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BIOECONOMIC ANALYSIS OF SHARK IN THE WATERS OF INDRAMAYU (CASE STUDY AT KARANGSONG FISH LANDING BASE)

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ABSTRACT

This research was conducted at the Karangsong Fish Landing Base Indramayu, West Java from April 2018 to July 2019. This research aims to analyze the utilization of shark resources in various regimes through Gordon-Schaefer model, actual utilization condition of shark and directives for proper management of shark resources in Indramayu waters. The results of this research showed the MSY regime in catch production (H_{MSY}) was 397,461 tons/year with fishing effort (E_{MSY}) of 39.253 trips/year, MEY regime obtained catch production (H_{MEY}) of 385,661 tons/year with fishing effort (E_{MEY}) of 32.714 trips/year, and the OA regime obtained catch production (H_{OA}) of 220,274 tons/year with fishing effort (E_{OA}) of 65.428 trips/year. The optimum profit was obtained in MEY regime of Rp 4.132.858.000. Actual utilization conditions for management shark resources have experienced overfishing. Management directions of shark resources are by reducing gill nets from 864 units to 216 units, and by adding fishing rods 0-5 GT from 56 units to 85 units, limited entry of shark fishing effort from 989 trips to 7.528 trips. Total Allowable catch for shark utilization is 317,969 tons, with a quota of gill nets of 276,633 tons and fishing rods of 41,336 tons. This management directive applies only to use of shark resources that can still be used (not prohibited), while the use of banned sharks (protected) is given strict sanctions through law enforcement against protected shark fishermen.

Key words : *Bioeconomic, Gordon-Schaefer, Shark, Indramayu*

INTRODUCTION

Indramayu District is one of the potential areas in the production of fisheries and marine products in West Java. The sub-sector of marine fishing is one of the leading sub-sectors in Indramayu District. The total of fishing fleets in Indramayu District reached 6,074 in 2017 with total catches production of 134,713,49 tons (Department of Fisheries and Marine Affairs, Indramayu District 2018).

Sharks are biological resources that exist in Indonesian waters. The activity of shark fishing and trade development of shark continues to increase, causing some species to be susceptible to population decline, especially in Indonesian waters. According to the International Union Conservation of Nature (IUCN), most of the existing species of sharks are listed as red. It shows that almost all types of shark with economic value have been faced with the threat of extinction.

Basically, production of shark catches are *by-catches* that is often encountered by fishermen. Most sharks are caught by the activities of large fishing boats carrying out fishing operations without determining the main catch fish and only chasing fish (schooling) which position is closest to fishing boats. According to Zainudin (2011), the activities of shark fishing in Indonesian waters mostly produced (by-catches) about 72% while the main target was only 28%.

District of Indramayu is one of the areas in West Java that landed shark catches with a large amount of production (Syahri, 2017). According to Department of Fisheries and Marine Affairs in Indramayu District (2018), total catches production of shark in 2017 was 2,869.40 tons, while in 2016 the total production of shark catch was 2,962 tons. This indicates that the production of shark catches has decreased.

Based on this, a good management is needed in utilizing shark resources, so that the threat of extinction of shark resources can be avoided. One way to manage the fisheries in order to remain sustainable and to get benefits optimally is by paying attention to the correlation between effort to fishing resources which are seen in aspects of biology and economic aspects. Bioeconomic model of Gordon-Schaefer is one way of analyzing fisheries to measure the level of utilization of fisheries resources, so that optimal and sustainable utilization can be known.

The goals of this research are to analyze the effort and actual sustainability and optimal production of various regimes, the conditions of actual use of shark resources, and directions of shark fishing management in Indramayu waters.

RESEARCH METHODS

This research was conducted from April 2018 to July 2019 at the Karangsong Fish Landing Base, Indramayu District, West Java. The research method is survey method through observation and interview activities. Primary data were obtained directly from the sampling of fishermen with a fleet size of from 0 to 5 *Gross Tonnage* (GT) catches including the total of average production of shark catches, fishing operational costs, recent activities of shark fishing in Indramayu waters and shark prices obtained from the Karangsong Fish Landing Base management.

Secondary data needed is obtained from the Department of Fisheries and Marine Affairs in Indramayu District including the catch of shark (*all species*) in Indramayu Waters in 2006 - 2017, and Department of Marine Affairs and Fisheries West Java covers fishing effort

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per fishing gear in Indramayu Waters in 2006 - 2017. Sampling has been done by Accidental Sampling methods. Sampling of fishermen with a fleet size of from 0 to 5 *Gross Tonnage* (GT) as many as 60 people.

Standardization of Fishing Gear

The standardization calculations of fishing gear (Spare and Venema, 1999), is showed below :

$$\textbf{FPIs} = \frac{\textbf{CPUEi}}{\textbf{CPUEs}} = 1$$

$$\textbf{Standart effort} = \textbf{FPI x fi}$$

Information :

i = Fishing gear
s = Standardization of fishing gear
c = Catch
f = Effort
FPI = Fishing Power Index

Sustainable Production Function

The maximum sustainable production function (MSY) using the Schaefer's model (Schaefer 1957 in Fauzi 2004) is showed below:

$$\frac{h}{E} = \alpha - 2\beta$$

$$\text{Emsy} = \frac{\alpha}{2\beta}$$

Information :

h = Catch
E = Effort
α = intercept
β = slope

Bioeconomic Analysis of Gordon-Schaefer

Bioeconomic analysis of Gordon-Schaefer model (Fauzi 2004), as in following Table 1:

Table 1. Bioeconomic Analysis of Gordon-Schaefer Model

Number	Variabel	Regime		
		Maximum Economic Yield	**Maximum Sustainable Yield**	***Open Access***
1.	*Effort* (E)	$\frac{\alpha p - c}{2\beta p}$	$\frac{\alpha}{2\beta}$	$\frac{\alpha p - c}{\beta p}$
2.	*Catch* (h)	Emey $\left(\frac{\alpha p + c}{2p}\right)$	h = α Emsy – β Emsy²	Eoa $\left(\frac{c}{p}\right)$
3.	Rente Ekonomi (π)	*p*. hmey - *c*. Emey	*p*. hmsy - *c*. Emsy	*p*. hoa - *c*. Eoa

Information :

π = Economic Rent
α = value of *intercept*
β = value of *slope*
c = Fishing cost
p = Price
h = Catch
E = Effort

Management Direction

Management directives are analyzed descriptively based on the results of Gordon-Schaefer bioeconomic analysis. The direction of management is directed at input, output and technical arrangements in utilizing shark resources.

The application of instruments with restrictions on inputs, outputs and technical implementation of shark fishing activities is only applied to the activities to the use of shark species which are still allowed (not prohibited), while the utilization of protected shark resources is not recommended in the application of existing instruments, but rather to give strict sanctions through law enforcement against protected shark fishermen.

RESULTS AND DISCUSSION

Input of Shark Resources

The resources of shark in Indramayu waters are managed by fishermen of gill nets (rampus) and rods (mini longline) with a fleet size from 0 to 5 *Gross Tonnage* (GT) for each fishing gear. The highest fishing effort occurred in 2011 with a total effort of 44.585 trips. The lowest fishing effort occurred in 2013 was only 29.154 trips, as in the following Figure 1.

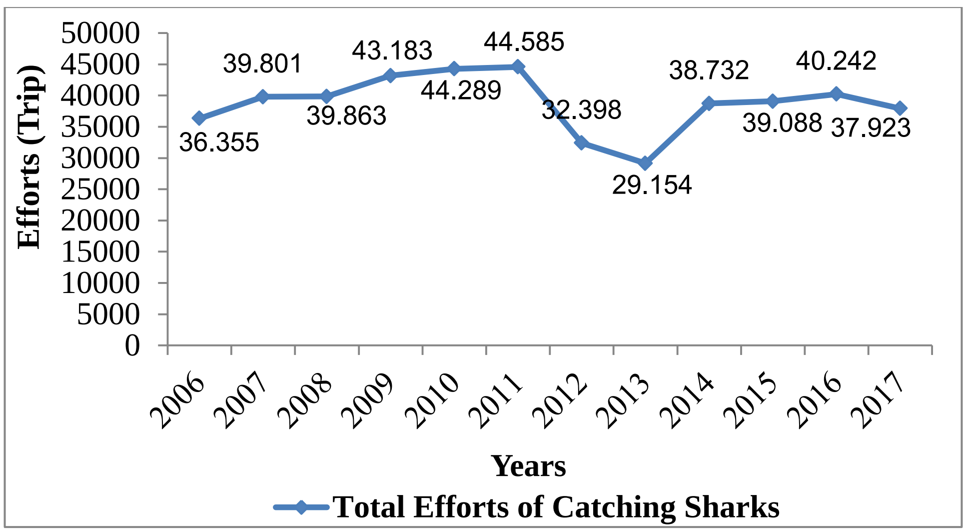

Figure 1. Total Effort of Shark Fishing in Indramayu District

The lowest of total effort to fishing shark in 2013 was influenced by the reduced total of gill nets, so that fishing operations using gill nets 0 - 5 *Gross Tonnage* (GT) also declined. According to Department of Fisheries and Marine Affairs in Indramayu District (2018), the decrease of fishing effort using gill nets is thought to be caused by conflicts between traditional fishermen in Cantigi and Kandanghaur, sub-districts in Indramayu District carried out by garoks fishermen and gill nets about the seizure of catch area and protest against the use of arad and scratching nets that damage the environment. Based on the results of interviews with fishermen, when operating arad and garok, nets are stuck with gill nets, so many gill nets are damaged and cannot be used in operation.

Effort of shark fishing in Indramayu waters from 2006 to 2011 has

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increased. This is influenced by the increasing total of gill nets. According to Hamdan (2007), gill nets are one of the targets in increasing total of fleets in Indramayu waters based on policies established by the Department of Fisheries and Marine Affairs, Indramayu District. The increasing total of gill nets is also based on a combine fishing recommendation that utilizes gill nets. Combine fishing is the form of two operating difference from fishing gear that is adjusted for the fishing season. Another factor of the increase in total standard effort of shark fishing is influenced by improving port services, as well as improving the skills of fishermen in conducting fishing activities. The total effort to catch shark in 2017 has decreased again. This is allegedly due to the difficulty of finding crew members for fishing activities. Based on the results of observations, in the past few years fishermen had difficulty in finding crew members to carry out fishing activities. That is because the crew prefers to work on the size of fishing fleet that is larger than the 5 GT fleet in order to get more wages.

Actual Utilization of Shark Resources

Production of shark catches in Indramayu waters has fluctuated from 2006 to 2017. The increasing in shark catch productions occurred from 2006 to 2012, and also from 2014 to 2016, until it reached the highest production in 2016 of 444.26 tons. The increasing catch of production is thought to be due to an increase in the total of fishing gear and fishing effort, as in the following Figure 2.

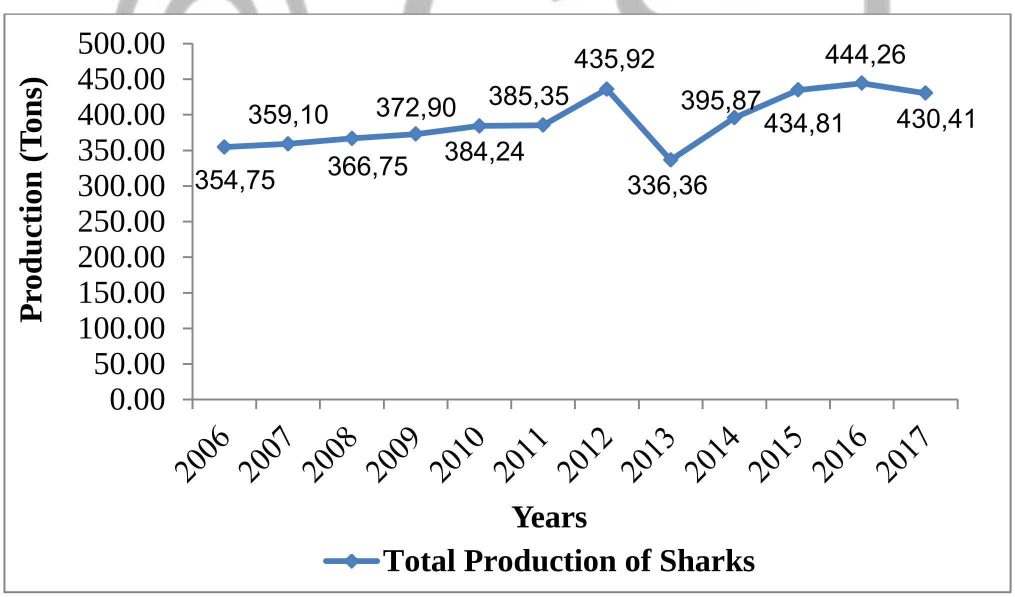

Figure 2. Total Production of Shark in Indramayu District

In 2012, the production of shark was high, but not accompanied by an increase in fishing effort and the total of gill nets. This happened because the productivity of shark in the waters of Indramayu was greater than the previous year. According to Department of Fisheries and Marine Affairs, Indramayu District (2018), the production of shark catches (*by-catch*) in 2012 is greater than the previous year's production of catches. This seen by the decreasing of fishing effort but the production of shark catches increase and at the landing time of fish catches at the Karangsong Fish Landing Base, the catch of shark obtained is quite large. Based on interviews with fishermen, many fishermen of gill nets using GPS and compass assistance in the activities of fishing to determine fishing grounds so that fishermen's catch increases.

The lowest production of shark catches occurred in 2013, amounting to 336,36 tons and in 2017 the production of shark catches fell again by 430,41 tons. This is allegedly due to a decrease in fishing effort so that the production of catch obtained is still low. According to Sriati (2011), catch fluctuations are influenced by several factors, namely, the availability of fish resources, the total of fishing effort, and the success rate of fishing operations. Another factor caused by fluctuation in catches was due to environmental, economic and fishermen factors (Sulistiyawati 2011).

Catch Per Unit Effort (CPUE)

CPUE is the value of catch production and fishing effort carried out at a certain time. The value obtained from the catch per fishing effort or catch per unit effort shows the productivity value of fishing effort. The value of catch per unit effort also shows how effective a fishing device is in fishing a particular type of fish (Hindayani 2011).

Based on observations, gill nets are the most dominant fishing tool for shark compared to fishing in Indramayu waters, therefore gill nets are used as standardization of fishing gear. Determination of standardization of fishing gear, gill nets has FPI value = 1, while fishing rods has value of FPI = 0,6267 as in the following Table 2.

Table 2. Fishing Power Indeks Values for Each Fishing Gear

Number	Fishing Gear	Average of CPUE	Values of Fishing Power Indeks
1	Gill Nets	0,01022	1
2	Rods	0,00641	0,6267

Catch per unit effort (CPUE) values from 2006 to 2017 trend to fluctuate up and down. The average of catch per unit effort (CPUE) value of shark is 0,01022 tons per trip. The highest catch per unit effort value of standardization results in 2012 amounted to 0,01346 tons per trip. This affected by the catch obtained is high but the catch effort is low, it can be concluded that in the productivity of fishermen has increased.

The lowest of catch per unit effort value from standardization results in 2011 amounted to 0,00864 tons per trip. This affected by in that year, the catch was low but the fishing effort was high, it could be concluded in that year the productivity of fishermen had decreased. According to Hindayani (2011), the amount of CPUE value is influenced by total of catches and effort to catch, as in the following Figure 3.

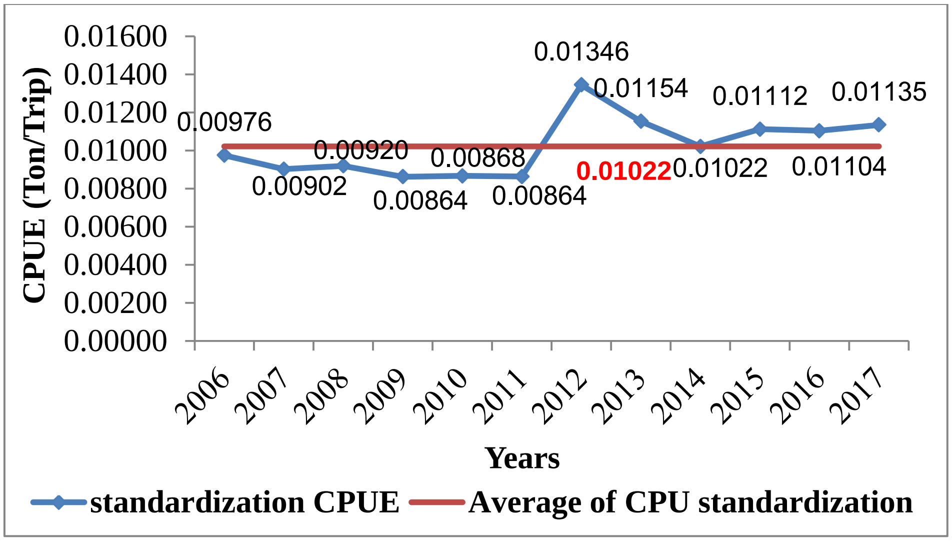

Figure 3. CPUE Values of Shark Fishing

The effect of fishing effort value in standard catch per unit effort (CPUE) value is obtained by regressing the standard CPUE value against standardized catching attempts. Based on the results of linear regression analysis, obtained the value of intercept (α) = 0,0202 and the slope value (β) = 0,00000025744 E, as in the following Figure 4.

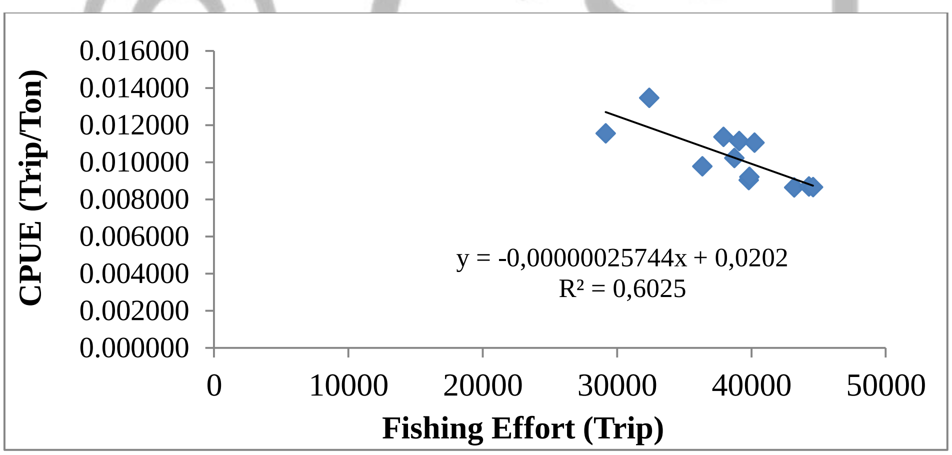

Figure 4. Correlation of CPUE with Shark Fishing Effort

The line equation obtained from the correlation is Y = 0,0202 – 0,00000025744 E. This equation explains that each additional effort is one unit effort (trip), there will be a reduction in CPUE of 0,00000025744 tons per trip. This shows that a higher the total of fishing attempts carried out, it will lower the total of catch production per standard effort (standard CPUE). The coefficient of determination or the value of R square (R^2) is equal to 0,6025 or 60,25%. This shows that the effect of fishing effort on increasing catch per unit effort (CPUE) value is 60,25% and the remaining 39,75% is influenced by other factors not explained in this model.

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Sustainable Production Function

Based on calculations from the results of linear regression analysis, the regression coefficient α = 0,0202 and β = -0,00000025744, so that systematically the function equation of sustainable production of shark resources in Indramayu waters is $h = 0{,}0202\,E - (-0{,}00000025744\,E^2)$. The correlation of fishing effort with shark catches in Indramayu waters shows a quadratic or parabolic curve, as in the following Figure 5.

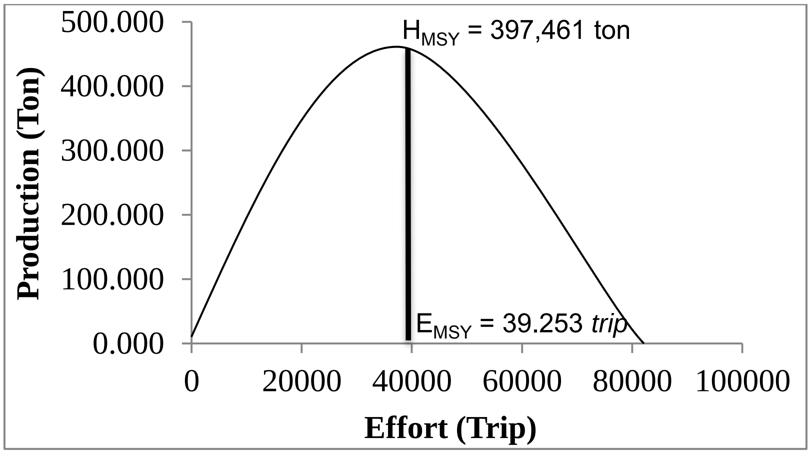

Figure 5. Correlation of Yield with effort

Based on Figure 5, shows the value of maximum sustainable yield (H_{MSY}) of 397,461 tons which can be achieved with the effort of maximum fishing (E_{MSY}) effort of 39.253 trips in one year. This explain that the H_{MSY} value shows that maximum sustainable effort level is in the highest catch without threatening the existence of shark in the sea waters, but if it exceeds this limit, the presence of sharks will be threatened or the degradation of shark stocks in the sea. Ratio of catches and levels of fishing effort in sustainable and actual condition can be described as a curve that shows the correlation between catches and fishing effort, as in the following Figure 6.

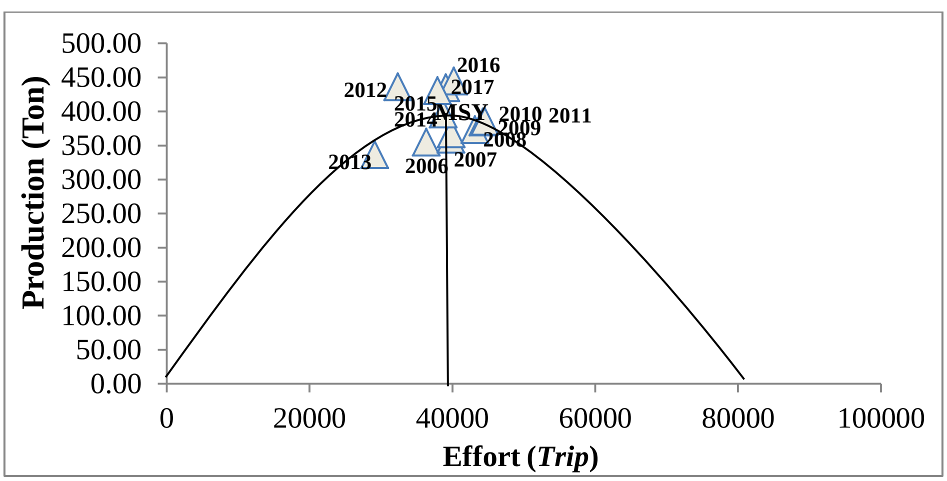

Figure 6. Ratio of Production and Effort with MSY Regime in 2006-2017

Based on Figure 6, indicates that fishing effort in 2012, 2015, 2016 and 2017 are at a level that exceeds the maximum production limit (biological overfishing). In 2007, 2008, 2009, 2010, 2011, and 2016 the limit for economical overfishing was exceeded. Biological overfishing has the potential to cause degradation of natural resources. Degradation of natural resources can occur and can be aggravated by the presence of various symptoms in environmental damage, such as pollution, overfishing, habitat damage, space use conflicts, etc. (Fauzi and Anna 2005).

According to Anna (2016), economic overfishing is caused by the occurrence of excessive inputs that exceed sustainable and optimal inputs. Fishing effort that have exceeded at maximum sustainable conditions can indicate that economic overfishing has taken place. Increased effort to arrest and increase the cost of shark input. Increasing input costs that occur continuously will result in a turning point of fishing business activities that will only give an economic rent value of 0 (*zero*) or it can be said that economic benefits have been lost from these resources.

Bioeconomyc Analysis of Various Management Regimes

Bioeconomic analysis of shark resources utilization is carried out under conditions Maximum Economy Yield (MEY), Maximum Sustainable Yield (MSY), and Open Access (OA). Bioeconomic analysis is carried out to determine the value of fishing effort, production, and economic rent from various management regimes.

Based on the results of research conducted, price of shark is 15.000 Rupiahs/kg and cost of fishing effort for 50.500 Rupiahs/trip, then included in Gordon-Schaefer bioeconomic calculation using the equation $\alpha = 0,0202$ and $\beta = -0,00000025744$ obtained from the CPUE regression test with fishing effort, so that the value obtained from each regime, as in the following Table 3.

Table 3. Results of Various Regimes in Bioeconomic Analysis

Number	Variabel	Regime		
		Maximum Economic Yield	Maximum Sustainable Yield	Open Access
1	*Effort* (E)	32.714	39.253	65.428
2	*Catch* (h)	385,661	397,461	220,274
3	*Rente Ekonomi*	4.132.858.000	3.979.638.500	0

a) Maximum Economic Yield (MEY)

The level of effort obtained in maximum economic yield (MEY) regime was 32.714 trips with catch production of 385,661 tons. The profits obtained amounted to Rp 4.132.858.000. This results indicate that the maximum level of production is economically and is the maximum level of effort socially, in order to achieve optimum sustainable profits, fewer effort are needed compared to the regimes of maximum sustainable yield (MSY) and open access (OA).

b) Maximum Sustainable Yield (MSY)

The level of effort obtained is 39.253 trips. The maximum catch obtained in maximum sustainable yield (MSY) regime is 397,461 tons. Based on the results obtained, the value of fishing effort and the catch is the maximum production level in the use of shark resources that can be done without threatening the sustainability of shark resources. Profits obtained amounted to 3.979.638.500.

c) Open Access (OA)

The level of effort in this regime amounted to 65.428 trips with catch production of 220,274 tons with profit = 0 (no profit). The regime of open access there is economic mismatch, because the fishing effort is quite large but the production of catch obtained is smaller, so it does not get a profit ($\pi = 0$). According to Fauzi (2004), the balance in open access can be seen with many inputs with a little biomass (too many boat chasing too few fish).

The Types of Sharks Caught in Indramayu Waters

Based on the results of research, there were four types of sharks captured in Indramayu waters using a fishing fleet of 0-5 GT with fishing gear of gill nets (rampus) and rods (mini longline). The following types of sharks are caught in Indramayu waters :

a) *Carcharhinus sorrah*

The local names of this shark type are lanjaman / lajam (Java), mungsing (Bali), peacock feather (Lombok), Spot-tail Shark in mention of English. This type of shark is the most captured in Indramayu waters. This type of shark is a catch from the ship unit that has capacity of 0-5 GT operating in Indramayu waters by using a gill nets, *Carcharhinus sorrah* can be seen in Figure 7.

Figure 7. *Carcharhinus sorrah*

Characteristics of this shark type : the second dorsal fin, pectoral fin and caudal bottom fin are black. There is a line between the fins, long and slightly pointed muzzle. The spread of this shark can be found in almost all Indonesian waters from tidal areas to a depth of 140 m (Campagno 1984). The conservation status of Shark *Carcharhinus sorrah* in IUCN is almost threatened (Fandi and Dharmadi 2013).

b) *Sphyrna lewini*

The local names of this shark type are caping (Java), capil (Bali), bingkoh (Lombok), and Scalloped Hammerhead, mention in English. This type of shark is the most captured in Indramayu waters. This type of shark is a catch from the ship unit that has capacity of 0-5 GT operating in Indramayu waters by using a gill nets, *Sphyrna lewini* can be seen in Figure 8.

Figure 8. *Sphyrna lewini*

Characteristics of this shark type are having a head that is quite large and wide which is shaped like a hammer. The back is gray, while in the lower abdomen is white. The spread of this shark type is found in tropical waters and subtropics with warm temperatures, living from the sea surface to a depth of 275 m (Campagno 1984). Conservation status in the IUCN red list, this type of shark is declared endangered and includes sharks protected under the Republic of Indonesia Minister of Maritime Affairs and Fisheries Regulation Number 34 / PERMEN-KP / 2015 (Fandi and Dharmadi 2013).

c) *Chiloscyllium punctatum*

The local names of this shark type are gedok (Lombok), cucut dolok (Java), and *Brownbanded Bambooshark*, mention in English. This type of shark is the most captured in Indramayu waters. This type of shark is a catch from the ship unit that has capacity of 0-5 GT operating in Indramayu waters by using a gill nets and rods (mini longline), *Chiloscyllium punctatum* can be seen in Figure 9.

Figure 9. *Chiloscyllium punctatum*

The characteristics of this shark type are the body and tail shape slender and long. The body color is plain with faint brown lines. Both dorsal fins are large and separate from each other. The spread of these sharks is at the bottom of the waters with coral reefs and seagrass beds, from tidal areas to a depth of 85 m (Campagno 1984). The conservation status of this shark type in IUCN is almost threatened (Fandi and Dharmadi 2013).

d) *Chiloscyllium plagiosum*

The local names of this shark type are bongo, cucut dolok (Java), and White-spotted, mention in English. This type of shark is the most captured in Indramayu waters. This type of shark is a catch from the ship unit that has capacity of 0-5 GT operating in Indramayu waters by using a gill nets and rods (mini longline), *Chiloscyllium plagiosum* can be seen in Figure 10.

Figure 10. *Chiloscyllium plagiosum*

The characteristics of this shark are that the body is filled with dark spots and brownish white, there are thin and thick lines that are dark and the back is light colored. The spread of these sharks is at the bottom of the waters with coral reefs and seagrass beds, from tidal areas to a depth of 85 m (Campagno 1984). The conservation status of this shark type in IUCN is almost threatened (Fandi and Dharmadi 2013).

Directions For Management Resources of Shark

Based on results of research was conducted, the management of shark fishing activities in Indramayu waters indicate that the state of shark resource utilization is already in overfishing conditions, so direction for shark resources management is needed in Indramayu Waters. Management directives are carried out based on the instrument utilization of fish resources. This policy is carried out to achieve a goal of sustainable fisheries development.

The application of instruments with restrictions on inputs, outputs and technical implementation of shark fishing activities is only applied to the activities to the use of shark species which are still allowed (not prohibited), while the utilization of protected shark resources is not recommended in the application of existing instruments, but rather to give strict sanctions through law enforcement against protected shark fishermen. The following are some instruments that can be applied, namely :

Input Limititaion of Shark Fisheries

a) Application of Limited Entry

The calculation of limited entry that use to be seen from fishing effort in the maximum sustainable regime (MSY) and the result of optimization in sustainable economic condition (MEY). Based on the results of bioeconomic analysis, the fishing effort (E_{MSY}) amounted to 39.253 trips and fishing effort (E_{MEY}) of 32.714 trips. The calculation of application in limited entry using the 2016 effort data. This is because in 2017, the total of shark fishing effort was lower than the maximum sustainable effort value (E_{MSY}):

***Limited Entry* (MSY) = 40.242 – 39.253 = 989 *trip*.**

***Limited Entry* (MEY) = 40.242 – 32.714 = 7.528 *trip*.**

It is necessary to reduce fishing effort from 989 trips to 7.528 trips based from fishing effort in 2016 so that the activity of utilizing shark resources in Indramayu waters can be biologically sustainable and economically profitable.

b) Arrangement of Total Fleets

Fishing effort can be reduced by a regulating system at the total of fishing fleets. Total of fleets in each fishing gear that should operate can use a simple mathematical approach and logic by knowing the fishing effort from each fishing gear for the regime of MSY or MEY, then the total of catches is estimated using a simple mathematical comparison.

The base year used is 2016. Based on the above calculation results, economically optimal utilization (MEY) can be done by reducing the gill nets unit that was originally 864 units to 216, and adding fishing gear which was originally 56 to 85 units. The arrangement of the total fishing gear taken to obtain effort in maximum potential sustainable point (MSY) is the gill nets, which was originally 864 units to 259 units, and by adding fishing rods, which were originally 56 units to 103 units.

Limitation Output of Shark Fisheries

a) Total Allowable Catch (JTB)

The JTB value used by Indonesia is 80% from HMSY. JTB weight of shark resources in Indramayu waters as follows:

JTB Resources of Shark = 397,461 ton x 80% = 317,969 ton.

b) Quota

The application of quota is based on total allowable catches of 317,969 tons per year, then divided based on total of fleets utilizing shark resources. The application of quota should have been adjusted to the proportion of the production contribution in each fishing gear. The proportion of the contribution can be seen using a ratio based on the proportion of shark catches in 2016 as in the following Table 4.

Table 4. Quota Calculation Based at Fleet of Each Fishing Gear

Number	Fishing Gear	Production (Tons)	Ratio	JTB (Tons)	Quota (Tons)
1	Gill Nets	385,02	0,87	317,969	276,633
2	Rods	59,23	0,13		41,336
Total		444,26	1,00	317,969	317,969

Based on Table 4, the fleet of gill nets 0-5 GT has a quota of 276,633 tons per year with a fleet of 864 units, so the quota of each fleet is 0.32018 tons per year, while the quota of fishing rods 0-5 GT is 41,336 tons per year with a fleet of 56 units, then the quota of each fleet is 0.73814 tons per year.

CONCLUSION

The results of this research shows, in MSY regime the catch production (H_{MSY}) was 397,461 tons/year with fishing effort (E_{MSY}) of 39.253 trips/year, MEY regime obtained catch production (H_{MEY}) of 385,661 tons/year with fishing effort (E_{MEY}) of 32.714 trips/year, and the OA regime obtained catch production (H_{OA}) of 220,274 tons/year with fishing effort (E_{OA}) of 65.428 trips/year. The optimum profit was obtained in MEY regime of Rp 4.132.858.000. The conditions for utilizing shark resources have experienced overfishing. Directions of shark fishing management are by reducing gill nets from 864 units to 216 units, and by add fishing rods 0-5 GT from 56 units to 85 units, limited entry of shark fishing effort from 989 trips to 7.528 trips. Total Allowable catch for shark utilization of 317,969 tons, with a quota of gill nets of 276,633 tons and fishing rods of 41,336 tons. This management directive applies only to use of shark resources that can still be used (not prohibited), while the use of banned sharks (protected) is given strict sanctions through law enforcement against protected shark fishermen.

There needs to be better supervision of shark fishing activities in Indramayu waters which are carried out using the authority of the Indramayu District Government and the Indramayu District in Fisheries and Marine Affairs of Department, considering that shark resources have an important role in the marine ecosystem cycle and there are several protected shark species from the threat of extinction.

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