Fisheries Management Costs in Thai Marine Fisheries

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Abstract: The paper first introduces the fisheries management dilemma faced by many Asian developing countries including Thailand and the key elements of a transition policy towards responsible fisheries. It then analyses current fisheries management costs in Thai marine fisheries. Major cost items include fisheries research (especially stock assessment), monitoring, control and surveillance, the placement of artificial reefs to rehabilitate inshore resources and to act as barrier against bottom trawling, and management administration. It then examines the required adjustments needed for improved management in order to increase the flow of net economic benefits and to reduce conflicts among fishermen using different types of fishing gear. The authors argue that in the Thai situation characterized by significant over-capacities large up-front adjustment costs arise in the transition to an effective fisheries management regime. These include compensation for the withdrawal of excessive fleet capacity, costs of facilitating the shift to alternative employment, and other incremental fisheries management costs. On the example of the Thai demersal fisheries in the Gulf of Thailand, it is shown that these large up-front adjustment costs could be recuperated in the long run through increased fishing licence fees but that the immediate financial needs may pose a heavy burden on the government budget that may justify external financial assistance.

Keywords: Thai marine fisheries; management costs; decommissioning; bio-economic analysis.

Introduction

The capture fisheries sectors of many developing countries need to undergo significant changes to achieve the objectives of sustainable use of fishery resources, conservation of habitats, economic efficiency and social acceptability. In many countries, there exist significant over-capacities of industrial, semi-industrial and artisanal fishing fleets, even though the precise extent of such over-capacities is difficult to measure. Many fisheries continue to provide employment of last resort attracting increasing numbers of poorly remunerated fishworkers who have to resort to damaging fishing practices to make a meagre living. The pressure on a limited natural resource base causes not only economic hardship but also increases the number and severity of conflicts among competing interest groups within the sector as well as between them and other users of coastal areas.

Governments are generally aware of these management issues and have taken various policy measures to reduce over-capacities, regulate access to fisheries and create alternative employment opportunities. These measures range from the withdrawal of subsidies for fishing inputs, licensing limits on the number of vessels allowed to operate in various fishing zones, and financial assistance to diversify employment opportunities for fishing communities. These policies have had some degree of success in some countries (e.g. Malaysia) where national economic growth has been sufficiently strong to attract capital and labour which otherwise would have entered the fisheries sector or continued to stay in it.

In other countries, the socio-political context did not allow to restrict the further inflow of capital and labour into the fisheries sector with the consequence of worsening over-capitalization and overfishing. Many governments face the dilemma of, on one hand needing to reduce present levels of capital and labour inputs in the capture fisheries sector and on the other hand, wishing to not cause more hardship for fishing communities which already rank among the lowest income groups in their countries. A possible desirable strategy to re-allocate access to fisheries resources from the semi-industrial and industrial segments of the fishing fleet to small-scale and artisanal fishermen whose transfer into other types of occupation would often face insurmountable difficulties, at least in the short and medium term, naturally faces opposition from the former fleet segments. Moreover, owners of industrial vessels are often better organized and have more influence with political decision-makers.

This socio-political fisheries dilemma faced by many governments in South, Southeast and East Asia is likely to be only resolvable in an orderly and peaceful manner if adequate economic compensation could be provided to those who are required to give up their acquired rights to exploit fisheries resources, however ill-defined these

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rights may be at present. Concomitantly with a reduction of fleet capacity, exclusive rights of resource access would need to become clearly defined and enforced for those who remain in the sector. In the inshore small-scale sector, these rights may not need to be defined on an individual basis but could rest with groups or communities of fishworkers. In this case however, safeguard measures may be required to avoid that the "commons problem" does not re-appear through the uncontrolled growth of fishing capacity and fishing effort. These measures may include the strengthening of the fisheries management capacities of fishing communities and fishworkers' organizations, and of local government agencies, special programmes targeted at the youth to enter other occupations, and the provision of adequate monitoring, control and surveillance capacities.

In the industrial fisheries sector, individual or company-based fishing rights may be more suitable either expressed through fishing effort quotas or catch quotas. The pros and cons of these alternatives will vary with the specific conditions of the fishery in question. Whatever approach will be chosen, a management system will have to be in place encompassing regular research and information acquisition for the annual setting of optimal harvesting and/or fishing effort levels, monitoring of compliance by companies and vessel owners, and legal basis and mechanism to persecute offenders and impose sanctions. There would also be the requirement to review at regular intervals the efficacy of the management system itself and to undertake desirable adaptations.

The above elements of the process of transition to responsible fisheries may require substantial financial resources to allow for various adjustment measures including the removal of excess fishing capacity, time-bound income support to displaced crews and employees, economic incentives for the creation of alternative employment and income opportunities and for facilitating occupational mobility, and adjustments of public fisheries management administrations. Many governments of developing countries experience difficulties to find political support for the allocation of adequate budgetary resources to finance such transition. These difficulties are based on several factors including already strained budgetary resources, the lack of precedents to invest into dis-investment, the lag between the time of investing into the transition and the time when economic benefits arise, and vested interests opposed to restructuring. Governments may have some leverage to re-allocate financial resources away from existing support programmes such as subsidies that create economic incentives to enhance fishing capacity and fishing effort. However, the withdrawal of such subsidies might face considerable political opposition if it is not part of a coherent transition policy which offers compensation for those who need to leave the sector and security of exclusive resource access for those who remain in the sector.

Salient features of current marine fisheries management in Thailand

Trawling for demersal resources and purse-seining for small pelagic resources are the main industrial and semi-industrial fishing techniques while the inshore small-scale fisheries use mostly gillnets, lines and traps. In 1997, there were approximately 8,885 trawlers, 1000 purse-seiners, more than 3000 pushnetters and over 40,000 small-scale fishing units employing some 160,000 fishermen.

The focus of current marine fisheries management by the Thai government is on resource conservation and rehabilitation and on conflict avoidance and resolution among different gear types. Common management measures include closed seasons and closed areas, 3 km inshore no-trawling zone and gear regulations. There is also a significant programme for the placement of artificial reefs in inshore waters since 1985. Its objectives include the prevention of trawling and pushnetting in inshore waters and the creation and restoration of fish habitat. These technical management measures have had some positive effect on resource conservation (e.g. mackerel fishery in the Gulf of Thailand) and have facilitated the resolution of conflicts among fishermen but have not been able to curtail an overall expansion of fishing capacity and effort.

Past efforts to limit the number of fishing vessels through a limit license scheme have not been successful for various reasons. These include divided responsibility between the DOF and the Department of Habours (the latter is the issuing authority for vessel licenses), industry pressure to allow for new entries and absence of a strict licensing policy. In addition to increasing numbers of vessels, average catching power per vessel has grown substantially through higher engine horse power, improved fishing gear and methods, and advanced navigation and fish detecting equipment.

A current priority of DOF is to effectively implement a ban on pushnet fishing. In spite of having been declared illegal in inshore waters as far back as 1972 it has expanded to over 3000 units employing some 9,000 fishermen. There is the view that fishermen's resistance to giving up this type of non-selective fishing gear can only be overcome through the provision of some type of compensation to either facilitate the shift to other types of fishing gear or to other types of occupations in fishery related activities (e.g. coastal aquaculture) or elsewhere in the economy.

Government expenditures on fisheries management

Total government expenditures for fisheries management are estimated at B 468 million (US $ 12.8 million) in 1999 (Table 1). This amounts to just above one and a half percent (1.64 %) of the total gross revenues of marine fish landings estimated at B 28.5 billion (US $ 780 million). In comparison with the few other countries for which estimates have been undertaken, this ratio is very low. Arnason, Hannesson and Schrank (2000) have estimated ratios ranging between 3 percent in Iceland, 8 percent in Norway and 20 percent in Newfoundland.

Table 1: Est. Fisheries Management Costs: Whole Kingdom (Mill. Baht)

Year	Admin.	Res.	Rehabil.	Enfor.	Total	Catch Value	% Cat.Val.
1991	34	36	36	50	156	22131	0.70
1992	50	111	6	67	233	22770	1.03
1993	80	93	38	90	300	26111	1.15
1994	76	95	45	98	314	26594	1.18
1995	85	87	45	119	336	30175	1.11
1996	95	102	60	133	389	27992	1.39
1997	102	157	40	146	445	27780	1.60
1998	84	145	85	127	442	29087	1.52
1999	87	138	100	143	468	28512	1.64

Thai fisheries management expenditures have increased nearly 3-fold since 1991. The increase is primarily due to greater expenditures for fisheries enforcement at sea (e.g. patrol vessels), fishery research and for resource rehabilitation, i.e. mostly placement of artificial reefs in inshore waters. The increase occurred principally prior to 1997. Thereafter, the economic crisis caused budgetary austerity measures and stagnation in management expenditures.

In 1999, enforcement (31%) and research (30%) contributed nearly two-thirds of management costs, and rehabilitation and management administration around one fifth each. Research expenditures fluctuated considerably during the period 1991 – 1999. When aggregated over the entire period 1991 to 1999, management expenditures by category are as follows: enforcement 32%, research 31%, administration 22% and resource rehabilitation 15%.

In 1999, about four fifths of the Kingdom's total marine fisheries management expenditures were for the Gulf of Thailand and the rest for the Andaman Sea. Expressed as a ratio of catch value, management costs in the Gulf of Thailand are about 20 percent higher than in the Andaman Sea due to higher enforcement and administration costs. This is could be due to the greater number of fishing villages and the longer coastline of the Gulf of Thailand of 1874 km as against 740 km in the Andaman Sea. A higher share of the expenditures for resource rehabilitation occurred in the Andaman Sea.

Table 2: Est. Fisheries Management Costs: Thai Gulf (Mill. Baht)

Year	Admin.	Res.	Rehabil.	Enfor.	Total	Catch Valu	% Cat.Val.
1991	33	25	19	43	120	16,237	0.74
1992	48	78	-	57	183	18,083	1.01
1993	77	65	35	76	253	18,553	1.36
1994	73	67	24	79	243	21,949	1.11
1995	82	61	39	99	281	22,088	1.27
1996	92	71	41	112	316	19,813	1.59
1997	98	110	21	123	352	20,052	1.76
1998	82	101	65	108	356	19,618	1.82
1999	84	96	56	126	363	18,086	2.01

Incremental fisheries management costs

This section attempts to make estimates of future incremental fisheries management costs under the scenario that fishing capacity and effort are reduced to a level where a large part or most of the potential resource rent is captured. As these estimates are of a speculative nature, they should be interpreted cautiously and seen largely as an example of the order of magnitude of incremental fisheries management costs that may arise in countries of the Asian region where currently large excessive fishing capacities exist.

The first issue that arises in the discussion of incremental fisheries management costs is one of definition. Arnason, Hannesson and Schrank (2000:234) subsume the following set of activities under fisheries management:

(a) Research (biological and economic)
(b) Formulation,dissemination and implementation of management policy and rules
(c) Enforcement of management rules.

These activities are fairly wide ranging and we could be tempted to presume that the authors had in mind a broad definition of fisheries management costs that would also encompass time-bound downward adjustment costs in fleet sizes and employment to the optimal level. This issue is, however, not specifically addressed in their paper. In our view, and in accordance with the authors' activities under point (b) above, temporary adjustment costs would have to be subsumed under the definition of fisheries management costs. In fact, it could be argued that where large excess fleet capacities exist, fisheries management that does not encompass such adjustments would remain ineffective and fail to increase resource rents and resolve conflicts. Accordingly, we will distinguish three broad categories of incremental fisheries management costs as follows:

- time-bound adjustment costs that arise in a fleet reduction programme;
- time-bound adjustment costs to institute an effective fisheries management regime;
- recurrent incremental fisheries management costs for research, enforcement and fisheries management administration once the fleet has been adjusted and the fisheries management regime upgraded.

In this paper, reporting on 'work in progress', we shall solely address time-bound adjustment costs through a buy-back or decommissioning scheme.

Time-bound adjustment costs to reduce fleet size

It is helpful to commence this topic with a discussion of the nature of adjustment costs. The well elaborated methodology of economic analysis of projects provides guidance on this matter.[4] In fact, project analysis appears to be very well suited for an analysis of the costs and benefits of a fleet adjustment programme for several reasons: Firstly, as with a typical project, there are large up-front costs (i.e. adjustment costs) while the stream of benefits occurs in successive years far into the future. Secondly, project analysis encompasses distinct assessments of financial and economic performances. In the case of a fleet adjustment programme, it is desirable to assess performances from, at least, three points of view: (a) the owners of fishing capacity; (b) the government treasury and (c) the economy at large. Financial analyses would apply to (a) and (b), while the gist of economic analysis is to estimate net benefits from the point of view of the economy at large.

The primary differences between the financial and economic analysis are that the former measures the actual flows of financial costs and benefits while the latter applies efficiency prices for inputs and outputs and omits pure transfer payments between different agents in the economy. Efficiency prices are based on opportunity costing and shadow pricing (i.e. willingness to pay) wherever observed market prices deviate from competitive market prices. In project analysis, goods are commonly distinguished by whether they are internationally traded or not. Internationally traded goods are priced at their international market prices while non-traded goods are adjusted through a conversion factor that reflects the premium people may be willing to pay on traded goods over what they pay for non-traded goods. (Gittinger p. 247) The premium represents the amount that, on an average, traded goods are mispriced in relation to non-traded goods when the official exchange rate is used to convert foreign exchange prices into domestic values.

[4] Standard works on project analysis include the following: J.Price Gittinger (1984). Economic analysis of agricultural projects. Second, completely revised and expanded edition. Published for the Economic Development Institute of the World Bank by The John Hopkins University Press. Other standard literature includes : I.M.D. Little and J.A. Mirrlees (1974) Project appraisal and planning for developing countries. New York, Basic Books. Lyn Squire and Herman van der Tak (1975). Economic analysis of projects. Baltimore and London. John Hopkins. Partha Dasgupta, Amartya Sen and Stephen Marglin (1972). Guidelines for project evaluation. UNIDO,Vienna.

In the following, we discuss the financial and economic costs of an adjustment programme on the example of the demersal fisheries of the Gulf of Thailand. In our elaboration, we shall assume that capital and labour withdrawn from the demersal fisheries in the Gulf of Thailand can not be used in other fisheries in a manner that would increase resource rents in these fisheries (the only exception being inshore pushnet fisheries that would convert to other types of small-scale fishing gear). Thus, we assume that other fisheries are also currently subject to economic or even biological overfishing. Furthermore, we assume that withdrawn fishing capacity cannot be sold profitably outside the country. This assumption reflects the fact that most Asian fisheries are in a similar state as those of the Thai fisheries in the Gulf of Thailand. This does not imply that no buyers could be found for at least some vessel types, especially if they are of recent make and in good condition. Our assumption is rather based on the need to avoid adding fishing capacity to already over-exploited fisheries.[5]

Financial costs of decommissioning excess capacity

We shall first discuss the financial costs of removing excess capacity from the point of view of the owners and the government treasury. Ignoring cultural and traditional factors of attachment to the fishing profession[6], an owner may give up his fishing vessel if compensation would fully cover the present value of forgone income from such a step. The factors that may have a bearing on forgone income include the following:

1) The market price of the vessel that would depend largely on its remaining economic lifetime.

2) The value of the privilege to fish that would depend on expected future returns in the fishery.[7] The owners' expectations about future returns would likely be based on incomplete information. Initially, owners may presume that current profits (or losses) would be maintained into the future. However, once vessels are withdrawn and average profitability increases, owners will acquire better knowledge on the rent potential in the fishery and the demand for compensation is likely to increase. Thus, a firm commitment by government to extract a significant part of the resource rent as and when it arises in a vessel buy-back scheme could be crucial to containing the demand for compensation payments.

3) The ability to profitably invest in other economic activities that in turn would depend on several factors including attained educational level of the owner, knowledge about alternative investment opportunities, current indebtedness and asset holdings, ease of access to and cost of credit, growth of the national economy, etc.

It is difficult to quantify the influence of the factors in point 3) on the required compensation. The results of a recent household survey among owners of Thai fishing vessels in the demersal fisheries of the Gulf of Thailand suggest that these factors may have a bearing. The average educational level of vessel owners is low with less than five years of schooling. The fact that less than one percent have moved to their current residence suggests low geographic mobility. The high extent of ownership of residential and farm land (63%) is also indicative of low geographic mobility.

At first sight, occupational mobility also appears to be low because owners have spent on an average 18 years in fishing, their average age is 46, and fishing is for 95 % the main occupation. As generally observed in open access fisheries, there has been mobility into the Thai demersal fisheries. This is evidenced not only by increasing fleet sizes but also by the survey finding that more than one quarter of the sampled owners of trawlers have given up another occupation to enter fisheries.

It is notable that more than half of the pushnet owners expressed the wish to leave the fishing sector, primarily because of low income, an uncertain and risky future, and hard working conditions. The number of those wishing to

[5] This requirement may be inferred from, inter alia, two provisions of the International Plan of Action on the Management of Fishing Capacity. Paragraph 37 calls upon States to ensure that no transfer of capacity to the jurisdiction of another State should be carried out without the express consent and formal authorization of that State; and according to Paragraph 39 (ii) States should use appropriate measures to control the transfer of overcapacity to fully exploited or overexploited fisheries, taking into consideration the condition of the fish stocks. This latter paragraph is referring to major international fisheries requiring urgent measures (i.e. transboundary, straddling, highly migratory and high seas stocks which are significantly overfished).

[6] It is notable that in a recent sample household survey of Thai fishing vessel owners and crew, two-thirds of the owner-respondents and four-fifths of the crew-respondents did not wish their children to take up the fishing occupation.

[7] The lowest compensation a fisherman will accept to voluntarily surrender his fishing licence (or quota) is, in Hannesson's words (1989:16) "the present value of the difference between the income he expects to get from fishing and the income he expects to be able to get by doing something else." Hannesson adds that expectations about an uncertain future can make for nasty surprises.

leave is, though, smaller among owners of small trawlers (22%) and even less among owners of medium and large trawlers (10%). The latter, however, produce the bulk of the demersal fishing effort in the Gulf and contribute 72% to the total catch of 890 thousand tons.

While the expressed desire to leave fishing may say little about the actual ability to do so, there are indications that there is some potential mobility out of fishing. For example, more than one quarter of the respondents (primarily pushnet owners) indicated the availability of jobs in the vicinity and one fifth of the owners had another occupation.

We shall not attempt to quantify the potential influence of the degree of geographic and occupational mobility on acceptable compensation. That would have to be revealed through a bidding or tendering procedure. Instead, we make the simplifying assumptions that acceptable compensation is solely influenced by (a) the current market value of fishing assets and (b) the value of the privilege to fish.

The estimated current market value by type of fishing vessel is given in Table 3. The figures are partly based on the above-mentioned sample survey of 176 owners and partly on a cost and earnings survey conducted in 1999. Table 3 shows too the estimated number of fishing vessels engaged in the demersal fisheries (excluding about 18000 small-scale fishing units). The total current value of the fleet of trawlers and pushnetters engaged in the demersal fisheries of the Gulf of Thailand (excluding the fleet of trawlers above 25m operating outside Thai waters) is estimated in the order of B 9.6 billion (US $ 263 million). Notable is the high percentage of capital employed in medium and large otter board and large pair trawlers.

Table 3: Estimated current market value by type of fishing vessel

Type of vessel	No. of units	Av. Curr. Val. per unit (B)	Total value by fleet (B)	In percent of Gr. Tot.
Otterboard Trawl				
<14 m	2012	178570	359282840	3.7%
14 - 18 m	2052	1158353	2376940903	24.7%
18 - 25 m	1773	1818757	3224656847	33.5%
Pair Trawl				
14 - 18 m	16	2316707	37067305	0.4%
18 - 25 m	745	3637515	2709948507	28.2%
Push Net				
<14 m	2351	178570	419818070	4.4%
>14 m	331	1464470	484739570	5.0%
Grand total	**9280**	**1035825**	**9612454041**	**100.0%**

Table 4 shows the current age composition of the fleet (data refer to the entire fleet in Thai waters and are assumed to show no significant difference between the Andaman Sea and Gulf of Thailand). Notable is the high percentage of vessels that are respectively between 10 and 20 years of age and above 20 years of age. A high average age of the fleet is not an unusual feature of a mature open access fishery as average returns are low or negative and owners have a hard time to re-invest.

Ignoring differences between vessel types, we assume that the current market values by age category are as follows (expressed in percentage of the average current value[8]):

Age class	% of average
0-5	200
5-10	120
10-20	80
>20	40

On the basis of this percentage distribution and the age structure in Table 4 the estimated current value of the fleet by age class is shown in Table 5.

We assume that the buy-back or decommissioning scheme would target trawlers of 10 years and older and large pushnetters of all ages. Small pushnetters are assumed to change to other inshore fishing gear such as gillnetting, trap and line fisheries. Compensation for the shift from pushnetting to other fishing gear is assumed to amount to one third of the current value of fishing assets (i.e. B 60000 per pushnet unit).

[8] Once the survey data have been fully processed, current market values by age class will become available.

Table 4:Age composition of the Thai fishing fleet

Unit: percent

Years Type of vessel	0-5 years	5-10 years	10-20 years	> 20 years
Otterboard Trawl				
<14 m	13.0	6.0	46.6	34.4
14 - 18 m	5.8	6.0	52.9	35.3
18 - 25 m	14.3	21.4	35.7	28.6
Pair Trawl				
14 - 18 m	30.8	23.0	26.9	19.3
18 - 25 m	20.0	50.0	30.0	-
Push Net				
<14 m	13.3	13.4	40.0	33.3
14 - 18 m	20.0	50.0	20.0	10.0

Source: Somying Piumsomboon (1999)

Financial costs of compensating displaced fishing crew

On economic grounds, the most desirable form of compensation is through the creation of alternative jobs in profitable and competitive economic activities. The investment costs in such new jobs would pay for themselves under the assumption that the economic activity is profitable and competitive The role of governments in this venture is likely to be primarily at the level of macro-economic and sectoral incentive policies to strengthen economic growth rather than direct employment creation. Incentive measures would include the provision of soft loans and occupation/business specific supply of infrastructure and other support.

A supplementary role could be in the areas of information provision on job openings and skill-training. The scope of re-training for other jobs may be limited for some groups of fishermen, especially those with low levels of formal education and those beyond a certain age. For these fishermen who are elsewhere unemployable, permanent direct income support might be needed.

In the demersal fisheries of the Gulf of Thailand, a special feature is the fact that on medium and large sized trawlers, most of the ordinary crew members are of Burmese origin. Their current number is estimated in the order of 16000. The assumption will be made that economic incentives would be provided to them in proportion to the ratio between the Thai and Myanmar GDPs.

For our exploratory calculations we shall assume that crew compensation would amount to B 91000 per person (approx.US $ 2500), equal to two times the minimum annual wage level of approx. B 45500. While this is an arbitrary amount it could be justified on the ground that it provides a minimum income for a length of time that gives a reasonable high probability for a displaced fisherman to find another job. For crew of Burmese origin, the compensation is adjusted downwards by the ratio of the Thai and Myanmar per capita GDP at purchasing power parity of 7:1. Thus, the compensation would be B 13000 (US $ 356) for a displaced Burmese crew member. This is a low, and possibly too low, estimate of required compensation.

Table 5 Estimated current value of trawlers and pushnetters by age class (Baht)

Age class	0-5 years	5-10 years	10-20 years	> 20 years	Total
Type of vessel					
OB Trawl <14m					
No. of units	262	121	938	692	2012
Curr. Value/unit	386766	232060	174045	96692	178570
Total Curr.Value	101162593	28014257	163183044	66922946	359282840
OB Trawl 14-18m					
No. of units	119	123	1086	724	2052
Curr. Value/unit	2756015	1653609	1240207	689004	1158353
Total Curr.Value	328009927	203592369	1346254537	499084070.1	2376940903
OB Trawl 18-25m					
No. of units	254	379	633	507	1773
Curr. Value/unit	3611870	2167122	1625342	902968	1818757
Total Curr.Value	915750033	822253876	1028777922	457875016.6	3224656847
Pair Trawl 14-18m					
No. of units	5	4	4	3	16
Curr. Value/unit	3765166	2259099	1694325	941291	2316707
Total Curr.Value	18554737	8313486	7292373	2906708	37067305
Pair Trawl 18-25m					
No. of units	149	372.5	223.5	-	745
Curr. Value/unit	5728370	3437022	2577766	-	3637515
Total Curr.Value	853527089	1280290633	576130785	-	2709948507
Push Net <14m					
No. of units	313	315	940	783	2351
Curr. Value/unit	374635	224781	168586	93659	178570
Total Curr.Value	117142145	70813748	158538241	73323936	419818070
Push Net >14m					
No. of units	66	166	66	33	331
Curr. Value/unit	2381252	1428751	1071563	595313	1464470
Total Curr.Value	157638885	236458327	70937498	19704861	484739570

Simulation results

The BEAM 5 simulation model was used to make estimates of the financial and economic effects of a decommissioning scheme and of the value of the privilege to fish. Due to data constraints, the input parameters may have considerable error margins. For this reason as well as for the many uncertainties that surround predictions of future resources abundance and of economic parameters, the simulation results should be interpreted cautiously and seen solely in terms of order of magnitudes.

BEAM 5 is a multispecies[9] and multifleet software implementation of a bio-economic stochastic simulation model. On the biological side, BEAM 5 is based on a non-equilibrium dynamic Thompson & Bell type model. The economic model is based on the concepts applied in project analysis. The principal performance measure applied in BEAM5 is the financial and economic net present value. The simulation model calculates separately financial NPVs for the fishing fleet(s) and the government treasury. The performance criterion for determining optimal fleet size is through the economic NPV. In the calculation of the latter, transfer payments are excluded, fisheries management costs are included and inputs are valued at efficiency prices. Further details are given in Sparre and Willmann (forthcoming).

The parameter values used in the simulation model of the Thai demersal fisheries in the Gulf of Thailand have been derived from a recent workshop.[10] The basic dimensions

[9] Only at the gear level as predator-prey relationships are not considered.

[10] The Thai Department of Fisheries workshop on bio-economic modelling of the Thai demersal fisheries in the Gulf of Thailand, Hua Hin, 31 May to 9 June 2000 was

of the model include 9 species or species groups, 8 fleets and two areas (inshore and offshore). Trawlers have been divided into 5 fleet categories according to length classes and gear types (i.e. otter board or pair trawl). Similarly, pushnetters have been divided into two size classes. The category "Other gear" includes a large variety of small-scale inshore fishing units. This category employs about one third of the estimated one hundred thousand fishermen engaged in the demersal fisheries in the Gulf. In the current simulation runs of the buyback programme, we have made the assumption that the number of fishing units and fishing effort remain constant of the inshore small-scale sector.[11] As trawling and pushnet fishing are reduced, this sector would greatly benefit in terms of increased profits. Thus, there would be heavy pressure for new entries in the absence of improved fisheries management. Improved management would require significant investments into the establishment of community-based or co-management schemes. Management cost estimates will be incorporated in a final version of this paper.

The simulation results are summarized in Table 6. The simulation horizon is 14 years whereby most output values remain stable from about the 3rd year onwards. This is largely due to the fact that except for grouper, the present catch comprises nearly exclusively fast growing and short-lived species.

The simulation results indicate that the annual financial net cash flow of the total fleet would increase more than 10-fold from B 719 million (US $ 19.7 million) to B 7.38 billion (US $ 202 million) if the fleets of trawlers and pushnetters were reduced to about 30% of current level. In spite of the high level of overcapitalization, the country appears to benefit substantially at current fleet size because some resource rent is captured through fuel taxes. The extent of fuel tax receipts, however, may have been over-estimated in this modelling exercise because of the unknown share of fuel purchased at sea outside Thai territorial waters. This may explain why some fleet segments continue to operate in spite of the simulated high losses, on average, based on the current set of parameters.
The high fuel tax income would allow the government to finance the decommissioning scheme without incurring a negative NPV except at the desirable level of fleet reduction of about 70 percent. In fact, fuel tax receipts would decrease with fleet size, thus enlarging the gap between needed compensation payments and revenues At the assumed level of compensation, however, the decommissioning scheme could be financed through a nearly 50-fold increase in fishing license fees for the reduced fleet of trawlers.[12] Even at this level of licence fees, the fleet would show in aggregate a high net financial cash flow of some B 6.6 billion (US $ $ 180 million). However, much of this amount would accrue to the inshore small-scale fisheries which is currently not subject to license fees. It might be doubtful that such fees could be levied in a cost effective manner in future.

Compared to the base year, in the year of decommissioning (in actual fact such a scheme may be stretched over a number of years) the government's net financial cash flow would drop by some B 7.6 billion (US $ 209 million). While this would be a very heavy burden on the Government budget, it appears not large in relation to the net benefit it could create for the national economy. At a discount rate of 12 percent (frequently used in World Bank funded investment projects), the NPV of net economic benefit would increase by 160% from B 21.7 billion (US $ 610 million) to B 56.4 billion (US $ 1.5 billion). At a lower discount rate of 8%, the NPV would increase to B 70.79 billion (US $ 1.94 billion).

Conclusion

Current Thai fisheries management is focused on technical management measures. Management expenditures expressed as a share in catch value appear to be small in comparison to the few other countries for which estimates have been made. The low level of management expenditures, however, is unlikely to be the sole, or even the primary reason, why Thai marine fisheries have largely remained open access.

As entry has remained free and open, a large share of the resource rent is currently dissipated. Still, through fuel taxes, the Government continues to extract a small share of a potentially large resource rent. To realize this potential, Thai fisheries would have to undergo a dramatic down-size adjustment of the fleet of trawlers and pushnetters. It is likely that political consensus on a drastic fleet reduction programme could only be obtained if a compensation scheme is established by the Government for those who would leave the fishery.

supported by FAO, the FAO/Norway Fish Code Project and ICLARM. (Thai DOF, FAO/Norway FISHCODE PROJECT, FAO. Forthcoming)

[11] The shift of small-scale pushnetters to other gear types will be considered in future simulation runs once estimates have been made on the increase in fishing effort (and mortality) in the ' other gear' category from such a shift.

[12] No license fee is considered for the pushnetters because the intent of the Thai Government is to ban pushnetting entirely. In the simulation exercise, the assumption is made that a ban cannot be enforced in full and thus, a small fleet may continue to operate illegally.

Table 6: Summary of simulation results of a decommissioning scheme

	Base year	Decommissioning of trawlers and pushnetters			
		minus 25%	minus 50%	minus 70% [pushnet -85%]	minus 70% (48-fold lic. fee)
Total catch value	18096	17366	16147	14065	14065
Total catch	884477	791606	656803	447643	447643
Av. sales price (B)	20	22	25	31	31
Crew No,	104100	85783	67474	50933	50933
No. of trawlers	7363	5519	3680	2153	2153
No. of pushnetters	2682	2011	1340	400	400
Small-scale units	18170	18170	18170	18170	18170
Vessel compensation	0	1372	2745	4595	4595
Crew compensation	0	587	1173	1672	1672
Licence fee	55	41	28	14	774
Fuel tax	1845	1403	962	494	494
Fleet Fin. NCF	719	3414	5645	7388	6628
Fleet NPV (r = 12%)	4765	22312	36912	48009	43649
Gov. Fin. NCF*	1660	-741	-3141	-5958	1028
Gov. NPV (r = 12%)	11003	6247	1492	-3781	578
Eco. NCF	3280	5749	7750	8893	8893
Eco. NPV (r = 12%)	21743	37260	49656	56439	56439
Eco. NPV (r = 8%)	27044				70790

*Remark: The Gov. net financial cash flow is shown for the year of decommissioning except for last column where it is shown for the year following the decommissioning

The approximate current exchange rate is B 36.5 = US $ 1

The simulation results indicate that compensation could be financed through extracting the higher resource rent that a smaller fleet would generate. However, rent extraction could be costly, or entirely impossible, among the small-scale operators who would be among the main beneficiaries of the adjustment programme. Without adequate safeguards, the increased returns in the inshore small-scale fisheries could induce redundant investments and a dissipation of resource rent. Therefore, substantial investments into community-based management and co-management schemes in these fisheries should accompany a decommissioning programme for the industrial sector.

Acknowledgement

The authors would like to acknowledge the contribution of the following persons to the implementation of BEAM 5 to the Thai demersal fisheries in the Gulf of Thailand: Mr. Per Sparre, Ms. Wasana Khamchompoo, Ms. Jiraporn Linlapo, Ms. Atchara Vibhasiri, Ms Pismorn Isara, Ms. Ratanawalee Phoonsawat, Ms. Jintana Jindalikit, Ms. Pakjuta Khaemakorn, Mr. Suthep Jualaong, Mr. Kanit Chuapun, Ms. Suvimol Sanalak, Ms. Tan Geik Hong, and Mr. Zhang Xiang-guo.

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