The International Journal Of Engineering And Science (IJES)
|| Volume || 3 || Issue || 9 || Pages || 38-43 || 2014 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Stock Assessment of Fishery Resources Using Surplus Production Model on Surabaya East of Java

[1,]Hari Subagio , [2,]Supriyatno Widagdo
[1,] *Departement of Fisheries Studies, Hang Tuah University*
[2,]*Departement of Oceanographi, Hang Tuah*

----------**ABSTRACT**----------
The development of fisheries on Surabaya indicated by the growing number of vessels and fishing gear units operated by fishermen. However, the increase in the number of fishing gear is a contradiction with the amount of fish catches landed. This study aims to determine the potential maximum sustainable yield (MSY) of fishery resources, the level of exploitation of fishery resources as well as the conditions that exist on fishing activities in the city of Surabaya. This study used a survey method. The survey was conducted to collect primary and secondary data which includes the type and number of vessels, the type and amount of fishing gear, as well as the number of catches. The potential maximum sustainable yield can be predicted by using the surplus production with Fox models (Sparre and Venema, 1999). The results of the study, the optimum catch effort (Fmsy) is 2,000 units of standard fishing gear. Estimated potential maximum sustainable yield is equal to 11,032.026 tons/year. Fishing activities conducted fishermen, in the last six years using a number of existing gear is as much as 123.2 to 159.95%, and at the same time their catch has exceeded the maximum sustainable yield with the trend indicated that the cumulative catches decreased.

KEYWORDS: *stock assessment, surplus production model, Fox Models, Surabaya.*

Date of Submission: 19 September 2014 Date of Publication: 30 September 2014

I. INTRODUCTION

Fishing activities in Surabaya has been going on since a long time and used the majority of the fleet size under 5 GT, as well as using simple fishing gear. To get around the limitations of the range of catchment area and fishing season, fishermen generally have more than one type of fishing gear (Dinas Pertanian Surabaya, 2013). The development of Surabaya fisheries indicated by the growing number of vessels and fishing gear units operated by fishermen. However, the increase in the number of fishing gear is a contradiction with the amount of fish catches landed. In the last decade the catch of fishermen showed a downward trend (Sulestiani and Subagio, 2011). Allegedly the decline is due to the increasing number of boats and fishing gear in the fishing activities. Fish is a resource that can be recovered, but if the rate of exploitation has exceeded the limit then it will be able to lower the existing fish stocks. So that the catches of fishermen has declined. Sustainability of fishing activities very demanding assurance of the availability of the stock of the target fish catch. Fish are creatures that are mobile and highly diverse species. Therefore, efforts should be made to determine the amount of existing stocks of fishery resources, which can be used as a basis for future management efforts.This study aims to determine the potential maximum sustainable yield (MSY) of fishery resources, the level of exploitation of fishery resources as well as the conditions that exist on fishing activities in the city of Surabaya. In this study analyzed the amount of preparation of fishery resources, the level of utilization, as well as how future management strategies. For stock assessment purposes, researchers using surplus production models. Surplus production model is one of a method that can be used in fish stock assessment, that is by using the data of the catch. This method can illustrate the condition of fish stocks and catches can predict the future based on the data of the Catch per Unit of Fishing Effort (CPUE). Sparre and Venema (1999) suggested that the purpose of assessment of fish stocks is to provide advice on the optimum utilization of marine living resources such as fish, shrimp and others. Assessment of fish stocks can be defined as the search for the utilization rate in the long term provide maximum sustainable yield of fisheries in terms of weight.

II. MATERIALS AND METHODS

The method used in this study is a survey method, with the object of fishermen and the Department of Agriculture Office of Surabaya, in charge of fisheries. The survey was conducted to collect primary and secondary data which includes the type and number of vessels, the type and amount of fishing gear, as well as the number of catches.

The data used as the basis for the analysis of production data and fishery potential of data obtained from the related department, processed in accordance with the latest trends of the data field that can represent the spatial and temporal distribution of the catch. Garcia, et al (1989) states that to suspect 'potential yield' on the stock of already exploited can use the Fox Model. Furthermore, the data were processed using the Surplus Production Method with Fox Models (Sparre and Venema, 1999), which is destined to know maximum sustainable yield, the optimum amount of effort (fopt), and the level of resource utilization in the waters of Surabaya. Data processing includes: determining gear rerlatif, determination of the optimum catch of effort, determination of the potential for sustainable resource. Determination rerlatif fishing gear intended to uniform units of different efforts so it is assumed that efforts to arrest a certain type of fishing gear on par with standard fishing gear catches comparison with the amount that is certain. The determination of standard fishing gear is based on the fishing gear such dominance in a particular area. Gear set as the standard fishing gear as determinants of perception or fishing power index (FPI) = 1. The FPI values of other types of fishing gear are calculated by dividing the value of catch per unit effort (CPUE another gear) with standard gear CPUE . FPI value is then used to find the standard tools of the fishing effort, as follows,

$$CPUEi = \frac{Ci}{fi}$$

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

$$FPIi = \frac{CPUEi}{CPUEs}$$

Standard Effort = FPIs * fs

Where:
CPUEs: the catch per fishing effort of standards fishing gear
CPUEi: the catch per fishing effort of fishing gears i
Ci: the amount of catches gear type i
fi: the amount of effort of fishing gear type i
fs: the amount of effort of standard gear types
FPIS is the capture power factor of standard fishing gear
FPIi is the capture power factor of the fishing gear type i

Given in Surabaya waters fishermen using various types of fishing gear are very diverse and fishing under the same conditions, then to know the size of the overall effort is to use the direct method of standardizing, in accordance with the principle of equality as above which works based 'relative fishing power' (Sparre and Venema, 1999). To determine the value of the overall effort (total effort) are:

Total Effort = 1,0*NA + PA(B)*NB + PA(C)*NC + PA(n)*Nn

Where:
PA (n): the relative fishing power of gear n
Nn: number of vessels with fishing gear n

Determination of the optimum catch effort, by the use of equation

Fmsy = -1/d

Determination of the potential Maximum Sustainable Yield, using the equation

MSY = - (1/d) * exp(c-1)

Where:

$$c = \ln(B) + \frac{Y}{(B * Fmsy)}$$

$$d = -\frac{1}{Fmsy}$$

Y: catch
B: biomass

III. RESULTS AND DISCUSSION

From the results of the survey in get that fishing activities are conducted year-round fishing, is to use the sixteen kinds of fishing gear, this refers to the Ministerial Regulation of Maritime and Fisheries Affairs No. 2 (*Peraturan Menteri Kelautan dan Perikanan Nomor 2*) 2011. For stock assessment purposes, the 16 types of fishing gear there are grouped into 6 groups gear among others: dredge, falling gear, gillnets and entangling nets, traps, hooks and lines), and other types of fishing gear The sixth group of existing fishing gear, in the arrest operation, essentially capturing more than one type of fisheries resources. The fisheries resources of the catch, as a whole is as much as 60 species. The number and amount of fishing gear catches of fishermen in the period 2007-2013 are as in Table 1.Among the six groups of existing fishing gear, fishing gear ownership dominance by fishermen gill nets. In accordance with the Sparre and Venema (1999), that standard gear in this case is a gill net fishing gear (gillnets and entangling nets). Besides, this gear is high productivity and has a high diversity of catches. Relative CPUE and standards CPUE value for each type of fishing gear can be seen in Table 2.

Table 1. Amount of Fishing Gear and the Catch Volume (ton).

Th.	Fishing Gear (Unit)	The Catch Volume (ton)
2007	2.093	10.428,19
2008	3.442	10.834,60
2009	4.310	11.367,23
2010	4.345	11.603,75
2011	4.464	8.702,85
2012	4.500	8.594,40
2013	4.500	9.095,68

Table 2 Catch Per Unit Effort Relative And Fishing Gear Standards.

No.	Fishing Gear	Relative CPUE	Standard CPUE
1	Dredge	1.778,6291	0,4190
2	Falling Gear	0,5966	0,0001
3	Gillnets and Entangling nets	4.245,3369	1,0000
4	Traps	1.683,1700	0,3965
5	Hooks and Lines	135,1934	0,0318
6	Others	2.166,0700	0,5102

Furthermore, to determine the level of effort and determination of the optimum fisheries sustainable resource was calculated intercept (a) and slope (b) by using the Fox Model as in Table 3.

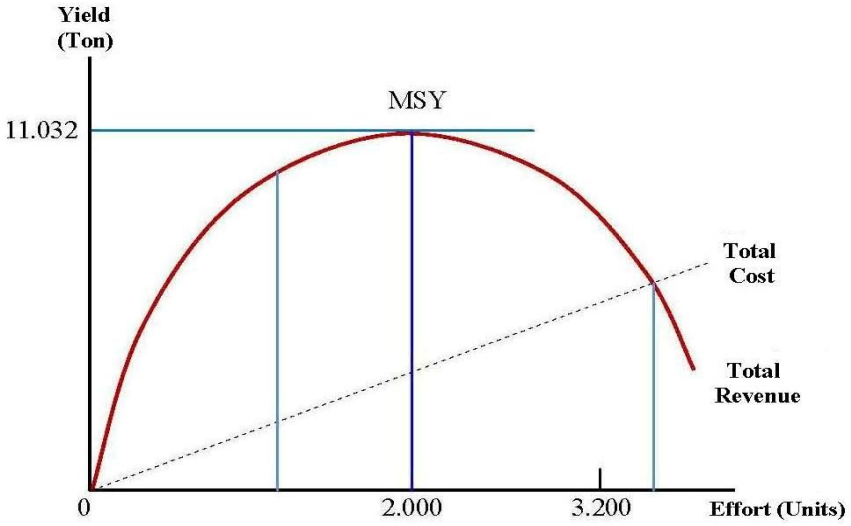
Table 3. Intercept Calculation (a) and Slope (b) Using the Fox Model

Year (i)	The Catch Volume (1.000 ton) Y(i)	Standard Fishing Effort f(i) - (x)	Fox Model ln (Y(i)/f(i)) - (y)
2007	10,4056	1.498	-4,9695
2008	10,8145	2.464	-5,4287
2009	11,3551	3.085	-5,6046
2010	11,6038	3.099	-5,5875
2011	8,7029	3.174	-5,8991
2012	8,5944	3.199	-5,9195
2013	9,0957	3.199	-5,8628
Mean Value		2.816,86	-5,6102

From the calculation obtained the value a = - 4.200100 and the value b = - 0.000500. The amount of effort catches the optimum (Fmsy) is 2,000 units of standard gear. Estimation of the potential of fisheries

resources sustainably or maximum sustainable yield (MSY) by using the method of Fox is at 11,032.026 tons/year. This means that the number of fishing gear that in the waters of Surabaya should be no more than 2,000 units is comparable with standard fishing gears.

Based on the calculation above, the amount of fishing effort and the maximum potential of sustainable fishing activities Surabaya can be clarified as in Figure 1.



Picture 1. Utilization Level of Fisheries Resources on Surabaya

As presented in Table 3, that the amount of fishing gear during the period 2007 to 2013 has increased in terms of number of units. But not so with the catch of fish landed, at the same time, the trend has increased in the year 2007 - 2010, and the following year results decreased, although the number of fishing gear operated has increased. This is a phenomenon called with overfishing. As outlined in Subagio (2007), in capture fisheries, the catch will increase with the increasing number of ships (gear units) which operated until the point (total catch) specific. As in Figure 1 is shown by the x-axis, the effort level of 2,000 units. If the amount of fishing gear continues to increase, totaling more than 2,000 units, hence the catch of fishermen rather than increasing even more decreased. Indicated by the total revenue line is decreased, meaning that the cumulative catch fishermen also declined, having already surpassed the point of B_{MSY}, the biomass of the fish groups were regarded as the catch at the level of maximum sustainable yield, MSY point .

Table 4. The Amount of Fishing Effort and Rate of Resources Utilization in the Context of Maximum Sustainable

Year	Effort (f)	% Effort (Fmsy)	Yield (1.000 ton)	% Utilization (MSY)
2007	1.498	74,90	10,4056	94.32
2008	2.464	123,20	10,8145	98.03
2009	3.085	154,25	11,3551	102.93
2010	3.099	154,95	11,6038	105.18
2011	3.174	158,70	8,7029	78.89
2012	3.199	159,95	8,5944	77.90
2013	3.199	159,95	9,0957	82.45

From the biological aspect, in fact this phenomenon showed that the activity of a number of fishing gear that exploitation has taken a number of quantitative fisheries resource has exceeded the ability of regeneration of existing resources (Subagio, 2007). So when associated with the real conditions of fishermen catch in the field, it is true that the catch per unit of fishing effort has declined, as well as catch any size fish in recent years increasingly smaller. The amount of fishing effort and the level of utilization during the period 2007 - 2013 in the context of the utilization of maximum sustainable yield is as in Table 4.

The development of the fishing effort levels (blue line) and utilization rates (red line) during the period 2007 - 2013 is expressed in percent in the context of MSY is as in Figure 2.

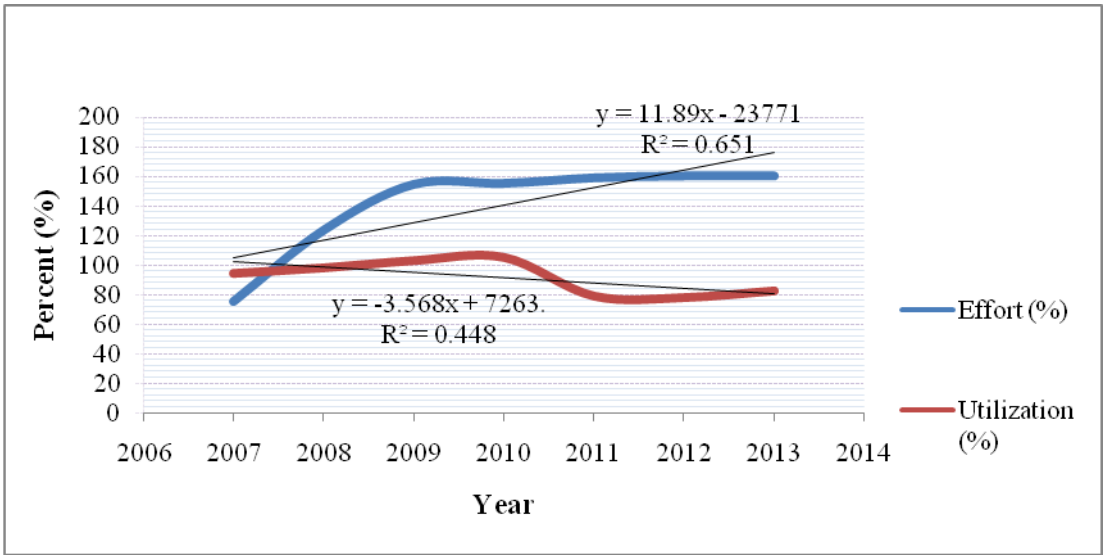


Figure 2. Level of Fishing Effort (Blue line) and the Level of Utilization (Red line) During the Period 2007-2013 (% of MSY Conditions)

In fishing activities, the amount of the catch is a function of the amount of fishing gear (boats). Reinforce the above description, as in Figure 2 shows that with the increasing number of fishing gear (blue line) with a slope value of 11,896 + followed by the decline in the number of catches (red line), with a slope value of - 3.5682. This means that the fishing activities in Surabaya was in a situation where the increase in the number of fishing gear will further decrease the number of catches. Theoretically, this condition indicates a phenomenon in which the exploitation activity has exceeded maximum sustainable yield, or is said to have suffered over fishing.

Under conditions of availability of fishery resources has been getting heavy fishing pressure enough, in 2008-2013 the number of attempts ranged 123.20% - 159.95% compared with the optimum catch effort. So for the sustainability of fisheries resources and the preparation itself, is necessary to reduce the number of fishing gear so that the maximum level of effort that may be in operation, as many as 2,000 units of fishing effort. As presented in the Sparre and Venema (1999), real sustainability of fishing activities is dependent upon the availability of fishery resources of the target catch. Further it is said that to maintain continuity needs to consider the maximum limits of the resources that may be exploited fish stocks available.

IV. CONCLUSION

Efforts to catch the optimum is 2,000 units (Fmsy) a standard gear. Estimation of the potential of fisheries resources sustainably or maximum sustainable yield is equal to 11,032.026 tons/year. The number of fishing gear during the seven years following the equation y = 11.896x - 23 771, while the number of catches following the development of the equation y = -3.5682x + 7,263.5. Fishing activities are done in the last six years using a number of fishing gear as much as 123.2% - 159.95%, and at the same time their catch has exceeded the maximum sustainable yield as indicated by the cumulative trend catches declined. Fishing activities in Surabaya was in a situation have exceeded the maximum sustainable yield or has experienced over fishing.

REFERENCES

[1] Subagio, H. 2007. Manajemen Operasi Penangkapan Ikan. Hand Out. Universitas Hang Tuah. Surabaya.
[2] Food and Agriculture, 1995. Code of Conduct for Responsible Fisheries. FAO. 41 p.
[3] Garcia, S., P. Sparre and Csirke, 1989. Estimating surplus production and maximum sustainable yield from biomass data when catch and effort time series are not available. *Fish. Res*. 8:13-22.
[4] Peraturan Menteri Kelautan dan Perikanan. Nomo2. 2011. Tentang Jalur Penangkapan ikan dan penempatan alat penangkapan ikan di wilayah pengelolaan perikanan.
[5] Sparre P dan Venema CS. 1999. *Introduksi Pengkajian Stok Ikan Tropis*. Jakarta: Pusat Penelitian dan Pengembangan Pertanian.
[6] Sulestiani, A., dan H. Subagio., 2011. *Karakteristik Sosial Ekonomi dan Pemanfaatan Sumber daya Perairan di Kelurahan Kedung Cowek Surabaya*. Laporan Penelitian. Universitas Hang Tuah. Surabaya