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Shrimp (*Penaeus* spp) Potential, Utilization (*Penaeus* spp) and Management Effort at Batang District Coastal Waters

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ABSTRACT

The study of potential and shrimp resource utilization (*Penaeus* spp.) at Batang Regency coastal waters made based on analysis of the catching data and shrimp fishing trip during the period 2002-2011. Analysis of the catch per unit effort (CPUE) is used to predict the long-lasting potential (MSY) shrimp and optimum fishing effort. The analysis was also conducted to determine the state of fishing season based on quarterly data. MSY value and shrimp fishing effort in Batang respectively 29,032 kg and 18,262 trip. The highest shrimp fishing season was in the first quarter that is in January-March and decreased in the third quarter (July–September). It is known that the status of the shrimp fishery in 2005-2006 and in 2010-2011 have shown overfishing, so the effort settings required. The sustainable resources is more aimed at limiting the catch and the catch effort with arad net, ie 80% of the sustainable resources.

Key words: Analysis of CPUE, shrimp (*Penaeus* spp.), MSY, Batang regency coastal waters.

INTRODUCTION

Shrimp resources Batang District coastal waters is relatively abundant. The suitability characteristics of physics, chemistry, and biology of Batang District coastal waters with shrimp allegedly closely associated with the abundance of the resource. This condition causes the shrimp fishing activities are also progressing well. In general, the dominant fishing gear used to catch shrimp is "arad" net (beach siene or seine net). The fishing gear is quite simple type of fishing gear, small-scale and artisanal. Indrawasih, R (2009) that the "arad" net is a highly productive nets to catch demersal fish and shrimp, that makes the arad net used by many fishermen in the coastal including Batang District coastal known as the estuarine area.

Widodo (1990) explained that the demersal fish, especially shrimp is one of the important fisheries sub-sector commodity, so the fishermen are trying to catch the shrimp capture as much should be considered in the sustainable management.

Based on the study conducted was 2012 the shrimp long-lasting potential (MSY) in Batang coastal waters is 29,032 kg. This MSY value is analyzed based on the data of shrimp production during 2002–2011. From that study also known in 2005, 2006, 2010, and 2011 this shrimp catch has exceeded MSY of 1,574.02 kg, 3,835.02 kg, 127,450.02 kg, 53,662.02 kg so the overfishing occurs were concerned.

The problem of overfishing indeed is a dilemma for the management of fisheries resources in Indonesia. On one side the fish production increased continuously pursued, but on the other hand the sustainability of fisheries resources should also be maintained. Management efforts are made to ensure the sustainable use of fisheries resources including through restrictions on the catch so it does not the MSY (Yudha 2011).

Based on those conditions, this study was aimed to review the shrimp resource utilization status in the Batang District coastal waters, both of fishing gear variability, potential sustainability, and the level of utilization.

MATERIAL AND METHOD

Sampling

The study was conducted in three Fish Auction in Batang District, ie Roban fish auction
, Celong fish auction and Siklayu fish auction, for three months, from October up to the December 2012.

Data Measurement

The obtained data can be classified in two group, ie primary data and secondary data. The primary data include: mesh size, boat size, and engine size. While the secondary data, among others, include: the catches production per quarter for each TPI (for 10 years), the annual catches production of each TPI (for 10 years), gear trip (for 10 years), were collected from the three TPI mentioned above.

Data Analysis

Utilization Status of Shrimp

The analysis shrimp utilization status conducted with the approach, ie the production data and catches trip. To calculate the potential sustainability (MSY) with the Surplus Production Model of Schaefer by using regression analysis. The data that used in is the 2002-2011 time series data ie the number of

fishing gear data that is an independent variable and the amount of catch per unit effort (CPUE) is the dependent variable. The model is based on the assumption that the biomass of fish in the sea is proportional to CPUE (Per Spare, 1999; Saputra, 2009).

In general, the catch per unit the fishing effort (CPUE = C/f; where C = catches; f = effort, the fishing effort), can be used as an index of relative abundance. "Surplus production method" based on the assumption that CPUE is a function of f, as in the linear model of Schaefer (Widodo and Arabia, 1996).

Analysis of CPUE and The Catch Effort

To obtain the value of CPUE (Catch per unit effort)was conducted by comparing the number of shrimp catches with the amount of fishing effort (trips) using the fishing gear (arad net) in Roban TPI, Celong TPI and Siklayu TPI for 10 years, between 2002–2011.

$$CPUE = \frac{c}{f}$$

Anayisis f_{opt} and MSY

$$f_{opt} = \frac{a}{2b}$$

$$C = af - bf^2 \; ; \; f_{opt} = \frac{a}{2b}$$

$$C_{max} = a\left(\frac{a}{2b}\right) - b\left(\frac{a^2}{4b^2}\right)$$

$$MSY = \frac{a^2}{4b}$$

$$CPUE_{opt} = \frac{MSY}{f_{opt}}$$

Shrimp Resource Utilization Levels

$$TP = \frac{C_i}{MSY} x100\%$$

Where:

TP = the level of utilization
Ci = the catch of the year i
MSY = maximum sustainable yields

Shrimp catch season

Production index of shrimp every four months can be calculated by the following equation:

$$I_i = \frac{C_i}{C_t}$$

Where:

Ii = index of shrimp production in the month / quarter i
Ci = catches average at the month / quarter-i
Ct = annual production average

Total Catchment Setting

$$CK_i = (I_i)x(MSY)$$

Where:

CKi = catch at quarter i
Ii = season index value at quarter i
MSY = maximum sustainable yields results

RESULT AND DISCUSSION

Total Catches Performance

The boat which has a lot of operating in Batang District coastal waters is compreng boat with 6.25-7 x 2.8 - 3 x 0.8-1 m sizes with a weight of ± 3 GT; Arad Net P_{net} = 12 m, $P_{upper\ ris\ rope}$ = 12 m, $P_{under\ ris\ rope}$ = 15 m, $P_{selambar\ rope}$ = 150 m, P_{total} = 177 m, Otter board 2 pcs = 30 cm, Ballast = 7-8 kg, Buoy = 5-6 pcs, Mesh size wing = 7 cm, Mesh size belly = 3.5 cm, Mesh cod end = 2 cm using an engine of Chang Chay and Dong feng brands with 18-20 GT strength.

Production and Production Value

Shrimp (*Penaeus spp*) in Batang District is one of the high economic resources. Fisheries resources are mainly produced from Roban fish auction, Celong fish auction and Siklayu fish auction. Shrimp fishery production from Roban TPI is the highest than other fish auction.

The average production of shrimp in the first quarter: 17,672.10 kg (January-April) is the highest than other quarters. Shrimp production in 2011 reached 122,666 kg with a production value of Rp. 4,166,583,400.00. Compared with the overall fisheries production in Batang District that reached 778,358.00 kg, this the shrimp fishery contributes about 16.28% of the 778,358.00 kg total production.

Catches Effort

Arad net (beam trawl or otter trawl) is commonly used along the north coast of Java including The Batang District, because this net considered the most effective because it uses a pair of mouth opener (beam) (Indrawasih, R, 2009). Arad net not only catch the shrimp but also caught a variety of fish such as layur, squid, mullet, crab, sripeng, rucah fish. The fishing effort and shrimp production with arad net in Batang District coastal waters between 2002-2011 are presented in Table 3.

Table 1. Shrimp fishery production based on district 2002-2011

TPI	Years									
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Roban	9,455	7,251	10,835	29,032	29,596	16,822	13,752	15,801	108,950	103,583
Celong	2,835	2,417	593	1,436	2,456	2,158	806	378	18,773	11,531
Siklayu	256	-	381	135	815	-	140	-	10,140	7,552
Sum	12,546	9,668	11,809	30,606	32,867	18,980	14,698	16,179	137,863	122,666

Sources: Batang District Department of Marine and Fisheries, 2012 (the data whould be explaines)

Table 2. Production and Shrimp Production Value in Batang Regency 2002-2011

Years	Production (kg)					Production Value (Rpx1.000)
	Quarterly 1	Quarterly 2	Quarterly 3	Quarterly 4	Sum	
2002	9,673	1,206	455	1,212	12,546	404,069,800
2003	5,556	2,298	115	1,699	9,668	220,862,600
2004	6,632	3,250	334	1,593	11,809	217,092,600
2005	8,678	12,309	3,206	6,423	30,606	480,056,500
2006	15,036	12,653	3,709	1,869	32,867	676,204,900
2007	7,522	5,784	3,776	1,898	18,980	466,758,000
2008	7,102	6,552	2,159	2,252	14,698	671,767,800
2009	5,765	5,284	3,635	2,809	16,179	373,975,500
2010	58,322	49,716	34,746	13,696	137,863	5,284,280,000
2011	52,925	35,750	23,472	14,592	122,666	4,166,583,400
Average	**17,672,10**	**13,385.70**	**8,167.80**	**4,939**	**43,177**	**1,296,165,130**

Sources: Batang District Department of Marine and Fisheries, 2012 (the data whould be explaines)

Table 3. Catching trip development and arad net shrimp production in Batang District coastal waters.

Tahun	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
F (trip)	6,253	2,869	5,193	10,597	11,204	12,743	9,032	7,986	31,903	61,235
C (kg)	12,546	9,668	11,809	30,606	32,867	18,980	14,698	16,179	137,863	122,666

Sources: Department of Marine and Fisheries (the data reprocessed)
Description: F = catches trip, C = shrimp production

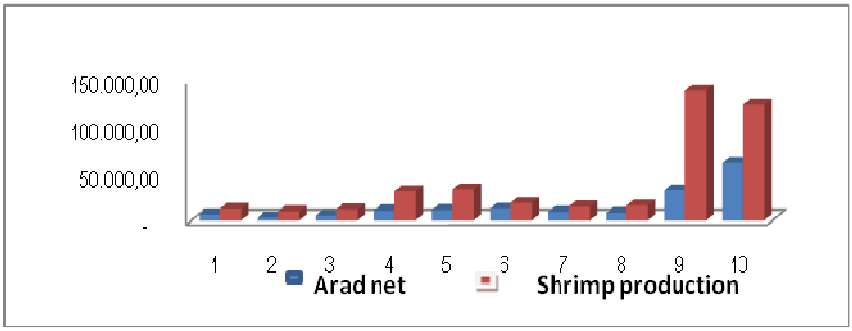

Figure . Arad Net Development and Shrimp Production between 2002-2011

Based on the data and the histogram above shows that an increase in the number of arad nets operated in Batang District coastal waters is also followed by the increase of shrimp production.

Catch Per Unit Effort (CPUE)

Based on the data analysis of the fishing effort and shrimp catch for ten years (2002-2011) obtained the CPUE values for arad net (Table 4).

Table 4. CPUE value of shrimp fishing in Batang District coastal waters between 2002–2011

Years	C (kg)	F (trip)	CPUE (kg/trip)
2002	12,546	6,253	2.01
2003	9,668	2,869	3.33
2004	11,809	5,193	2.27
2005	30,606	10,597	2.89
2006	32,867	11,204	2.93
2007	18,980	12,743	1.49
2008	14,698	9,032	1.63
2009	16,179	7,986	2.03
2010	137,863	31,903	4.31
2011	122,666	61,235	2.00

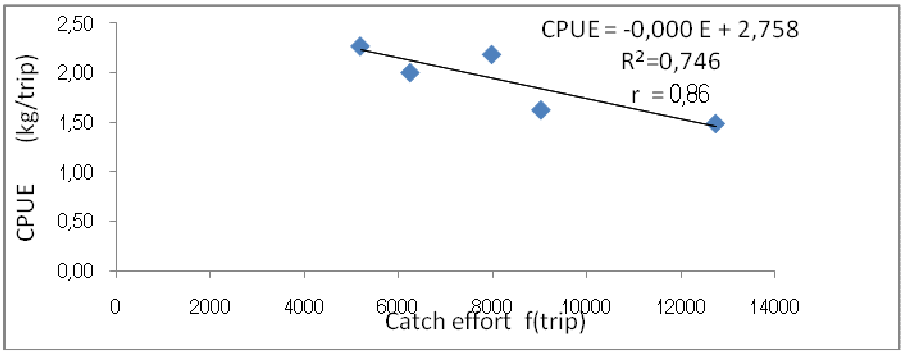

Figure 1. CPUE curve shrimp trawls effort in Batang District coastal waters

Further to see the trend of CPUE values of shrimp trawls effort during 2002-2011 used the approach with regression function (Figure 1).

Based on the curve above shows that 74.6% CPUE is affected by the amount of fishing effort, and each additional one-time trip fishing operations (CPUE) will decline by 2,758 kg/trip.

Maximum Sustainable Yield (MSY) and Optimum Fishing Effort (Fopt)

Based on the analysis of fisheries data between 2002-2011 known that MSY value for shrimp trawling in Batang District coastal waters is 29,031.98 kg. Shrimp production in 2005, 2006, 2010, and 2011 respectively amounted to 30,606 kg, 32,867 kg, 137,863 kg, and 122,666 kg was exceeded MSY value of 1,574.02 kg (5.42%), 3,835.02 kg (13.21%), 108,831 kg (374.87%), and 93,634 kg (322.52%). These analysis results will clearly the shrimp trawl from arad net catches status has been overfishing.

Optimum shrimp fishing effort (F_{opt}) in Batang District coastal waters is 18,262 trip/year. In 2010 and 2011 the amount of fishing effort have exceeded the F_{opt} then actually in these years the arad net gear has higher effectiveness (CPUE greater than $CPUE_{opt}$), so that the catch has exceeded MSY. Under these conditions, the setting is more aimed at limiting catches and not the catch effort.

Shrimp Trawl Season

A shown table 5 showed the data from shrimp production per quarter note that the shrimp fishing season was highest in the first quarter, ie in January-March and has declined in the third quarter (July-September). Furthermore increased again as the fourth quarter in October-December that coincided with the start of the rainy season. During the rainy season (Januari-April) many shrimp come to the surface so easily caught by fishermen. This is in accordance to the Nontji (1987) high rainfall occurred in February until April where in that months are the rainy season or summer monsoon and a shrimp fishing season in Indonesia.

Table 5. The catch of shrimp per quarter and the index arrest in Batang Regency coastal waters

Years	Quarterly			
	I	II	III	IV
2002	9,673	1,661	1,212	455
2003	5,556	2,298	1,699	115
2004	6,632	3,250	1,593	334
2005	12,309	8,678	6,423	3,193
2006	15,036	12,253	3,709	1,869
2007	7,522	5,784	3,776	1,898
2008	6,612	5,552	1,413	1,121
2009	5,765	5,284	3,635	2,809
2010	58,322	49,716	34,746	13,696
2011	52,925	35,750	23,472	14,592

Description: Quarter I: January-March; II: April-June; III: July-September; IV: October November
Catches Unit: kg

Based on explain value in Table 5 shows that shrimp trawling in Batang coastal waters does not have vacant or lean season. The abundance of shrimp resources in Batang District coastal waters along the year thought to be caused by the appropriate coastal waters environmental conditions as the coastal shrimp habitat and the availability of food either in the form of plankton and other microscopic (Naamin, 1987). Accors to Naamin (1987), various types of aquatic biota associated with mangroves, good fish, crustaceans, and mollusks. Generally, there are species that settled living there and spending the entire its life cycle in the mangrove areas. This is consistent with the opinion of Garcia and Le Reste (1985) that the spread of penaeid shrimp in the ecosystem is divided into two areas ie estuary river/estuarine and offshore areas. When tillers shrimp post larvae live as crawling or attached to the objects in the bottom of waters (Martosubroto,

1978). Young shrimp then attempt to go back to the ocean to grow into large, mature and eventually spawning.

The Concept of Total Catchment setting

This catch shrimp is a practical concept that can be used to limit the number of shrimp catch in order not to exceed MSY value, so that overfishing will not. This approach merely considering the rate of mortality due to the catchment and did not account the natural mortality factors or the shrimp population dynamics due to the absence of the studies results support.

This catch setting is adjusted to shrimp resources abundance each quarter according to the index of the catch. Based on the calculations, the distribution of the catch that is recommended for each quarter as shown in Table 6. In one year, the amount that can be captured is 29,032 kg and this value is equal to the value of its MSY value.

For *prudence* in the management of fishery resources some *experts* suggest that the amount of the catch is limited to 80% of MSY. It is based on the premise that if the catch is close to or right at the point of MSY there is a tendency to over the MSY value and result in a failure of management.

Table 6. Shrimp catches are recommended every quarter in Batang District coastal waters (kg)

Quarterly	Index	The recommended number of catches (kg)	
		As MSY	80% from MSY
I	0.50	14.401,13	11.520,91
II	0.29	8.311,65	6.649,32
III	0.13	3.812,46	3.049,97
IV	0.09	2.507,11	2.005,69
Number of catches in a year		29.032,35	23.225,88

The fishing effort (F) has exceeded the optimum value (Fopt), and the catches in 2005-2006 has exceeded the MSY of 1,574.02 kg and 3,835.02 kg (5.42% and 13.21%) and in 2010, 2011 respectively amounted to 137,863 kg. 122,666 kg has exceeded the MSY value of 108,831 kg and 93,634 kg (374.9%, and 322.5%). This shows that the arad net has a high effectiveness in catching shrimp, so it is necessary to restrict the arad net usage and the amount of catches restriction.

According to Dahuri (2003) and the guidelines from the General Directorate of Fisheries which refers to the Code of Conduct for Responsible Fisheries capture level of resource stock should not exceed 80% of MSY value. In addition, the utilization of marine resources activities, principles cautious approach needs to be considered, given the properties of marine resources highly dynamic and susceptible to environmental damage.

Based on the optimum catches analysis obtained the recommended total catch distribution is 80% of the optimum catch, the value was lower than the catch rate. Compared to the catch status in 2011, apparently arad net production has exceeded the allowable catch of 80% of the Copt. Whereas the recommended shrimp catch distribution for dominant arad net fishing gear in one year in Batang District coastal waters are as follows: $C_{average}$ = 57,575.00 kg; C_{opt} = 29,032 kg; 80% C_{opt} = 23,225.60 kg; C_{2011} = 122,666 kg; difference = 93,634 kg (+) should be limited.

CONCLUSION

Based on the result of this study it can be concluded some points :

1. The boat's performance, arad net and engine driving used in shrimp trawling operation in Batang District coastal waters is compreng boat with 6.25-7 x 2.8 - 3 x 0.8-1 m sizes and weight of ± 3 GT; Arad Net P_{net} = 12 m, $P_{upper\ ris\ rope}$ = 12m, $P_{under\ ris\ rope}$ = 15 m, $P_{selambar\ rope}$ = 150 m, P_{total} = 177 m, Otter board 2 pcs = 30 cm, Ballast = 7-8 kg, Buoy = 5-6 pcs, Mesh size wing = 7 cm, Mesh size belly = 3.5 cm, Mesh cod end = 2 cm using an engine of Chang Chay and Dong feng brands with 18-20 Pk strength.
2. The sustainable resources analysis with surplus production model has 29,032 kg, the optimum fishing effort 18,262 trip/year. The highest shrimp fishing season was in the first quarter (January-March) and decreased in the third quarter (July-September).
3. Utilization rates in 2005, 2006, 2010 and 2011 has exceeded the MSY of 1,574 kg (5.42%), 3,835 kg (13.21%), 93,634 kg (374.87%), 108,831 kg (322.52%). As condition has shows that the shrimp trawl fisheries from the arad net catches status had alredy overfishing.

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