Optimal Fish Shipments From Kuala Trengganu, Malaysia

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Approximately 80 percent of all fish landed in Malaysia is landed on the peninsula or West Malaysia. In recent years, government programs to bring about higher and more equitable prices to fishermen in West Malaysia have included marketing regulatory schemes in major fish wholesale centers. In Kuala Trengganu on the east coast of the peninsula, MAJUIKAN, the Federal Fisheries Development Authority, has directed that all fish landed in the area be marketed through the central wholesale fish market at Pulau Kambing. About 5 percent of the total peninsular landings is channelled through this facility. A system of bidding up prices for graded fish above a predetermined minimum floor level has been advocated with limited success. Market intermediaries have not responded to bidding up prices as long as supply and demand conditions do not warrant such actions, and also compensatory adjustments to recoup losses are not possible. This would tend to indicate that if there are potential gains in marketing efficiencies to be captured, such potentials must be sought elsewhere in the marketing chain from fishermen to consumers.

An important component in the marketing margin for fresh fish is the cost of transportation from supply points to consumption centers. Since the economic functioning of this transfer system spans wider time and space horizons than the wholesale market center itself, there is reason to suspect that efficiency gains may be possible in this wider distribution network. An analytical approach which can shed light on this prospect is the transportation model.

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The Transportation Model

The purpose of the transportation model is to compute the optimum shipment pattern of a product from its sources of supply to its consumption centers. Using the mathematical programming approach, the objective is to minimize the total costs of transportation subject to sets of linear structural constraints that establish the boundary conditions for solving the problem. In the case of fresh fish distribution, a simple adaptation of the model can be specified as follows:

Minimize:

$$TC = \sum_{i=1}^{n} \sum_{j=1}^{m} C_{ij} Q_{ij} \quad \text{(Objective function)}$$

Subject to:

$$\sum_{j=1}^{m} Q_{ij} = B_i \quad \text{(Capacity constraints)}$$

$$\sum_{i=1}^{n} Q_{ij} = R_j \quad \text{(Requirement constraints)}$$

$$Q_{ij} \geq 0, \text{ all } i, j \quad \text{(Non-negativity constraints)}$$

where:

C_{ij} = unit transportation cost for middle man i, to market j (M$/picul).

Q_{ij} = quantity of fish shipped by middleman i, to market j (piculs).

B_i = shipping capacity of middleman i (piculs).

R_j = market requirement of market j (piculs).

A standard unit of weight measure in Malaysia is the picul, which is equivalent to 60.48 kg. All money values are expressed in terms of Malaysian dollars (M$) which, at the time of this study, had an exchange rate of M$1=US$0.40.

All species of fish can be lumped together for the purposes of this model since the same unit transportation cost applies to all species. In the solution of the problem, the optimal shipping pattern can be obtained by using ($n+m$-1) number of routes, i.e., one less than the sum of supply and destination points. In this case, the number of shippers is counted as supply points.

Existing Pattern of Shipments

Six out of nine market intermediaries shipping fresh fish out of the Pulau Kambing wholesale market to seven major consumption centers around West Malaysia were selected for this study (Fig. 1). The other market intermediaries are essentially minor part-time operators whose main function is to help clear the market during periods of extraordinary supply and demand conditions. Thus, under ordinary conditions, the optimal number of routes would be expected to be 12 (i.e., 6+7-1).

Table 1 shows a typical daily shipment pattern under the present structure of transfer costs for each shipper to the different destination points. The total costs of transfers corresponding to this pattern of shipments amounts to M$2,887 per day.

Included in the transfer costs are expense items for storage, wages, ice, and related packing materials, and the hiring of trucks (Malaysian lorries)—the largest expense item. None of the shippers owns trucks. Although these transfer costs vary with distance, the change in costs is not necessarily in strict relation to distance. Also, there are some differences in costs among dealers, but the volumes of fish shipped through selected routes do not appear to be so much the result of relative efficiencies in transfer as the simple lack of business contracts between different locations. A total of 18 routes are used rather than the theoretically efficient 12. The volumes shipped by the various shippers vary widely (4.5-99 piculs, or 272-5,988 kg, per day) as well as the demand requirements from each of the destination markets (5.5-123.8 piculs, or 333-7,487 kg, per day).

On the average, it costs M$4.24/picul (M$0.0701/kg) to transport fish from Kuala Trengganu to Kota Bharu, and M$5.28, M$7.44, M$9.25, and M$12.00/picul (M$0.0873, M$0.1230, M$0.1529, and M$0.1984/kg) to Kuantan, Kuala Lumpur, Johore Bharu, and Melaka, respectively. The export cost to Singapore is estimated at M$29.00/picul (M$0.4795/kg) which is relatively higher because of the tax paid at the port of entry. The average cost of exporting fish to Penang is M$15.00/picul (M$0.2480/kg) and most of the fish is utilized for canning. In general, the demand for canning is higher than the requirement for fresh consumption. Whenever fish is not marketed directly to the destination, additional cost is incurred by the exporters. Fish exported to Singapore can only go by truck transport to Kuala Kemaman where it must be reloaded for further transport. Fish marketed to Penang sometimes changes transport at Bukit Mertajam, an intermediate point. In both cases, extra cost of transportation is incurred by the handlers.

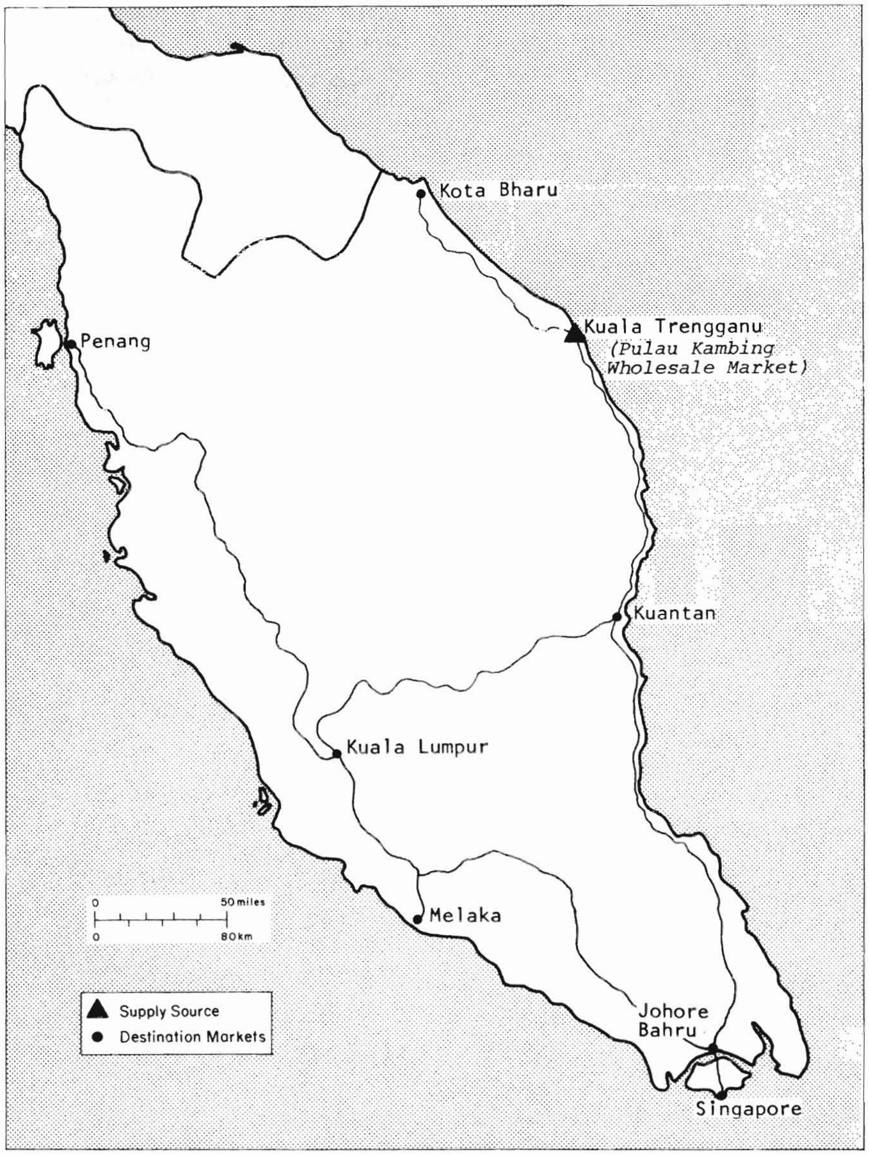

Figure 1.—Peninsular Malaysia and Singapore—major connecting highways between Kuala Trengganu and its markets for fresh fish

Optimal Shipment Pattern

In the computation of the optimal shipment pattern (Table 2), the average transfer costs for each destination were assumed to apply to the corresponding routes that are not utilized under the existing pattern. The total transfer costs under this optimal pattern calculates to M$2,697 per day which, by comparison with the existing costs, amounts to a savings equivalent to about M$5,700 per month.

There are no changes in the total quantities shipped by each shipper and received by each destination market. These efficiency gains are possible by changing the shipment pattern with only 12 selected routes instead of the existing 18. In terms of unit prices per fish, the possible savings could amount to about M$0.69/picul (M$0.0114/kg), which may be either reflected in higher prices for fishermen or lower prices to consumers. Assuming that present consumer prices are held up in the retail markets where the effective demands are not affected, part of this cost savings can accrue to fishermen. Some implication of real world complexities that would, however, control the actual distribution of efficiency benefits are discussed in the concluding section.

Conclusions

There is evidence that significant economic gains in terms of transportation cost savings may be possible from more efficient shipment patterns of fresh fish from supply points to consûmption centers around Peninsular Malaysia. This indication comes from our analytical results in the case of the Kuala Trengganu fishery. An optimal shipment pattern can lead to potential savings of M$5,700 per month in total transportation cost for this single fishery. If similar potential savings exist for other fisheries

Table 1.—Existing pattern of shipments, costs, and quantities of fish marketed from Kuala Trengganu to various destinations.

Market intermediary (*i*)	Kota Bharu M$	Kota Bharu pcl.[1]	Kuantan M$	Kuantan pcl.	Kuala Lumpur M$	Kuala Lumpur pcl.	Johore Bharu M$	Johore Bharu pcl.	Melaka M$	Melaka pcl.	Penang M$	Penang pcl.	Singapore M$	Singapore pcl.	Total cap./day (pcl.)	Total cost (M$)
Chew Seng	—	—	—	—	8.33	12.0	—	—	12.00	22.5	—	—	30.00	16.5	51.0	864.96
Mohd Embong	—	—	—	—	8 33	15 0	—	—	—	—	—	—	—	—	15 0	124 95
Ah Seng	—	—	—	—	8.00	36 0	10.00	15 0	—	—	15.00	12.0	28.00	7 5	70 5	828 00
Aziz Abd. Rahman	4.24	5.5	5 00	1.0	6 00	50 0	9 00	37 5	—	—	—	—	30.00	5 0	99.0	815.82
Ismail Ngah	—	—	5 56	16 5	6 00	8 25	9 00	8 25	—	—	—	—	—	—	33.0	215 49
Samsuddin Sulong	—	—	—	—	8.00	2 5	9 00	2 0	—	—	—	—	—	—	4 5	38 00
R_j = Total requirement/day (piculs)		5.5		17.5		123 75		62 75		22 5		12.0		29 0	273 0	
Total cost	M$23 32		96.74		882 41		579.75		270 00		180 00		855.00			M$2,887.22

[1]Piculs
Note Typical cell = C_{ij} Q_{ij} Where C_{ij}=M$ cost/picul, and Q_{ij}=total piculs
C_{ij}/60 48=M$ cost/kg
Q_{ij}×60.48=total kg

Table 2.—Optimal patterns of shipments, costs, and quantities of fish marketed to various destinations under the optimum shipping program.

Market intermediary (*i*)	Kota Bharu M$	Kota Bharu pcl[1]	Kuantan M$	Kuantan pcl.	Kuala Lumpur M$	Kuala Lumpur pcl.	Johore Bharu M$	Johore Bharu pcl	Melaka M$	Melaka pcl	Penang M$	Penang pcl.	Singapore M$	Singapore pcl.	Total cap./day (pcl)	Total cost (M$)
Chew Seng	4 24	—	5.28	7 75	8 33	—	9.25	43 25	12.00	—	15.00	—	30.00	—	51 0	440 98
Mohd Embong	4 24	—	5 28	—	8 33	—	9 25	15.0	12 00	—	15 00	—	29 00	—	15.0	138 75
Ah Seng	4.24	5 5	5 28	1 5	8 00	—	10 00	—	12 00	22.5	15 00	12 0	28 00	29.0	70.5	1,293.24
Aziz Abd Rahman	4 24	—	5 00	8 25	6.00	90 75	9 00	—	12 00	—	15 00	—	30 00	—	99 0	585.75
Ismail Ngah	4 24	—	5.56	—	6 00	33.0	9 00	—	12 00	—	15 00	—	29 33	—	33 0	198 00
Samsuddin Sulong	4 24	—	5 28	—	8 00	—	9.00	4 5	12 00	—	15 00	—	29 33	—	4 5	40.50
R_j=Total requirement/day (piculs)		5 5		17 5		123 75		62 75		22 5		12.0		29.0	273.0	
Total cost	M$23 32		90 09		742 50		579 31		270 00		180 00		812 00			M$2,697.21

[1]Piculs
Note Typical cell=C_{ij} Q_{ij} where C_{ij}=M$ cost/picul, and Q_{ij}=total piculs
C_{ij}/60 48=M$ cost/kg
Q_{ij}×60 48=total kg

throughout the peninsula, the economic savings for the total fresh fish industry may easily range around M$1 million per year.

Implied in the analytical results of the transportation model are ideal market conditions which allow for instantaneous adjustments. In fact, the divergence between our ideal optimum and reality suggest the existence of market imperfections which may act as constraints toward improving the economic performance of the fresh fish industry in Malaysia.

The economic functioning and performance of any industry depend heavily on the institutional systems that control decisions within that industry. Among these institutional systems are the various market structures through which business transactions are carried out

Time was inadequate during this study to delve deeply into this important area of economic research; however, as a follow-up to our initial findings, this particular area is the focus of a research project that has recently been initiated at the University Pertanian Malaysia. Since the results of this new follow-up project cannot be expected for a while, some implications may be drawn from our own study which may be useful in the formulation of testable hypotheses.

In the short run, as long as effective demands at the consumers' level hold up retail prices of fresh fish, the savings in transportation costs can be reflected in the overall value of the fishery. In the case of the Trengganu fishery, this could amount to as much as M$345 per metric ton per month of fish harvested and sold from the fishery. This, of course, depends on retail prices being primarily determined by the effective demands of consumers rather than by the marginal charges in supply costs from Trengganu.

The possibility of offsetting price changes at the retail level depends upon the overall supply and demand conditions for fresh fish at each of the destination markets. Our analysis limited its focus on the transportation costs of the several shippers from Trengganu. Nothing was said about consumer demands since there were no a priori reasons to expect consumer preferences and incomes in the widely spaced destination markets to be in any way related to changes in shipping patterns from Trengganu alone. Fresh fish are supplied to these various markets from multiple sources and not only from the Trengganu fishery.

Contractual arrangements are typically found among the individual shippers and retailers. This might impose some institutional rigidities on price-quantity relationships and possible adjustments in shipping patterns over time. However, to the extent economic incentives can operate to realize any existing potential efficiencies, these efficiency changes can be expected to lead toward concentration at the intermediary level. The implications of this concentration tendency are not limited to distributional effects at the intermediary level itself but also extend to the bargaining relations forward to retailers and backward to fishermen.

In their dealings with retailers at the various destination markets, a concentration of intermediaries at one fishery, e.g., Trengganu, would tend to strengthen their own bargaining positions relative to intermediaries from other fisheries dealing with the same retailers. The economic forces that control bargaining with retailers are, thus, partly external to the adjusting fishery. Unless an overwhelming bargaining advantage already exists with the retailers, the efficiency benefits can be expected to accrue to the adjusting fishery rather than being passed on to consumers through offsetting retail price changes.

How these efficiency benefits would tend to be distributed among intermediaries and fishermen of the adjusting fishery is another matter. Here the economic forces that control decisions are primarily internal to the fishery. Some initial gains and losses can be expected at the intermediary level and among the fishermen connected with the gaining or losing intermediaries. The impact on fishermen may be lessened to the extent they are free to deal among intermediaries. If the fishery is made more profitable through efficiency adjustments, then we might expect to see more investments into expansion of the fishery. Some of the distributional losses may then be eventually offset by organizational changes within the fishery itself.

In the long run, both fishermen and consumers may also benefit as price competition at the retail level begins to reflect cost savings through more efficient transportation schemes on a broader peninsula-wide basis.

There are other important opportunities to improve transfer schemes in Malaysia. These opportunities relate to possible changes in technology for transporting fish in modern refrigeration units and also to changes in institutional rules which presently prevent landings of fish caught in coastal waters to ports nearest the major market centers of consumption. Analytical studies on the potential impacts of such changes on a peninsula-wide scale might indicate possibilities for substantial economic gains.