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Analysis of Bioeconomic Utilization of Skipjack Tuna (*Katsowonus Pelamis*, *Linnaeus* 1758) Landed in Nizam Zachman Oceanic Fishing Port, Jakarta, Indonesia

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Abstract

The largest commodity in PPS Nizam Zachman in 2013-2015 is skipjack with average production 34,472,08 ton / year. The main focus of the research is purse seine that operates in FMA 572 that catches skipjack and landed in Nizam Zahman. The purpose of this study was to evaluate resource utilization level, to analyze the standard of fishing gear, to formulate CPUE and effort relationship, and to analyze the level of benefit. This research, conducted by using quantitative research method, with approach case study. Analysis of sustainable production function used by Schaefer Model and Fox Model. The result of standardization of fishing gear, with the value of FPI purse seine 1 and long line 0.08. The standard effort average value is 917 attempts or trips. The result of the average standard CPUE is 24,69. The value of sustainable fishing was 180,884 tons, with EMSY effort 19,185 trips and TAC of 144,707 tons. The utilization rate of resources of 10% of fox models and 12.5% of the schaefer model. Overall business is still profitable, from 58 vessels or 93.5% of the total respondents have a value of BC ratio above 1 which ranges from 1.01 to 15.17 declared feasible to cultivate.

Keywords: bioeconomics; skipjack tuna; purse seine; Oceanic Fishing Port Nizam Zachman Jakarta.

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1. Introduction

Skipjack tuna is of high economic value. It is said that because these fish species are used as raw materials by various types of processing industries such as smoked skipjack, wooden fish, canned fish, and many more. Based on data from the Directorate of Logistics Systems, Ministry of Marine Affairs and Fisheries of Indonesia in 2016 retailer price ranges from Rp 22.000.00 - Rp. 34,000.00 per kg. Skipjack tuna are also listed as export commodities in the form of fresh, frozen and processed.

One type of marine pelagic fish resource that has important economic value and has good prospect is skipjack. Potential big pelagic fish in fishery management area (FMA 572) according to Decree of Minister of Marine and Fishery No 45 Year 2011 that is in West Indian Ocean of Sumatera 315,9 thousand ton / year with level of utilization of skipjack moderate [1]. Whereas in Decree of Minister of Marine and Fishery No 47 No. 2016 SDI potential for big pelagic fish non skipjack tuna of 364,830 / year with Total Alowable Catch (TAC) equal to 291,864 ton / year with utilization rate as big as 1,29[2]. The capture technology commonly used in Indonesia to exploit the skipjack resource potential is purse seine and pole and line, tonda fishing line, longline fishing line and long line. Fishery production in PPS Nizam Zachman consists of fish catching products in the sea and incoming fish production. In the last 6 (six) years (2010-2015), the production of fish catches in the sea averaged 49.54 percent contribution to fishery production in PPS Nizam Zachman while the fish production entered by land and imported on average, contributed 50.46 percent to fishery production in PPS Nizam Zachman. The largest commodities for fish production in the sea in 2013-2015 include skipjack (average production 34,472.08 tons), squid (average production 11,767.57 tons), yellow fin tuna (average production 16,692, 99 tons), big eye tuna (average production 13,313.40 tons), mackerel (average production 10,314.76 tons), and lisong (average production 1,708.39 tons) [3] .

2. Material and Methods

The research was conducted in December 2016 until February 2017, with the location at the Ocean Fishing Port of Nizam Zahman. The main focus of the research is the fishing ships purse seine that operates in WPP 572 (Indian Ocean West Sumatra) that catches skipjack and landed the catch in Nizam Zahman. This research, conducted by using quantitative research method, with approach based on case study, that is case of resource utilization of skipjack fish in PPS Nizam Zahman. In this study, collected data and information, both primary and secondary, as a result of interviews, as well as study reports and literature. Primary data collected in the form of trip and catch data and interview result related to economic analysis of skipjack tuna business.

2.1. Data analysis

Standardization of Cost per Unit Effort

Standardized cost per unit effort (unit of standardized effort) in this study follow the standardization pattern used The formula used to find out CPUE is as follows

CPUE = Catch / Effort

CPUE: The catch per catch effort (ton / trip), Catch: Annual catch (ton); and Effort: Catching effort per year (trip)[4].

Bioeconomics

The analysis of the sustainable capture fisheries production function developed by Schaefer (Schaefer Model), can only determine the maximum utilization rate sustainably based on the biological aspect, so it has not been able to establish the maximum sustainable utilization rate economically. To address the problem, Gordon developed the Schaefer Model by including the price factor per unit of catch and cost per unit effort on the function equation, which known as the "Static Model Gordon - Schaefer" [5].

Using a simple regression analysis of existing times series data, we can calculate the value of intercept (a or c) and slope (b or d) so that the maximum catch and maximum effort of both models can be estimated. Differences between intercept values a and c will be used for two models: Schaefer (a and b) and Fox (c and d), [6] models which can be seen in the following table:

Table 1: Schaefer and Fox Bioeconomic Calculations

SCHAEFER		**FOX**
MSY/C	-0.25*a2/b	- 1/d*Exp (c-1)
EMSY/F(opt)	-0.5*a/b	-1/d

Utilization Rate

The utilization rate is expressed by percent (%) and is obtained by using the formula [7]

TP i = ci / MEY x 100%

Where TP (i): The utilization rate of the year- i, C (i): Total catch (catch) of year- i, MEY: Maximum Economic Yield

Feasibility Study

Feasibility study of purse seine fishery business in FMA 572 is important to avoid losses, and for the development and business continuity. Financially, business feasibility can be analyzed using several indicators of approach or analysis tool. Economic Aspects, which analyze the elements of finance and economy and trade. Orientation of economic analysis is the financial gain that a business will obtain. Some approach indicators or analysis tools, such as Net Present Value, Interval Rate Return and Benefit-Cost Ratio (B / C ratio). B / C Ratio (Benefit Cost Ratio) is a measure of comparison between income (Benefit = B) and Total Cost of production

(Cost = C). Within the limits of the value of B / C can be known whether a business is profitable or unprofitable [8].

B / C ratio = Total Revenue (B): Total Production Cost (TC)

If B / C ratio> 1, effort is feasible

If B / C ratio <1, business is not feasible or loss

3. Result and Discussion

The largest commodity for marine fish production in PPS Nizam Zachman in 2013-2015 includes skipjack with average production of 34,472,08 ton, squid with average production 11,767,57 ton, yellow fin tuna with average production 16,692.99 tons, large eye tuna with an average production of 13,313.40 tons, overpass with an average production of 10,314.76 tons, and levees with an average production of 1,708.39 tons. Skipjack production during the period 2013 to 2015 tends to fluctuate with an average production of 34,472 tons in Figure 4.2.1. The highest production reached in 2014 with a volume of 39,299 tons and the lowest production occurred in 2015 with a production volume of 30,848 tons. The production of 2013-2015 is shown in Figure 1 below:

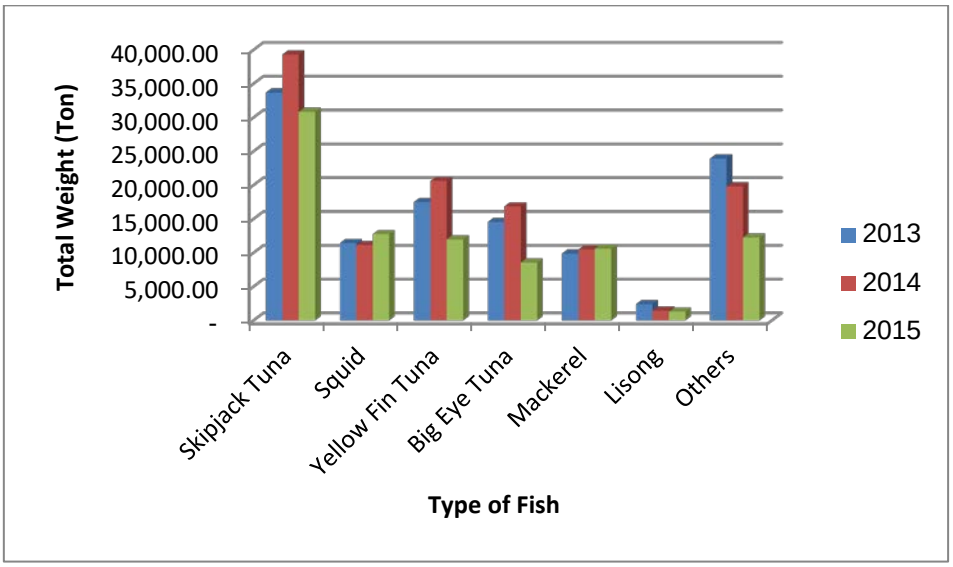

Figure 1: Fish Production by Species in Nizam Zachman during 2013-2015

The decline of production in 2015 occurs due to the implementation of Regulation of the Minister of Marine Affairs and Fisheries No. 56 of 2014 on Temporary Suspension (Moratorium) of Capture Fisheries Business License in Fisheries Management Area of the Republic of Indonesia effective from November 3, 2014 to April 30, 2015 [9]. Based on the average data of skipjack tuna production which landed in 2010-2015 at Ocean Fishing Port Nizam Zachman seen in Figure 2 follows. It turns out the highest production in October. While the lowest skipjack production occurred in February.

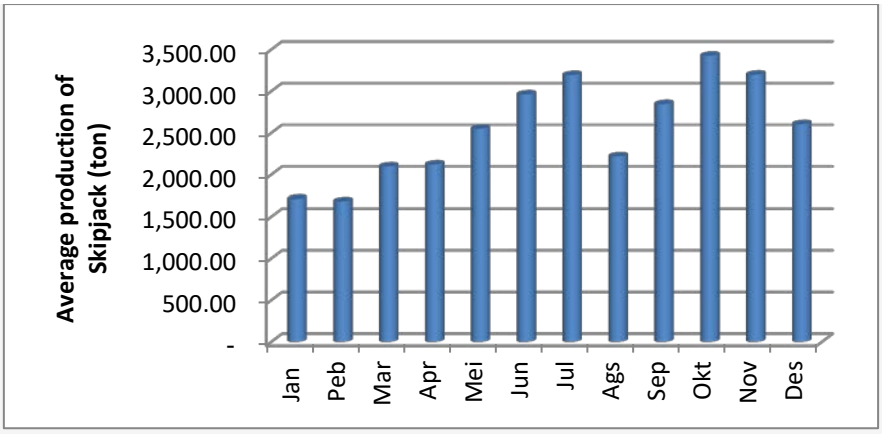

Figure 2: Average Production of Skipjack Fish per month Landed In Nizam Zachman Year 2010-2015.

Overall it is seen that in the period 2010-2015 throughout the year the catch of skipjack is not less than 1,500 tons every month. There was an increase in production from March to December and peaked in October. Biologically predictable at that time skipjack bands are abundant in the fishing grounds. This can be expected biologically and ecologically for skipjack life in the fishing area as follows:

1. At that time May-August in the Indonesia ocean occurred east monsoon season, then September-October season transition season from east to west monsoon. While from November to December occurred the west season [10]. In the east season there is upwelling in the waters of the Western Region of Indonesia, namely in the West Waters of Sumatra and southern island of Java in May-November. Similarly in the east monsoon there is upwelling on the Flores Sea and Banda Sea [11]. Skipjack is widespread throughout tropical and sub-tropical waters in the Atlantic, Indian and Pacific oceans, except the Mediterranean sea. This distribution can be divided into two kinds: horizontal spread or dispersal according to geographic location of waters and vertical spread or dispersion according to depth of water. Skipjack dispersal often follows the circulation or current flow of convergence lines between cold currents and heat currents is a region rich in organisms and it is suspected that the area is an excellent fishing ground for skipjack tuna. In skipjack fisheries the knowledge of current circulation is necessary, since the density of the population in a waters is closely related to the currents [12].This phenomenon resulted in the two areas of Indonesian waters in the area of skipjack tuna fishing is very abundant food for skipjack tuna hordes so abundant as well.

2. Skipjack was long-distance feeding, it can be assumed that in many fishing areas it will become their migration destination so that they move and cluster very densely in the catchment area.

3.1. Skipjack Tuna Fishing Efforts

Overall total effort of each fishing gear in waters of FMA 572 to catch skipjack fish that landed in Nizam Zachman in Table 2 tends to fluctuate with the average effort of 1,632 trips a year. However, based on the dominant fishing gear used in skipjack fishing, the average purse seine effort amounted to 1,063 trips and the tuna line effort of 568 trips per year.

Table 2: Efforts and Production of Skipjack Fishing Based on Fishing Gear during 2010-2015

Year	*Effort (Vessel Trip)*		Effort Total (Vessel Trip)	Production by gear (ton)		Total (ton)
	Purse Seine	Long Line		*Purse Seine*	Rawai Tuna	
2005	*109*	1.820	1.929	-	88	88
2006	*630*	838	1.468	133	630	763
2007	*270*	400	670	6.482	1.302	7.784
2008	*239*	282	521	5.846	294	6.140
2009	*772*	737	1.509	21.802	621	22.423
2010	800	711	1.511	16.706	1.158	17.864
2011	936	810	1.746	24.076	1.106	25.182
2012	1.048	650	1.698	26.169	2.672	28.841
2013	1.154	587	1.741	28.293	1.704	29.997
2014	1.178	514	1.692	33.506	1.067	34.573
2015	1.030	308	1.338	29.709	477	30.186
2016	1.298	398	1.696	22.164	449	22.613
Average	1.063	568	1.632	25.803	1.233	27.037

Due to economic and technological advances, many people turn to more effective purse seine fisheries for skipjack tuna. Similarly, with the advancement of rumpon technology by using echo sounder and satellite transmitter that enables FADs monitored remotely by the ship owner, so that the effectiveness and productivity of purse seine fishery becomes very high. As a result, many fisheries entrepreneurs have turned to purse seine fisheries rather than tuna long line. Purse seine operations can be done during the day often using rumpon or payaos as a fish gathering tool. While the collecting tools are often used at night are the lights, generally using petromax lamps. Its suggests that payaos besides functioning as a fish collecting device also serves as a barrier to the movement or ruaya of fish, so that fish will be around the payaos longer [13]. Uktolseja states that payaos can keep or assist skipjack remain in its installation location for 340 days[14]. The operation of purse seine and payang is assisted by FADs as a fish lure or Fish Aggregating Division (FAD). In addition, lamps either patromax lamps or electric lights are sometimes combined with the rumpon that is located in the loose waters. The size of the vessels used will affect the tactics and operational strategies of catching, for the fleet purse seine generally have ships with a capacity of about 30-80 metric tons with a duration of 3-40 days [15].

3.2. Standardization of Fishing Power Index

The catching unit used as the standard is the most dominant catchment unit catching certain species of fish in a region (having the largest average catch rate per CPUE in a given period) and having the mean fishing power factor of FPI (fishing power index) is equal to one. The FPI of each of the other fishing units can be determined

by dividing the average catch rate of each catching unit by the average catch rate of the catching unit being standardized. In PPS Nizam Zachman there are 2 types of fishing gear used in skipjack fishing that is purse seine and tuna long line. The following is the calculation of the average catch rate of each fishing unit in PPS Nizam Zachman in Table 3;

Table 3: Selection of Standard Fishing Gear of Skipjack Tuna Fishing

Year	Purse Seine			Tuna Long Line		
	Catch (Ton)	Effort (Trip)	CPUE (ton/trip)	Catch (Ton)	Effort (Trip)	CPUE (ton/trip)
2007	*6.482*	*270*	24,01	1.302	400	3,26
2008	*5.846*	*239*	24,46	294	282	1,04
2009	*21.802*	*772*	28,24	621	737	0,84
2010	16.706	800	20,88	1.158	711	1,63
2011	24.076	936	25,72	1.106	810	1,37
2012	26.169	1.048	24,97	2.672	650	4,11
2013	28.293	1.154	24,52	1.704	587	2,90
2014	33.506	1.178	28,44	1.067	514	2,08
2015	29.709	1.030	28,84	477	308	1,55
2016	22.164	1.298	17,08	449	398	1,13
Average	21.475	873	**24,72**	1.085	540	**1,99**

Based on the calculation of the average productivity / CPUE, the largest average CPUE is presented in Table 4 the purse seine catching tool will serve as the standard or basis in the standardization of fishing gear.

Table 4: The value of fishing power index (FPI)

Index	Purse Seine	Tuna Long Line
CPUE	24,72	1,99
FPI	**1**	**0,08**

Apparently from the results of standardization of fishing gear, purse seine fishing gear is more productive and effective than the use of tuna longline gear.

3.3. Catch Per Unit Effort (CPUE) Standard

Catch Per Unit Effort (CPUE) or catch-per-catch effort is the division between the production of catches by fishing effort that operates in a waters. After obtaining the value of FPI, it is calculated the standard effort value

of purse seine fishing gear and standard effort of tuna longline fishing gear. Both standard efforts of the two fishing gear were summed and the total value of the standard effort was obtained. From Table 4.6 (1). a standard effort average of 917 attempts or trips appears. From the total catch value of the two catching tools, purse seine and tuna rawai divided by total standard effort, the result of the average standard of effort cacth per unit effort (CPUE) is 24,69.

Table 5: Standardization of Catching Efforts

Year	Standard Effort of Purse Seine	Standard Effort of Tuna Long Line	Total Standard Effort	Total Catch	Standard CPUE
2007	270	33	303	7.784	25,673
2008	239	23	262	6.140	23,399
2009	772	61	833	22.423	26,913
2010	800	59	859	17.864	20,796
2011	936	67	1003	25.182	25,101
2012	1.048	54	1102	28.841	26,173
2013	1.154	49	1203	29.997	24,941
2014	1.178	43	1221	34.573	28,323
2015	1.030	26	1056	30.186	28,597
2016	1.298	33	1331	22.613	16,989
Average	873	45	917	22560	**24,690**

Apparently from figure 3 the development of CPUE in the period 2007-2016 there is an increase and decrease. The decline occurred in year 2010 and 2016. The highest increase in the year 2015. CPUE skipjack in Nizam Zachman ranged from 16-28.

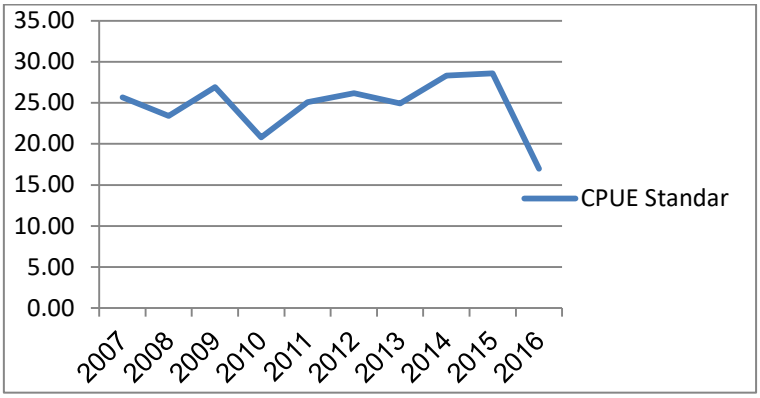

Figure 3: Graph of Skipjack CPUE Development Year 2007-2016

In November 2014 - April 30, 2015 there was a moratorium on fishing and the banned on the operation of foreign-made fishing vessels resulting in a decrease in fishing effort that caused CPUE to increase by 2015 to reach 28 tons / trip. It is expected that during the moratorium period and thereafter where the use of foreign ships using large-sized vessels is more controlled so the results obtained are not too abundant so as not to threaten the preservation of skipjack resources. As a result in the future, skipjack tuna and tuna fisheries in our waters can be controlled.

3.4. Bioekonomic of Skipjack Tuna

Bioeconomic approach is needed in the management of fish resources because management has been based on biological approaches only when Schaefer introduced the concept of MSY. The MSY concept is aimed at the biological approach of obtaining maximum production and ignoring the fish harvesting costs, not considering the socio-economic aspects of the management of fish resources and not taking into account the economic value of unharvested resources. Lack of biological approaches gave birth to a new concept of bioeconomic approach. With the bioeconomic aspects of social and economic become important in management. In the biological approach the main objective is biological growth but in the bioeconomic approach the main objective is the economic aspect with the constraints of the biological aspect of fish resources [16].

Using a simple regression analysis of the existing times series data, we can calculate the value of intercept (a or c) and slope (b or d) so that the maximum catch and optimal effort of both models can be estimated. Differences between intercept values a and c will be used for two models of Schaefer models (a and b) and Fox models (c and d), [17] which can be seen in Table 6 below:

Table 6: Schaefer and Fox Bioeconomic Calculations

SCHAEFER		**FOX**	
a	25,35205494	c	3,243731776
b	(0,00072123)	d	(0,00005212)
MSY/C	-0.25*a2/b	MSY/C	- 1/d*Exp (c-1)
MSY/C	**222.788**	**MSY/C**	**180.884**
EMSY/F(opt)	-0.5*a/b	EMSY/F(opt)	-1/d
EMSY/F(opt)	**17.576**	**EMSY/F (opt)**	**19.185**
TAC/JTB	80 % x MSY	TAC/JTB	80 % x MSY
TAC/JTB	**178.231**		**144.707**

From the calculation of the maximum value of sustainable yield / production for fox model is 222,788 tons / year. The optimum catch / EMSY effort is 17,576 trips / year. As for the Total Alowable Catch (TAC) of 178,231 tons / year. According to the calculation of the maximum yield of sustainable yield / production for fox model is 180,884 ton / year. The optimal capture / EMSY effort is 19,185 trips / year. As for Total Alowable

Catch (TAC) of 144,707 tons / year. From the value of TAC and F opt a region is used as the basis for preparing quota of fishery fleet and production quota of fishery in the region. In this case means for skipjack fishing in WPP 572 the number of optimal fishing trips is limited to 17,576 trips per year. For the management of skipjack resources in FMA 572 landed in PPS Nizam Zahman based on Responsible Fisheries rules that are very concerned about the prudence based on both the results of Schaefer and Fox analysis then taken the values developed by fox, ie MSY worth 180,884 tons, with EMSY worth 19,185 trips and TAC of 144,707 tons.

3.5. Utilization Rate

The utilization rate of skipjack fishery resources in 2007 - 2016 landed at Nizam Zachman is still below the TAC average (the number of catches allowed) of 10% of potential fox models and 12.5% of the schaefer model. The maximum potential for sustainable schaefer model is 222,788 tons per year so that based on TAC formulation that is skipjack resource that can be captured equal to 80% from the available potency then the total catch is 178,231 tons. While the maximum potential of sustainable fox model is 180,884 ton per year so that based on TAC formulation that is skipjack resource that can be captured equal to 80% from available potency then the total catch is 144,707 ton. The complete results of the utilization rates in Table 7 below:

Table 7: Resource Utilization Rate

Year	Total Cacth (Ton)	Total Effort Standard	EMSY Model Schaefer	EMSY Model fox	Rate Utilization Rate model schaefer	Rate Utilization Rate model fox
2007	7.784	303	17.576	19.185	1,7	1,6
2008	6.140	262	17.576	19.185	1,5	1,4
2009	22.423	833	17.576	19.185	4,7	4,3
2010	17.864	859	17.576	19.185	4,9	4,5
2011	25.182	1003	17.576	19.185	5,7	5,2
2012	28.841	1102	17.576	19.185	6,3	5,7
2013	29.997	1203	17.576	19.185	6,8	6,3
2014	34.573	1221	17.576	19.185	6,9	6,4
2015	30.186	1056	17.576	19.185	6,0	5,5
2016	22.613	1331	17.576	19.185	7,6	6,9
Average	22560	917	17.576	19.185	5,2	4,8

The skill level of skipjack fishery resources in 2007 - 2016 landed in PPS Nizam Zachman as shown in Table 4.8 (2) the average is still below the f optimal ie 5.2% of EMSY / Fopt fox model and 4.8% from schaefer model. EMSY or Optimal Efforts of schaefer model of 17,576 trips per year. While EMSY or Optimal effort fox model of 19,185 trips per year.

3.6. Feasibility Study of Skipjack Fishing

The skipjack fishing effort done by using purse seine, the sampling (respondent) is focused on this fishing gear. Calculation with maple software 16:

> $N := 789$

$N := 789$

> $Z := 1.64$

$Z := 1.64$

> $d := 0.1$

$d := 0.1$

> $$n := \frac{N \cdot Z^2 \cdot 0.25}{\left(d^2 \cdot (N-1)\right) + \left(Z^2 \cdot 0.25\right)}$$

$n := 62.03213132$

The number of respondents as many as 62 people / ship owners. Respondents were taken from a population of purse seine boats based at PPS Nizam Zachman.

Purse seine fishing gear is taken because it is a standard fishing tool according to Fishing Power Index calculation of skipjack catching business in Nizam Zachman. In the calculation of business feasibility analysis used assumptions.

The assumption or benchmark that is used in accordance with the business feasibility standard for the People's Fishery Business Credit is the Regulation of the Minister of Maritime Affairs and Fisheries No 73 / PERMEN-KP / 2016 concerning General Guidelines for People's Business Credit of Marine and Fishery Sector. In this case the purse seine entered in a group of fishing gear with a circumference of 60-150 GT circumference [18].

From result of calculation of business feasibility analysis got result as follows:

1. There are 4 vessels or 6.5% of the total respondents whose BC ratio below 1 is 0.71-0.87 is not feasible to cultivate. With IRR value of 2,99 - 6,46%.

2. A total of 58 vessels or 93.5% of the total respondents have a value of BC ratio above 1 which ranges from 1.01 to 15.17 declared eligible to be cultivated. With IRR value 9,12 - 241,04%.From the result of the above calculation, it can be concluded that generally skipjack fishing business using purse seine in FMA 572 is still profitable.

4. Conclusion

Skipjack tuna skill resource utilization rate in 2007 - 2016 landed at PPS Nizam Zachman is still below the JTB average (the number of catches allowed) of 10% of fox model potential and 12.5% of the schaefer model. From the results of standardization of fishing gear, purse seine fishing gear is more productive and effective than the use of tuna lineage tool with the value of fishing power index (FPI) purse seine 1 and tuna rawai 0, 08. The average standard effort value of 917 attempts or trips. From the total catch value of two fishing gear, purse seine and tuna rawai divided by the total standard effort, the result of the average standard effort (CPUE) cacth per unit effort (CPU) is 24.69. The value of sustainable tuna fishing production in WPP 572 landed at Nizam Zachman was 180,884 tons, with EMSY worth 19,185 trips and TAC of 144,707 tons. Overall skipjack fishing business is still profitable, ie 58 vessels or 93.5% of the total respondents have a value of BC ratio above 1 is ranging from 1.01 to 15.17 declared feasible to cultivate.

References

[1] Ministry of Marine Affairs and Fisheries of Indonesia, Decree of the Minister of Marine Affairs and Fisheries Number KEP.45 / MEN / 2011 on Estimation of Potential of Fish Resources in Fishery Management Area of the Republic of Indonesia,pp 1-, 2011

[2] Ministry of Marine Affairs and Fisheries of Indonesia. Decree of the Minister of Maritime Affairs and Fisheries Number 47 / KEPMEN-KP / 2016 About Potential Estimates, Total of Exploited Captures, and Level of Utilization of Fish Resources In Fishery Management Areas of the Republic of Indonesia, pp 1-6

[3] Data Center, Statistics and Information MMAF, Fishery Management Profile of Fishery Oceanic Fishing Port of Nizam Zachman Jakarta, 2016, pp 1-42,

[4] Gulland, J. A. Fish Stock Assessment. A Manual of Basic Methods. FAO/Wiley Series on Food and Agriculture. John Wiley and Sons, Vol. I. Chichester. pp 1- 223. 1983.

[5] Badrudin. Catch & Effort Data Analysis for MSY Assumption. Ministry of Marine Affairs and Fisheries, Jakarta, 2013, pp 1-14 .

[6] Sparre, P & S.C Venema. Introduction of Tropical Fish Stock Assessment. Book I: Manual. Fisheries Research and Development Center. Jakarta, 1999,pp 1- 438,

[7] Garcia S, P.Sparre and J.C sirke. Estimating Surplus Production and Maximum Sustainable Yield from Biomass Data when Catch and Effort Time Series are not Available. Elselvier Science Publishers B.V, Amsterdam Printed in The Netherlands. Fisheries Research, 1989: pp 13-23.

[8] Primyastanto, M.. Feasibility Study of Fishery Business (As Application Of The Theory of Feasibility Study of Fishery Business). Malang , UB Press.. 2011.. pp190.

[9] Ministry of Marine Affairs and Fisheries of Indonesia, Decree of the Minister of Marine Affairs and Fisheries Number No. 56/Kepmen-KP/ 2014 on Temporary Suspension (Moratorium) of Capture Fisheries Business License in Fisheries Management Area of the Republic of Indonesia, 2014.,pp 1-3.

[10] Wyrtki, K. Physical Oceanography of The Southeast Asian Water , Naga Report. (2) 1961..pp 195.

[11] Susanto D, AL Gordon, and Q. Zheng. Upwelling along the Coast Java and Sumatera and its Relation to ENSO. Geophysichal Research Letter. 2001. 28(8) :pp 1599 -1602.

[12] Sumadhiharga, O. K.. Tuna Fish. Center for Oceanographic Research. Indonesian Institute of Sciences. Jakarta. 2009.pp129.

[13] Gafa, B., T. Sufendrata and J.C.B. Uktolseja.. Cakalang and Madidihang Fishing at Rebon Tomini Bay - North Sulawesi. Marine Fisheries Research Journal No. 43 Year 1987. Fisheries Research Institute, Jakarta. pp67-74. 1987.

[14] Uktolseja JCB. Estimates growth parameters and migration of skipjack tuna (Katsuwonus pelamis), in the eastern Indonesian waters through tagging experiments. Journal of marine fisheries research 43 pp: 15-21. 1987.

[15] Widodo, J.. Review of the Small Pelagic Fisheries of Indonesia dalam Small Pelagic Resources and Their Fisheries in the Asia – Pasific Region. Prosiding of the First session of the APFIC Working Party on Marine Fisheries, Bangkok, Thailand, 13 – 16 May 1997. Asian Pasific Fisheries Commission FAO. pp 199-226.

[16] Fauzi, A and S. Anna. Modeling of Fisheries and Marine Resources for Policy Analysis. Gramedia. Jakarta. 2005 .pp 1-339.

[17] P. Sparre and S.C. Venema. Introduction to Tropical Fish Stock Assessment, Part I: Manual. 1999, p.434.

[18] Ministry of Marine Affairs and Fisheries of Indonesia . Regulation of the Minister of Maritime Affairs and Fisheries Number 73 / KEPMEN-KP/ 2016 Regarding General Guidelines for the Implementation of People's Business Credit for Marine and Fisheries Sector. 2016, pp 1-15.