

Analysis Pattern of Potency and Fisheries Development in The Bengkalis Regency, Riau Province

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ABSTRACT

Bengkalis waters is experiencing over fishing (DKP Riau Province, 2011). The purpose of this study is to analyze the fisheries potency and the level of exploitation in the coastal and marine zones and to understand the level of fishermen income in the Bengkalis waters. Data were obtained directly from the fishermen and the secondary data were obtained from related institutions. Results shown that the potential of sustainable fisheries in the coastal zone of the Bengkalis is 1,287.09 tons / year, while that of the marine zone is 7,608.17 tons/ year. The exploitation rate in the coastal zone is 113.04% and that of the marine zone is 90.94% in 2013. In the coastal zone, the average of *Benefit Cost of Ratio (BCR)* = 1.89, with the average of income revenue was Rp 19,035,000,-/year, while those of the marine zone is 1.96 and Rp 83.442.000,-/year respectively.

Keywords: Bengkalis, sustainable potency, fishermen income, sustainable fishery

INTRODUCTION

The poverty of farmers and fishermen in the countryside will lead to pressure to natural resources, which means negative impact on the sustainability of natural resources and environmental quality. Due to the poverty, the poor tend to use natural resources to fulfill their need, but as a consequence it leads to damage of the environment.

Fish availability in the Bengkalis territorial waters is estimated to be decreased due to excessive fishing effort. As there is no fishing regulation, the fishermen take almost all of fish captured such small sized fish and fish that is in reproductive stage. This condition may damage the fishery condition in general as the fish exploitation rate is more than the fish reproduction rate. To understand the fisheries general condition in the Bengkalis waters, a study has been conducted.

MATERIALS AND METHODS

This study was conducted in Bengkalis waters, in 2 study sites, namely the coastal and marine zones of the Bengkalis waters, a one year period (2013 to 2014). Data were obtained by distributing questionnaire as a data collection guidelines, stationery, tape recorder for recording the interview and a digital camera for documenting the research. Methods used in this study is a survey method. The primary data were obtained through interviewing respondent individually (200 fishermen) and in a groups (the coastal and marine groups).

Table1. The number of respondent in each study site

No	District	Total Population	Coastal Zone	Marine Zone
1	Bantan	859	60	60
2	North Rupal	613	40	40
T O T A L		1.472	100	100

Analisis of Potensial Sustainable Fisheries. To calculate the MSY and optimum sustainable yield in the natural resources, a Scheafer model is used, with these following equations:

1. Maximum Sustainable Yield (MSY) : $\hat{A}^2/4b$

2. Effort optimal : $a/2b$
3. Level Exploitation (T.Eks) : $(T.prod/MSY) \times 100\%$

Business Analysis and fishing income. The feasibility of fishery business in the coastal and marine zones can be calculated using these following formulas:

1. $BCR = GI/TC$
2. $IRR = NI/ I \times 100\%$
3. Net income = $GI - TC$

RESULTS AND DISCUSSION

There is high fishery potential resources in the Bengkalis Regency. Data on the fishery related potency in the Bengkalis Regency during 9 years (2005-2013) period is presented in Table 2.

Table 2. Fishing gear, boat and marine fisheries production in Bengkalis Year 2005-2013

Year	Gear (unit)	Boat (unit)	Ratio of gear and Boat	Production (ton)
2005	3.811	3.140	1,21	8.285,3
2006	4.447	4.215	1,06	8.468,8
2007	5.810	4.205	1,36	9.103,5
2008	5.670	4.882	1,16	10.083,9
2009	5.059	3.953	1,28	9.443,8
2010	5.132	2.997	1,71	9.291,9
2011	5.232	3.475	1,51	8.530,0
2012	5.364	3.453	1,55	8.735,0
2013	5.584	3.519	1,59	8.373,9

Source: Department of Marine and Fisheries Bengkalis

Sustainable Fisheries Potency in Bengkalis. Prediction of sustainable fisheries potency in Bengkalis coastal and marine zones are presented in Table 3

Table 3. The number of fishing boats and gears in the coastal and marine zones of Bengkalis Regency in the year of 2005 – 2013

Year	Boats			Gears		
	Coastal	Marine	Total	Coastal	Marine	Total
2005	1.880	1.260	3.140	2.287	1.524	3.811
2006	2.770	1.445	4.215	2.668	1.779	4.447
2007	2.797	1.408	4.205	2.895	1.915	4.810
2008	2.927	1.955	4.882	3.402	2.268	5.670
2009	2.368	1.585	3.953	3.055	2.024	5.059
2010	1.777	1.200	2.977	3.079	2.053	5.132
2011	2.089	1.386	3.475	3.139	2.093	5.232
2012	2.070	1.383	3.453	3.218	2.144	5.364
2013	2.115	1.404	3.519	3.351	2.233	5.584

Source: DKP Bengkalis 2005-2013

Production, amount of equipment, fleet, fishing effort (effort) and average catch per-unit apparatus (CPUE) marine fisheries Bengkalis, for 9 years presented in Table 4

Table 4. Production, gears, boats, Effort and CPUE in the Bengkalis waters in the year of 2005-2013

Year	Production (ton)	Gears (unit)	Boat (unit)	Efforts	CPUE
2005	8.285,3	3.811	4.215	2.242	3,70
2006	8.468,8	4.447	4.206	2.616	3,24
2007	9.103,5	4.810	4.882	2.829	3,22
2008	10.083,9	5.670	4.953	3.335	3,19
2009	9.443,8	5.059	3.977	2.976	3,17
2010	9.291,9	5.132	4.475	3.019	3,08
2011	8.530,0	5.232	4.503	3.078	2,77
2012	8.735,0	5.364	4.519	3.155	2,77
2013	8.373,9	5.584	4.323	3.284	2,55

Source: DKP Bengkalis 2005-2013

The fishery production as well as the gear used in fish captured activities in bengkalis waters was increase during the period 2005 -2013. However, the increment of the fishery production (0.32% per year) is lower than that of the gear (5.24% per year). As a consequence, the effort also increase and the CPUE drcrease into 4.40% per year. These data indicate that the fishermen need higher cost to catch the same type of fish.

The potential of fisheries in the coastal zone of Bengkalis. The common fishing boats used in the coastal zone of Bengkalis are traditional or non-motorized boat (PTM), 3GT boat, 5 GT boat and >5 GT boat. Fishery production (catch), fishing gear used, Effort index, CPUE and exploitation level are presented in Table 5

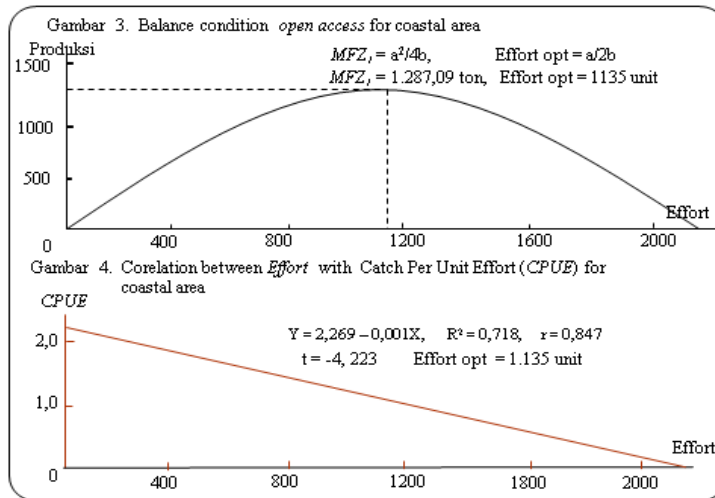
Table 5. Production (catch), fishing gear, Effort indexes and the catch per unit effort (CPUE) and exploitation level in the coastal zone of Bengkalis waters in the year of 2005-2013

Year	Production (ton)	Totalgear (unit)	Index conversion	Effort (unit)	CPUE (ton)	Exploitation (level)
2005	1.657,0	2.287	1,84	243		128,74
2006	1.693,8	2.668	1,84	450		131,60
2007	1.775,2	2.895	1,84	573		137,92
2008	1.915,9	3.402	1,84	849		148,86
2009	1.747,0	3.035	1,84	649		135,73
2010	1.772,5	3.079	1,84	673		137,71
2011	1.492,7	3.139	1,84	706		115,97
2012	1.489,9	3.218	1,84	749		115,37
2013	1.454,9	3.351	1,84	821		113,04

Source: DKP Bengkalis 2005-2013

The relationship between fishing effort (effort) with catch-per-unit effort (CPUE) of the coastal fisheries, can be described by a linear regression equation: $Y = 2,269 - 0.001X$ (R^2 is 0.718). It means that the catch per unit effort is equal to 2,269 tons/year. If the fishing effort is zero, the catch will be decreased into 0,001 tons/year. The fisheries condition in the coastal zone is presented in Figure 3 and 4.





The fisheries potency in the marine zone of Bengkalis. The potency of sustainable fisheries in the marine zone of Bengkalis waters is presented in Table 6. The fisheries condition in this area can be predicted based on data available (2005-2013), especially the data on production and exploitation level.

Table 6. Production (catch), fishing gear, catching effort (Effort) and the catch per unit effort (CPUE) and Exploitation in the marine zone of Bengkalis, in the year of 2005-2013

Year	Production (ton)	Total gear	Conversion Index	Efforts (unit)	CPUE (ton)	Exploitation level
2005	6.628,3	1.524	1,49	1.023	6,48	87,12
2006	6.675,0	1.779	1,49	1.194	5,67	86,89
2007	7.328,3	1.915	1,49	1.258	5,70	96,32
2008	8.168,0	2.268	1,49	1.522	5,37	107,16
2009	7.696,8	2.024	1,49	1.358	5,67	101,16
2010	7.519,4	2.053	1,49	1.378	5,46	98,83
2011	7.037,3	2.093	1,49	1.405	5,01	92,50
2012	7.250,1	2.144	1,49	1.439	5,04	95,29
2013	6.919,0	2.233	1,49	1.497	4,62	90,94

Source: DKP Bengkalis 2005-2013

Relationship between Fishing Enterprises (effort) with catch-per-unit effort (CPUE) of the coastal fisheries, can be described by a linear regression equation: $Y = 9.394 - 0.003X$ (R^2 was 0.750). It means that the catch per unit effort is equal to 9.394 tons / year. If the fishing effort is zero, it means that the catch decrease into 0.003 tons / year with the addition of an effort unit.

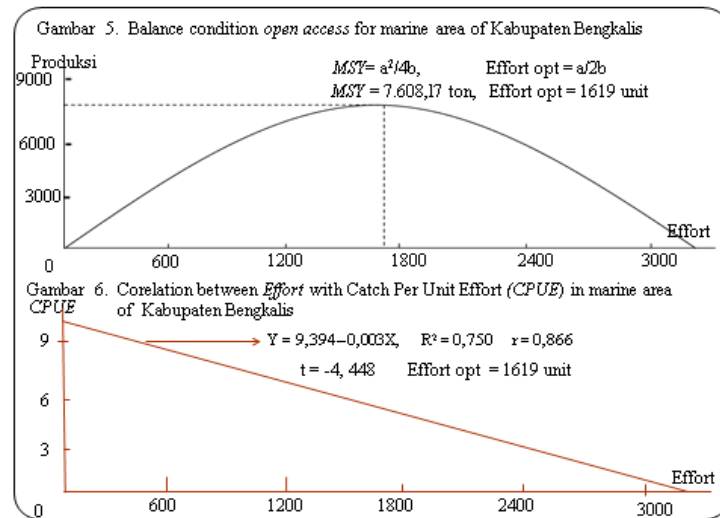


Figure 5 and 6 shown the potential condition of marine zone fisheries in the Bengkalis waters.

Analysis of income and business feasibility level. The coastal zone fisheries. The initial capital is often called the main capital. The initial capital costs are issued/ invested by fishermen to build one unit of fishing effort. The main capital is not changed eventhough the production is changing. The business capital in coastal zone are presented in Table 7.

Table 7. The price of each fishing gear type used in the Bengkalis coastal waters

No	Type of gear	Type & big spending (Rp 000)				
		Boat	Gear	Boat engine	Roller machine	other
1	Gill net (PTM)	1.000	1.000	-	-	50
2	Gill net (PTM)	15.000	20.000	15.000	-	300
3	Trammel net (MT)	15.000	15.000	15.000	-	300
4	Long line (MT)	10.000	10.000	10.000	-	300
5	Gombang (MT)	10.000	15.000	10.000	-	300
6	Ambai (MT)	4.000	7.000	5.000	-	30

Feasibility Index Value. The values of BCR, IRR and Income are strongly influenced by the amount of capital invested and costs issued in fishing effort. The index value of fishing effort in coastal is presented in Table 8.

Table 8. The index value of fisheries in the coastal zone of Bengkalis

No	Gear	Armada	BCR	IRR	Income / year	Bussines condition
1	Gill net	PTM	2,08	45,25	6.500.000	Worthy
2	Gill net	MT	1,73	28,40	44.500.000	Worthy
3	Trammel net	MT	1,92	38,24	33.000.000	Worthy
4	Long line	MT	1,78	29,20	24.000.000	Worthy
5	Gombang	MT	1,39	17,37	11.000.000	Worthy
6	Ambai	MT	1,80	29,85	8.000.000	Worthy

The fishing effort in the marine zone of Bengkalis. Business capital. The initial capital of the marine fisheries in Bengkalis shown in Table 9.

Table 9. The initial capital of each type of fishing gear in marine zone in Bengkalis waters

No	Gear	Boat	Types & Cost (thousand Rp)			
			Gear	Boat engine	Roller machine	other
1	Gill net (KM 5GT)	60.000	40.000	30.000	7.500	2.000
2	Gill net (KM 5GT)	50.000	40.000	25.000	7.500	2.000
3	Trammel net (KM 5 GT)	30.000	20.000	20.000	7.500	1.000
4	Long line (KM 7GT)	100.000	100.000	42.000	8.000	3.000
5	Gombang (KM 7GT)	80.000	70.000	40.000	8.000	3.000
6	Ambai (KM 7GT)	50.000	50.000	30.000	7.500	2.000

Source: survey and interview

Index value of the marine zone. The value of the BCR, IRR index and Income is strongly influenced by the amount of capital invested and costs issued in fishing effort. The index value of fishing effort in the waters off the marine area is presented in Table 10.

Table10. Index value of marine fisheries in the Bengkalis waters

No	Gear	Boat Size	BCR	IRR	Income / year	Bussines condition
1	Gill net	KM 5GT	2,06	38,72	37.500.000	Worthy
2	Trammel net	KM 5GT	1,78	25,95	29.600.000	Worthy
3	Long line	KM 5GT	1,54	17,94	20.200.000	Worthy
4	Gill net	KM 7GT	2,26	41,72	160.000.000	Worthy
5	Kurau net	KM 7GT	2,25	41,24	127.000.000	Worthy
6	Bamboo trap	KM 7GT	2,07	31,47	62.000.000	Worthy

General condition of fisheries condition in the Bengkalis Regency can be predicted based on the average of fishermen catch/ gear/ zone. Data on the fisheries condition are presented in Table.11

Table 11. Data on fishing equipment, boat, average costs, catches, BCR and IRR income /year

Fisheries zones	Respo ndent	Gear	Boat	Engine type	Cost (thousand Rp)	Output (kg)	Gross revenue (Thousand Rp)	Net Income (Thousand Rp)	BCR	IRR
coastal zone	37	Gill net	PTM		6000	500	12.500	6500	2,08	45,25
	20	Gill net	MT(2GT)	15	52.000	3600	90.000	38.000	1.73	28,40
	18	T. Net	MT(2GT)	10	36.000	1500	69.000	33.000	1,92	38,24
	7	Long line	MT(2GT)	8	27.000	1600	48.000	21.000	1,78	29,20
	6	Gombang	MT(2GT)	8	28.000	1300	39.000	11.000	1,39	17,37
	12	Ambai	MT(2GT)	6	10.000	600	18.000	8000	1,80	29,85
	100				23.870	1437	44.705	19.035	1,89	35,98
marine zone	38	Gill net	KM 5GT	24	80000	6600	165.000	85.000	2,06	38,72
	25	T.Net	KM 5GT	16	62000	2400	110.000	48.000	1,78	25,95
	10	Long line	KM 5GT	16	39000	1900	57.000	18.000	1,46	15,38
	17	Gill net	KM 7GT	60	135000	11.800	295.000	160.000	2,18	41,34
	6	Kurau net	KM 7GT	26	98000	6100	225.700	127.700	2,30	42,72
	4	Bamboo trap	KM 7GT	26	58000	4000	120.000	62.000	2,07	31,47
	100				80.950	5830	164.322	83.442	1,96	36,11

The criteria of coastal and marine fisheries condition in Bengkalis Regency based on statistical analysis are presented in Table 12.

Table12 . Results of regression analysis of coastal (a) and marine (b) fisheries condition in the Bengkalis Regency.

Coastal Zone	Regression parameter	Coefficient	q	Standard Error	t	F	R ²	r
	$\beta_0(a)$	2,269		0,294	7,716			
	$\beta_1(b)$	-0,001	0,001	0,003	-4,223	17,837	0,718	0,847
<p>Y = 2,269 – 0,001X Production / C (2013) = 1.454,90 ton No = (a/q) x 250 (operating days per year) = 567.250,00 ton Nt = No-C = 565.795,10 ton MSY= a²/4b = 1.287,09 ton/year Optimal Effort = a/2q = 1.135 unit The lower rate of exploitation (2013) = 113,04% BCR = 1,89 Average net income = Rp 19.035.000,-/year</p>								
Marine Zone	Regression parameter	Coefficient	q	Standard Error	t	F	R ²	r
	$\beta_0(a)$	9,394		1,339	11,238			
	$\beta_1(b)$	-0,003	0,003	0,006	-4,448	19,786	0,750	0,867
<p>Y = 9,394 – 0,003X Production / C (2013) = 6.919,00 ton\ No = (a/q) x 235 (operating days per year) = 735.863,33 ton Nt = No-C = 728.944,33 ton MSY= a²/4b = 7.608,17 ton/year Optimal Effort = a/2q = 1.919 unit The lower rate of exploitation (2013) = 107,36 % BCR = 1,96 Average net income = Rp 83.442.000,-/year</p>								

CONCLUSIONS AND RECOMMENDATIONS

Fishery condition in the coastal zone indicates excess fishing (over fishing), with the potency of sustainable fishery is 1,287.09 tons / year. The highest rate of exploitation level in that area was 148.86%, with the optimum effort 1,135 units, but the effort in 2008 was higher than that of the optimum effort, it was 1,849 units. In the marine zone, the general fisheries condition is better than that of the coastal zone. In the year of 2008, the exploitation level was 107.16% and the fishing effort was 1,522 units or 94 %. As the optimum effort is 1,619 units, and the fishing effort in the marine zone is lower than that of the maximum effort, the fisheries effort in this area can be developed.

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