MAPPING THE FISHERIES RESOURCES MANAGEMENT: A NATURAL RESOURCES ACCOUNTING APPROACH

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ABSTRACT

Marine resources, especially capture fisheries, become one of the leading sector that need to be improved for the future of national economy. For the need of capture fisheries management, a mapping model should be employed to provide such user friendly information of fisheries sector to the local or national government. Fisheries resources accounting map can fulfill this need by giving some reliable information. Using Poso in Central Celebes province, a model was developed to meet the need of information. The result indicates the prospect of capture fisheries can be developed for further local fishermen prosperity and local regional income. Indeed, the result also indicates the fisheries resource accounting map, a spatial information model, is good tool in providing condition and possible management of capture fisheries sector.
Keywords: capture fisheries, fisheries accounting, spatial model

ABSTRAK

Sumberdaya laut, terutama sektor perikanan tangkap merupakan sektor utama yang harus terus ditingkatkan guna menunjang peningkatan pendapatan ekonomi negara. Untuk keperluan manajemen perikanan tangkap ini, maka dirasakan sangat perlu dibuat suatu model spasial guna mendukung program perikanan yang berkesinambungan. Akutansi sumberdaya perikanan dapat memenuhi kebutuhan ini melalui pemodelan ekologi-ekonomi. Sebagai studi kasus digunakan perairan pesisir daerah Poso, Sulawesi Tengah. Hasil yang diperoleh menunjukan, bahwa melalui pemodelan spasial ini dapat dilihat prospek sektor perikanan tangkap untuk meningkatkan kesejahteraan nelayan dan pendapatan pemerintah kabupaten. Selain itu, hasil kajian ini juga memperlihatkan peran model spasial akutansi sumberdaya perikanan sebagai alat yang dapat diandalkan untuk menunjang manajemen perikanan tangkap.

Kata Kunci: perikanan tangkap, akuntansi perikanan, model spasial

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INTRODUCTION

Background

Marine resources become one of the leading sectors for improving the future of national economic. This condition is due to the huge coverage of marine and coastal area that still under usage. Indeed, the information of marine and coastal resources still limited as such policy and strategy that make the exploration of the resources cannot be established properly. In this condition, a good mapping program of the prospect and the characteristic of the area become a good strategy to optimally use the resources. The spatial natural resources accounting can fulfill the need of this information to meet the sustainable management strategy. Spatial natural resources accounting is able to describe the potentiality, sustainable yield and the trend of changes utilization of such resources in multi time approach. Even it can be modeled to predict the future's utilization of the resources.

Dealing with this study, capture fisheries is one of the marine resources that should be accounted beforehand. This assessment is urgently needed to be employed due to the Indonesian high prospect of this sector but not optimally utilized. In western part of Indonesian ocean capture fisheries has been exploited and tend to be overfishing. Meanwhile in eastern is still under usage. Therefore, information of the fisheries potentiality and the utilization has to be assessed to achieve the sustainability of capture fisheries management. To meet the need, a model of spatial fisheries resources accounting was developed using a geographical information system approach. Poso regency -Central Celebes province is selected to be the study area. Poso represent the eastern area of Indonesia that has high potentiality in capture fisheries.

Aim of the study

The goal of this study is to develop of a model of spatial capture fisheries information by assessing spatial fisheries resources accounting. The information will able to

indicate the fisheries prospect in spatial and sustainable manners as an input for policy in fisheries management.

METHOD

The spatial fisheries resources accounting calculate the utilization of capture fisheries to assess the changes of potentiality. Surplus and deficit of this resources will easy learnt through this assessment that can be utilized as a tool for early warning system management in capture fisheries sector. The unit mapping of fisheries accounting was based on ecosystem and the concept of water column as three dimensions object. For this need, the zone of marine species communities was based on their ability to live within such vertical and horizontal oceanographic characteristics. Bathymetry and sea temperature are the two factors that affect the life zone of these marine species that easily can be map using the remote sensing and geographical information system method. The research approach of the model was described in the following diagram:

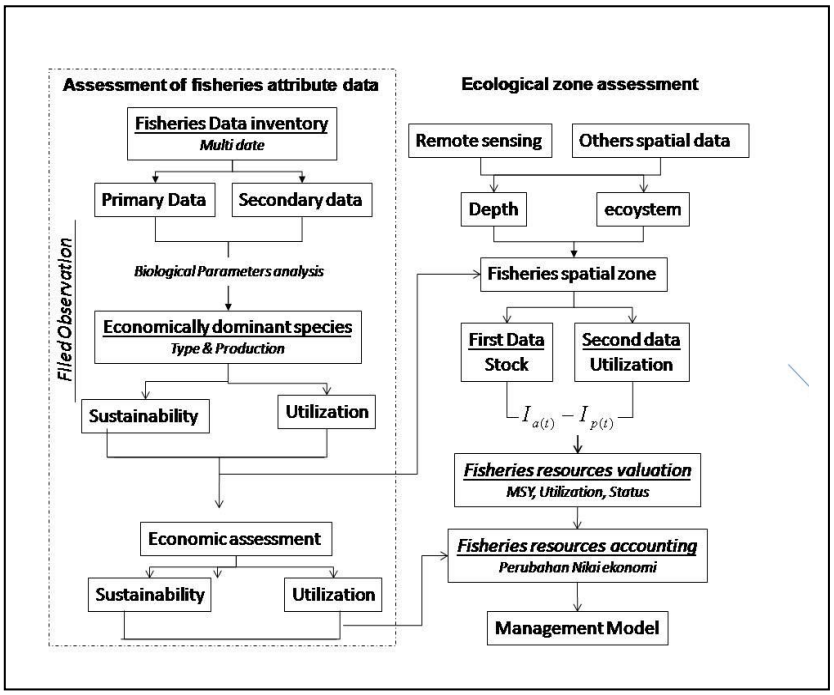

Figure 1: Flow chart of Research approach

Basically, the development of the fisheries spatial information model can be divided into three steps of processes, i.e

a. Ecological zone assessment

This process provides spatial information data for fisheries accounting model, using both remote sensing and geographical information systems. The unit mapping was develop based on ecological approach due to the assumtion that the ecological zone of marine species can be classiffied into sea temperature or depth or both of them (Nybakken 1992). Using this approach, the spatial zone of marine species' habitat can be developed in vertical and horizontal approach within the surface and the water column. Remote sensing data were being employed for analysing and clasifying the sea surface temperature and its related eufotic zone and thermocline layers within the sea water column. The coastal ecosystem such as mangrove, coral reef and sea grass also can define using remote sensing data. Meanwhile other spatial data such as bathymetry data support the vertical information data for the living zone of the marine species. Both remote sensing derived map and bathymetri map were being assess to clasify the zone of marine's species habitat. The clasification of the zone can be describe in as follow;

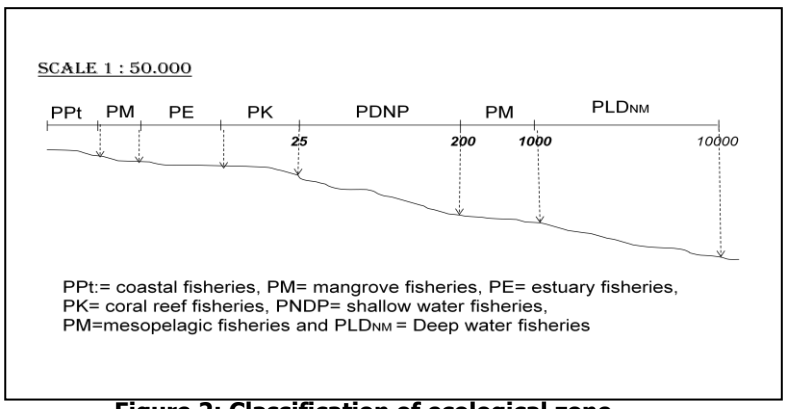

Figure 2: Classification of ecological zone

These units mapping were prepare for time series attribute fisheries data assessment.

b. Assessment of fisheries attribute data

The assessment of fisheries attribute data is depended on the inventory of both secondary and primary data. The secondary data is any fisheries activities derived from related institution. Meanwhile, the primary data is any *in situ* fisheries data that usually done in the field observation. Both of these data may consist of: production, species, production/ species, fishing gears, species production/fishing gears, number of trips, market price of each species, cost per trip etc. These data are the time series data that was being further employ to assess the potentiality and the sustainable yield of the fisheries resources as the parameters for assessing the fisheries resources accounting. The processes of analysis are;

1. Assessment of biological parameters

   Surplus production approach (Clark , Yoshimoto and Pooley 1992) was used for assessing the potentiality of fisheries resources based on fisheries production and efforts. The formula for this assessment was;

   $\mu = \frac{h}{E}$ .... (1)

   where μ = CPUE (catch per unit effort), *h* = Production and *E* = effort. Standardization of fishing gears were also being employed for assessing the dominant fishing gears that was used for productivity of capture fisheries.

2. Assessment of sustainable yield

   Based on related inventory of fisheries time series data, the sustainable yield were calculate using Gompert method (Fauzi 2004), i.e;

   i. $h = qKE\left(\frac{qE}{r}\right)$..... (2)

   where h = sustainable yield, q = Production, E = effort (trip)

   By applying this Gompert formula, the actual production can also be analyzed besides the sustainable yield parameters that can be further applied for contrast analyzes.

3. Assessment of fisheries resources accounting

   Based on productivity, the assessment used Fauzi and Anna (2005) method

for fisheries resources accounting. This can be described as:

i. $\Delta NP_t = \left[\frac{NO_t}{x_t}\right] x\Delta\Omega$ ..... (3)

Where ΔNP_t = *Change of productivity at t*, $NO_t = output\ value\ at\ t, x_t = ouput\ at\ t, \Delta\Omega$ = *Change of productivity*

Change of productivity can be calculated using the formula:

$\Delta\Omega = \bar{x} - x_t$ ..... (4)

where

$$\bar{x} = \frac{1}{n}\sum_{t=1}^{T_b} X_t$$

$\bar{x} = average\ of\ productivity\ from$ *year 1 to basic year (T_b) of productivity change. The basic year is the year of productivity change.*

The next step is calculating the monetary unit that can be describe as follow;

1. Conversion the market price to the real price using the market price and consumer index price

   $Price_{riil} = \frac{price_{min}}{index\ \ consumer\ \ price} x\ 100\%$ ..... (5)
2. Calculate the average of fisheries product (= year of basic)
3. Calculate the productivity change = average production – productivity at year i
4. Calculate the depreciation value.

c. Integrating spatial and attribute data

The Attribute data (b) then integrate to the ecological spatial data (a) to derive the fisheries resources accounting maps.

The data that were used for theses study are: fisheries statistical data of Central Celebes province and Poso Regency (Fisheries department and Center for Statistic Agency, 1991 – 2005), Aster data (2005), Coastal Environmental Map (LPI), ETOPO2 Global 2-Minute Gridded Elevation Data (NGDC) and Bahtymetry map

RESULT AND DISCUSSION

The assessment of remote sensing data, geographical information system and surplus fisheries production data indicates that there are three spatial ecological zones for capture fisheries in the central Celebes, i.e Coastal fisheries, Coral reef fisheries and Shallow water fisheries. Deep water and mesopelagic ecological zone cannot be described since this study was focused in the traditional capture fisheries activities that usually employ the traditional fishing gears and traditional vessels. Indeed the other ecological fisheries such as mangrove and estuary cannot be classified due to the non existences of these ecosystems within the study area. The types of marine species that can be taken from these zones are:

1. Coastal fisheries

   The assessment of marine species for this zone can be classified as small pelagic fisheries. The dominant species are: *Bombay duck, Peperek, Blotched grunt, Threadfin bream, White spotted, Scad mackerel, Yellowstrip trevally, Trevally, Hardtail scad, Slender Leatherfish, Rainbow runner, Anchovy, Sardinella, Oil Sardinella, Short bodied and Hairtail*
2. Coral reef fisheries:

   The assessment of marine species for this zone is classified as the demersal fisheries, with the dominant species such as *Yellow goatfish, Red snapper, Grouper, Baramundi, Yellowtail.*
3. Shallow water fisheries:

   The assessment of marine species for this zone also can be classified as pelagic fisheries, with the dominant species such as *Bigeye tuna , Skipjack, Barracuda, Spotted flyingfish, Barred garfish, Spotted spanish mackerel.*

The result of Fisheries resources accounting assessment that compare the year of observation (2005) to the basic year (2002) was described in Figure 3. The map shows the ecological zone (number I to IV) and the information of capture fisheries within the area of study. The assessment that can be shown in the map indicates there is the decreasing productivity and the increasing species type within the three ecological zone.

However, this decreasing value does not automatically indicate the biological overfishing of the capture fisheries sector in the province. The sustainable yield assessment for these three zones, based on time series statistical data, i.e 42.847 ton for Coastal fisheries, 10.184 ton for Coral reef fisheries and 12.633 ton for Shallow water fisheries indicates that the utilization of capture fisheries within the area is still under its potentiality, means that the stock is still available to be utilized for the future of capture fisheries sector. This can be shown in the map as No I_S...IV_S, indicating the over stock fisheries status.

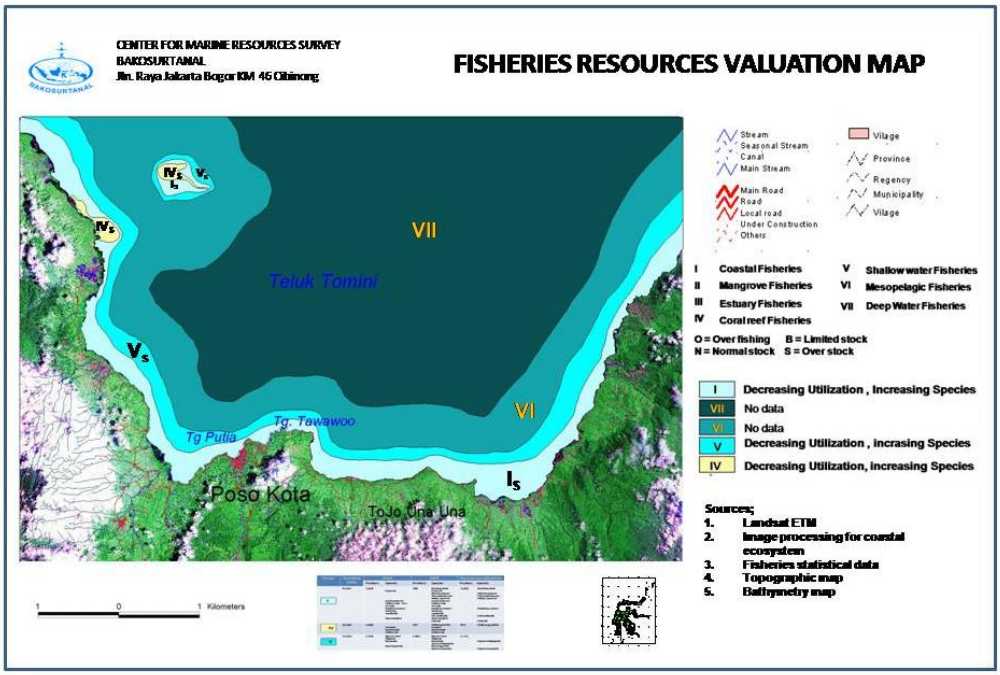

Figure 3: Capture Fisheries assessment map

The decreasing productivity will affect the prosperity of fishermen and the local income in the capture fisheries sectors. This information can be shown in Figure 4, where the map shows the economic loss information in capture fisheries sector within the three ecological zone which cause by the decreasing productivity. The lost is about 15x 10^9 to 217x 10^9 IDR, indicates the prospect of fisheries economic value that need to be improved.

The information of high prospect in capture fisheries sector can be seen in the graphic in the map (Figure 4) that is shows by the green line. This information is a Maximum economic yield that can be improved for the future of marine fisheries sector for local economy purposes. Management Strategies should be further assessed for this need. Economic instruments such as incentive for the local fishermen in accordance with quota in productivity and should be consider as one of the local management strategy. This incentives can carried out by offering soft loan for increasing the fishing gears, vessel and other high technology instruments for the local fishermen.

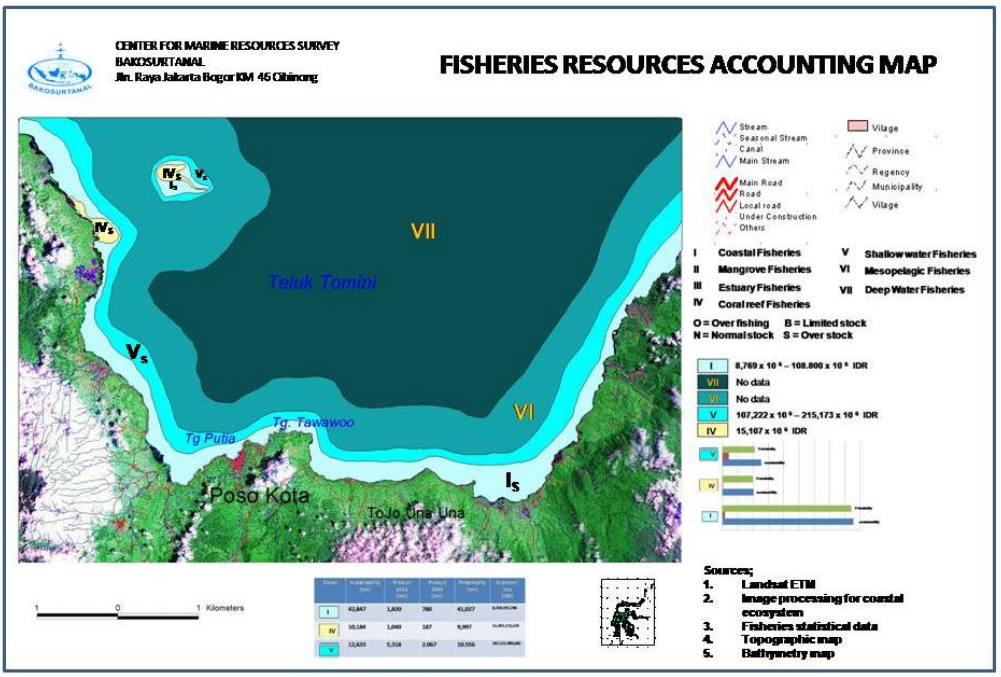

Figure 4: Fisheries Resources Accounting Map

CONCLUSION AND RECOMMENDATION

Assessment of fisheries resources accounting of Central Celebes coastal and marine area, especially Poso Regency, indicates the utilization of capture fisheries is still under usage. This assessment can be simulated in a resources accounting map for user friendly information. A map as a model of spatial capture fisheries information that was

develop in this study can fulfill the need for better management of the fisheries sector since it is able to indicate the fisheries prospect in spatial and sustainable manners as an input for policy in fisheries management. Indeed, this study also indicates that Fisheries resources accounting maps are the best tools to inform the status and the condition of capture fisheries sector within the years of observation. However, the spatial information should be updated yearly in order to get a accurate information supported by the accurate data from the related institution and in situ observation.

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