STUDY OF POTENTIAL FISHING GROUND FOR SKIPJACK TUNA (*Katsuwonus pelamis*) in SAWU SEA EAST NUSA TENGGARA PROVINCE USING REMOTE SENSING SATELLITE AND FISHERY DATA

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ABSTRAK

Wilayah perairan laut Indonesia memiliki kandungan sumberdaya alam khususnya sumberdaya hayati (ikan) yang berlimpah dan beraneka ragam. Cakalang merupakan salah satu ikan pelagis besar yang memiliki nilai komersial yang tinggi yang dapat ditemukan di perairan bagian timur Indonesia, khususnya di perairan Kupang, Provinsi Nusa Tenggara Timur.

Penelitian ini menggunakan data komposit rata-rata dari Suhu Permukaan Laut (SPL), konsentrasi Klorofil-a, dan Photosyntetically Active Radiation (PAR) yang di peroleh dari satelit Aqua MODIS tahun 2006, dan data kecepatan angin yang diperoleh dari satelit Quickscat. Vertically Generalized Production Model (VGPM) di populerkan oleh Behrenfeld and Falkowski (1997) digunakan untuk memperkirakan Produktivitas Primer (PP) di perairan, sedangkan Produksi Ikan dapat diperkirakan dengan menggunakan formula yang dipopulerkan oleh Pauly and Christensen (1995). Data produksi ikan yang diperoleh dari Dinas Kelautan dan Perikanan Provinsi Nusa Tenggara Timur pada tahun 2006 adalah 4.685,75 ton/tahun. Daerah tangkapan ikan yang potensial untuk Cakalang (*Katsuwonus pelamis*) dibagi ke dalam musim Timur, musim Peralihan II, dan musim Barat. Pada musim barat, daerah tangkapan ikan rendah. Daerah tangkapan ikan yang baik yang diamati terdapat di bagian barat dari Laut Sawu.

Tangkapan ikan tertinggi diperkirakan terjadi sepanjang musim Timur dan Peralihan II. Hasil dari Produktivitas Primer memperlihatkan pola yang sama dengan Klorofil-a. perkiraan Produksi Ikan di Laut Sawu adalah 6.563,08 ton/tahun. Dengan membandingkan data perkiraan produksi ikan dengan data produksi ikan dari Dinas Kelautan dan Perikanan menunjukkan tingkat pemanfaatan sebesar 71.39 % di Laut Sawu.

Korelasi antara SPL dan tangkapan ikan adalah -0,25 dan korelasi antara klorofil-a dan tangkapan ikan adalah 0,12. korelasi antara Klorofil-a dan SPL di Laut Sawu menunjukkan nilai yang berbanding terbalik (nilai koefisien korelasi -0,24 dan mempunyai pola yang berbeda dan bertentangan). Korelasi antara Produktivitas Primer (PP) dan Klorofil-a menunjukkan hubungan yang sangat kuat yaitu 0,98 (R=0,98).

Kata kunci: Laut Sawu, Cakalang (Katsuwonus pelamis), Produktivitas Primer, Produksi Ikan, Musim.

ABSTRACT

Indonesia's marine waters contain natural resources, especially biological resources, such as fish abundant and diverse. Skipjack tuna is one of the pelagic fish that have a high commercial value and can be found in the sea water of the eastern part of Indonesia, especially in the sea water of Kupang, East Nusa Tenggara Province.

This study employed the average composite data of Sea Surface Temperature, Chlorophyll-a and Photosyntetically Active Radiation (PAR) are got from Aqua MODIS satellite in 2006, and wind speed data from Quickscat satellite. Vertically Generalized Production Model (VGPM) was proposed by Behrenfeld and Falkowski (1997) was used to estimate the Primary Production (PP). The Fish Production was estimated using the formula was proposed by Pauly and Christensen (1995). Fish Production in-situ data were provided by Ministry of Marine and Fisheries East Nusa Tenggara Province in 2006 that was 4,685.75 ton/year. Potential fishing zone for Skipjack Tuna (*Katsuwonus pelamis*) was divided into Southeast, Transition II, and Northwest monsoon. At Northwest monsoon was low potential fishing ground. The good fishing zone was observed in western part of Sawu Sea

 ISSN : 1907-5626

The Estimation of higher fish catching estimated during Southeast and Transition II monsoon. The results of Primary Production (PP) showed the same patterns with Chlorophyll-a. The estimation of fish production in Sawu Sea was 6,563.08 ton/year. With comparing between fish production estimation and fish production from Ministry of Marine and Fisheris data showed the utilization rate was 71.39 % in Sawu Sea.

The correlation between SST and fish catching was low (-0.25) and the correlation between Chlorophyll-a and fish catching in Sawu Sea was low (0.12). The correlation between Chlorophyll-a and SST in Sawu Sea showed inversely relationships (correlation coefficient of -0.24 and has a different and opposite patterns). The correlation between Primary Production (PP) and Chlorophyll-a showed close relationships of 0.98 (R=0.98).

Key words: Sawu Sea, Skipjack Tuna (Katsuwonus pelamis), Primary Production, Fish production, Monsoon

INTRODUCTION

Utilization of Indonesia's marine fish resources in the various regions are not evenly distributed. In some areas of open sea water, there are still great opportunities for development of its utilization, while some other areas has reached a solid state fishing or overfishing. The main problem encountered is the effort to optimize the catch of pelagic fish; especially limited data and information of oceanographic conditions that are strongly associated with the potential fishing. Fishing boat out from the base rather than to capture but to find the location to fishing so that the Fisherman go for fishing at an uncertainty potential locations of fishing ground. Sea water habitats are suitable for large numbers of pelagic fish populations, especially the large pelagic fish species, such as Skipjack tuna (*Katsuwonus pelamis*). Skipjack tuna is one of the pelagic fish that has high commercial value and are found abundant in the sea water of the Eastern part of Indonesia, especially in the waters of Kupang, East Nusa Tenggara Province. The aims of this research are to estimate the fishing ground distribution of Skipjack tuna during monsoonal in Sawu Sea, to estimate the correlation between fish catching of Skipjack Tuna (*Katsuwonus pelamis)* and the satellite data of Chlorophyll-a and Sea Surface Temperature in Sawu Se, and to estimate fish production by primary production.

RESEARCH METHODOLOGY

Research location

Sawu Sea is part of Kupang regency, East Nusa Tenggara Province, (122° E – 125° E and 9° S – 11° S).

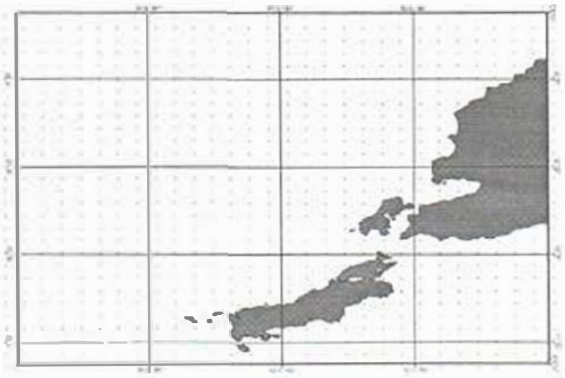

Figure 1: Research Location

Research materials

The materials were used such as Fish catching data in year 2006 from Marine and Fisheries Office, East Nusa Tenggara Province, Chlorophyll-a, Sea Surface Temperature, and PAR data Level 2 Aqua-MODIS data, and Wind Speed data from Quickscat data.

Research instruments

Some instruments were used such as hardware (i.e. a set of computer Intel Core 2 Duo 2,8 GHz with 512 MB of RAM, hard disk 160 GB, keyboard, and mouse) and software (i.e. Envi 4.5, ArcView 3.3, SeaDAS under Linux OS, and Microsoft Excel 2007).

Research procedures

The research procedures were as follows:

1. Calculations of SST, Chlorophyll-a, and PAR data using the following equation:
   SST (Celcius) = DN × 0.075 – 3.0
   Chlorophyll-a (mg) = 100.015 x DN-2
   PAR (Einstein) = DN × 0.3
2. Calculations of Depth-integrated model (DIM) primary production are expressed as follows: (Behrenfeld and Falkowski (1997b).

3 Fish Production has estimated from integrated production assuming a simple trophic chain, with

a fixed trophic efficiency and average number of trophic links. The formula proposed by Pauly and Christensen (1995) :

4. Correlation between Satellite Data and Fisheries Data were analyzed with correlation of Pearson. Rasyad (2003). Formula of correlation coefficient was:

$$r = \frac{n\sum_{i=1}^{n} XiYi - \sum_{i=1}^{n} X \sum_{i=1}^{n} Y}{\sqrt{\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X\right)^2}\sqrt{\sum_{i=1}^{n} Y_i^2 - \left(\sum_{i=1}^{n} Y\right)^2}}$$

R

5. Prediction of fishing ground the estimating value of SST and Chlorophyll-a from satellite for one year and determination as well as classification of range parameters for each category. It bas classified into three categories which are High Potential, Potential and Low Potential fishing ground.

Table 1. Classify of Fishing Ground Area for Skipjack Tuna (*Katsuwonus pelamis*).(Gower, 1972)

Variable		Value of SST (° C)		
		> 29	28 - 29	< 28
Value of Chlorophyll-a (mg/m³)	0.10 – 0.20	Low Potential	Low Potential	Low Potential
	0.21 – 0.40	Low Potential	Potential	Potential
	0.40	Low Potential	Potential	High Potential

RESULTS AND DISCUSSIONS

The total of Fish Catching in Sawu Sea in year 2006

Table 2. Total of Skipjack Tuna (*Katsuwonus pelamis*) in Sawu sea 2006

Number of Fish Catching in Sawu Sea 2006 (kg)						
Southeast			Transition II			Northwest
June	July	August	September	October	November	December
2698.25	1962	603.25	3683.5	3333.75	2175	2698.75
1547.5	1340	813.75	2747.75	3111.25	2155.25	1648.5
2128.5	2429.75	381.75	3437.5	2058.25	2795.75	1319.5
1945	2564	566	2836.5	1797	2073.5	2607.75

Amount of fish catching in Sawu Sea at Southeast monsoon was low. At Transition II monsoon, total of fish catching in Sawu Sea was high. Total of fish catching at Northwest monsoon increased, but lower than Southeast monsoon. Wouthuyzen, *et.al.*, (1990) showed, fishing number of Skipjack Tuna in Southeast monsoon was low, because of wind from southwards is strong. Finally, fish catching decreased. The higher of fish catching occurs in Transition II monsoon (Septemher, October, and November) because Upwelling phenomenon was occurred and affecting high the catching Matsumoto *et.al.*, (1984) showed, an area which has fast current as in Sawu Sea, getting upwelling phenomenon during Southeast. Wrytki, (1961) explains that upwelling is enhancement process lifted water mass to the surface.

Sea Surface Temperature.

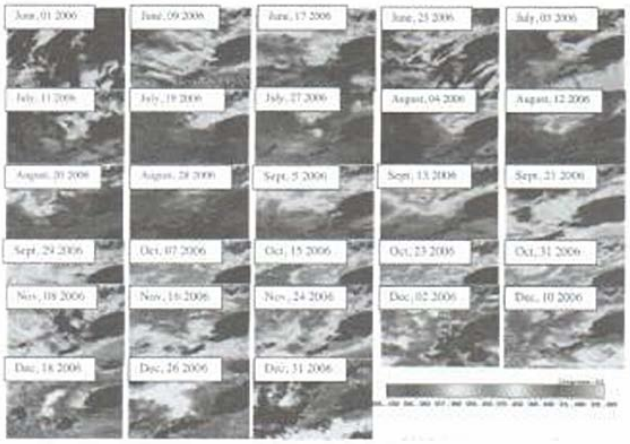

Figure 2. SST in Sawu Sea in year 2006 during monsoonal

The average of Sea Surface Temperature in September 2006 in Sawu Sea was 26.29°C with the maximum SST was 26.65°C and the minimum SST was 26.06°C. In October 2006, the average of SST in Sawu Sea was 27.3●°C with the maximum SST was 27.67°C and the minimum SST was 26.99°C. The average of SST in November 2006 was 28.77°C with the maximum SST was 29.10°C and the minimum SST was 28.21°C. The variability of Sea Surface Temperature in Sawu Sea shows in the Figure 2 During Southeast monsoon, rainy season was occurs, where the dilution of waters occurs in the Sunda shelf. The ward of high salinity reversed, flowing from the east and encourages low salinity water returned to the west. The temperature is slightly low. During Northwest monsoon, dry season was occurs where transportation water flows from Natuna island, Java sea, Makassar Strait to the North of Sumbawa dominated low salinity water. The temperature slightly high (Writky, 1961 and Nontji, 1987).

Chlorophyll-a Concentrations

The average of Chlorophyll-a concentration in September 2006 in Sawu Sea was 0.31 mg/m³ with the maximum Chlorophyll-a concentration was 0.37 mg/m³ and the minimum Chlorophyll-a concentration was 0.23 mg/m³. In October 2006, the average of Chlorophyll-a concentration in Sawu Sea was 0.18 mg/m³ with the maximum Chlorophyll-a concentration was 0.20 mg/m³ and the minimum

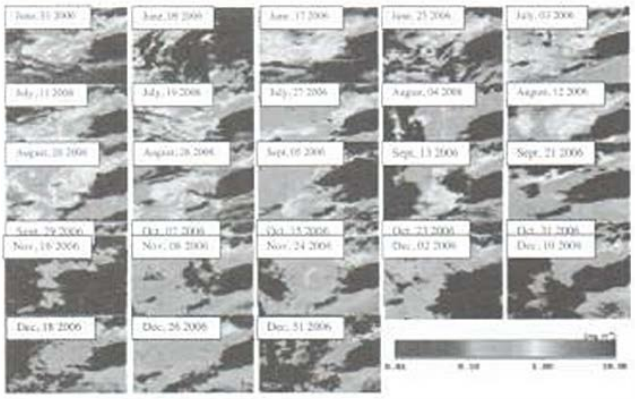

Figure 3. Chlorophyll-a Concentrations in Sawu Sea in year 2006 during Monsoonal.

Chlorophyll-a concentration was 0.17 mg/m^3. The average of Chlorophyll-a concentration in November 2006 was 0.22 mg/m^3 with the maximum Chlorophyll-a concentration was 0.45 mg/m^3 and the minimum Chlorophyll-a concentration was 0.14 mg/m^3.

Generally, cholorophyll-a concentration in Sawu Sea during Southeast monsoon relatively higher compared with northwest monsoon. The higher value in November has a different value with the other months. This indicated that the area was occurred ocean phenomenon i.e. upwelling which is followed by high catches in the same month.

Syamsuddin, *et al* (2006) showed that upwelling occurs in Southeast monsoon of Sawu Sea as the result of this research where the upwelling is enhancement process of waters from the bottom to the surface. Upwelling was used to describe the processes that cause waters are moving from a depth into the surface layer. Upwelling effected higher nutrient concentrations compared with surface nutrients has been reduced by the growth of phytoplankton (Bowden and Stewart, 1983 cited in Syamsuddin, *et al.* 2006).

The Correlation between Fish Catching Trends and Satellite Data

Sea Surface Temperature (SST) influential to fish catching, because of Skipjack Tuna (*Katsuwonus pelamis*) would be choose the temperature that suitable to Skipjack Tuna's environment. The correlation (R) between SST and fish catching showed -0.25. Chlorophyll-a concentration has close relationships between fish catching. The correlation between Chlorophyll-a and fish catching in Sawu Sea showed 0.12.

The Correlation between Chlorophyll-a and Sea Surface Temperature

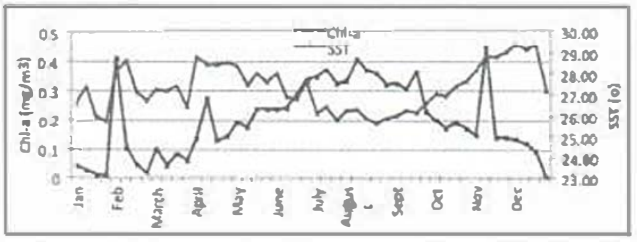

Figure 4. Correlation between Chlorophyll-a and SST in Sawu Sea year 2006

SST and Chlorophyll-a concentrations have an inverse pattern, when the sea surface temperature was minimum, chlorophyll-a concentration was maximum value, (Figure 26). The correlation between chlorophyll-a and SST in Sawu Sea was inversely correlated with correlation coefficient (R) -0.24. Palenzuela *et al.*, (1998) showed that the sea surface temperature and chlorophyll-a concentration were inversely correlated.

Estimation of Primary Production in Sawu Sea

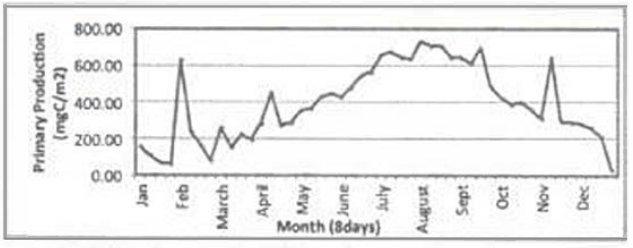

Figure 5. Primary Production in Sawu Sea year 2006

Maximum of PP in August was 726.23 (mg C/m2), minimum PP in December was 26.02 (mg C/m2). Average PP in Sawu Sea was 394.64 (mg C/m2). In this research, the relationship between primary production and Chlorophyll-a concentration is very strong and proportional, with the correlation coefficient is 0.98. According to Sarwono (2006), its mean that the correlation was strong. This highly correlation coefficient indicates that the area with highly Chlorophyll-a concentration also produce the highly primary production.

Estimation of Fish Production in Sawu Sea

The Higher of Fish Production occurred during Southeast monsoon in Sawu Sea was 225.66 ton/year and the lower of Fish Production occurred during Northwest monsoon in Sawu Sea was 65.84 ton/year. The total fish production in Sawu Sea 2006 is estimated 6563.08 ton. Fish catch data from Ministry of Marine and Fisheries in East

Nusa Tenggara Province showing that the total fish catch in Sawu Sea in 2006 is 4.685,75 ton. There is considerable mismatch between the estimated of fish production and actual catch data in 2006. The difference value between the total fish production and fish catching in Sawu Sea is 1.877,33 ton. The utilization rate of potential fisheries in Sawu Sea is 71.39%.

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