PRODUCTIVITY AND ECONOMIC ANALYSIS OF THE INDIAN OCEAN LONGLINE FISHERY LANDED AT BENOA PORT BALI INDONESIA

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ABSTRACT

This study highlighted the occurrence of productivity and economic analysis of Indian Ocean longline fishery which was landed in Benoa port Bali Indonesia. The aim of this study is to determine feasibility of tuna longline effort based on business analysis and current condition. The data used in this study based on the Research Institute for Tuna Fisheries (RITF) observer program in Benoa from 2010-2011. This paper presents the current information on Catch per Unit of Effort (CPUE) and feasibility analysis based on the recent economic parameters. The CPUEs of tuna longline vessel in 2010 and 2011 respectively were 288.35 kg/effort and 281.97 kg/effort. The feasibility analysis of Indian Ocean tuna longline effort showed that tuna longline efforts remains profitable and feasible with payback periods (year-3, month - 2 and day- 18), internal rate of return (53%), average rate of return (61.24%) and net present value between Rp 1.709.897.950,- (first year) and Rp 85.331.099.211,- (at the end of 25 years).

KEYWORD: CPUE, payback periods, net present value, internal rate of return and average rate of return

INTRODUCTION

Tuna fisheries resource is one of the potential fisheries resources that are widely spread in Indonesia water and become an important economic value as the local consumption and exports. Tuna fishery is an important product in the world characterized by a tuna trade which was reached up to 65% for the sector of fisheries biological resources (Zulham, 2003). Tuna product is the second biggest of the Indonesian fishery exports, contributing 14 percent of total export value (USD 352 million in 2009). The main markets for tuna export from Indonesia are Japan (35%), the United States (20%), Thailand (12%), European Union (9%), and Saudi Arabia (6%) (MMAF 2010). Indonesia is also the biggest fresh and frozen tuna supplier to the US, contributing about 27 percent (or about 13 thousand tons) of total US fresh and frozen tuna import in 2010, valued at USD 112 million. Indonesia was the leader of tuna supplying countries to Japan (mainly yellowfin and bigeye), supplying about 20 thousand tons per year of tuna to Japan's market. Indonesia only contributes about 2 percent of total canned tuna import to the EU market, amounting to 9,800 tons in 2008 (NMFS 2011).

Indonesia is the biggest tuna producing countries, contributing to 12.45% of total commercial tuna production in 2007, followed by Philippines (11.36%), Japan (10.23%), Taiwan (8.3%), and Korea (6.1%). Indonesia also holds important position for highly commercial species, such as yellowfin tuna, big eye, albacore, southern bluefin tuna and skipjack. Indonesia is the second important countries to produce yellowfin tuna, after Philippines, contributing to 7.5% of total global yellowfin tuna catches. Indonesia is the third biggest producing country for bigeye, albacore and Southern bluefin tuna in the world, contributing to 9.5%, 8% and 9% of their global catches respectively (FAO, 2012).

Tuna fishing in Indonesia is dominated by industrial scale using tuna longline fishing gear (longline tuna). Directorate General of Capture Fisheries (2011), record the number of units of tuna longline fishing gear has increased an average of 3.46% from the year 2000-2010. Entering 2006, the tuna longline fisheries in Indonesia faced with many changes and challenges as a result of the rising prices of fuel oil (BBM). The increase in diesel prices greatly affected vessel operating costs and total production of the catch. Hapsari (2006), the total production of tuna fishing effort in the tuna longline vessels owned by PT Perikanan Samudera Besar (now PT Perikanan Nusantara), before and after the increase in diesel prices decreased by 14.37%. Another problem encountered in the tuna longline fishery is the reduction of hooking rate, which is one indication of the low abundance of tuna fish stocks in the waters, so many tuna longline company required to have the ability to survive and compete in the sea.

This paper presents the development of production, productivity and economic analysis of tuna longline fishing vessel in Indian Ocean. This paper also presents a feasibility evaluation of tuna longline vessels based on Research Institute for Tuna Fisheries observer data.

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MATERIALS AND METHODS

Productivity /Catch per Unit Effort (CPUE)

Productivity is commonly defined as a ratio of a volume measure of output to a measure of input use among others productivity measure such as multi-factor productivity or capital productivity. Productivity is an average measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs of capital, labor, land, energy, materials, etc.). The measure of productivity is defined as a total output per one unit of a total input (Freeman, 2008). Fishing productivity according to Minister of Marine and Fisheries Decision Number 38 of 2003 is a level of fishing vessels to obtain fish catches per year. Production per trip (Catch per Unit Effort) tuna longline vessel calculated based on the volume of fish catch and the amount of tuna longliner trip (CPUE), with equation:

$$\text{Production per Trip (CPUE)} = \frac{\text{Cacth Volume (Ton)}}{\text{Number of Setting}} \quad ..1$$

Productivity is also based on Hook Rate (HR%) and Fishing Rate (Kg/Setting). The Hook Rate (%) is number of fish caught per 100 hooks (Klawe,1980).

HR(%)= (Number of Fish/Number of Hook) x 100…........2

Because of the limitations of equipment to measure the fish weight on boat, we use the length-weight conversion by Zhu *et al.*, 2008 (Table 1).

Table 1. Equation used to convert from standard length lower jaw fork length (LJFL) into rounded weight per species (Zhu *et al.*, 2008).

Species	Gears	From type measurement to type measurement	Equation	Parameters	Length
Yellowfin Tuna	Purse seine, pole and line & gill net	Fork length (cm)-Round weight(kg)	RND=a*L^b	a=0.00001886 b=3.0195	Min= 29 Max=164
Bigeye Tuna	Purse seine, pole and line & gill net	Fork length (cm)-Round weight(kg)	RND=a*L^b	a=0.000027000 b=2.95100	n/a
Skipjack	Purse seine, pole and line & gill net	Fork length (cm)-Round weight(kg)	RND=a*L^b	a=0.0000074800 b=3.25260	Min= 32 Max=78
Albacora	All Gears	Fork length (cm)-Round weight(kg)	RND=a*L^b	a=0.0000569070 b=2.75140	n/a
Swordfish	All Gears	Tip of lower jaw fork length(cm)-Round Weight (kg)	RND=a*L^b	a=0.0000042030 b=3.21340	Min= 80 Max=253
Black Marlin	All Gears	Tip of lower jaw fork length(cm)-Round Weight (kg)	RND=a*L^b	a=0.00000144217 b=2.98851	Min= 95 Max=274
Blue Marlin	All Gears	Tip of lower jaw fork length(cm)-Round Weight (kg)	RND=a*L^b	a=0.00000272228 b=3.30967	Min= 109 Max=269
Strip Marlin	All Gears	Tip of lower jaw fork length(cm)-Round Weight (kg)	RND=a*L^b	a=0.000000133263 b=3.41344	Min= 101 Max=278
Sailfish	All Gears	Tip of lower jaw fork length(cm)-Round Weight (kg)	RND=a*L^b	a=0.0000690103 b=2.52429	Min= 86 Max=187

Remark: RND= Rounded Weight (kg)

Feasibility Analysis

Analysis of financial feasibility of the business or investment using the Discounted Criteria such as : Pay Back Period (PP), Net Present Value (NPV), Internal Rate of Return (IRR) and Average Rate of Return (ARR).

Payback Periods (PP)

According to Williams *et al.*, 2012, payback period in capital budgeting refers to the period of time required for the return on an investment to “repay” the sum of the original investment. Payback period intuitively measures how long something takes to “pay for itself “. The formula to calculate payback period of a project depends on whether the cash flow per period from the project is even or uneven. In case they are even, the formula to calculate payback period is:

$$\text{Payback Period} = \frac{\text{Initial Invesment}}{\text{Cash Inflow per Period}} \quad ....(3)$$

When cash inflows are uneven, we need to calculate the cumulative net cash flow for each period and then use the following formula for payback period:

$$\text{Payback Period} = A + \frac{B}{C} \quad ....(4)$$

In the above formula,

A. is the last period with a negative cumulative cash flow;
B. is the absolute value of cumulative cash flow at the end of the period A;
C. is the total cash flow during the period after A

Payback Period (PP), is a method for calculating the time period required to return the money that has been invested from cash inflows (proceeds) which have been generated by the annual investment projects longline tuna. The faster of the payback period could give the better prospects of the business.

Discounted Cash Flow (DCF)

According Herbohn & Harrison. 2010, Discounted Cash Flow (DCF) analysis is the technique used to derive economic and financial performance criteria for investment projects. DCF is a valuation method used to estimate the attractiveness of an investment opportunity. Discounted cash flow (DCF) analysis uses future free cash flow projections and discounts them (most often using the weighted average cost of capital) to arrive at a present value, which is used to evaluate the potential for investment. If the value arrived at through DCF analysis is higher than the current cost of the investment, the opportunity may be a good one. Calculated as:

$$DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + ... + \frac{CF_n}{(1+r)^n} \quad ....(5)$$

CF = Cash Flow

r = discount rate (WACC)

Net Present Value (NPV)

NPV or net present value is the sum of the present value of net benefits. If the calculation results mean positive NPV investment will result in a higher than average return on the desired minimum. Formula Net Present Value (NPV) (Suliyanto, 2010)

$$\text{Net Present Value (NPV)} = \sum_{t=0}^{n} \frac{At}{(1+K)^t} \quad ....(6)$$

Where :

k = *Discount rate*

At = Cash Flow at t Periods

n = the last period in which the cash flow expected

Net Present Value (NPV) shows the average net profit earned during the next 25 years (2010-2035) the discount rate (interest) specific. We could make prediction using this method NPV after 25 years according to the age of ship. When the value of NPV> 1, we conclude that the tuna longline effort feasible.

Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is a method for calculating the interest rate to equate the present value of all cash inflows with the flow of cash out of an investment project. IRR formula according to Suliyanto, (2010) is

$$\text{Internal Rate of Return} = P1 - C1^{*}\left(\frac{P2-P1}{C2-C1}\right) \quad ......(7)$$

Where :

P1 = the First Interest Rate

P2 = the Second Interest Rate

C1 = the First Net Present Value

C2 = the Second Net Present Value

Internal Rate of Return (IRR) describes the discount rate (interest rate) that is able to be paid by the tuna longline effort so that profits equal to zero. When IRR> discount rate/interest rate, the tuna longline investment more feasible.

Average Rate of Return (ARR)

Average Rate of Return is the method used to measure the benefits of an investment. A rate of return in this case is the profit after tax compared to the total or average investment. According to Suliyanto, (2010), Average Rate of Return is divided into 2 sections, there are:

1. Average Rate of Return on the basis of initial investment
   Average Rate of Return (ARR)
   $$= \frac{\textit{Profits after Tax}}{\textit{Initial invesment}} * 100\% \quad ……………………(8)$$
2. Average Rate of Return on the basis of average investment
   Average Rate of Return (ARR)
   $$= \frac{\textit{Profits after Tax}}{\textit{Average invesment}} * 100\% \quad ....……………………(9)$$

Average Rate of Return (ARR) is a method used to measure the level of gains from an investment. A rate of return in this case is the profit after tax compared to the total or average investment.

RESULTS AND DISSCUSION

Results

Productivity /Catch per Unit Effort (CPUE)

From direct observations made by the observer of Fisheries Research Centre Benoa on the Indian Ocean Tuna Benoa year 2010-2011, hook rate, catch rate and catch composition calculated in (Table 2) and (Table 3) as follows:

Feasibility Analysis

Based on the analysis, tuna longline vessel required an initial investment in the form of ships, machinery, longline equipment (gears) and other equipment can be seen in Table 4. Besides that , it also required an operational and maintenance costs (Table 5). This calculation used only for tuna longline vessels with size 30 GT (according to ships document).

Table 2. The average of Hook Rate and Catch Rate of Indian Ocean tuna longline vessel collected by observers of Research Institute for Tuna Fisheries Benoa in 2010.

No	Species	∑ Setting	∑ Hook	Cacth		Tonnage	Average Weight	Hook Rate	Cacth Rate
				Number (pcs)	Percentage (%)	(kg)	(kg)	(%)	kg/setting
1	Big Eye Tuna	133	189,192	426	34.60	13,270	31.15	0.225	99.77
2	Yellow Fin Tuna	133	189,192	134	17.91	6,870	51.27	0.071	51.65
3	Albacor	133	189,192	553	28.67	10,995	19.88	0.292	82.67
4	Sword Fish	133	189,192	53	4.99	1,915	36.13	0.028	14.40
5	Black Marlin	133	189,192	1	0.17	67	67.00	0.001	0.50
6	Blue Marlin	133	189,192	4	0.58	223	55.75	0.002	1.68
7	Strip Marlin	133	189,192	1	0.07	28	28.00	0.001	0.21
8	Sortbill Spearfish	133	189,192	20	1.99	765	38.25	0.011	5.75
9	Skip Jack	133	189,192	62	1.21	465	7.50	0.033	3.50
10	Others	133	189,192	353	9.78	3,752	10.63	0.187	28.21
	Total			**1607**	**100.00**	**38,350.00**		**0.849**	**288.35**

Table 3. The average of Hook Rate and Catch Rate of Indian Ocean tuna longline vessel collected by observers of Research Institute for Tuna Fisheries Benoa in 2011.

No	Species	∑ Setting	∑ Hook	Cacth		Tonnage	Average Weight	Hook Rate	Cacth Rate
				Number (pcs)	Percentage (%)	(kg)	(kg)	(%)	kg/setting
1	Big Eye Tuna	111	114,576	260	30.06	9,410	36.19	0.227	84.77
2	Yellow Fin Tuna	111	114,576	74	6.37	1,993	26.93	0.065	17.95
3	Southern Blue Fin Tuna	111	114,576	9	3.19	998.00	110.89	0.008	8.99
4	Albacor	111	114,576	406	22.74	7,118	17.53	0.354	64.13
5	Sword Fish	111	114,576	20	5.77	1,805	90.25	0.017	16.26
6	Black Marlin	111	114,576	35	10.80	3,381	96.60	0.031	30.46
7	Blue Marlin	111	114,576	30	5.69	1,782	59.40	0.026	16.05
8	Strip Marlin	111	114,576	2	0.28	88	44.00	0.002	0.79
10	Sortbill Spearfish	111	114,576	3	0.23	71	23.67	0.003	0.64
11	Skip Jack	111	114,576	10	0.19	61	6.10	0.009	0.55
12	Others	111	114,576	432	14.67	4,592	10.63	0.377	41.37
	Total			**1281**	**100.00**	**31,299.00**		**1.118**	**281.97**

Table 4. Initial investment of tuna longline vessel with capacity 30 GT

No	Invesment	Invesment Value (Rp)	Economic Life (Years)	Depreciation (Rp/Y)
1	Ship	1,200,000,000.00	25	48,000,000.00
2	Fishing Gear	400,000,000.00	10	40,000,000.00
3	Machine	800,000,000.00	10	80,000,000.00
4	Another Equipment	100,000,000.00	5	20,000,000.00
	Total	2,500,000,000.00		

Table 5. Operasional cost of tuna longline vessel 30 GT

No	Details of operasional cost	Requirement	Unit	Price(Rp/unit)	Details	Cost
1	Diesel Fuel	25,725	Liter	4,590.00		**118,077,750.00**
2	Baits	5,550	Kg	11,000.00		**61,050,000.00**
3	Lubricants	329	Liter	17,000.00		**5,593,000.00**
4	Clavus(oli frezer)	90	Liter	17,500.00		**1,575,000.00**
5	Fishing Gear					**2,114,750.00**
6	Suplai Deck					**8,332,750.00**
7	Machinery supplay					**7,381,000.00**
8	Other material					
	a. Freon	2	Tabung	585,000.00	1,170,000.00	
	b. Plastic	27	Rol	25,000.00	670,000.00	
	c. Battery	1	Dos	605,000.00	605,000.00	
	d.LPG	7	Tube	71,000.00	497,000.00	
	e. Service				2,750,000.00	
	Sub Total					**5,692,000.00**
9	Salary/Honour					
	a. Man power 10 Orang	75	day	25,000.00	18,750,000.00	
	b. Kapten	75	day	50,000.00	3,750,000.00	
	Sub Total					**22,500,000.00**
10	Medicine					**325,000.00**
11	Food Stuf					**15,909,800.00**
12	Document					
	a.Permit				800,000.00	
	b. Accomodation V/V				1,500,000.00	
	Sub Total					**2,300,000.00**
13	Ship Doc dan Overhead					**5,850,000.00**
14	Marketing Cost					**4,099,200.00**
15	Fish Care Cost					**16,678,500.00**
	Total					**277,478,750.00**
	Average Cost/Day					**3,699,716.67**
	Average Cost per setting (85% from active day)					**4,335,605.47**
	Depreciation per setting (10% from Initial Invesment per year)					**980,392.16**
	Average Cost per setting+ depreciation					**5,315,997.63**
	Annual Cost					**1,355,579,394.53**

From the operating costs components, cost of fuel was the highest, reached up to 42.55% of the total operating costs. Followed by 22% cost of bait and 8% labor salaries. The U.S. dollar exchange rate of Rp 9.500, - / $ 1 in September 2012, the price of tuna exports in this month was around $ 6 - 6.5/kg while the price of local market was $ 3.5 - 4/kg. The local market for Albacore was around Rp 26,500, -/kg. According ASTUIN (Indonesia Tuna Association) in 2010, the acquisition of export quality fish is 50-60% of the overall total catch of fresh fish that landed at Benoa port Denpasar, Bali.

The revenue analysis of 30 GT tuna longline vessel with 75 days of work and 64 days setting is as follows (Table 6):

Assuming 300 days of operations by effectively setting day 255 days (85% of operating days), the gross income earned by tuna longline vessel for a year was Rp 3.236.467.140,-. Operating costs and depreciation during this year was Rp 1.355.579.395,. Tuna longline net income was Rp 1.880.887.745,-. This Income according to assuming diesel fuel price of Rp 4.590, -/liter (fuel subsidy).

Here we present the analysis of the financial feasibility of this kind of business with some assumptions (Table 7) and the appraisal according to Discounted Cash Flow (DCF) and Net Present Value (NPV) for the next 25 years as follows :

1. Tuna Longline vessel with 30 GT (Gross Tonage) capacity, 75 days operation and 64 days setting.
2. The increase in subsidized fuel prices by 15% per year.
3. The increase in average operating costs by 15% per year.
4. The increase in fish price by 15% per year in local or export market.
5. The percentage of exports and reject of tuna are each 50%.

Table 6. Tuna Longline Revenue analysis, ships capacity 30 GT with 64 setting, with exchange rate (Rp 9.500,- per 1 $ US)

No	Species	Production Per Trip (64 Setting)(kg)	Exsport Price($)	Total (Rp)	Reject Price($)	Total (Rp)
1	Big Eye Tuna	5,426	6.5	167,514,955	4	103,086,126
2	Yellow Fin Tuna	1,149	6	32,749,838	3.5	19,104,072
3	Southern Blue Fin Tuna	575	8	21,866,090	6	16,399,568
4	Albacor	4,104			26,500	108,757,910
5	Sword Fish	1,041	5.6	27,683,171	3	14,830,270
6	Black Marlin	1,949			20,000	38,988,108
7	Blue Marlin	1,027			20,000	20,549,189
8	Strip Marlin	51			20,000	1,014,775
9	Sail Fish	41			20,000	818,739
10	Sortbill Spearfish	35			20,000	703,423
11	Skip Jack	2,648			15,000	39,714,595
12	Others	18,046			11,000	198,508,973
	Total	36,093		249,814,054		562,475,748
	Grand Total					812,289,802
	Production per setting					12,692,028

Table 7. Feasible analysis of tuna longline vessel 30 GT capacity

No	Descriptions	Project Years 0	1	2	3	4	5
A	**CASH OUT FLOW**						
1	**Investment**						
	Ships	1,200,000,000					
	Fishing Gear	400,000,000					
	Machine	800,000,000					
	Another Equipment	100,000,000					
	TOTAL CASH EXPENDITURES	2,500,000,000					
2	**Operational Cost**						
	Diesel Fuel		470,466,035	541,035,940	622,191,331	715,520,031	822,848,036
	Baits		243,246,094	279,733,008	321,692,959	369,946,903	425,438,938
	Lubricants		22,284,609	25,627,301	29,471,396	33,892,105	38,975,921
	Clavus(frezer oil)		6,275,391	7,216,699	8,299,204	9,544,085	10,975,697
	Fishing Gear		8,425,957	9,689,851	11,143,328	12,814,827	14,737,052
	Deck Supply		33,200,801	38,180,921	43,908,059	50,494,268	58,068,408
	Machine Supply		29,408,672	33,819,973	38,892,969	44,726,914	51,435,951
	Material and Service		22,679,063	26,080,922	29,993,060	34,492,019	39,665,822
	Labour/Honour		89,648,438	103,095,703	118,560,059	136,344,067	156,795,677
	Medicine		1,294,922	1,489,160	1,712,534	1,969,414	2,264,826
	Foodstuff		63,390,609	72,899,201	83,834,081	96,409,193	110,870,572
	Document, Permit and Accomodation		9,164,063	10,538,672	12,119,473	13,937,394	16,028,003
	Ship doc. And Overhead		23,308,594	26,804,883	30,825,615	35,449,458	40,766,876
	Marketing Cost		16,332,750	18,782,663	21,600,062	24,840,071	28,566,082
	Fish Care Cost		66,453,398	76,421,408	87,884,619	101,067,312	116,227,409
			1,105,579,395	1,271,416,304	1,462,128,749	1,681,448,062	1,933,665,271
3	Depreciation		250,000,000	250,000,000	250,000,000	250,000,000	250,000,000
	TOTAL CASH EXPENDITURES		1,355,579,395	1,521,416,304	1,712,128,749	1,931,448,062	2,183,665,271
B	**CASH INFLOW**						
1	Fish Sales		3,236,467,140	3,721,937,211	4,280,227,793	4,922,261,962	5,660,601,256
2	Residual Value						
	TOTAL CASH INFLOW		3,236,467,140	3,721,937,211	4,280,227,793	4,922,261,962	5,660,601,256
C	**BALANCE**	-2,500,000,000	1,880,887,745	2,200,520,907	2,568,099,043	2,990,813,900	3,476,935,985
	NPV	**4,976,881,367**					
	IRR (%)	**53**					
	ARR (%)	**61.24**					
	PAYBACK PERIODE	**Year- 3, Month -2 and 18 days**					

Table 8. Investment appraisal according to Discounted Cash Flow (DCF) and Net Present Value (NPV) for the next 25 years.

Years	Fixed Cost (Rp) (A)	Operational Cost (Rp) (B)	Income (Rp) (C)	Net Cash In Flow (Rp) (D)	Discount Factor (E)	DCF (Rp) (F)	NPV (Rp) (G)
0	2,500,000,000						
1		1,355,579,395	3,236,467,140	1,880,887,745	0.10	1,709,897,950	1,709,897,950
2		1,521,416,304	3,721,937,211	2,200,520,907	0.10	1,818,612,320	3,528,510,270
3		1,712,128,749	4,280,227,793	2,568,099,043	0.10	1,929,450,821	5,457,961,092
4		1,931,448,062	4,922,261,962	2,990,813,900	0.10	2,042,766,136	7,500,727,228
5		2,183,665,271	5,660,601,256	3,476,935,985	0.10	2,158,903,692	9,659,630,920
6		2,473,715,062	6,509,691,444	4,035,976,383	0.10	2,278,203,450	11,937,834,370
7		2,807,272,321	7,486,145,161	4,678,872,840	0.10	2,401,001,582	14,338,835,952
8		3,190,863,169	8,609,066,935	5,418,203,766	0.10	2,527,632,044	16,866,467,997
9		3,631,992,644	9,900,426,975	6,268,434,331	0.10	2,658,428,071	19,524,896,067
10		4,139,291,541	11,385,491,021	7,246,199,481	0.10	2,793,723,584	22,318,619,651
11		4,472,685,272	13,093,314,675	8,620,629,403	0.10	3,021,478,015	25,340,097,666
12		5,143,588,063	15,057,311,876	9,913,723,813	0.10	3,158,817,925	28,498,915,591
13		5,915,126,272	17,315,908,657	11,400,782,385	0.10	3,302,400,558	31,801,316,149
14		6,802,395,213	19,913,294,956	13,110,899,743	0.10	3,452,509,674	35,253,825,824
15		7,822,754,495	22,900,289,199	15,077,534,704	0.10	3,609,441,932	38,863,267,756
16		8,996,167,669	26,335,332,579	17,339,164,910	0.10	3,773,507,475	42,663,191,194
17		10,345,592,820	30,285,632,466	19,940,039,646	0.10	3,945,030,542	46,581,805,772
18		11,897,431,743	34,828,477,336	22,931,045,593	0.10	4,124,350,112	50,706,155,884
19		13,682,046,504	40,052,748,936	26,370,702,432	0.10	4,311,820,571	55,017,976,455
20		15,734,353,480	46,060,661,276	30,326,307,797	0.10	4,507,812,416	59,525,788,871
21		18,094,506,501	52,969,760,468	34,875,253,966	0.10	4,712,712,980	64,238,501,851
22		20,808,682,477	60,915,224,538	40,106,542,061	0.10	4,926,927,206	69,165,429,057
23		23,929,984,848	70,052,508,219	46,122,523,371	0.10	5,150,878,443	74,316,307,500
24		27,519,482,575	80,560,384,452	53,040,901,876	0.10	5,385,009,281	79,701,316,781
25		31,647,404,962	92,644,442,119	60,997,037,158	0.10	5,629,782,430	85,331,099,211

Discussion

Analysis of Productivity

From the information above, we obtained that total hook rate of species caught by tuna longline vessel were 0.849 % (2010) and 1.118% (2011). Catch per Unit Effort (CPUE) was 288.35 kg/setting (2010) and 281.97 kg/setting (2011). CPUE of overall species from 2010-2011 tended to stable at the ranged 280-290 kg/effort. The CPUE of tuna/tuna like species (bigeye, yellowfin, southern bluefin and albacore) declined occurred in the year 2010 to 2011 (Table 9).

Table 9. Catch per unit effort of tuna in 2010-2011

No	Species	CPUE (kg/setting)Year 2010	2011
1	Bigeye tuna	99.77	84.77
2	Yellowfin tuna	51.65	17.95
3	Southern bluefin tuna	0	8.99
4	Albacora	82.67	64.13
	Total	**234.09**	**175.84**

The trend of the CPUE of tuna species continue to decline in the long term, suggesting that the tuna resource management required a new attention in order to obtain optimal results in the future. According BRKP (2007) in Ghofar (2007), which states that the use of large pelagic fish resources are already fully exploited on the state, meaning that it can no longer increase fish capture. FAO (2012) also published the condition of the fish resources of Indonesia waters; especially Indian Ocean and the Pacific Ocean are fully exploited. Even the waters of the Indian Ocean conditions are likely to lead to over exploited.

According to Sparre & Venema (1989) CPUE is an index of abundance of fish stocks in the waters. If we compared it with the data from PT Perikanan Nusantara, CPUE of tuna longline vessels was difference. According to PT Perikanan Nusantara, trend in CPUE of PT Perikanan Nusantara of the years 1995-2010 was declined from 291-120 kg/setting (Figure 1).

The Hook Rate (HR) of tuna (bigeye, yellowfin, southern bluefin and albacore) has also declined in the year 2010 to 2011.The HR of tuna showed at Table 10.

Sadiyah *et al*. (2011), based on analysis of data collected by the observer shows, that the development of hook rate tuna longline vessels based in Benoa also tend to decrease since 2009.

Figure 1. Trend of catch per unit effort for tuna longliner owned by PT.Perikanan Nusantara, 1995- 2010.

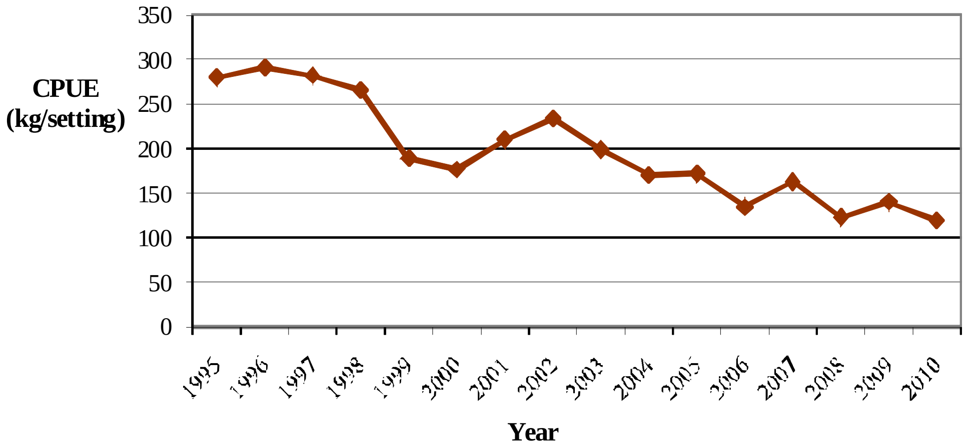

Table 10. Hook Rate (HR) of tuna/tuna like species in 2010-2011

No	Species	Hook Rate (%)/Years		
		2010	2011	Range
1	Bigeye tuna	0.225	0.227	-0.0020
2	Yellowfin tuna	0.071	0.065	0.0060
3	Southern bluefin tuna	0	0.008	-0.0080
4	Albacora	0.292	0.354	-0.0620
	Total	**0.588**	**0.654**	**-0.0660**

Figure 2 shows that the total value of hook rate peaked in 2008 (0.63) and the lowest was in 2005 (0.34). The lowest occurred in 2005 because at that time there was an increase of fuel oil price that reduced the number of operations in one trip. The hook rate of albacore was highest followed by big eye tuna, yellowfin tuna and the southern bluefin tuna (Figure 2).

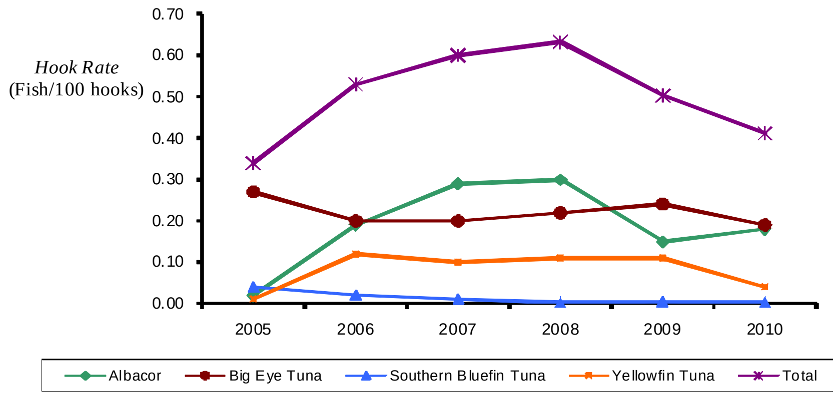

Figure 2. Value of average hook rate for tuna based on recorded by observers, 2005- 2010.

Analysis of Feasibility

From the financial analysis above, it can be seen that the tuna longline effort is feasible to develop. Invested in this effort will achieve payback in year-3th, 2th month and18th days. With discount factor/ bank interest rate 10% annual, Net Present Value (NPV) was achieved in the initial conditions (first year) of Rp 1.709.897.950,- and Rp 85.331.099.211,- at the next 25 years (in accordance to the age of ship). The discounted cash flow (DCF) was 1.709.897.950,- (first year) and Rp 5.629.782.430,- at the next 25 years. Its mean that this kind of business classified as a profitable (positive values) business. The investment value would be increased over Rp 80 billion for the next 25 years from the first year investment (table8). Tuna longline effort is able to restore bank lending rates despite a 10% in the interest rate. Internal Rate

Return (IRR) was 53% or 43% above interest rate level (10%). The level of income after tax was 61.24 % of the total initial investment.

CONCLUSIONS

Tuna longline effort is a capital-intensive business which is requires a careful planning to start. CPUE of tuna longline effort in 2010 and 2011 respectively were 288 kg/effort and 282 kg/effort. The feasibility studies showed that tuna longline effort was still profitable business with Payback Periods (year-3, month - 2 and day-18), Net Present Value (NPV) was achieved in the initial conditions (first year) of Rp 1.709.897.950,- and Rp 85.331.099.211,- at the next 25 years (in accordance to the age of ship). The discounted cash flow (DCF) was 1.709.897.950,- (first year) and Rp 5.629.782.430,- at the next 25 years. Internal Rate of Return was 53% and Average Rate Return was 61.24% of the initial investment.

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