fandoi and Bosnik fish market. Although the fishing industry has been the economic backbone of the fisheries sub-sector in Biak Numfor regency, but the aquaculture industry should continue to be developed. Thus, Biak Numfor regency has a diverse portfolio of industry as a economic growth source in fisheries sub-sector, i.e. fishing, fish processing and aquaculture.

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