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RESEARCH ARTICLE

THE DEVELOPMENT OF FAD-BASED POLE AND LINE (HUHATE) FISHERIES IN BACAN ISLAND WATERS

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ABSTRACT

Geographically, Bacan Island is truly strategic due to its position that situated at the center of skipjack fishing ground. The fishermen who are based in coastal fishing port (PPP) Panamboang using pole and line to catch this economist pelagic species in this site assisted by Fish Aggregate Devices (FADs). This fishing operation particularly requires live baits. However, the problems that are being faced by the fishermen are not having their own FADs. Additionally, live baits depend on the coastal dynamic such as tides and current. To solve these problems, this work prioritized on the strategy of pole and line development with FAD-basis. The objectives of this work are to evaluate the performance of pole and line and to formulate the priority and strategy of pole and line FAD-based in Bacan Island. This research was conductedin Bacan Island Waters during 30 days. Data collection was carried out using survey method to the object of the fishermen as the subject. Fishing gear used to catch skipjack was pole and line and the fishing ground was at the FAD area. The production trend during 10 years (2007 – 2016) had been increasing. Whereas, the productivity trend of caught tripe underwent a decreasing in 2014. This fishery business is profitable and feasible to continue. One of the strategy to save pole and line that has been operating in Bacan Island and based in coastal fishing port (PPP) Panamboang. South Halmahera has established a cooperation which has been coordinating the fishermen needs such as facilitating FAD, the small fleet units to obtain live bait and license arrangement.

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INTRODUCTION

Bacan Island belongs to the South Halmahera Regency which situated at Maluku Sea. According to the Fisheries Management (WPP), Bacan Island Waters is part of WPP 8 or 715 (Maluku Sea, Tomini Bay, Seram Sea and Halmahera Sea). The position of Bacan Island is truly strategic since it situated at the center of skipjack fishing ground. The type of pole and line as fishing gear has been developing rapidly to be semi industry as shown by the increasing of catch capacity (boat size and encompassing the power of the machine), the expanded of fishing ground and FADs uses as the aids gear as well. Pole and line boat that is being operated in Bacan Island waters based in Panamboang FLB, beside belongs to Bacan fishermen and the fishermen from Ternate and Tidore as well. These boats have been registered at Fisheries and Marine Agency of North Maluku Province. The fishermen who based in Panamboang FLB using pole and line to catch skipjack assisted by FADs is a complete food web system where there is a producer component (phytoplankton) through the predators (for instance small pelagic fishes, largest pelagic fishes, therefore, the existence of FADs is the fishing ground which is the fishermen truly depend on. The pole and line operation requires live baits. Gafa and Merta (1987), live baits are one of principal limiting factor in pole and line system. These factors play an important roles to the successfulness beside the license, because without SIPI a pole and line could not be operated. The main problem that are being faced by pole and line fishermen are owning the FADs the availability of the baits and SIPI. To resolve these problems, it is needed to study to answer these principal questions such as: Is the pole and line fishing still feasible carried out in this location? Is this business still efficient or probably needed to regulate? Therefore we are searching several solutions to answer these questions. The aims of the research are to evaluate the successfulness of pole and line business with FAD-basis, to formulate and determine the strategy of priority of pole and line development in Bacan Island. The results could be scientific evidence as a basic of local development in term of skipjack fisheries FAD-based development in Bacan Island waters that based in Panamboang FLB, South Halmahera Regency. The previous research on the assessment of skipjack exploitation in Prigi Waters East Java was carried out by Setiawan (2016). Jufri et al (2014), studied on the characteristics of skipjack fishing ground during wet

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season in Bone Bay Waters, Angraeni et al (2014) assessed the spatial and temporal analysis of skipjack fishing yield and thermal front during transition season in Bone Bay. Moreover, Husair (2014), assessed the skipjack catch at the fishing ground using FADs and without FADs at Northwest of Banda Sea. Beside, Karman et al 2016 found skipjack fishing season in Bacan Island waters. However, the information on pole and line development with FADs-based has not been studied.

MATERIALS AND METHODS

This work was carried out at coastal fishing port (PPP) Panamboang, South Halmahera Regency from October through November 2017. Data collection was conducted from 13 – 19 November 2017 (Figure 1). The reason why we chose this site because this location was the most visited by pole and line in North Maluku.

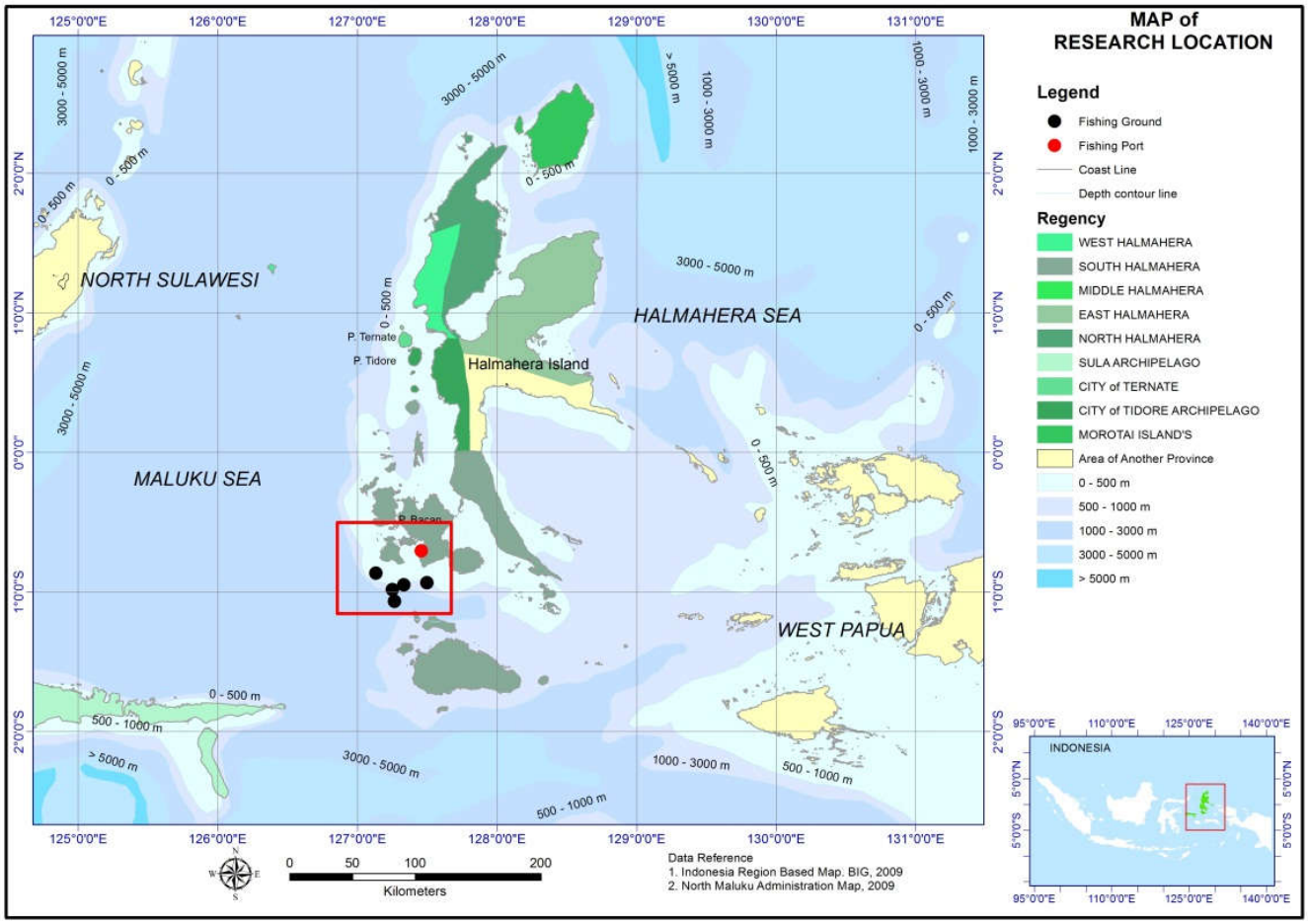

Figure 1. Research location

Data collection was carried out using survey method of the fishermen as the object along with the questioner so that the information that would be obtained would be more accurate. The technical data such as fishing gear, boat, and FADs was done using direct assessment and interview with the owner of pole and line. The information on fisheries product chain, institution and other information related with fisheries business of pole and line obtained from other institution. Respondents encompass fishermen of pole and line which were based in Panamboang PPP including the owner and the crews. Considering the numbers of fishermen who were based in Panamboang PPP relatively large, time limit, worker and budgeting, so in this research we selected the samples instead of completed census. These respondents were the owner of this pole and line business, fishing master and the fishermen. The object of this research was pole and line business unite which was based in Panamboang PPP South Halmahera Regency. The description of fishing gear and pole and line was done by identified the specification of the boat and fishing gear. This specification encompasses boat sizes (main dimension and GT), engine, fishing gear (materials and sizes), FAD, and fishermen. Fishing operation model was elaborated as the length of fishing operation, fishing gear operation model, sharing yields of fishes selling. Yield trend (tonnes) and productivities trend of fishing trip.Performance business unit of pole and line fishery was assessed by calculating:

- Total revenue (TR) and total coast (TC) to quantify the business revenue or profit (π) (Schaefer 1954; Gordon 1954 *dalam* Ghaffar *et al*. 2007).
- To quantify net B/C values on the discount rate of 6% during 276 production trip per year.

This social aspect of fisheries was assessed by analyzing the institution and the owner of the FADs that were used in these business activities. The alternative of pole and line development in this location determined by the application of SWOT analysis (Rangkuti 2004).

RESULTS AND DISCUSSION

Results

General condition of Pole and Line: Skipjack fishing in Bacan Island waters carried out by the fishermen from Ternate city, Tidore Island and South Halmahera (Bacan Island). The

three fishermen used pole and line and FADs which has the similar specification (Table 1 and 2), but the different sizes of the boats (Table 3).

Table 1. Pole and line specification (huhate)

No.	Gear Components	Material	Size
1	Pole	*Bamboo*	L = 2,00-2,50m; Diameter at the base 2,50-3,00 cm
2	Main line	*Polyethilene*	L = 1,00-2,00 cm; No 5 Φ 0,35 cm
3	Branch line	*Monofilament*	L = 20,00-30,00cm; No. 120
4	Hook	*Steel*	No. 2,50-3,00

Table 2. The material, size, number, and weight of the material components of FADs

	Components	Materials	Specification
1	Raft	Bamboo	P = 5,00 m – 6,00 m; L = 3,00 m – 4,00 m; T = 0,40 m – 0,70 m, Consists of 3 - 4 layers
2	Ropes		
	a. bamboo fastening rope	PE Ø 3 mm	P = 100,00 m – 200,00 m
	b. Main rope	PE Ø 12 mm	P = 1.000,00 m – 4.500,00 m
	c. float lifeline	PE Ø 12 mm	P = 10,00 m – 15,00 m
	d. Rope binding coconut leaves	PE Ø 3 mm	P = 5,00 m – 15,00 m
	e. Rope weighing connectors	PE Ø 12 mm	P = 5,00 m – 10,00 m
3	Bouy	Steel	Σ = 1 buah
4	Attractor	coconut leaves	Σ = 6 – 12 pelepah
5	Kili-kili (*swivel*)	Stainless stell	Σ = 4 buah
6	Anchor		
	a. Main anchor	Drum cor	Σ = 2 buah; W = 200 kg/bh
	b. anchor attractor	basket cor	Σ = 1 buah; W = 50 kg

Table 3. Pole and line vessel specifications

Specification	Size
1. Dimensi utama	
• Lenght	15,25-27,00 m
• Breadth	3,50-5,00 m
• Depth	1,70-2,30 m
2. Tonnage	29,00-37,00 GT
3. Main engine	inboard (Mitsubisi, Hyundai dan Nisan; 165 – 315 PK)
4. Auxilliaryengine	Honda 5,5 PK

Teble 4. The division of tasks and responsibilities of the fishing pole and line

No	Jabatan	Tugas dan tanggung jawab	Jumlah (orang)
1	Captain (fishing master)	Bertugas sebagai pemimpin dan bertanggung jawab terhadap keberhasilan operasi penangkapan.	1
2	Machinist	Bertugas dalam masalah mesin dan menjalankan kapal menuju rumpon maupun pada saat operasi penangkapan sampai balik ke *fishing based*	1
3	Baitman	Bertugas melempar (menabur) umpan hidup dan penyemprotan air pada saat operai penangkapan (pemancingan)	1
4	Fisherman	Bertugas untuk memancing ikan	10-16
5	Chef	Bertugas untuk menyiapkan konsumsi	1

Fishermen numbers who operated pole and line in term of catch relatively the same namely ranged between 15 to 20 persons fishing master. The function of the other fishermen was machinist, baitman, and cook. According to the interview with the pole and line fishermen who were based in Panamboang PPP, they have the same model of operation. Fishing operation was conducted in the early day until the late afternoon. The operation steps were divided in 4 parts, namely; (1). Preparation, (2).Trip to the baits location, (3). Trip to FADs (fishing ground), (4). Fishing operation (Fig. 3).

Catch and business feasibility

Catch of skipjack during 10 years (2007 – 2016) tended to increase. The highest catch was in 2016 of 3.246,37 ton and the lowest one was in 2007 of 1.127,07 ton. (Figure 3). Meanwhile the productivity of pole and line catch trip (product per catch trip) showed that the productivity tended to incline till 2013, then decline drastically in 2014. The highest productivity was in 2013 of 1,75 ton/trip and the lowest one was in 2008, 2010 and 2011 of 0,90 ton/trip (Figure 4). The result of the measurement of FL that were caught in the vicinity of the FAD of Bacan Island waters during the research (each week within a month) which was landed in FLB Panamboang South Halmahera was described in Figure 5. The average of FL Cakalang that were caught ranging between 33,7 cm to 47,3 cm. The benefit of this fisheries business that based in Panamboang FLB in South Halmahera during a year was Rp 538.230.000,00. Meanwhile, the Net B/C ratio of pole and line business was *1, 4(net B/C>1)*.

Pole and line development with FAD-based

The main problems that were being faced by the pole and line fishermen who were based in Panamboang PPP namely not having their own FAD, live baits were not always available,

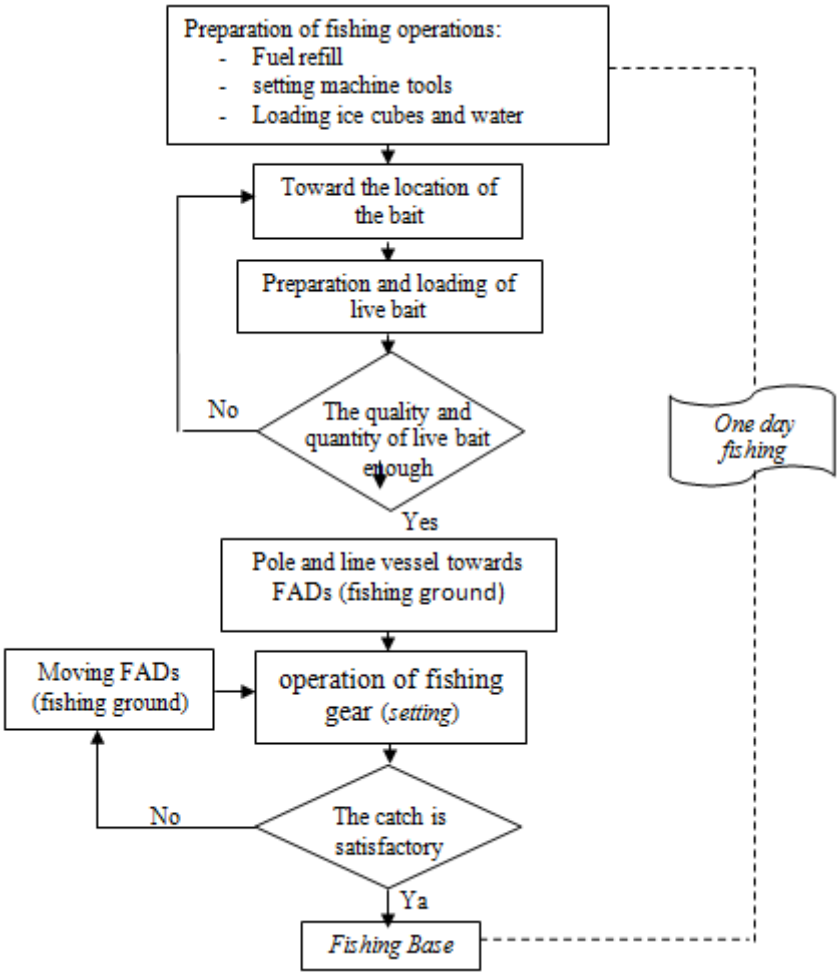

Figure 2. Scheme of skipjack fishing with pole and line

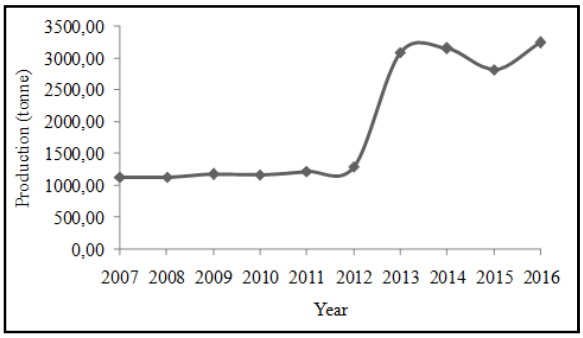

Figure 3. Trend of skipjack catches landed in PPP Panamboang of South Halmahera Regency, 2007-2016

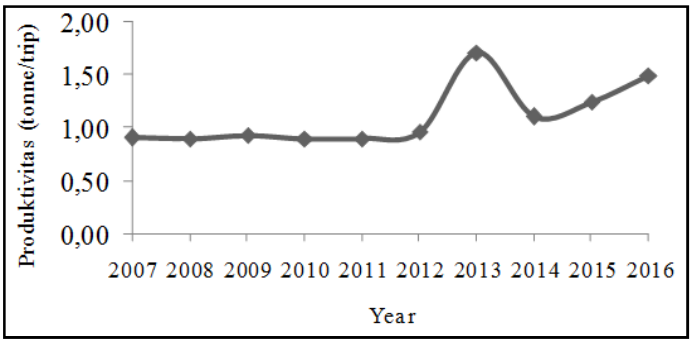

Figure 4. Trend productivity fishing trip pole and line based in PPP Panamboang South Halmahera Regency, 2007-2016

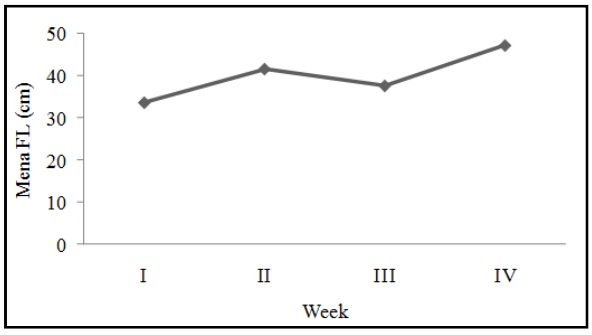

Figure 5. The mean length of forked (FL) skipjack caught around FADs Bacan Island waters

and the time that was relatively longer, high budgeting in term of license arrangement. This condition shows the inconvenience circumstances, whereas these fisheries activities showed the profitable and feasible. One of the strategies to save the pole and line business which are operated in Bacan Island waters are established the cooperation. This cooperation aim at coordinating the fishermen needs such as (providing FADs, small unit of fishing boat to catch live baits and arranging the SIPI).

DISCUSSION

Generally, pole and line that exists in the study site were made of the same materials but the different sizes. According to the study conducted by Jamal (2011), pole and line was the fishing gear constituted of pole and line.The pole was made by bamboo of 2 m, with the diameter of 3 cm at the base and 0,5 cm at the end. While the robe was made of white monofilament nylon material as long 1,50 – 2,00 m with the diameter of 3 mm. Generally, the hooks that were used having the number of 2,8 made by stain without reversed hook. Based on Tampubolon (1980) that the hooks sizes of 2,5 to 3,8 would be balance with the baits of 73 cm.

purpose of catching, the condition of the waters, and the range of the trip causing their size to vary. The number of fishermen who operate the pole and line at the research sites (pole and line fishermen based in Panamboang PPP of South Halmahera Regency) is relatively the same, ranging from 15-20 people including "captain". The captain was the person who leads the fishing operation. In fisheries pole and line the number of fishermen (labor) does not affect the factors of production but the skill of using fishing rods by fishermen that greatly influence the number of catches (production), based on research results from Muksin (2006), the number of fishermen (labor) pole and line production in Tidore Island Province of North Maluku, any increase or decrease in the number of fishermen (labor) did not result in increase or decrease of catch (production). This was because at the time of catching, what needed was fishing skill from the fisherman that was not the number or number of fishermen who did fishing. The mode of operation of pole and line fishing (huhate) based at Panamboang PPP of South Halmahera Regency was conducted one day in one trip. The catching operation mode in the waters around the Island of Bacan that was highly dependent on the FADs. The advantages of using the FADs, fishermen went straight to FADs and did not catch fishing catching area that there were skipjack, this was

Tabel 5. Some Lm values at other locations

Value Lm (cm) FL	Sex Fish	Negara	Location
43,5 – 45,4*)	-	USA	Nort Carolina
40,0 – 45,0*)	Betina	USA	Hawai
40,0*)	Betina	Cuba	Northeast region
43,0*)	-	Polinesia	Marquesas and Tuamotu Islands
43,0*)	-	Filipina	Bohol Sea
45,0*)	-	Papua New Guinea	Papua New Guinea
41,0 – 43,0**)	-	Madagaskar Barat Daya	Madagaskar

*) Collette B.B and C. E. Naeun (1983) *diacu dalam* Froose and Pauly 2011)
**) Stequert (1976) diacu dalam Matsumoto *et al*., (1984)

Moreover, Sudirman and Malawa (2004) revealed that pole and line cinsisted of bamboo of 2,00 – 2,50 m with the diameter at the base of 3,00 – 4,00 cm, main line made of PE no 7 of 1,50 – 2,00 m and the diameter of 0,50 cm, the second line made of white monofilament of 20 cm and the hooks that were employed No. 2,50 – 2,80 without reversed hook. FADs that exist in research location is generally relatively same with the FADs that exist in other area in Indonesia. In Molibagu of North Sulawesi Province based on Luasunaung (1999), FADs consists of three main components; bamboo raft with length size (L) 6,50 m, width 3,50 m, height 0,70 m; rope of PE material; and the Attractor from coconut leaves as much as 9 midrib and anchor from cast drum material. Subani (1986) further states that FADs consists of three main components: attractor, anchor, and buoy. The length of the anchor rope (rope) used on the FAD in the waters of Bacan island ranges from 1.5 to 2.0 times the depth of the sea where the FADs was installed (planted). According to Subani (1986), the length of the anchor rope varies, but is generally 1.5 times the depth of the sea where the FADs was planted. Length of anchor rope (main rope) 1.5 times to anticipate that FADs were not easily broken. Pole and line vessel based at the Panamboang PPP of South Halmahera Regency have the same relative dimensions and main dimensions. This was because the distance traveled by pole and line fishermen based in Panamboang PPP was relatively the same, which was about 15-40 miles. According to Ayodhya (1972), fishing vessels have more complex and heavy operational functions; it was further said that the types and shapes of different fishing vessels were caused by the because FADs in addition to functioning as a collector of fish schooling, in principle also allows fish schooling to be caught in accordance with the desired fishing gear. The use of FADs by fishing vessels can also save time and fuel, as they did not need to seek and pursue fish schooling (Subani, 1986; Wudianto & Linting, 1988). Monintja (1993), further states that the expected benefits with the use of FADs in addition to saving time and fuel can also increase catch per unit of fishing effort, improve the quality of catches in terms of species and size composition based on fishing gear selectivity. Production of pole and line catches in the waters of Bacan Island of South Halmahera Regency increased (Figure 3), as well as with the trend of pole and line trip, productivity tends to increase until 2013 and then decrease drastically in year 2014 (Figure 4). Although production was increasing but the productivity of catch (tons/trips) tends to decrease. Thus, the increase of fleet units no longer had an effect on increasing the production of catch. The possibility of decreasing the productivity of pole and line fishing trips (ton/trips) was caused by the location of the fishing ground only focused on the existing of the FAD in the waters of Bacan Island, South Halmahera Regency, and due to the influence of natural/environmental conditions (sea surface temperature, chlorophyll-a, salinity, weather, and wind) to the communities. The stock of pelagic fish was very sensitive to environmental changes especially the spatial salinity spreading generated by the munson wind; Furthermore, according to Boely et al. (1990), the influence of aquatic environment played a significant role in the change of CPUE (catch per effort unit), while wind and rain had a direct effect on catching and

catching activities. This was an indicator that the utilization of skipjack fish resources was already high. This phenomenon was a natural consequence in the use of open resources. Therefore, it is necessary to immediately take appropriate management action for example by not increasing the number of units of fleet pole and line so that the utilization of skipjack resources can be sustainable and guaranteed sustainability. The average skipjack catch around Bacan Island waters was predominantly the size of the unsuitable catch. Of the 500 samples of skipjack tuna measured, the average FL size ranges from 33.7 to 41.7 cm by 375, while the size of FL 47.3 cm is 125 head. Based on research result Karman et al. (2016) skipjack catching in waters of Bacan island measuring 43 cm. Captureable fish was defined as a fish that has a length greater than the length of the first mature gonad (length at first maturity, Lm). The Lm of skipjack was different in each place, but was generally larger than 40 cm (Table 5). Pole and line fishery (huhate) business based in Panamboang FLB of South Halmahera Regency was profitable and feasible to continue. The Net B / C ratio of the pole and line business was 1.4 (net B / C> 1). The problems regarding to the pole and line fishermen which was based in Panamboang PPP were not having their own FADs and live baits, ease to arrange operation license. Thus, based on the identification, the best strategy of using SWOT with QSPM results the strategy; creating the cooperation to coordinate the fishermen needs. By this, it would provide more significant impacts to this fisheries business. Therefore, this strategy prioritized to apply in the pole and line fisheries business at the study site.

The strategy of fisheries business development is fishermen cooperation needed to enforce long term financial support or political support infrastructure that has been getting lack of attention in term of fisheries business development. These strategies are expected to educate the fishermen and fisheries businessmen at the study site in term of feasibility of financial matters, organization capacity and long term administratively. High productivity, efficiency and the strengthens of the capital would support the business sustainability if the fishermen have a good capacity of business and good institution. In order the existence of the cooperation can be benefited by all of the members, the up grading of this institution can be directed to the increasing of market accessibility, capital empowering (being able to have their own live bait, having the small unit to catch their own baits, be able to solve the problem of SIPI arrangement), increasing of human resources (understanding and recognizing the feasibility sizes to be caught), the increasing of business management and the increasing of technology. The objectives of these strategies is to create an industry oriented to pole and line business which based in the Panamboang PPP (good time, good quantity, and good quality). Personal business is not efficient, therefore it has to be a cooperation.

Conclusion

Fishing gear used to catch skipjack In Bacan Island Waters was pole and line and fishing ground was in the vicnity of the rumpon. The production trend of the catch during 10 years (2007 through 2016) increased significantly. Meanwhile the productivity trend of the catch underwent the decrease in 2014. This fisheries business shows the reliable profit and feasible to continue. One of the strategy to save pole and line fishing which is being operated in Bacan Island waters and based in Panamboang PPP, South Halmahera Regency has established a unit of cooperation. This cooperation aims at coordinating the requirements of fishermen such as pole and line (facilitating FADs, small fleet unit to catch live bait and arranging SIPI).

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