Renewable Resources in the Pacific
Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981
Renewable Resources in the Pacific

Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981

Editors: H.E. English and Anthony Scott

1Department of Economics, Carleton University, Ottawa, Canada.
2Department of Economics, University of British Columbia, Vancouver, Canada.
The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

©1982 International Development Research Centre
Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa, Canada

English, H.E. Scott, A. IDRC-181e


/ Renewable resources/, / forest resources/, / fishery resources/, / energy sources/, / Pacific region/ — / regional cooperation/, / fishery development/, / fishery economics/, / fish products/, / fishing rights/, / forestry development/, / forestry economics/, / forest products/, / timber/, / overexploitation/, / foreign investments/, / trade/, / regulations/, / fiscal policy/, / case studies/, / conference report/, / list of participants/, / bibliography/.

UDC: 620.91(9) ISBN: 0-88936-312-9

Microfiche edition available
Technical editing: Amy Chouinard
Contents

Foreword 5
Preface 6
Introduction 7

General Studies
Intensive, Extensive, and Optimal Development of Forestlands
Anthony Scott 13
Optimizing the Use of Ocean Fish Resources in the Context of Extended National Jurisdictions Parzival Copes 33
Discussion Peter Drysdale, Narongchai Akrasanee, John Bene, Wontack Hong, Francis T. Christy Jr 48
Trade and Investment in Fish Products among Pacific-Area Countries
Biing-Hwan Lin, Rebecca J. Lent, and Richard S. Johnston 57
Discussion Hak Yong Rhee, Yoshiaki Matsuda 71
Pacific Trade and Investment in Forest Products K.L. Aird and W.A.J. Calow 73
Discussion Kenji Takeuchi 81
The Northeast-Asian Market Economies’ Response to Tighter Controls on Fish and Forest Resources Sueo Sekiguchi 83
Discussion Helen Hughes 89
Resources of the Eastern USSR Jan J. Solecki 91

Forestry Case Studies
Forest Plantations, Production, and Trade in the Pacific Basin
Roger A. Sedjo 97
Discussion K. Hemmi 102
Pacific Northwest Timberlands David R. Darr 103
Discussion Wontack Hong 115
Development Prospects for Forestry in Indonesia A.T. Birowo 117
Discussion R.N. Byron 120
Tree Crops in Malaysia Francis K. Chan 123
Discussion Mohamed Ariff 133

Fisheries Case Studies
The Economic Future of Alaska Groundfish under Extended Jurisdiction
R.L. Stokes 137
Discussion Yoshiaki Matsuda 142
Canadian Regulation of Pacific Fisheries David G. Moloney 144
Discussion Yoshiaki Matsuda 154
The Developing Skipjack Tuna Fishery of the Central and Western Pacific Ocean David J. Doulman 156
Discussion Theodore Panayotou 163
Fisheries Development in the South China Sea Teruji Sakiyama 165
Discussion Aida R. Librero, Norman J. Wilimovsky, Theodore Panayotou 171
The Squid Fishery in New Zealand: the Role of Joint Ventures and Foreign Fleets C.C. Wallace 178
Export Potential of Coastal Shrimp Cultured in Thailand Kamphol Adulavidhaya and Thanwa Jitsanguan 188
Discussion Hugh Patrick 193

Renewable Substitutes for Fossil Fuels
Substitution of Nonexhaustible Resources for Fossil Fuel Energy and Industrial Raw Material Resources Ben Smith and Hugh Saddler 197
Discussion Miguel S. Wionczek 207
Prospects for Renewable Energy Resources in South Korea Hoesung Lee and Jee Dong Kim 209
Discussion Romeo M. Bautista 219
Energy Constraints and the Open Economic Strategy in China’s Modernization Li Guong-on and Luo Yuanzheng 221
Discussion Jan J. Solecki, Lawrence B. Krause 227

Policy Issues
Location of Mechanical Processing of Tropical Hardwood K. Takeuchi 233
Discussion Alhambra Rachman 245
Cooperative Fisheries Arrangements between Pacific Coastal States and Distant-Water Nations Gordon R. Munro 247
Discussion K. Hemmi 254
Fiscal Policies and Resource Rents in the Extraterritorial Oceans Ross Garnaut 256
Discussion T.K. Shoyama, Hugh Patrick 267

Summary Keith A.J. Hay 271

References 279

Participants 291

Official Hosts and Observers 293
Export Potential of Coastal Shrimp Cultured in Thailand

Kamphol Adulavidhaya and Thanwa Jitsanguan

Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand

Thailand is searching for a new marine resource to meet its future demand for fishery products and to maintain the contribution of fisheries to the national economy. The cultivation of marine shrimp appears particularly advantageous as a means to expand production for export. To obtain one unit of foreign exchange from this export would require only 0.55–0.77 units of domestic resources. In other words, the cost in bahts to realize U.S.$1 from export would be only 12.97–18.14 baht at the shadow exchange rate. Therefore, the promotion of coastal shrimp farming is highly recommended, and government policies that encourage its growth should be formulated.

La Thaïlande s’engage dans l’exploitation d’une nouvelle richesse marine afin, d’une part, de répondre à la demande toujours croissante de produits de poisson et d’autre part, de maintenir la contribution de ce secteur à l’économie du pays. L’élevage de la crevette marine est particulièrement indiqué, étant donné les possibilités d’exportation de cette espèce. Il n’en coûterait à la Thaïlande que de 0,55 à 0,77 unité monétaire locale par unité de devise étrangère; par exemple, au taux de change fictif, cette production rapporterait 1 $ US pour de 12,97 à 18,14 bahts. L’élevage intensif de la crevette dans les eaux côtières est donc hautement recommandé et le gouvernement doit élaborer une politique qui favorisera la mise en œuvre de cette nouvelle industrie.

With a long and fertile coastline of 1900 km along the Gulf of Thailand and another 700 km along the Andaman Sea, Thailand has long supported a thriving fishing industry. Of its total 72 provinces, 22 are located in such areas. However, only after 1960, did fishing operations become more than subsistence activities with stationary gear such as bamboo traps, fence traps, block nets, and winged set bags, etc. The contribution of fishing to the Thai economy was minor — a source of village employment and domestic food supply.

The rapid development of the fishing industry began when Thailand, with the technical cooperation of the German government, succeeded in using a movable gear — trawl nets — in the Gulf of Thailand. The otter-board trawl proved most effective among the various types of trawl net and became increasingly popular. Trawl nets have gradually replaced all other equipment, including the Chinese purse seine. During 1960–70, the number of fishing boats increased from about 700 to more than 5000. Thus, the Thai fishing industry has become one of the most vigorous sectors of the economy.

Thailand now has the most developed fishing industry in Southeast Asia and, in terms of production, is one of the top 10 countries in the world (Table 1). The industry is not only a source of employment but also a source of foreign exchange. In 1979, it comprised about 25,000 fishing boats, earning 7326 million baht (U.S.$358.24 million) from exports of only 15–20% of the total catch. In Thailand, the per-person consumption of fish is about 20 kg annually. About 300,000 people are now directly involved in the industry, and not fewer than 100,000 are involved in related activities such as cold storage, processing, and ice industries.

Current Problems

Thailand’s fishery production increased gradually from about 170,000 t in 1957 to 762,188 t
and 1.47 Mt in 1967 and 1971 respectively. In 1977, the total catch of marine fish was 2.07 Mt; this was the highest production ever achieved by the Thai fishery. The growth in production reflected two key factors: the efficiency in management as well as technology and the fertility of the natural marine resource in the Gulf of Thailand.

In a survey conducted in the Gulf of Thailand, the Department of Fisheries found that an hour of trawling in 1965 produced 300 kg; by 1973 this number had dwindled to 57 kg (Manasawet 1976); and, in 1978, a survey conducted by Kasetsart University revealed that the fish captured in an hour of trawling in some areas around the Gulf of Thailand had dropped to 30 kg. These figures indicate that the fish resource is inadequate to support current trawling efforts. As a consequence, the amount of fish captured per unit of fishing effort must be decreasing. The maximum sustainable yields of demersal fish from the Gulf of Thailand and the Andaman Sea have been, respectively, estimated to be not greater than 500 000 and 200 000 t annually; the figures for pelagic fish are about 380 000 and 100 000 t. The reason that fishery production has continued to increase (average annual production for the last decade was 1.75 Mt) is that a considerable number of fish have been taken from waters outside the Thai boundaries — the Indian Ocean and South China Sea and joint-venture projects with neighbouring countries like Bangladesh. The ratio of fish by-catch (Thailand, Government of 1979) to the total catch increased from 33% in 1970 to 48% and 65% in 1973 and 1976, respectively, whereas it accounted for only about 10% of the total-catch value. Moreover, only 46% of the by-catch is species that would be unsuitable for domestic consumption or export if given time to mature. Therefore, the increase in by-catch production incurs a long-run economic loss to the Thai economy.

Other factors that have had negative effects on the Thai fishery industry are the expansion of exclusive economic zones and the oil crisis. Almost half of the total fish production in recent years has come from waters now under coastal states’ jurisdiction, and the input cost of oil has accounted for 30–50% of the total costs in operating a common trawler.

The spectacular development of the fishing industry has benefited only the large-scale operations (Panayotou 1979); small-scale operators, who are the majority (70%) of the fishing-dependent population, account for only 30% of the total catch. Using traditional fishing gear, such as bamboo traps, hooks, winged set bags, etc., they must compete with modern trawlers for a portion of the fishing grounds and inshore resources. Thus, they not only have not participated in the recent boom of the Thai fishery industry but also have lost ground in their occupation.

One solution to the problems facing the Thai fishery is to enlarge the source of fish production through cultivation, in particular, cultivation of marine shrimp along the fertile coastlines of the country.

Although 85% of shrimp production is at present consumed domestically, shrimp is the most important marine export. The commercial shrimp species in Thailand can be categorized as white (Penaeus merguiensis), flower (Penaeus semisulcatus), black tiger (Penaeus monodon), and pink (Metapenaeus monoceros) (Koyama 1976).

---

### Table 1. Fishery production and exports, Thailand, 1970–78.

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity (10³ t)</th>
<th>Value (million baht)</th>
<th>Quantity (10³ t)</th>
<th>Value (million baht)</th>
<th>Quantity (10³ t)</th>
<th>Value (million baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>1335</td>
<td>4096</td>
<td>112</td>
<td>906</td>
<td>44</td>
<td>369</td>
</tr>
<tr>
<td>1971</td>
<td>1470</td>
<td>4554</td>
<td>116</td>
<td>973</td>
<td>55</td>
<td>497</td>
</tr>
<tr>
<td>1972</td>
<td>1548</td>
<td>4936</td>
<td>131</td>
<td>1371</td>
<td>82</td>
<td>807</td>
</tr>
<tr>
<td>1973</td>
<td>1538</td>
<td>6562</td>
<td>140</td>
<td>1646</td>
<td>104</td>
<td>1649</td>
</tr>
<tr>
<td>1974</td>
<td>1351</td>
<td>4093</td>
<td>158</td>
<td>1646</td>
<td>88</td>
<td>1548</td>
</tr>
<tr>
<td>1975</td>
<td>1394</td>
<td>5102</td>
<td>106</td>
<td>2092</td>
<td>98</td>
<td>2106</td>
</tr>
<tr>
<td>1976</td>
<td>1551</td>
<td>5968</td>
<td>147</td>
<td>2152</td>
<td>133</td>
<td>3097</td>
</tr>
<tr>
<td>1977</td>
<td>2067</td>
<td>8622</td>
<td>122</td>
<td>2038</td>
<td>180</td>
<td>3590</td>
</tr>
<tr>
<td>1978</td>
<td>1957</td>
<td>11458</td>
<td>141</td>
<td>2369</td>
<td>235</td>
<td>5086</td>
</tr>
</tbody>
</table>

Source: Department of Fisheries, Fisheries Record of Thailand, Bangkok, Ministry of Agriculture and Cooperatives, various issues.
Thailand started trading shrimp in the 1950s and accelerated its export in 1962 when Japan began to import the products at a relatively high price. Because of the export demand, the Thai shrimp industry has emphasized quality control and standardization of products. This emphasis encouraged the growth of the cold-storage industry, which gradually increased from 3 units in 1963 to 24 and 32 units in 1973 and 1977, respectively. During 1962–72, annual exports of shrimp were about 6000 t, rising to about 14000 t after 1973. In 1980, Thailand exported 18000 t of shrimp to the world market, with Japan importing about 56.21% of this amount (Table 2).

Most of the shrimp traded internationally are beheaded and frozen in a block or beheaded, peeled, deveined, and frozen individually.

The export market for shrimp is still considerable. Although Thai shrimp account for only 6–10% and 1–2% of the shrimp imported respectively by Japan and the United States, they represent 60% and 15% of Thailand's total exports in marine products. The annual increase in export price between 1967–78 was 11.68%, whereas the increase in amount exported was only 7.71%.

Shrimp Cultivation

There is no record of when shrimp cultivation began in Thailand, but local shrimp farmers say it was practiced before 1930. Historically, farmers reclaimed estuaries around their rice fields, allowing the brackish water to flow in and out of the fields after the paddy had been harvested. Thus, the fields became sanctuaries for shrimp and other species. Eventually, the profit from selling the shrimp led some farmers to full-time shrimp cultivation. The industry received renewed interest about 1950 when prices for salt dropped, and many salt farmers switched to shrimp-pond operation.

Conditions in Thailand are favourable for shrimp farming: the temperature is lower than 34°C along the coastline, and there are rich natural food areas (about 72 720 ha coastline). Although the area under shrimp cultivation almost trebled between 1970 and 1979, it is still less than half the potential.

Cultivated shrimp totaled 664 t in 1979, of the total 63 652 t harvested. In 1972, the Thai government initiated a shrimp culture development program in the Third Development Plan (1972–76). Three marine fishery stations were established to conduct research and to produce shrimp seeds for shrimp farmers.

Increases in cultivated shrimp, however, have mainly been reflections of the response by private shrimp farmers to higher market prices. To date, most shrimp farming in the country is still done with traditional techniques. Hence, the production has remained far below the target in the development plan.

To test the hypothesis that shrimp farming in Thailand is economic, we have evaluated the endeavour's social costs and returns; we have also attempted to determine whether or not Thailand would have a comparative advantage in the production of cultivated shrimp and how much foreign exchange the country could earn from exports of cultivated shrimp.

The data derive from traditional operations in 1980 at Samutsakorn, a province at the mouth of Chao Phraya River and the Gulf of Thailand.

Table 2. Marine shrimp production and exports, Thailand, 1970–79.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th></th>
<th>Export</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity</td>
<td>Value (million baht)</td>
<td>Quantity</td>
</tr>
<tr>
<td>1970</td>
<td>63653</td>
<td>1527</td>
<td>6421</td>
</tr>
<tr>
<td>1971</td>
<td>67614</td>
<td>1758</td>
<td>5593</td>
</tr>
<tr>
<td>1972</td>
<td>66887</td>
<td>1872</td>
<td>6726</td>
</tr>
<tr>
<td>1973</td>
<td>77525</td>
<td>2635</td>
<td>14875</td>
</tr>
<tr>
<td>1974</td>
<td>80093</td>
<td>1141</td>
<td>10251</td>
</tr>
<tr>
<td>1975</td>
<td>87039</td>
<td>1498</td>
<td>13541</td>
</tr>
<tr>
<td>1976</td>
<td>86672</td>
<td>1987</td>
<td>15218</td>
</tr>
<tr>
<td>1977</td>
<td>118953</td>
<td>2844</td>
<td>13663</td>
</tr>
<tr>
<td>1978</td>
<td>127414</td>
<td>4247</td>
<td>15378</td>
</tr>
<tr>
<td>1979</td>
<td>na</td>
<td>na</td>
<td>18626</td>
</tr>
</tbody>
</table>

*na = not available

Source: Department of Fisheries, Fisheries Record of Thailand, Bangkok, Ministry of Agriculture and Cooperatives, various issues.
Table 3. Cost structure of shrimp cultivation in Thailand, 1980.

<table>
<thead>
<tr>
<th>Item</th>
<th>Costs (baht/rai)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30-rai farm</td>
</tr>
<tr>
<td>Investment</td>
<td>3099</td>
</tr>
<tr>
<td>Water pump</td>
<td>833</td>
</tr>
<tr>
<td>Water gate</td>
<td>1333</td>
</tr>
<tr>
<td>Drain</td>
<td>533</td>
</tr>
<tr>
<td>Warehouse</td>
<td>333</td>
</tr>
<tr>
<td>Other</td>
<td>67</td>
</tr>
<tr>
<td><strong>Annual operating costs</strong></td>
<td><strong>2733</strong></td>
</tr>
<tr>
<td>Fuel</td>
<td>833</td>
</tr>
<tr>
<td>Pond maintenance</td>
<td>700</td>
</tr>
<tr>
<td>Labour</td>
<td>1200</td>
</tr>
</tbody>
</table>

Yields per rai (0.16 ha) were 60 kg/year, with an average farm-gate price of 70 baht/kg (U.S.$1 = 20.45 baht) (Table 3).

Methods

We assumed that Thailand would have a comparative advantage in shrimp cultivation for export if the domestic resource cost in producing one unit of foreign exchange were less than the shadow price of foreign exchange (Bruno 1972). To such a model, the two numerator terms are the direct domestic factors including land, labour, and capital evaluated at their opportunity costs and the indirect nontraded domestic commodity inputs, whereas the denominator is the net foreign exchange earned. To make the model more applicable to Thailand where the inputs and outputs for the agricultural sector are not available, we used a modified version of the model (Pearson et al. 1976) such that the domestic inputs were divided into tradable (if they were fully traded) and nontradable (if they were not fully traded). The nontradable inputs were subdivided again into tradable components and primary domestic factors.

We calculated opportunity costs of land, labour, and capital. In general, the land would be used for mangrove-tree growing, the net benefits of which, according to Department of Forestry data, would be 123 baht/rai annually. We multiplied the number of person-days (both hired and family labourers) by the market wage rate. Funds invested in the fixed assets were assumed to be 15%, and 10% depreciation was assumed.

Indirect costs of production were the intermediate input costs incurred in shrimp cultivation: costs for fuel, shrimp seed, pond maintenance, transportation, marketing, and processing (conversion ratio from raw to frozen shrimp was 1:0.65). Cost of input at the farm-gate price was calculated as the sum of the foreign content of the input, the value of the input generated in the country, and overall taxes levied by the Thai government. Because our study concentrated on traditional cultivation, in which shrimp seeds are obtained from natural seawater, the opportunity cost for the use of shrimp seeds was zero.

The price of foreign exchange or the social value of production is the FOB price of one unit of output, whereas the private value of production is the FOB price less all direct and indirect taxes at the border. These taxes are export duty, business tax, municipal tax (and other equivalent tax in terms of premium or quota for some commodities such as rice). In this study, the social value of the final output was the FOB price/kg of frozen shrimp, which is 130 baht, the private value being 127.14 baht.

The shadow price of foreign exchange, which is the rate of exchange that would apply if there were no trade barriers such as tariffs, taxes, subsidies, etc. (McCleary 1976), is the product obtained from multiplying the official exchange rate by the sum of the foreign exchange premium (weighted average of import barriers and export subsidies) plus 1. The official exchange rate for 1980 was 20.45 baht/U.S.$1 and the foreign exchange premium 0.15; hence, the shadow exchange rate 23.52 baht/U.S.$1.

Findings and Implications

The domestic resource cost would be 0.55–0.77/unit of foreign exchange; that is, Thailand would spend 11.28–15.77 baht/U.S.$1 at the official exchange rate or 12.97–18.14 baht/U.S.$1 at the shadow exchange rate. The social benefits from investment would be more than 2000 baht/rai, and society would receive a net benefit of between about 1000 and 2000 baht, depending on the scale of operation with increasing returns to scale (Tables 4 and 5).

The activity is highly labour intensive, with labour costs accounting for 63% of the total domestic cost and capital costs accounting for only 32%. Shrimp farming, therefore, could be a means of decreasing unemployment in the country. Jobs would be created both directly in the farm and indirectly in activities such as processing, cold storage, transportation, and marketing.

To determine the relationship between factor costs and the comparative advantage in shrimp production, we estimated the domestic resource cost sensitivity and found again that labour costs were more significant than any other factors. An increase in cost of 1.56% (30-rai operation) or 1.58% (50-rai farm) would result in an increase of

<table>
<thead>
<tr>
<th>Item</th>
<th>30-rai farm</th>
<th>50-rai farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct</td>
<td>Indirect</td>
</tr>
<tr>
<td>Primary factor costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>1200</td>
<td>882</td>
</tr>
<tr>
<td>Capital</td>
<td></td>
<td>368</td>
</tr>
<tr>
<td>Opportunity cost</td>
<td>464</td>
<td></td>
</tr>
<tr>
<td>Depreciation (on nontraded only)</td>
<td>226</td>
<td></td>
</tr>
<tr>
<td>Foreign input costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>517</td>
<td></td>
</tr>
<tr>
<td>Transportation, marketing</td>
<td>116</td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>Tax, tariff</td>
<td>264</td>
<td></td>
</tr>
</tbody>
</table>

1% in domestic resource cost. The elasticities with respect to capital and foreign-input costs for 30- and 50-rai farms were 3.09, 3.15 and 4.93, 5.95 respectively; land exhibited the highest value (20.00, 26.66), the effect of this elasticity being relatively insignificant compared with the other factors. The elasticity with respect to yield was negative, indicating that increasing yield per rai by 0.93%, 0.96% would decrease cost by 1%.

Policy Recommendations

The potential of shrimp cultivation indicates that government should implement policies that promote increased shrimp production along the coast. Improvements in cultivation technology such as shrimp pond management, use of fertilizer and feed, and removal of predator fish should be a priority, and training programs in shrimp farming should be provided by the government. Moreover, effective credit and marketing systems are needed for this industry to grow. One direct way to increase shrimp production is to increase the shrimp-seed supply; thus, government should aim for increases in its shrimp-seed producing units (usually within the fishery station) as well as those within the private sector by providing both financial and technical support.

Mangrove Preservation

Expansion of the area devoted to shrimp production should be directed in such a manner that mangrove forests are preserved. Because the forests are essentially natural sources of shrimp seed and feed, destroying the mangrove trees should be avoided and the boundaries of the forest reserve should be clarified.

Environment Controls

Environmental pollution from the industrial sector, especially from factories located near the river estuary, must be carefully controlled because contaminated water would be a hazard to the shrimp seeds. Also, control of overfishing is important in the promotion of shrimp cultivation. Particularly, enforcing the prohibition of trawling inshore would mitigate shrimp-seed scarcity and encourage a biologic equilibrium. Overfishing in Thailand is the core of all fisheries problems in the country and must be controlled.