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Controlling Over-Capacity of West Coast of Peninsular Malaysia Zone B Trawlers with Different Level of Licenses Issuing Policy

[1]*Moe Shwe Sin,* [2]*Tai Shzee Yew,* [1]*Kusairi Mohd Noh,*
[1]*Shaufique Fahmi Ahmad Sidique and* [1]*Aswani Farhana Mohd Noh*

[1]Institute of Agricultural and Food Policy Studies, Universiti Putra Malaysia,
43400, UPM Serdang, Selangor, Malaysia
[2]Faculty of Economics and Management, Universiti Putra Malaysia,
43400, UPM Serdang, Selangor, Malaysia

Abstract: The marine fishery resources in the West Coast of Peninsular Malaysia are overexploited with the overcapacity of the fishing effort by the trawlers. The overcapacity of trawlers is controlled with the license issuing policy for sustainable management of trawl fishery. The fishermen decided to increase their fishing capacity based on the profit and dynamic of fishing effort was occurred with the different levels of fishing effort. The simulation analysis was carried out for the effort dynamics and the performance of the industry is evaluated with different levels of license reduction. The results indicated that, the decreasing of the fishing effort gives higher catch and higher profit and the licensing for the trawl vessel should be reduced to fifty percent of 2012 issuing number of licenses. The proposed policy for the zone B trawlers in the West Coast of Peninsular Malaysia is reduction of license with the half of the number of licenses issued in 2012.

Key words: Simulation · Trawlers · Overcapacity · Overexploitation · Number Of License

INTRODUCTION

The Malaysian trawl fishery is besetting with many issues including overcapacity, overfishing, trash fish landings, IUU (Illegal, Unreported and Unregulated) fishing etc. The fishery resources in the West Coast of Peninsular Malaysia are alleged to be overexploited due to the rapid development and expansion of the trawl fleets since 1960s. Management policies have been implemented in the hope of attaining sustainable exploitation of the fisheries resources in the region. The zonal licensing scheme was applied to control the over-capacity of trawlers by restricting access through the issuance of vessel licenses. However, problems such as excessive fishing effort and overexploitation of the demersal fish stocks by trawlers, encroachment of trawlers into the inshore areas and conflicts among traditional fishermen and trawlers still exist in the West Coast of Peninsular Malaysia.

The destructive fishing nature of the trawlers is dragging out the seabed and it destroys the habitat of the fishery and increasing landings of trash fish. The increasing number of fishing vessels coupled with increasing fishing capability of the trawlers greatly increased the fishing pressure on the fish stocks. The use of overcapacity of trawlers in WCPM (West Coast of Peninsular Malaysia) and the overexploited conditions of fish resources still exists based on the resource studies in this area. The decreasing of commercially important species composition apparently occurs both in inshore and offshore waters of the WCPM [1].

Management of fisheries seeks to influence the responses by fishing industries on policy regulations through various effective measures to ensure sustainability of proposed regulation such as enforcement of the policy regulations [2]. Moreover, management plans to be applied to the fishery industry must deliver in line with what the goal of management expects to be achieved in future [3]. In the context of management of trawl fishery on WCPM, the impact of management measures needs to be evaluated in order to predict the appropriate combination of management interventions. The management interventions include controlling effort in terms of a number of licenses issued for trawl vessels

Correspondent Author: Moe Shwe Sin, Institute of Agricultural and Food Policy Studies, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia.

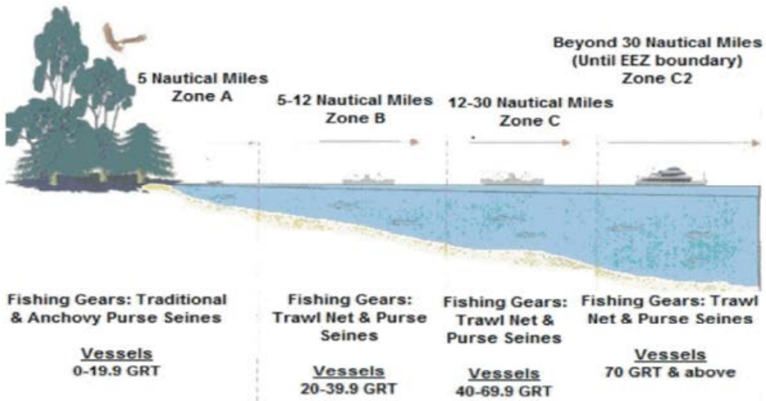


Fig. 1: The zoning system of Marine fishery in Malaysia
Source: http://www.dof.gov.my/en/1373

in different zoning area, the control of inputs such as adjusting the fuel subsidy and proposed licenses fees and managing the operation cost through imposing a jetty charge. Crucially, it is needed for the evaluation of current management measures and understanding the adjustment process of fishing effort for designing and implementing efficient and equitable fishery management policies [4].

The study is conducted with the objectives of evaluating the fishing effort dynamics with alternative management policy implications and proposing the recommendation for the sustainable management of zone B trawl fishery in WCPM. Therefore, the research questions call for what type and level of policy intervention should be applied to the management of sustainability of trawl fisheries on the west coast of Peninsular Malaysia.

Fisheries management legislations are provided for the control of fishing effort and are the amendment of Fisheries Act 1963 provided the Fisheries (Amendment) Regulations 1980 to control the problems of overexploitation and overcapitalization in inshore fisheries. The allocation of fishing grounds by zoning (Figure 1) and licenses are issued in specific zones and the four main zones were established in this regulation such as zone A, B, C and C2. Zone A is within 5 nautical miles from shoreline reserved for traditional fishing gears, Zone B is between 5 and 12 nautical miles reserved for trawlers and purse seiners less than 40 GRT, Zone C is between 12 to 30 nautical miles reserved for trawlers and purse seiners between 40-70 GRT and Zone C2 is from 30 nautical miles until the EEZ of Malaysia waters reserved for the fishing vessels of greater than 70 GRT [5, 6].

Fisheries regulations undoubtedly affect the fish stocks being managed and the fishers also respond accordingly to the type of regulations imposed [4]. The current management regulations on the trawl fishing industry of the west coast of Peninsular Malaysia will impact on the socio-economic welfares of communities and also resources sustainability. Sound management of the complex interaction between resources stocks and fishers under the proposed regulation should take these impacts into consideration. The fishery system is complex and also dynamics in nature. Analyzing the effect of management regulations and to establish the alternative management regulations needs to take cognizance of the complexities inherent in the marine fisheries system and which will enable policy makers to choose the effective policies towards achieving the predetermined goals and objectives of fisheries management of controlling over-capacity [7].

MATERIALS AND METHODS

The conceptual model used in this study is the interconnection of three main modules of the system. The three main modules: biological, economic and industry module of the system are interconnected each other and the performance of the system is evaluated with the impact of various proposed management policy implications.

Biological Module: The main output of the biological module is the estimate of total catch by species group harvested by trawlers. The total catch of the trawl industry in the West Coast of Peninsular Malaysia includes the catches of the three targeted species groups: pelagic, demersal and crustacean species group and the by-catch. The marine fishery of Malaysia is multispecies tropical fishery and the trawl fishing gear is non-selective and catches all species groups including not only the targeted species groups also the by-catch. By-catch is regarded as the catches of trash fish, mixed fish and also Mollusca species. However, the landing function of the by-catch is not explicitly specified in this study but the revenue from by-catch will be included in the total revenue of the industry.

The total catch is the summation of the three targeted species and is calculated as follow:

$$Land_{t,n} = \sum_{i=1}^{3} Catch_{t,n,i} \quad (1)$$

where, $Land_{t,n}$ is Total landing of trawlers in zone B at time t, $Catch_{t,n,i}$ is the sustainable catch of the main targeted species (Pelagic, demersal and crustacean) group by the trawlers, subscript "n" represents the fishing zones B, "t" represents time in terms of year, "1" represents pelagic species group, "2" represents demersal species group and "3" represents crustacean species group.

The Catch of each species groups: pelagic, demersal and crustacean species are calculated by using the Logistic and Gompertz forms of catch equation and Surplus Production function [8].

Economic Module: The economic module describes the economic performance of the trawl fleet in terms of revenue, costs and profit. The mathematical specification of revenue function, ex-vessel price function, total cost function and total profit are presented in the economic module.

The total gross revenue of the industry is the summation of revenues from the three targeted species group and by-catch. The revenue of the three targeted species groups is calculated by multiplying catch of each species group and their respective ex-vessel price. In addition, trawlers also harvest other non-targeted species groups such as trash fish, mixed fish and Mollusca species which are collectively known as by-catch and the revenue from by-catch also must be included in the total revenue of the industry. Total Revenue of the trawlers in zone n at time t (Yt, n) can be computed as follow:

$$Y_{t,n} = \left[\left(\sum_{i=1}^{3} (Catch_{t,n,i} \times P_{t,i})\right)\right] + (\mathrm{Re}vByCa_{t,n}) \quad (2)$$

where, $Catch_{t,n,i}$ is total catch of the targeted specie group i by trawlers in zone n at time t; and $P_{t,i}$ is ex-vessel price of species group i at time t and $RevByCa_{t,n}$ revenue from by-catch in zone n at time t. The revenue from by-catch is assumed to change according to linear trend as given by the equation below:

$$RevByCa_{t,n} = \gamma_0 + \gamma_1 t \quad (3)$$

The ex-vessel price of each species group is endogenously determined in the system according to the supply and demand condition. The total catch is one of the main variables determining in the ex-vessel price. Other factors that can affect the ex-vessel price include prices of related goods and income. The other factors such as fish size, freshness of fish, price expectations and seasonal variations are not included in the ex-vessel price function due to unavailability of data. The ex-vessel price of species group i at time t ($P_{i,t}$) can be represented by the log-linear equation below [5, 9].

Total cost of the fishing industry is the sum of Total fixed cost and Total variable costs.

$$Tc_{t,n} = (TFC_{t,n} + TVC_{t,n}) \quad (4)$$

where, $TC_{t,n}$ is total cost at time t in zone n, $TFC_{t,n}$ is total fixed cost at time t zone n and $TVC_{t,n}$ is total variable cost at time t in zone n.

Total Fixed cost for each zone at time t is calculated by multiplying fixed cost per vessel and number of trawl vessels in the zone. Fixed cost per vessel includes (1) fishing license fees and (2) Other fixed cost which includes the cost of insurance, depreciation cost of the fishing vessel and equipment and rental cost of landed jetty. Depreciation cost is derived from the market value of the fishing assets and their corresponding economic life using a straight line method with zero salvage value. Salvage value is the estimated resale value of an asset at the end of its useful life. Fixed cost of the vessel can be calculated using following equation:

$$Fc_{t,n} = Lf_{t,n} + OtherFC_{t,n} \quad (5)$$

where, $FC_{t,n}$ is fixed cost per vessel and $LF_{t,n}$ is license fee per vessel with the unit of RM/Vessel. Other fixed cost at time t is estimated with the changes of consumer price index (CPI).

$$OtherFC_{t+1,n} = OtherFC_{t,n}\,(1 + \delta) \quad (6)$$

where, $OtherFC_{t+1,n}$ is other fixed cost per vessel at time t+1 in zone n, $OtherFC_{t,n}$ is other fixed cost per vessel at time t and δ is the average CPI from 1987 to 2012.

Variable cost per vessel at time t ($VC_{t,n}$ includes (1) Operation cost, (2) Crew cost and (3) Marketing cost as shown in equation 18 below:

Table 1: Annual Cost per Trawl Vessel

Parameter	Definition	Value in Ringgit Zone B	Unit
$TFC_{t,n}$	Total Fixed Cost	4, 179.48	RM/Vessel
$OthFC_{t,n}$	Other fixed cost		
S_t	Insurance Cost	579.48	RM/Vessel
?? t	Depreciation cost	2, 200.10	RM/Vessel
i_t	Jetty rent	1, 200.00	RM/Vessel
$LF_{t,n}$	License Fees	200.00	RM/Vessel
$TVC_{t,n}$	Total Variable cost	378, 819	RM/Vessel
$OperaC_{t,n}$	Operation cost		
$FuelC_{t,n}$	Fuel cost	168, 134.40 (1250lit/trip*1.65)*96	RM/Vessel
$OtherVC_{t,n}$	Other variable cost	49, 427.80	RM/Vessel
$CrewC_{t,n}$	Crew Cost	161, 258.83	RM/Vessel
Total Cost		382, 998	RM/Vessel
Total Cost/Effort(Fday)		1, 315.34	RM/Fday

Source: Fish Capacity Survey Data, August 2011 (Unpublished Report)

$$Vc_{t,n} = OeraC_{t,n} + CrewC_{t,n} + MarketC_{t,n} \quad (7)$$

The cost data of the trawl vessels by zone used in this study was from the survey data of the west coast marine fishery (Fish capacity survey, 2011) and the survey was carried out with selected trawl vessels of different tonnage class of zone B and zone C. The annual cost data for the trawl vessel in zone B is shown in Table 1.

Total profit at time t ($\Pi_{t,n}$) is the difference between Total revenue ($Y_{t,n}$) and Total cost at time t ($TC_{t,n}$) as shown in equation 25.

$$\Pi_{t,n} = Y_{t,n} - Tc_{t,n} = Y_{t,n} - \{(Vc_{t,n} + Fc_{t,n})\} * V_{t,n} \quad (8)$$

Total fishing cost by zone n at time t is calculated by multiplying total cost per vessel by zone at time t and the total number of trawl vessels at time t.

Industry Module: The industry module determines the nominal fishing effort of trawlers exerted on the fish stocks. The nominal fishing effort used in this study is in terms of fishing days for Zone B. It is assumed that the fishing power of all the trawl vessels in zone B is homogeneous.

The dynamics of effort is the changes of effort over time in line with the changes in profit. The fishermen's decision to increase or decrease on fishing effort is depended on the profit achieve and if the profit is increase the fishing effort will be increased. In this study, the effort in terms of number of fishing days by trawlers in area n at time t (E, t, n) can be calculated as follow:

$$E_{t+1,n} = E_{t,n} + \Delta E_{t,n} \quad (9)$$

where, $E_{t+1,n}$ is the effort for the next year, $E_{t,n}$ is effort used in current year and the changes of effort, $\Delta E_{t,n}$ with increase or decrease effort by the fishermen. The change in effort, $\Delta E_{t,n}$ is considered base on the profit of last year. However, in this study, it is assumed that the change in fishing effort $\Delta E_{n,t}$ is the function of three-year moving average profit and threshold income. The changes of fishing effort for trawlers in area n at time t, $\Delta E_{j,n,t}$ can be calculated with the following equation (Wilen, 1976; Tai and Heap, 1996):

$$\Delta e_{t,n} = \Omega[(X) - \beta] \quad (10)$$

where, Ω is the response effort to changes in profit X (3 years moving average profit per fishing day) and β is the threshold profit per fishing day. The coefficients (Ω and $\Omega\beta$) of effort dynamic equation (equation 10) can be estimated with the regression analysis. From the estimates, the effort response parameter (Ω) and threshold profit per fishing day (β) can be calculated. The increasing or decreasing of fishing effort with respect to the profit gives the dynamic of fishing effort.

Types and Source of Data: The data used in this study include both primary and secondary data for the estimation of the parameters and constants of the mathematical equations. The annual catch and effort data of the three targeted species groups is used from the Annual Fishery Statistics of Department of Fishery, Malaysia.

The economic data especially for the cost data such as operation costs: bait, fuel, maintenance, gear replacement or repair and food for the workers and fixed costs: haul, engine, equipment and the possible opportunity cost of the vessels will be collected from survey data. The secondary data of catch and effort by state, by species, by tonnage classes and also the by-catch data, the ex-vessel price of each main targeted species group were obtained from the Department of Fisheries, Malaysia (DOF, Malaysia), Fisheries statistics of various years (1980-2012). The data for per capita income include GNI of Malaysia and population of Malaysia and collected from Department of Statistics, Malaysia (1980-2012). The prices of the related goods are collected from the year books of statistics of Agri-food Industry, Ministry of Agriculture.

Licenses Control Policy: The open-access simulation of the zones B trawl fishery is leading to increasing fishing effort and overexploitation of fish stocks occurs and, the alternative management policy should be imposed for the management of the fishery. The alternative policy implication imposed to Zone B is aimed at the effort controlling and the detailed of alternative policy scenarios are shown in Table 2. The licensing policy includes the different level of license reduction percentage for trawlers in each year. The initial value for the simulation is used the figure of 2012 issued licenses.

The fishing effort is constrained with maximum fishing effort calculated from the number of the license issued multiply with the average fishing effort per vessel per year. In this study, the average fishing effort per vessel is assumed as 290 fishing days per year. The constraint variables of maximum fishing effort were set in the model and these variables were calculated from a multiplication of reduced licenses issued and average fishing effort per vessel. The constraints in fishing effort are needed to set in the model in order to control the unlimited increase of fishing days within the one-year license of fishing operation. The number of vessels can be limited with the limited licenses issued for each vessel, however, the fishermen can increase their fishing effort in a one year license period. Therefore, the fishing effort can be increased only by the maximum fishing effort set as a constraint variable in the model.

The simulation of fishing effort dynamics and performance of the fishing industry is carried out for thirty years period of from 2012 to 2042. The simulation analysis on the performance of the industry is carried out by the key performance variables of fishing effort total sustainable catch and profit of the industry. The proposed policy implications are calculated from the data of 2012 as the base value especially for the number of license issued for the trawl vessel.

Table 2: Description of License Reduction Policy for Zone B Trawlers in WCPM

	Zone B
Policy	Description
1 A	10 % License reduction from 2012 value
1 B	20 % License reduction from 2012 value
1 C	30 % License reduction from 2012 value
1 D	50 % License reduction from 2012 value

RESULTS AND DISCUSSION

The results of the study consist of two parts: (1) the value of the parameters used in the simulation analysis and (2) the simulation result for the dynamics of fishing effort and performance of the industry with alternative management policy implications. Based on the simulation results, the proper policy implications are selected and proposed for the management of the zone B trawl fishery in WCPM.

Parameters of Biological, Economic and Industry Modules: The biological parameter estimation of the three targeted species groups are estimated by using surplus production model and the detailed of the parameter estimation were presented in Moe & Tai [8], the economic parameters were also estimated and the details of the estimation and values of the parameters were presented in Moe & Tai [9].

The dynamics of fishing effort is the function of threshold income and the fishermen decide to increase or increase their fishing effort depends on the threshold income for each fishing operation. The values of parameters in equation 10 are estimated using ordinary least square and the regression results of effort dynamics equation is presented in Table 3. The effort dynamic functions showed the statistically significant with F-values 77.79. The parameter estimates are significant with 10 % level and are correctly signed with R^2 values 0.36. The estimated coefficients of effort dynamics equations (Ω) showed that every ringgit increase in profit of the fishery, the fishing effort will increase by 18 days and the threshold income or opportunity cost of the effort (Ω) is calculated from the estimated parameters $\Omega\beta$ from the effort dynamic equations divided by value of effort response parameter, Ω. The threshold income for zone B trawler is 1, 408 ringgit per fishing day. The estimated threshold profit is a bit higher in compare with other study and Abu Talib (1994) mentioned that the net profit for the trawlers less than 40 GRT (Zone B trawler) is 3, 866 RM per month and for the trawlers less than 70 GRT (Zone C trawler) is 4, 764 RM per month. The profit per effort with this reference is about 200 ringgit per fishing day for zone B and 250 ringgit per fishing day for zone C.

The threshold income for the trawlers (β) showed the negative value and the changes in fishing effort will be positive if the profit is greater than threshold income and will be negative if the profit is less than threshold income. The changes of effort might be increasing or decreasing and it depends on the profit achieved per fishing day. In zone B, if the profit is greater than 1, 400 ringgits per fishing day, the effort will increase with the rate of 18 days in every ringgit increasing.

Simulation Results of Effort Dynamics with License Reduction Policy: The results of simulation analysis with license reduction were evaluated on the fishing effort, total sustainable catch and profit of the industry. Limited entry licensing regulation through the issuing licenses for the vessels is one of the effort control management regulations applied in Malaysia marine fishery. The initial number of licenses issued to Zone B trawl vessel is based on the 2012 figure of 3, 000 licensed vessels. The impact of license control policy with different levels of the license issued for Zone B including four levels such as Policy 1A, 1B, 1C and 1D is evaluated. The results of the model simulation with policy of reduction in vessel licenses for Zone B were presented in Figure 2 (a) to (g).

As shown in Figure 2 (a) the policy 1A showed the highest fishing effort and 1D showed the lowest fishing effort. The fishing effort of policy 1A is increasing from 2012 (416, 493 fishing day) to 2027 and after 2027, it is limited in the maximum effort of 783, 000 fishing day until 2042. The fishing effort of policy 1B and 1C also showed the same behavior as in policy 1A and the maximum fishing efforts of 696, 000 fishing days and 609, 000 fishing days respectively are found at 2025 and limited until 2042. Policy 1D showed the fishing effort increases until 2020 and thereafter limited with its maximum fishing effort of about 435, 000 fishing days.

The impact of policy (1) on the total sustainable catch of the three targetted species groups was shown in Figure 2, (b). For policy 1A, total sustainable catch tends to increase until 2020 and reached the maximum of 98, 319 metric ton. Since then, total sustainable catch starts to decline until 2027 and it stabilized from 2028 until 2042 at 87, 517 MT. For policy 1B, the maximum sustainable catch is also achieved in 2020 but decreased and stabilized in 2026 with 92, 559 MT which is higher maximum catch than policy 1A. For policy 1C, the maximum sustainable catch is achieved same as policy 1A and 1B in 2020 and it

Table 3: Regression results of parameters for dynamics of effort in the West Coast trawl fishery by zone

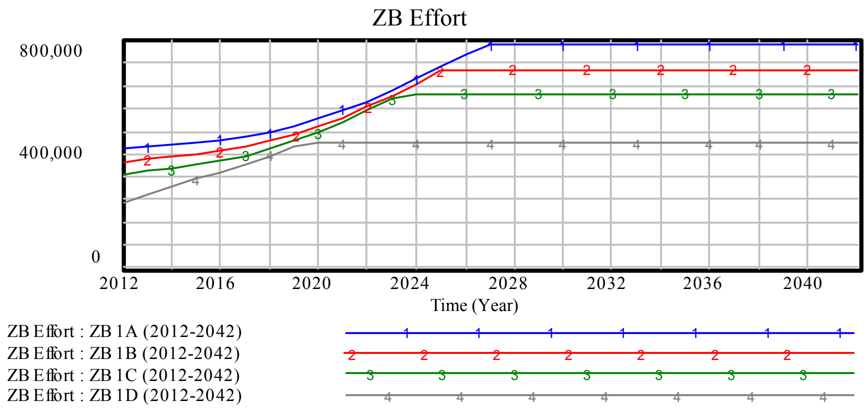
Parameter	West coast Zone B	Zone C
Ω	18.06	3.84
	(0.287963)*	(0.28090)*
Ωβ	-25434.58	- 4904.75
	(-1.868408)*	(-0.13323)*
R^2	0.36	0.32
Over all F	77.59	87.23
β	1, 408.34	1, 277.21

Note: * P = 0.10, **P = 0.05, *** P = 0.01
Figures in parentheses denote t-ratios.

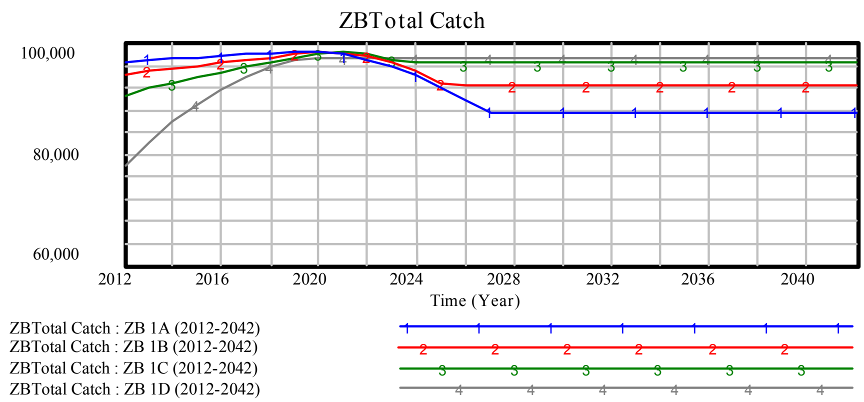
stabilized with the catch of 96, 991 until 2042 which is the higher catch than 1A and 1B. For policy 1D, the sustainable total catch increases to 97, 177 until 2019 and stabilized from 2020 until 2042 with 97, 442 metric ton which is the highest catch amount in compare with other three levels of license limitations. The results reveal that total sustainable catch of the three targetted species is at its maximum value with policy 1D than 1A, 1B and 1C. As the major performance variable, the total catch with different levels of license reduction should be considered in the evaluation of alternative management policies.

The impact of policy (1) on pelagic catch was shown in Figure 2(c). All level of license increasing gives the increasing of pelagic catch. The policy 1A showed the lowest pelagic catch and policy 1D showed the highest pelagic catch. Policy 1A showed that the pelagic catch is increasing from 2012 until 2042 with the pelagic catch of about 29, 898 MT in 2012 and 37, 247 MT in 2042. Policy 1B showed that the pelagic catch is increasing from 2012 until 2042 with the pelagic catch of about 33, 807 MT in 2012 and 37, 617 MT in 2042. Policy 1C showed that pelagic catch is increasing with 35, 545 MT in 2012 and 37, 661 MT in 2042. Policy 1D showed that pelagic catch is increasing from 37, 564 MT in 2012 to 37, 664 MT in 2042. The policy (1) analysis of pelagic catch indicates that the maximum pelagic catch is achieved with policy 1 C and 1 D (50 % & 100 % license increasing) and the results revealed that increasing fishing effort gives the higher pelagic catch.

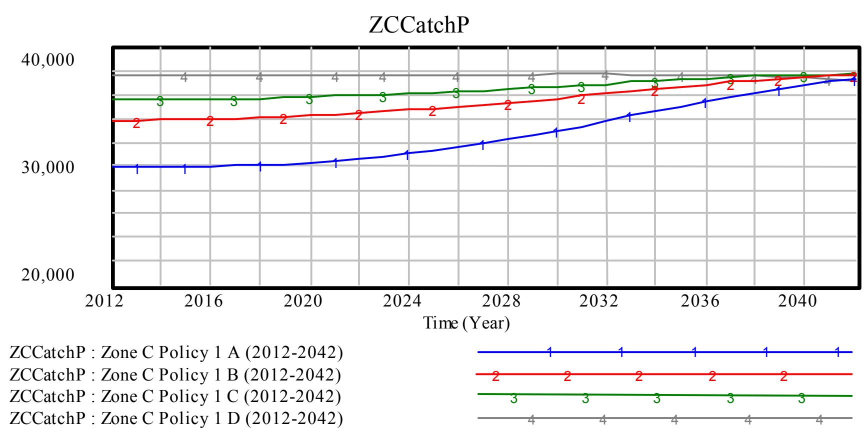
The impact of policy (1) on demersal catch was shown in Figure 2(d). All level of license increasing gives the increasing of demersal catch. The policy 1A showed the lowest demersal catch and policy 1D showed the highest demersal catch. Policy 1A showed that demersal catch is increasing from 2012 until 2042 with about 19, 385 MT in 2012 and 24, 804 MT in 2042. Policy 1B showed that demersal catch is increasing from 2012 until 2042 with about 22, 128 MT in 2012 and 25, 109 MT in 2042.


ZB Effort
800,000
400,000
0
2012
2016
2020
2024
2028
2032
2036
2040
Time (Year)
ZB Effort : ZB 1A (2012-2042)
ZB Effort : ZB 1B (2012-2042)
ZB Effort : ZB 1C (2012-2042)
ZB Effort : ZB 1D (2012-2042)

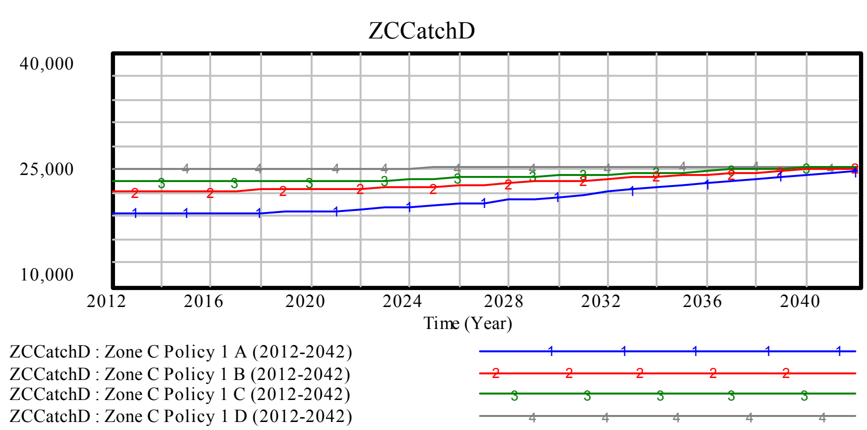
(a)


ZBTotal Catch
100,000
80,000
60,000
2012
2016
2020
2024
2028
2032
2036
2040
Time (Year)
ZBTotal Catch : ZB 1A (2012-2042)
ZBTotal Catch : ZB 1B (2012-2042)
ZBTotal Catch : ZB 1C (2012-2042)
ZBTotal Catch : ZB 1D (2012-2042)

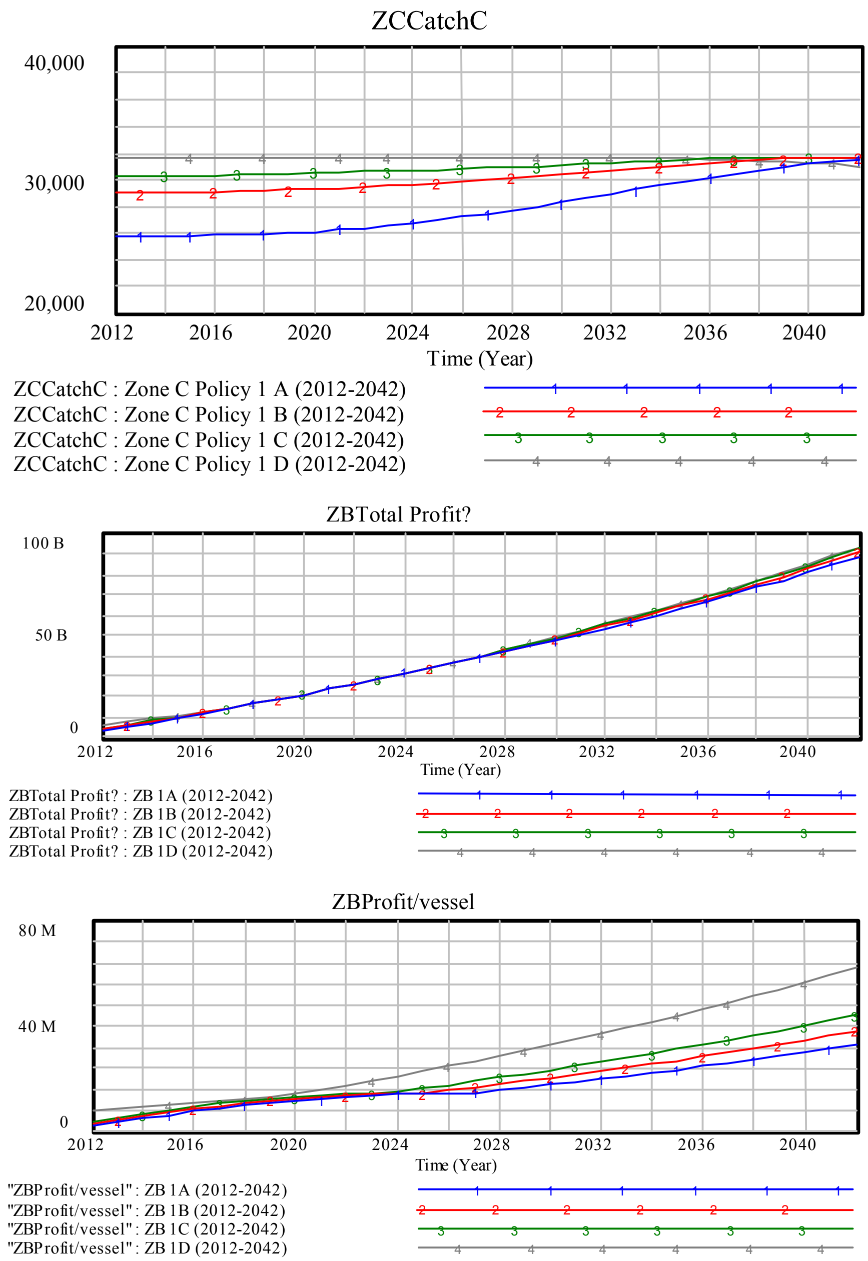
(b)


ZCCatchP
40,000
30,000
20,000
2012
2016
2020
2024
2028
2032
2036
2040
Time (Year)
ZCCatchP : Zone C Policy 1 A (2012-2042)
ZCCatchP : Zone C Policy 1 B (2012-2042)
ZCCatchP : Zone C Policy 1 C (2012-2042)
ZCCatchP : Zone C Policy 1 D (2012-2042)

(c)


ZCCatchD
40,000
25,000
10,000
2012
2016
2020
2024
2028
2032
2036
2040
Time (Year)
ZCCatchD : Zone C Policy 1 A (2012-2042)
ZCCatchD : Zone C Policy 1 B (2012-2042)
ZCCatchD : Zone C Policy 1 C (2012-2042)
ZCCatchD : Zone C Policy 1 D (2012-2042)

(d)



(e)

(f)

(g)

Fig. 2: The impact of policy (1) to (a) fishing effort, (b) total sustainable catch, (c) pelagic catch, (d) demersal catch, (e) crustacean catch, (f) total profit and (g) profit per vessel

Policy 1C showed that demersal catch is increasing from 23, 413 MT in 2012 to 25, 334 MT in 2042. Policy 1D showed that demersal catch is increasing from 25, 137 MT in 2012 to 25, 282 MT in 2042. The policy (1) analysis of demersal catch indicates that the maximum demersal catch is achieved with policy 1 C and 1 D (50 % & 100 % license increasing) and the results revealed that increasing fishing effort gives the higher demersal catch.

The impact of policy (1) on crustacean catch was shown in Figure 2 (e). All level of license increasing gives the increasing of crustacean catch. The policy 1A showed the lowest crustacean catch and policy 1D showed the highest crustacean catch. Policy 1A showed that crustacean catch is increasing from 2012 until 2042 with about 25, 728 MT in 2012 and 31, 449 MT in 2042. Policy 1B showed that crustacean catch is increasing from 2012 until 2042 with about 28, 913 MT in 2012 and 31, 680 MT in 2042. Policy 1C showed that crustacean catch is increasing from 30, 275 MT in 2012 to 31, 645 MT in 2042. Policy 1D showed that crustacean catch is increasing from 31, 667 MT in 2012 to 31, 669 MT in 2042. The policy (1) analysis of crustacean catch indicates that the maximum crustacean catch is achieved with policy 1 C and 1 D (50 % & 100 % license increasing) and the results revealed that increasing fishing effort gives the higher crustacean catch.

Figure 2 (f) showed that the total profit does not show much difference between the policies of 1A to 1D. The trend of total profit increased from 2012 until 2042. The total profit of the industry is about 3 billion ringgit in 2012 and increased drastically to 88 billion ringgit in 2042. The increasing of total profit might be the effect of the price because the simulated ex-vessel price showed increasing trend even the catches of the targetted species groups are decreasing.

Figure 2, (g) showed that the pattern of profit per vessel which is the same as that of total profit, however, the amount of profit per vessel is different among different license reduction levels. Policy 1A gives less profit than other three levels with 349, 370 ringgit in 2012 and 8 million ringgit in 2042. Among the four different policies, policy 1D gives the higher profit per vessel than 1A, 1B and 1C. Policy 1D gives the highest profit and the catches of the three target species groups are higher than other policies. The higher profit per vessel is the effect of the price and the profit showed continuously increasing trend. Moreover, the increasing revenue of the industry also causes the increasing of total profit as well as the profit per vessel.

The overall results of policy (1) analysis, the proper level of license issued reduction should be policy 1C and 1D of 30 % and 50 % license reduction levels and the proper policy giving highest catch and also highest profit was policy 4D of 50 % license reduction. With this license reduction levels, the number of licenses should be issued in 2012 is 1, 500 licenses and this license limitation will give the maximum catches of all targeted species groups and also give the higher profit for the trawl fishing industry in WCPM.

Malaysia capture fisheries play important role and trawl fisheries are one of the important components in Malaysia because of their significant landings. However, the trawl fisheries in Malaysia showed many issues including overcapacity, overfishing, trash fish landings, IUU fishing etc. The fishery resources are exploited with the overcapacity in this area especially in the southern part of West Coast of Peninsular Malaysia.

In the open-access simulation of Zone B trawl fishery, the fishing efforts are increasing over time from 2012 until 2062. However, the catches of the targeted species groups are declining and the CPUEs of the three targeted species groups are also decreasing. This condition can be explained due to the unlimited increasing of fishing effort. Even with the increasing of fishing effort, the catches of all target species groups are decreasing. Base on the results of the open-access simulation analysis, this may suggest that the zone B trawl fishery will be overexploited in the long run. .

The results of policy (1) analysis of reduction in vessel license, the results indicated that decreasing licenses give the decreasing of fishing effort and the higher catch. Base on the simulation result, the proper level of license issued reduction in zone B is policy 1 C and 1D of 30 per cent and 50 per cent license reduction levels. With this license reduction levels, the number of licenses should be issued in 2012 is 1, 500 licenses and this license limitation will give the maximum catches of all targeted species groups and also give the higher profit for the industry. From the simulation results from the study indicated that the zone B trawlers should be decreased and the recommendation for the proposed policy option is to reduce the zone B trawlers by the licensing control policy by fifty percent of number of licenses issuing in 2012 for better management of the sustainable fishery.

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REFERENCES

1. Taupek and Nasir, 2003. Monitoring, Measurement and Assessment of fishing capacity-The Malaysia experience. In: Pascoe, S., & Greboval, D. (eds.) Measuring capacity in fisheries. FAO Fisheries Technical Paper, pp: 445.
2. Needle, C.L., 2011. Fleet Dynamics in fisheries management strategy evaluations. Ph.D thesis. University of Strathclyde. Glasgow.
3. Kell, L.T., J.A.A. De Oliveira, A.E. Punt, M.K. McAllister and S. Kuikka, 2006. Operational management procedures: An introduction to the use of evaluation frameworks, in L. Motos and D. G. Wilson (eds.), The Knowledge Base for Fisheries Management, Elsevier, Amsterdam.

4. Tai, S.Y. and T. Heap, 1996. Effort Dynamics and Alternative management Policies for the small Pelagic Fisheries of Northwest Peninsular Malaysia. Marine Resource Economics, 11: 85-103.
5. Tai, S.Y., 1992. Management of small pelagic fishery on the northwest coast of Peninsular Malaysia: A Bio-socioeconomic simulation analysis. Ph.D thesis, Simon Fraser University, Canada.
6. Abdullah, N.M.R. and K. Kuperan, 1997. Fisheries management in Asia: The way forward. Marine Resource Economics, 12: 345-353.
7. Stouten, H., H. Polet, J. Depestele, E. Vanderperren, A. Heene and X. Gellynck, 2006. System Dynamics in sea fisheries policy building. 7th System dynamics PhD Colloquium; 2006. International conference of the System Dynamics Society.Nijmegen, The Netherlands.
8. Moe, S.S. and S.Y. Tai, 2016 a. Assessing the Exploitation Status of Marine Fisheries Resources for the West Coast of Peninsular Malaysia Trawl Fishery. World Journal of Fish and Marine Sciences, 8 (2): 98-107.
9. Moe, S.S. and S.Y. Tai, 2016b. Estimation of Ex-Vessel Price for the Three Major Fish Species Groups in the West Coast of Peninsular Malaysia Trawl Fishery. American-Eurasian J. Agric. & Environ. Sci., 16(6): 1037-1042.