Johnson, B. (ed.) 2007. Economics and market analysis of the live reef-fish trade in the Asia–Pacific region. ACIAR Working Paper No. 63, 173 pp.

Demand for fish in Asia: a cross-country analysis

Madan Mohan Dey[1] and Yolanda T. Garcia

with Praduman Kumar, Somying Piumsombun, M. Sirajul Haque, Luping Li, Alias Radam, Athula Senaratne, Nguyen Tri Khiem and Sonny Koeshendrajana

Introduction

Fish is an important economic commodity in Asia. About 61% of the world supply of fish comes from this region (Table 1), where a large proportion of it is consumed domestically. It contributes 30% to the world's export of fish, which is either traded inter-regionally or to other parts of the world. On the other hand, total fish imports are only 12%, rendering Asia a net fish-exporting region.

Table 1. World production, consumption and trade of fish and other marine products

Continent	Total production[a] ('000 t)	Per-capita consumption[b] (kg/year)	Export (%)[c]	Import (%)[c]
Asia	78.7	27	30.3	11.8
Africa	7.3	7	4.9	1.6
Europe	17.9	20	34.9	40.1
North and Central America	8.8	21	6.8	10.4
South America	15.8	8.3	20.8	20.0
Oceania	1.1	22	2.3	1.3
World	129.9	18		

Sources: Ahmed et al. (2004); Dey and Senaratne (2004).
[a] 2001 values; [b] 2000 values; [c] 1999 values.

Annual per-capita consumption in Asia averages about 27 kg, which is higher than the world average of 18 kg. Across the region, per-capita consumption varies significantly, with the highest registered in Japan (65 kg/year) and the lowest in India (6 kg/year), where only one-third of the population are fish-eaters (Table 2). China and most of the countries in South-East Asia registered per-capita consumptions that are comparable to the overall Asian average. Notably, Malaysia and Thailand registered higher per-capita consumption levels (45 and 33 kg/year, respectively) than the rest of South-East Asia.

Accompanying the high per-capita fish consumption in the Asian region, the growth in consumption is similarly increasing at significant rates. Data from the Food and Agriculture Organization of the United Nations (FAO) show growth rates in annual per-capita consumption for China, South-East Asia, and South Asia averaging 10.4, 1.3, and 0.9%, respectively, during 1985–1997, whereas for the rest of the developing world, per-capita annual consumption had shrunk marginally (Delgado et al. 2003). A large part of the increase in fish consumption in Asia was attributed to recent population growth, urbanisation and rising per-capita incomes in the region.

Responses of demand for fish to changes in prices and incomes are important in analysing the effects of any technological change, infrastructure development or economic policy on future production, consumption and trade of various fisheries products. While many past research studies on fish demand have treated fish as a single commodity in the consumer food basket, recent studies have evolved into more disaggregated analyses (Herrmann et al. 1992; Wessells and Wilen 1993; Tada 2000; Dey 2000; Garcia et al. 2005). The intention is to

1 Corresponding author: Madan M. Dey, Regional Director, WorldFish Center, Penang, Malaysia; email: <m.dey@cgiar.org>.

capture short-term responses of species-specific markets to price and non-price factors, a feature that is not easily analysed using aggregated data. Since the market for fishery products is rapidly gaining competitiveness, both at the domestic and international scene, more detailed and disaggregated market analyses are often needed. There are several reasons for this. First, fish species usually come from different production environments, e.g. farmed fish or aquaculture versus capture fisheries, and the latter can be further classified into deep-sea and coastal capture. Second, fish preferences vary according to type of consumer, e.g. rural versus urban consumers, and poor versus non-poor households. Last, fish trade is often differentiated through market destinations, i.e. certain fish species are intended exclusively for domestic consumption while other species are intended for the international market. The effects of these factors (i.e. fish types/species, ecological source and behavioural/cultural responses of consumers) are often useful to stakeholders in the fishery sector (fishers, fish farmers, traders and consumers) in assessing market sensitivity to new developments in the sector.

Table 2. Per capita consumption of fish in Asia

Country/region	Per-capita consumption (kg/year)
Japan	64.8
China	25.0
India	5.6
Other South Asia	18.8
Bangladesh	20.4
Sri Lanka	17.2
South-East Asia	28.1
Indonesia	21.6
Malaysia	45.4
The Philippines	27.0
Thailand	32.7
Vietnam	14.0
All Asia	27.4

Sources: FAO (2004); country national statistics offices

The present study aims to address the need to recognise fish[2] as a heterogeneous product, especially in analysing market structure and policy effectiveness in the fishery sector. For example, as the role of Asian aquaculture becomes more important in the global supply of fish, the market responses of various species aquacultured in the region have important implications in technology development, species selection, welfare effects (in terms of consumption and livelihood) and foreign exchange derived from the sector.

This study is focused on the estimation of demand, price and income elasticities for major fish groups that are commonly found in Asia. The next section of the paper is devoted to the model used in the analysis of the study. Following that is a discussion of the cross-country comparison of consumption and the estimated own-price and income elasticities for various fish types, derived from the empirical demand model. Furthermore, the discussion focuses on how the elasticity estimates behave at different levels of household income. Such an analysis of fish consumption is expected to lead to a better understanding of how household decisions may vary as income changes. The final section presents some policy implications of the results of the study. Specifically, this section demonstrates how the elasticity estimates can be useful in assessing welfare issues of fisheries and aquaculture development as they affect consumers and producers, especially the poorer members of the sector.

2 In this study, the term fish includes finfish (both fresh and processed) and non-finfish, e.g. shrimps, crabs, bivalves, squids and other aquatic products.

Model and estimation procedure

Demand studies are traditionally approached either through utility maximisation, which yields a Marshallian demand specification, or through expenditure minimisation, in turn yielding a Hicksian compensated-demand function. Both formulations can be used for empirical investigations of demand models using single-equation and system approaches. Earlier demand models often used a single-equation approach, but more recent empirical works were focused on system specifications, a technique pioneered by Stone (1954). Forerunners of these models include the Rotterdam demand model (Thiel 1965), the S-branch demand model (Brown and Heien 1972), the Translog demand model (Christensen et al. 1975) and the 'almost ideal demand system' (AIDS) model (Deaton and Muellbauer 1980).

A multi-stage budgeting framework[3] was used in this paper to model the fish consumption behaviour of Asian households, similar to the approach employed by Dey (2000) and Garcia et al. (2005). The present model is built on the framework used by Deaton and Muellbauer (1980), Blundell et al. (1993) and Heien and Wessels (1990). This approach made use of the concept of Strotz (1957) who extended the idea of exhaustive expenditure systems to different levels or stages.

This technique addresses a common problem in empirical estimation of the AIDS models requiring a sizeable number of equations in the demand system, given the wide variety of consumption goods jointly purchased by households. Specifically, the full demand system containing all these commodities warrants a huge number of own- and cross-price parameters that are impractical to estimate under the constraint of limited data availability. Hence, the solution is to estimate the model in stages, whereby expenditures on goods belonging to broad food categories are incorporated in the model by estimating them sequentially.

In this study, a three-stage budgeting framework was adopted to enable the specification of a fish-demand system in the final stage that is species-specific, while keeping the number of equations in the demand system manageable (Figure 1). Expenditure functions for food, and subsequently for fish, were specified at the initial two stages of the model, while the quadratic extension of the Deaton and Muellbauer's linear approximate AIDS model (1980), hereinafter referred to as the QUAIDS model, was formulated at the final stage.

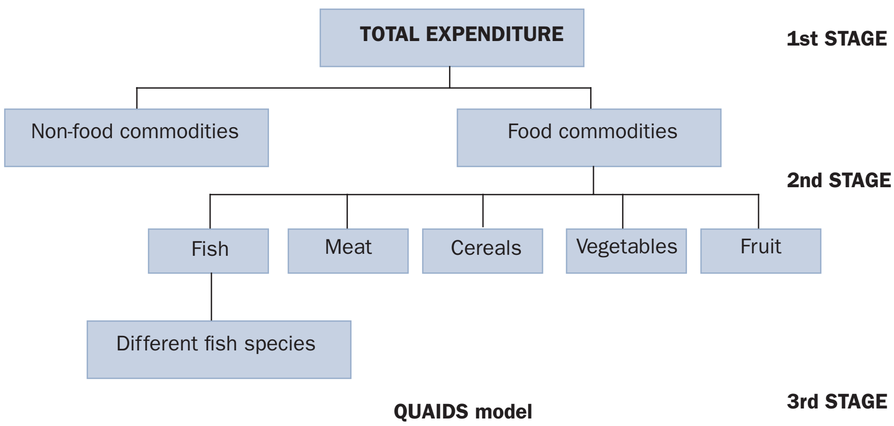

Figure 1. Diagram of three-stage budgeting framework

[3] For more detailed discussion of multi-stage budgeting framework, see Thomas (1987); Blundell et al. (1993); Mustapha et al. (1994); Fan et al. (1995); Gao et al. (1996); Tiffin and Tiffin (1999).

In the first stage of the model, the consuming household is assumed to allocate consumption expenditures to broad groupings such as food and non-food commodities that are affected by income and some demographic characteristics of the household. The food expenditure (FD) function is specified as follows:

$$FD = f(PF, PNF, Y, Y^2, Z) \quad (1)$$

The price index for food (PF) was computed as the geometric mean of food prices ($\Sigma w_j \ln P_j$), where w_j is the share in total food expenditure of the j^{th} food commodity and P_j is the price. The price index for non-food commodities (PNF) was included in the model to take into account the 'income effect' of the changes in non-food prices. However, due to unavailability of data to construct this variable, the total expenditure for non-food commodities was used as a proxy variable. Additionally, it is assumed in the model that the 'substitution effect' between food and non-food commodities is negligible.

The income variable (Y) was included in the model in both linear and squared forms. The quadratic income term (Y^2) was intended to capture the possible non-linearity in the food expenditure behaviour of households with respect to income. Similarly, the variable Z, which represents the vector of household characteristics, was included to account for some demographic factors that may affect household consumption, such as number of children in the household, family size and urbanity of the locality.

In the second stage, the fish expenditure (FS) equation was specified as a function of the prices of various types of food commodities, such as cereal, fish, meat, poultry products, pulses, vegetables and beverages, and is defined as follows:

$$FS = f(P, FD^*, FD^{2*}, Z) \quad (2)$$

The variable P in equation (2) is defined as a vector of prices of the various food commodities listed above, while Z is a vector of demographic variables similar to those defined in equation (1). To incorporate the effect of the food expenditure variable in the second stage, the predicted values of FD from equation (1) (both linear and squared forms) were included in the model as instrumental variables. The squared term of FD* (i.e. FD^{*2}) was added to the model to capture the non-linearity in food consumption, which is assumed to exhibit a certain threshold level.

The QUAIDS model for various fish types is specified in the third stage as a system of equations where the budget share of each fish type (W_i) is expressed as a function of fish prices (PF), predicted fish expenditures (FS*) from stage 2 in linear and squared forms, and some demographic characteristics of households (Z). The demand system is expressed as follows:

$$W_i = f(PF, FS^*/P^*, FS^{*2}/P^*, Z, IMR_i) \quad (3)$$

The linear approximate form of the AIDS model is achieved by deflating the predicted fish expenditure variables (both the linear and squared forms) by P*, which is the household-specific Stone's price index for fish. This price index allows the empirical approximation of the non-linear AIDS model (with translog price index) to be estimated linearly. The index is approximately proportional to P*, where $\log P^* = \sum_k W_k \log P_k$ for k number of goods (Stone 1954).

The quadratic term of the predicted fish expenditure variable (FS^{*2}) from stage 2 was added to the linear approximate AIDS model as an explanatory variable to achieve the QUAIDS specification (Blundell et al. 1993; Dickens et al. 1993; Meenakshi and Ray 1999; Dey 2000; Garcia et al. 2005). This term captures the non-linearity in fish consumption, which is similarly assumed to exhibit threshold level just like the case for food consumption. More importantly, however, the quadratic term relaxes the equality restriction imposed by linear demand functions in considering the allocation of marginal expenditures for various fish types among rich and poor households (Beach and Holt 2001). Such an assumption limits the classification of certain fish types into either essential or luxury commodities and denies the possibility that some fish types may be considered luxuries at a low level of incomes but can become necessities at a higher level of incomes. This type of consumption behaviour is often observed in the case of high-value fish and other marine products such as prawns, molluscs and crustaceans.

The inverse Mills ratios[4] (IMRs) are also incorporated into the model to correct for the possible bias created by the presence of zero consumption[5] for certain fish types (Heckman 1979). Zero consumption results when households report no consumption due either to abstention or 'corner solution' in the household's utility maximisation problem. Corner solution results when consumers cannot afford to pay the price of certain fish types (e.g. shrimp and other high-value fish types) given their budget, while abstention may be due to non-preference or infrequent purchases. Both cases render the share in expenditure W_i to zero. In this paper, the correction of the sample-selection bias resulting from the presence of numerous instances of zero consumption of certain fish types was done either through the use of the Heckman two-step procedure (1979) in estimating the IMRs for the various fish types or through the Tobit specification of the fish expenditure function in equation (2).

The QUAIDS model used in this study assumes that fish is weakly separable[6] from all the other categories of food commodities—cereals, meat, poultry products, fruits, vegetables, and beverages. The weak separability assumption of the utility function over various groups of commodities is necessary to satisfy the condition for estimating the AIDS model in a multi-stage budgeting framework.[7]

To ensure that the specification of the QUAIDS model will conform to the theory of optimal consumption (i.e. that the consumer is a utility maximiser), three restrictions on the parameters of the model need to be satisfied. These are: (1) the homogeneity condition (i.e. consumers react only to real prices and income); (2) the additivity condition (i.e. all the budget shares w_i add up to 1); and (3) the symmetry condition (i.e. the cross-effects of a change in the price of a certain fish type on the demand of another fish type and vice versa are equal). At the same time, due to the quadratic nature of the demand model used in this study, the symmetry restriction also requires that the ratios of the income coefficients must all be equal to a constant, implying that the relative effects of the linear and squared income terms in each demand equation must be the same for all fish types.

Incidentally, the additivity property of the QUAIDS model implies a singular variance–covariance matrix for the error terms of the model when all the demand functions are estimated jointly. To impose this restriction, the last equation in the model is simply deleted to avoid the singularity problem in the estimation of the model parameters. The parameters of the omitted demand equation are then calculated by substituting the parameters of the

---

4 For further discussions on the use of IMR in censored demand functions, see Cheng and Capps (1988), Heien and Wessels (1990), Heien and Durham (1991) and Byrne et al. (1996).

5 More detailed discussions of zero consumption can be found in Keen (1986), Shonkwiler and Yen (1999) and Perali and Chavas (2000).

6 Demand separability is the condition of ordering goods based on the independence of their marginal utilities derived from the consumption of some specific goods falling under one food group versus another food group.

7 For further discussion of separable utility functions in multi-stage budgeting framework, see Brown and Heien (1972), Eales and Unnevehr (1988), Jorgenson et al. (1988), Yen and Roe (1989), Michalek and Keyzer (1992) and Gao et al. (1996).

estimated equations in the formula of the additivity constraint. Note that all the parameter estimates of the model are invariant with respect to the demand function that is deleted from the system (Pollack and Wales 1969). To estimate the parameters of the QUAIDS model, the 'iterative seemingly unrelated regression' (ITSUR) method of the SYSNLIN (non-linear systems) procedure of SAS (1984) was employed.

By using the parameter estimates of the QUAIDS model, the price elasticities for the different fish types are estimated as follows:

$$\xi_{ij} = (b_{ij} / w_i) - \{c_{1i} + 2c_{2i} \text{ Ln(FS)}\} (w_j/w_i) - k_{ij} \quad (4)$$

where k_{ij} is the Knonecker delta which is equal to 1 for own-price elasticity and zero for cross-price elasticity; w_i is the consumption share of the i^{th} fish type; while b_i and c_i are obtained from the parameter estimates of the QUAIDS model. Equation (4) yields the uncompensated price elasticity (ξ_{ij}) of demand. Alternatively, the compensated demand (Hicksian) elasticity (ξ_{ij}^H) can be computed using the Slutsky formulation specified below:

$$\xi_{ij}^H = \xi_{ij} + w_j \eta_i \quad (5)$$

where: ξ_{ij}^H stand for Hicksian elasticity, while η_i is the fish expenditure elasticity of the individual fish type, which is given by the following equation:

$$\eta_i = (c_{1i} + 2c_{2i} \text{ Ln(FS)}/wi) + 1 \quad (6)$$

The income elasticity, η_i^Y for a specific fish species is then computed as the joint product of food expenditure elasticity η^{FD} from stage 1, fish expenditure elasticity η^{FS} with respect to food from stage 2, and fish expenditure elasticity for the individual fish type, i.e.

$$\eta_i^Y = (\eta^{FD}) (\eta^{FS}) (\eta_i) \quad (7)$$

Using equations (4) and (7), the price and income elasticities of fish demand for households belonging to different income groups can easily be computed by simply substituting in the elasticity formula the income level that is specific to a certain income group, i.e. poor and non-poor households. This technique implies that only one set of demand parameters needs to be estimated from the global sample to arrive at the estimates of price and income elasticities by income group. A disaggregated approach such as this is more useful in analysing consumer demand than using 'average' estimates of price and income elasticities for the whole population, especially when significant variation in demand responses is expected from the various income groups.

Sources of data

The data used in this paper were condensed mostly from the results of a study (ADB-RETA 5945) entitled 'Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in Asia' conducted by the WorldFish Center with funding from the Asian Development Bank. This project was implemented from 2001–2004 in nine Asian countries: Bangladesh, China, India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam. Fish consumption data were obtained mainly from the national or regional household consumption and expenditure surveys conducted either by the project or the statistics bureaus of partner countries (Table 3). Specifically, five of the nine partner countries—China, Indonesia, Malaysia, Philippines and Sri Lanka—used consumption data from nationally published sources. Each dataset covered all the provinces/states in the respective country, with the sample size ranging from 9,198 households (in Malaysia) to 61,482 households (Indonesia).

The remaining four partner countries—Bangladesh, India, Thailand and Vietnam—on the other hand, conducted their own primary surveys since figures on fish consumption by species or types were not available in their respective national household expenditure surveys. Sample size ranged from 456 in Thailand to 810 in Bangladesh. All datasets used in this study were relatively recent (1999–2002), except for that for Sri Lanka, which dated back to 1996.

Table 3. Summary of information regarding data source and content, by country

Country	Type of data	Year	Coverage	Sample size (households)	Data source
Bangladesh	Primary	1999	Nine of 64 districts	810	Own survey
China	Panel; secondary	1997 and 2001	Nationwide (20% of total national sample)	49,508	National Statistics Bureau (household expenditure survey)
India	Primary	2002	Consumers in 6 of 18 fish-eating states	591	Own survey
Indonesia	Secondary	1999	Nationwide (all 26 provinces)	61,482	Central Bureau of Statistics (socioeconomic national survey)
Malaysia	Secondary	2000	Nationwide (all 13 states)	9,198	National Statistics Bureau (household expenditure survey)
The Philippines	Secondary	2000	Nationwide (all 16 regions)	39,615	National Statistics Office (family income and expenditure survey)
Thailand	Primary	1999 2002	10 inland provinces 5 coastal provinces	456	Own survey
Sri Lanka	Secondary	1996	Nationwide	19,752	Department of Census and Statistics (household income and expenditure survey)
Vietnam	Primary	2002	13 of 62 provinces	780	Own survey

Data are based on ADB-RETA 5945 study, country reports.

Analysis of the effect of income on fish demand was implemented by partitioning the country data into quintile groups and then comparing the respective price and income elasticities that were estimated from the model by income category. All country elasticities that are presented in this paper are weighted averages using the expenditure share of specific fish species/groups with respect to total fish expenditure as weight. Individual elasticity estimates by species, country and income group are presented in the annex to this paper.

Results and discussion

An important innovation in this study is the highly disaggregated approach to fish-consumption analysis. This is particularly important in Asia since, unlike in many western and developed countries in which processed and value-added fish products are popular[8],

8 Despite the growing preference for processed fish products in developed countries (which place less importance to the intrinsic fish characteristics like colour, size, freshness etc.), studies on fish demand that evolved in these countries have generally recognised fish as a heterogeneous product. Ironically, in Asia, where fish consumption is species- and characteristic-specific, existing demand studies have mostly treated fish as a single commodity. Unfortunately, such an approach obscures the enormous heterogeneity of fishery products in terms of fish types/species, sources of production and behavioural responses of consumers, thus blunting the usefulness of most demand analyses pertaining to the sector.

consumers in the region generally prefer whole and live fish, including choice cuts like head, belly, roe etc. Often, consumer preference is based on fish characteristics such as size, freshness, colour, flesh quality and particular flavour. Since most past demand and consumption studies in Asia rarely differentiated fish according to species or fish types, the present study attempts to remedy this gap.

Table 4 presents the allocation of the food budget on various food groups commonly purchased by Asian households. The share of cereal in total food expenditure is generally the largest, ranging from 24 to 38% across the nine countries. This is immediately followed by the shares of meat (ranging from 3–26%) and fish (ranging from 5–21%). Generally, the share of fish was observed to be higher than or equal to the share of meat, with the exception of China, Sri Lanka and Thailand. This highlights the important role of fish in the animal-protein intake of most Asian households.

Table 4. Share (%) in total food budget, by food item in the selected countries, 2004

Food item	Bangladesh	China	India	Indonesia	Malaysia	Philippines	Sri Lanka	Thailand	Vietnam
Cereals	38	24	32	24	24	33	23	31	34
Fish	20	5	6	9	21	14	11	16	19
Meat	12	26	6	3	15	13	14	22	20
Eggs	–	–	1	4	–	–	–	4	–
Milk	–	–	11	–	10	–	–	–	–
Pulses	2	–	7	–	4	–	–	–	–
Fruits & vegetables	9	17	9	13	7	10	–	14	15
Beverages	–	–	–	3	8	5	–	–	–
Fats & oils	5	5	9	5	–	–	–	–	–
Spices	7	–	–	–	–	–	–	–	–
Tubers	3	–	–	1	–	–	–	–	–
Others	4	23	19	40	10	25	52	12	12
Total	100	100	100	100	100	100	100	100	100

Moreover, as presented in Table 5, the proportion of the budget spent on fish was found to be larger for consumers in the higher income group (ranging from 8–21%) than for consumers in the lower income group (ranging only from 5–16%). Similarly, the share of fish expenditure was higher in urban areas (ranging from 6–32%) than in rural areas (ranging from 3–15%). Unsurprisingly, these results suggest that increasing affluence and urbanisation can potentially increase the consumption of fish and fishery products.

Table 5. Share (%) of fish expenditure to total food budget by income group and geographic location, 2004

Food Item	Bangladesh	China	India	Indonesia	Malaysia	The Philippines	Sri Lanka	Thailand	Vietnam	Average
Total population	20	5	6	9	21	14	11	16	19	13
Income group										
Lowest	–	–	5	–	–	16	–	15	15	13
Highest	–	–	8	–	–	12	–	18	21	15
Location										
Rural	10	3	7	–	15	–	–	–	–	9
Urban	21	7	6	–	32	–	–	–	–	16

– = data not available.
Data are based on ADB-RETA 5945 study, country reports.

To estimate the species-specific responses of fish demand to price and income changes, the study made use of the fish classifications found in the data from each country (Table 6). Since there was wide variation in fish classifications found in the datasets (each containing 6–11 fish types), some degree of aggregation was necessary to facilitate cross-country comparison.

Johnson, B. (ed.) 2007. Economics and market analysis of the live reef-fish trade in the Asia–Pacific region. ACIAR Working Paper No. 63, 173 pp.

Table 6. Fish species included in the major fish groupings, by source and country, 2004

Fish types	Bangladesh	China	India	Indonesia	Malaysia	Philippines	Sri Lanka	Thailand	Vietnam
Freshwater fish									
High-value fish	Indian major carp, live fish, hilsa	Grass carp, crucian carp	Indian major carp	–	Freshwater fish	Milkfish	Freshwater fish	Snakehead, silver barb	Snakehead, silver barb, high-value freshwater fish
Low-value fish	Tilapia, pangas, other carp, freshwater fish	Common carp, silver carp	Common carp, other freshwater fish	Other freshwater fish	Other fish	Tilapia	–	Tilapia, catfish	Tilapia, carp, catfish, low-value freshwater fish
Marine fish									
High-value fish	High-value marine fish	Yellow croaker, hairtail, marine fish	Pelagic high-value fish, demersal high-value fish	High-value fish	High-value fish	Other fresh fish	Large pelagic fish, demersal fish	Indo-Pacific mackerel, other high-value fish	High-value marine fish
Low-value fish	Low-value marine fish	Other finfish	Pelagic low-value fish, demersal low-value fish	Low-value fish	Anchovy, other fish	Anchovy, roundscad	Small pelagic fish, other marine fish	Other low-value fish	Low-value marine fish
Non-finfish	Shrimp	Shrimp	Shrimp, molluscs	Crustaceans	Crustaceans, molluscs	Shrimp, squid, crabs and shells	–	Shrimp	Shrimp
Processed fish	Dried fish	–	–	Dried fish, preserved fish	–	Preserved fish	Processed fish	Dried fish	–
Number of fish types	11	9	9	6	7	10	6	9	10

Seven broad categories were adopted in the study, covering four types of finfish, two types of non-finfish and one category for processed fish (Figure 2). The four types of finfish are follows: (a) low-value freshwater fish; (b) high-value freshwater fish; (c) low-value marine fish; and (d) high-value marine fish. The non-finfish group is divided into (a) shrimps and prawns and (b) crustaceans and molluscs. Processed fish, the final category, is represented by dried fish.

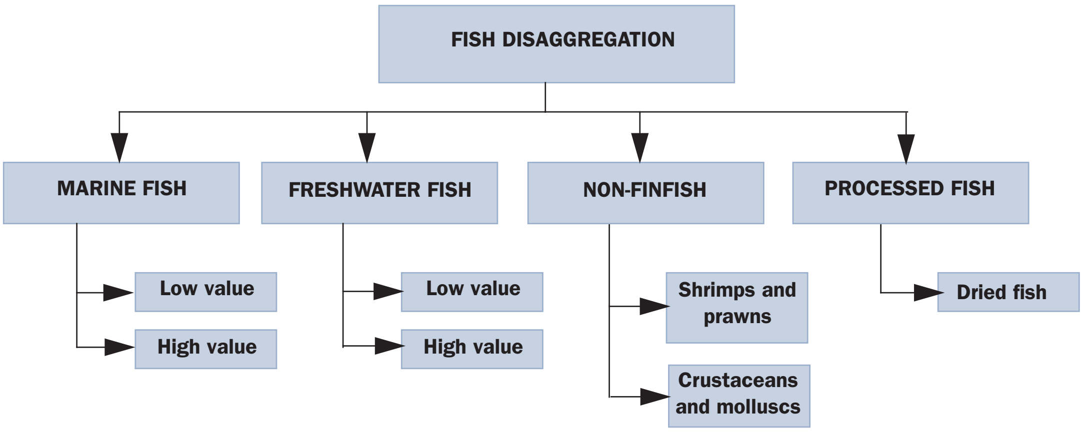

Figure 2. Categories of fish adopted in the study

Table 7 presents the share of each fish group in total fish expenditure across countries. The share of freshwater species was found to be consistently higher than that of the marine species, except in the case of Malaysia and the Philippines. This emphasises the relative preference of most Asian households for freshwater species, especially among people living in deltaic countries with abundant inland waters, such as Bangladesh, India, China, Vietnam and Thailand. On the other hand, for countries such as like the Philippines and Malaysia with long coastlines, marine species appeared to dominate household fish consumption. These results suggest that geographic factors mould the preference of fish consumers.

Considering fish prices, the low-value species generally registered higher expenditure shares than the high-value species, especially within the marine subgroup. This result is emphasised in countries like Bangladesh, India, Malaysia and Vietnam. Within the freshwater subgroup, a similar trend was observed for Bangladesh, China and Vietnam. Such results are expected due to the predominance of low-income households in the region, and points to the importance of low-value species in fish consumption, especially in the low-income countries such as Bangladesh and Vietnam.

Processed fish appeared to be an important component of total fish expenditure, especially among Indonesian and Philippine households, with expenditure shares in both countries reaching 22%. This could be explained by the abundant supply of marine fish in these countries, due to their archipelagic geography, thus encouraging a culture of fish processing. The share of processed fish, however, was found to be minimal in the other countries.

Expenditure shares of non-finfish such as shrimp, other crustaceans and molluscs were found to be low—generally less than 10% except in China, Bangladesh and Thailand. The relatively high expenditure shares of these commodities could be related to the fast growth of cultured species (especially shrimp) in these countries making them easily accessible and affordable.

Table 7 also presents the cross-country prices of the various fish categories. Higher average fish prices were found in Sri Lanka, Malaysia and Vietnam (registering over $2/kg) with the lowest average price registered in India (less than a $1/kg). Specifically, the average price of marine species was found to be slightly higher than that of the freshwater species: $1.23 versus $1.12/kg. This trend was observed in all countries except Bangladesh, India, Malaysia and the Philippines, where the case was reversed.

Table 7. Shares (%) in fish expenditure and prices (US$) of major fish groups in the selected countries, 2004

Fish type	Bangladesh	China	India	Indonesia	Malaysia	The Philippines	Sri Lanka	Thailand	Vietnam	All
Shares										
Freshwater fish	0.71	0.40	0.62	0.42	0.07	0.28	0.69	0.43	0.68	0.48
High-value	0.25	0.04	0.49	–	0.02	0.15	0.69	0.22	0.27	0.26
Low-value	0.46	0.36	0.13	0.42	0.05	0.13	–	0.21	0.41	0.27
Marine fish	0.13	0.35	0.29	0.30	0.81	0.41	0.29	0.16	0.27	0.33
High-value	0.01	0.17	0.08	0.13	0.10	0.23	0.21	0.08	0.04	0.12
Low-value	0.12	0.18	0.21	0.17	0.71	0.18	0.08	0.15	0.23	0.22
Non-finfish categories:										
Shrimp	0.14	0.13	0.05	0.06	0.05	0.04	–	0.09	0.02	0.07
Crustaceans/ molluscs	–	0.12	0.04	–	0.07	0.05	–	0.23	–	0.10
Processed fish										
Dried fish	0.02	–	–	0.22	–	0.22	0.02	0.09	0.03	0.10
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prices										
Freshwater fish	1.46	1.02	0.59	0.48	2.52	1.40	0.48	0.71	1.03	1.12
High-value	1.72	1.24	0.66	0.95	3.28	1.61	0.50	0.88	1.22	1.34
Low-value	1.21	0.81	0.52	–	1.75	1.18	0.45	0.53	0.84	0.91
Marine fish	1.28	1.75	0.40	0.84	1.94	1.23	1.29	0.86	1.47	1.23
High-value	1.34	2.16	0.49	0.97	2.84	1.42	1.46	1.47	2.10	1.58
Low-value	1.22	1.34	0.30	0.71	1.04	1.04	1.12	0.26	0.84	0.87
Non-finfish categories:										
Shrimp	1.61	2.85	1.23	4.30	4.30	3.72	10.94	3.58	6.30	4.03
Crustaceans/ molluscs	–	–	0.32	2.11	2.11	1.80	–	1.20	0.70	1.23
Processed fish	1.34	–	–	1.82	–	1.77	–	0.63	2.10	1.53
Average	1.41	1.68	0.59	1.23	2.55	1.79	2.90	1.22	2.02	1.71

– = data not available.
Data are based on ADB-RETA 5945 study, country reports.

In all the countries, shrimp was the most expensive fish type, averaging to $4/kg. It was found to be highest in Sri Lanka and Vietnam ($11/kg and $6/kg, respectively) and was lowest in India (about $1/kg). The wide variation in the observed shrimp prices can be attributed to the diverse quality and size of shrimp and prawn mix commonly found in the local markets.

For brevity, the estimated parameters of the cross-country QUAIDS model are not presented in this paper, but are available from the authors upon request. Own-price elasticities of fish demand by species/types in the selected countries are presented in Table 8.[9] Elasticity estimates for the lowest and highest income quintiles[10] are also given.

9 Cross-price elasticities of the various fish species/groups were also estimated in the country models and can also be obtained from the authors upon request.

10 Although elasticity estimates for all quintile groupings were generated for each country model, comparisons were made between only the two extreme groups, i.e. first versus fifth quintiles, which were used to represent the lowest and highest income groups, respectively. Eliminating the three middle quintiles allowed the study a more dramatic comparison of elasticity differences between the poor and the non-poor households.

Table 8. Own-price elasticities of major fish groups across countries, 2004

Fish type	Bangladesh	China	India	Indonesia	Malaysia	The Philippines	Sri Lanka	Thailand	Vietnam	All
Freshwater fish										
High-value fish	–1.22	–0.29	–0.99	–	–0.98	–2.14	–1.08	–0.13	–0.91	–0.97
Low-value fish	–0.96	–0.39	–0.99	–0.94	–1.08	–1.58	–	–0.76	–1.23	–0.99
Marine fish										
High-value fish	–1.92	–0.44	–0.98	–1.40	–0.91	–1.61	–0.98	–0.60	–1.04	–1.10
Low-value fish	–0.88	–0.95	–1.03	–0.27	–1.12	–1.34	–0.85	–1.28	–	–0.96
Non-fish categories:										
Shrimp	–1.00	–0.46	–0.99	–1.04	–0.89	–0.95	–	–0.64	–4.25	–1.28
Others	–	–	–1.00	–	–0.99	–0.79	–	–	–	–0.93
Processed fish	–	–	–	–0.72	–	–1.33	–0.85	–0.66	–	–0.89
Average	–1.01	–0.46	–0.92	–0.84	–1.07	–1.51	–1.04	–0.46	–1.12	–0.94
Lowest income group										
Freshwater fish										
High-value fish	–2.02	–	–0.99	–	–1.46	–3.61	–1.06	–0.16	–0.88	–1.45
Low-value fish	–1.08	–	–0.99	–0.89	–1.08	–1.87	–	–0.75	–1.74	–1.20
Marine fish										
High-value fish	–2.78	–	–0.62	–1.45	–0.58	–1.48	–0.96	–0.61	–0.94	–1.26
Low-value fish	–1.04	–	–0.96	–0.37	–1.12	–1.30	–0.84	–1.20	–	–0.98
Non-fish categories:										
Shrimp	–0.98	–	–0.96	–1.06	–1.24	–0.92	–	–0.66	–2.21	–1.18
Others	–	–	–1.01	–	–1.08	–0.87	–	–	–	–0.98
Processed fish	–0.40	–	–	–0.84	–	–1.19	–0.86	–0.62	–	–0.78
Average	–1.29	–	–0.95	–0.87	–1.07	–1.70	–1.02	–0.46	–1.03	–1.06
Highest income group										
Freshwater fish										
High-value fish	–1.08	–	–0.99	–	–0.97	–1.46	–1.15	–0.36	–0.90	–0.99
Low-value fish	–0.83	–	–0.99	–0.94	–1.08	–1.40		–0.70	–0.92	–0.98
Marine fish										
High-value fish	–1.49	–	–0.97	–1.35	–0.91	–1.73	–0.98	–0.64	–1.09	–1.17
Low-value fish	–0.80	–	–0.94	–0.10	–1.12	–1.48	–0.79	–1.32	–	–0.94
Non-fish categories:										
Shrimp	–1.04	–	–1.00	–1.02	–0.89	–1.00	–	–0.74	–3.06	–1.25
Others	–	–	–0.99		–0.99	–0.78	–	–	–	–0.92
Processed fish	–0.40	–	–	–0.56	–	–1.51	–0.83	–0.71	–	–0.80
Average	–0.92	–	–0.98	–0.77	–1.07	–1.47	–1.08	–0.52	–0.72	–0.94

The item ‘others’ under non-finfish categories refers to crustaceans and molluscs. Data are based on ADB-RETA 5945 study, country reports.

On average, the own-price elasticities were found to vary widely across fish types, ranging from –0.13 to –4.25, demonstrating the heterogeneity of fish demand in the region. Except for the high-value marine fish (e.g. large pelagic and demersal species) and shrimp, all the other fish types were found to have average elasticities less than 1, implying that the demand for fish is generally inelastic. This suggests that fish is largely considered as an essential food item among Asian households, especially the low-value species.

Furthermore, the own-price elasticity of fish demand was observed to be lower among households with higher incomes. These results suggest that the poorer households consider fish as an elastic commodity while their more affluent counterparts regard it as an inelastic good. In general, these imply that the poorer households tend to exhibit more demand responsiveness to changes in fish prices than do the richer households.

Similarly, it is important to note that price elasticity seems to move from elastic to inelastic as households move into higher income brackets. This result emphasises the potential flexibility in fish demand of the Asian poor by absorbing potential supply expansions in the market. This observation is consistent with most published studies on demand for various food commodities, e.g. rice (Senauer 1990), rice and cassava (Timmer and Alderman 1979), breakfast cereals (Jones et al. 1994) and fish (Park et al. 1996).

While the highest income group exhibited inelastic demand for most of the fish types, the elasticities for high-value species were surprisingly elastic. One possible explanation for this is that the high-value species, like grouper, tuna, and shrimp, can have numerous substitutes at their price range in terms of meat and poultry products. Hence, even if the rich households can afford to pay the price of the high-value fish, they tend to respond quickly to any price change, thus rendering this subgroup to be price elastic.

Also, it is interesting to note that, among the low-income households, while average elasticities were found to be mostly greater than 1, the cheaper fish types such as the low-value marine fish (e.g., anchovy, roundscad, small pelagic and demersal species), crustaceans/molluscs and dried fish were found to be price inelastic. Despite the expected elastic response of the poor to price changes of the more expensive fish types like shrimp and large fish species, the cheaper fish types are still considered necessities. This can be explained in two ways. Firstly, the low-value fish is the cheapest form of animal protein that is affordable to the poorer households. Secondly, since the price is low, there is a limited number of potential substitutes for fish as a protein source at that price range, thus making it inelastic.

The estimated income elasticities for fish demand for the total population and by income groups are presented in Table 9. Income elasticities for all the fish types are positive, suggesting that fish in general (whether fresh or processed) is considered as a normal good in the Asian region, by all households, whether rich or poor.

Across all the nine countries, income elasticities, on average, were found to be elastic, with values greater than or equal to 1. This implies that fish is generally considered as a luxury good by Asian consumers. On average, freshwater fishes (both low- and high-value) were found to have lower income elasticities than their marine counterparts suggesting less variability in demand as income rises. This reconfirms the preference of most Asian households for freshwater fish species.

With respect to income groups, average income elasticities for all fish types were found to be elastic for the low-income households, with values in the range 1.25–2.19. Conversely, the high-income households yielded inelastic values for all the fish types, ranging from 0.61 to 0.90. As in the case of own-price elasticities, income elasticities exhibited the same trend of shifting from elastic to inelastic as households move into a higher income bracket.

Table 9. Income elasticities of major fish groups across countries, 2004

Fish type	Bangladesh	China	India	Indonesia	Malaysia	The Philippines	Sri Lanka	Thailand	Vietnam	All
Freshwater fish										
High-value fish	1.43	0.99	1.62	1.46	0.87	0.57	0.86	0.12	0.99	1.00
Low-value fish	0.91	0.99	1.62	1.46	1.94	0.56	–	0.06	0.66	1.02
Marine fish										
High-value fish	1.56	1.05	1.62	1.46	0.52	1.89	0.98	0.64	1.06	1.20
Low-value fish	1.05	0.95	1.62	1.46	1.13	0.64	1.00	0.62	–	1.06
Non-fish categories:										
Shrimp	0.68	1.36	1.61	–	–	1.78	–	0.66	0.94	1.17
Others	–	–	1.66	1.46	0.73	1.38	–	–	–	1.31
Processed fish	1.06	–	–	1.46	–	1.01	1.01	0.62	–	1.03
Average	1.03	0.92	1.62	1.46	1.12	1.07	0.90	0.26	0.59	1.00
Lowest income group										
Freshwater fish										
High-value fish	2.63	0.58	1.63	3.05	1.12	0.14	0.72	0.41	0.99	1.25
Low-value fish	1.15	1.07	1.64	3.05	2.34	0.49	–	0.32	0.66	1.38
Marine fish										
High-value fish	3.07	0.90	1.14	3.05	0.69	2.14	1.19	0.91	1.14	1.58
Low-value fish	1.25	0.52	1.65	3.05	1.04	0.87	0.86	0.77	–	1.25
Non-fish categories:										
Shrimp	0.80	0.93	1.14	3.05	–	2.66	–	1.00	0.98	1.51
Others	–	–	3.75	–	0.92	1.91	–	–	–	2.19
Processed fish	1.38	–	–	3.04	–	1.08	1.03	0.88	–	1.48
Average	0.70	0.66	1.35	0.53	0.68	0.73	1.04	0.13	0.73	0.73
Highest income group										
Freshwater fish										
High-value fish	0.94	0.44	1.36	0.53	0.54	0.59	1.05	0.03	0.99	0.72
Low-value fish	0.59	0.77	1.36	0.53	1.18	0.48	–	0.01	0.98	0.74
Marine fish										
High-value fish	1.00	0.87	1.37	0.53	0.40	1.54	1.00	0.37	1.04	0.90
Low-value fish	0.85	0.47	1.35	0.53	0.76	0.33	1.01	0.35	–	0.71
Non-fish categories:										
Shrimp	0.47	0.99	1.39	0.53	–	0.89	–	0.35	0.96	0.80
Others	–	–	1.12	–	0.45	0.89	–	–	–	0.82
Processed fish	0.78	–	–	0.53	–	0.39	1.00	0.33	–	0.61
Average	0.70	0.66	1.35	0.53	0.68	0.73	1.04	0.13	0.73	0.73

The item ‘others’ under non-finfish categories refers to crustaceans and molluscs. Data are based on ADB-RETA 5945 study, country reports.

This suggests that fish consumption among the poorer households similarly responds more to income changes than it does in the richer households. Specifically, the poorer households tend to treat fish as a luxury food item while the richer households see it as a basic food necessity.

Among the high-income households, except for Malaysia, the high-value species generally exhibited higher income elasticities than the low-value species, especially for the marine subgroup. A similar trend is observable among the low-income households. This means demand for high-value fish becomes more unstable in the face of rising incomes. This could similarly be related to the wide variety of substitutes/choices available to consumers at the price range of the high-value fish, thus making demand more volatile when income increases. On the other hand, the elasticity of high-value fish in Malaysia was found to be lower than the low-value species. This is expected since Malaysia is one of countries in the region with very high per-capita fish consumption.

Conclusions and policy implication

Two important results emerged from this analysis. First, fish is clearly a heterogeneous product, as shown by the wide disparity in the estimated income and price elasticities for the different fish types. This result is important for future modelling and analysis of the fisheries sector. Also, it highlights that past assumptions that regarded fish as a single or homogenous commodity are faulty and unrealistic, especially in the case of Asian demand models.

Second, the estimated price and income elasticities for all fish types tend to be higher among the poorer sector of the economy than among the more affluent. This implies that the poorer households often consider fish, especially the high-value species, as a luxury commodity, whereas the rich consider it as simply a basic food item. Hence, partitioning the population by income groups allows a better measurement of fish demand responses that are characteristic of the poor and rich consumers.

Both of these results have important policy implications. The analysis showed that as per-capita income and population grow in most Asian countries, there will be very large increases in fish demand that are expected to come mostly from the poorer sector of the economy. If there is no commensurate increase in fish supply, then there will be pressure for fish prices to go up, which will likely hurt consumers. This has worrying consequences for the protein intake of households, particularly among the poor. A way to circumvent this welfare loss is to expand fish production, which to date can possibly be addressed through fish farming or aquaculture. However, increasing fish supply will, in turn, exert downward pressure on the price of fish, which may disadvantage fish farmers. Nevertheless, when fish demand is price elastic, then a decline in the price can bring about rising revenues. There is, therefore, a need to focus aquaculture expansion on fish species where demand exhibits elastic responses, e.g. low-value species, in order to avoid misplaced investment for product intensification. Hence, future expansion and development in fishery technology, especially in aquaculture, need to consider these important relationships between demand elasticities, price of fish species and household incomes. Based on the results of this study, it is important to note that low-value species such as tilapia, carp and catfish can be expected to play a key role in such developments.

Acknowledgments

The authors wish to acknowledge the financial support of the Asian Development Bank and the WorldFish Center for the conduct of this study. Special thanks are accorded to Mr Ferdinand J. Paraguas, Ms Sheryl M. Navarez and Ms Oai Li Chen for their excellent research support and Dr Rhoelano Briones for his insightful comments on the model's specification.

Johnson, B. (ed.) 2007. Economics and market analysis of the live reef-fish trade in the Asia–Pacific region. ACIAR Working Paper No. 63, 173 pp.

References

Beach R. and Holt M. 2001. Incorporating quadratic scale curves in inverse demand systems. American Journal of Agricultural Economics 83(1), 230–245.

Blundell R., Pashardes P. and Weber G. 1993. What do we learn about consumer demand patterns from micro data? American Economic Review 83, 570–597.

Brown M. and Heien D. 1972. The S-branch utility tree: a generalization of the linear expenditure system. Econometrica 40, 737–747.

Bryne P., Capps O. and Saha A. 1996. Analysis of food-away-from-home expenditure patterns for US households. American Journal of Agricultural Economics 78, 614–627.

Cheng H. and Capps O. 1988. Demand analysis of fresh and frozen finfish and shellfish in the United States. American Agricultural Economics Association 70, 533–542.

Christensen L.R., Jorgenson D.W. and Lau L.J. 1975. Transcendental logarithmic utility function. American Economic Review 65, 367–383.

Deaton A.S. and Muellbauer J. 1980. An almost ideal demand system. American Economic Review 70, 359–368.

Delgado C., Rosegrant M., Wada N., Meijer S. and Ahmed M. 2003. Fish to 2020: supply and demand in a changing world. International Food Policy Research Institute and WorldFish Center, 226 pp.

Dey M.M. 2000. Analysis of demand for fish in Bangladesh. Aquaculture Economics and Management 4, 65–83.

Dickens R., Fry V. and Pashardes P. 1993. Non-linearities and equivalence scale. The Economics Journal 103, 359–368.

Eales J.S. and Unnevehr L.J. 1988. Demand for beef and chicken products: separability and structural change. American Journal of Agricultural Economics 70, 521–532.

Fan S., Wailes E.L. and Cramer G.L. 1995. Household demand in rural China: a two-stage LES-AIDS model. American Journal of Agriculture Economics 77, 54–62.

FAO (Food and Agricultural Organization) 2004. Fisheries statistics online. At: <http://www.fao.org>.

Gao X.M., Wailes E.J. and Cramer G.L. 1996. A two-stage rural household demand analysis: micro data evidence from Jiangsu Province, China. American Journal of Agricultural Economics 78, 604–613.

Garcia Y., Dey M. and Navarez S. 2005. Demand for fish in the Philippines: a disaggregated analysis. Aquaculture Economics and Management 9(1–2), 141–168.

Heckman J. 1979. Sample selection bias as a specification error. Econometrica 47, 153–161.

Heien D. and Durham C. 1991. A test of the habit formation hypothesis using household data. Review of Economics and Statistics 8, 189–199.

Heien D. and Wessells C.R. 1990. Demand system estimation with microdata: a censored regression approach. Journal of Business & Economic Statistics 8(1), 365–371.

Herrmann M., Mittelhammer R. and Lin B. 1992. Applying almon-type polynomials in modeling seasonality of the Japanese demand for salmon. Marine Resource Economics 7, 1–13.

Jones E., Chern W.S. and Mustiful B.K. 1994. Are lower-income shoppers as price sensitive as higher income ones? A look at breakfast cereals. Journal of Food Distribution Research 25(1), 82–92.

Jorgenson D.W., Slesnick D.T. and Stoker T.M. 1988. Two-stage budgeting and exact aggregation. Journal of Business and Economic Statistics 6, 313–325.

Keen M. 1986. Zero expenditures and the estimation of Engel curves. Journal of Applied Econometrics 1, 277–286.

Meenakshi J.V. and Ray R. 1999. Regional differences in India's food expenditure pattern: a completed demand systems approach. Journal of International Development 11, 47–74.

Michalek J. and Keyzer M. 1992. Estimation of a two-stage LES-AIDS consumer demand system for eight EC countries. European Review of Agricultural Economics 19, 137–163.

Mustapha N., Ghaffar R.A. and Poerwono D. 1994. An almost ideal demand system analysis of fresh fish in Semarang, Indonesia. Journal of International Food and Agribusiness Marketing 6(3), 91–128.

Park J., Holcomb R., Raper K. and Capps O. 1996. A demand systems analysis of food commodities by US households segmented by income. American Journal of Agricultural Economics 78, 290–300.

Perali F. and Chavas J. 2000. Estimation of censored demand equations from large cross-section data. American Journal of Agricultural Economics 8(4), 1022–1037.

Pollack R.A. and Wales T.J. 1969. The estimation of the linear expenditure system. Econometrica 27, 611–628.

SAS (SAS Institute Inc.) 1984. SAS/ETS user's guide, version 5 edition. SAS Institute, Cary, NC, 738 pp.

Senauer B. 1990. Household behavior and nutrition in developing countries. Food Policy 15, 408–417.

Shonkwiler J.S. and Yen S. 1999. Two-step estimation of a censored system of equations. American Journal of Agricultural Economics 81, 972–982.

Stone J.R.N. 1954. Linear expenditure systems and demand analysis: an application to the pattern of British demand. Economics Journal 64, 511–527.

Strotz R.H. 1957. The empirical implications of a utility tree. Econometrica 25, 269–280.

Tada M. 2000. Demand for marine products in Japan. National Research Institute of Fisheries Science Report no. 15, Fukuura, Kanazawa, Yokohama, Japan.

Thiel H. 1965. The information approach to demand analysis. Econometrica 33, 67–87.

Tiffin A. and Tiffin R. 1999. Estimates of food demand elasticities for Great Britain: 1972–1994. Journal of Agricultural Economics 50, 140–147.

Timmer C.P. and Alderman H. 1979. Estimating consumption parameters for food policy analysis. American Journal of Agricultural Economics 61(5), 982–987.

Thomas R.L. 1987. Applied demand analysis. Longman Group Limited, Harlow, England.

Wessels C. and Wilen J. 1993. Economic analysis of Japanese household demand for salmon. Journal of the World Aquaculture Society 24, 361–738.

Yen S.T. and Roe T. 1989. Estimation of a two-level demand system with limited dependent variables. American Journal of Agricultural Economics 71, 85–99.

Annex

Price and income elasticities (ξ) of various fish species belonging to major fish groupings, by country and income group, 2004

Fish species	All income groups		Low income group		High income group	
	Price ξ	Income ξ	Price ξ	Income ξ	Price ξ	Income ξ
High-value freshwater fish						
Bangladesh						
Indian major carp	–1.22	1.49	–2.52	3.10	–1.02	0.98
Live fish	–1.84	1.25	–2.01	1.50	–1.63	0.88
Hilsa	–0.58	1.38	–0.30	2.09	–0.72	0.84
China						
Crucian carp	–0.29	0.95	–	0.59	–	0.41
Grass carp	–	1.04	–	0.56	–	0.48
Indian (Major carp)	–0.99	1.62	–0.99	1.63	–0.99	1.36
Indonesia	–	1.46	–	3.05	–	0.53
Malaysia	–0.98	0.87	–1.46	1.12	–0.97	0.54
Philippines (Milkfish)	–2.14	0.57	–3.61	0.14	–1.46	0.59
Sri Lanka	–1.08	0.86	–1.06	0.72	–1.15	1.05
Thailand						
Snakehead	–0.24	0.24	–0.18	0.74	–0.29	0.07
Silver barb	–0.13	0.09	–0.25	0.39	–0.70	0.01
Vietnam						
Snakehead	–0.87	1.00	–0.81	1.00	–0.89	1.00
Silverbarb	–1.78	0.96	–1.92	0.96	–1.68	0.96
Other high-value fish	–0.52	0.97	–0.54	0.98	–0.53	0.97
Low-value freshwater fish						
Bangladesh						
Tilapia	–1.24	0.99	–1.45	1.29	–1.21	0.62
Pangas	–0.78	0.62	–	–	–	–
Other carp	–1.08	1.36	–1.70	2.00	–0.97	0.96
Assorted small fish	–0.80	0.72	–0.82	0.89	–0.75	0.52
China						
Silver carp	–0.39	0.94	–	0.51	–	0.03
Common carp	–	0.85	–	0.52	–	0.05
Freshwater fish	–	1.00	–	1.10	–	0.82
India						
Common carp	–0.99	–	–	–	–	–
Other freshwater fish	–0.99	1.62	–0.99	1.64	–0.99	1.36
Indonesia	–0.94	1.46	–0.89	3.05	–0.94	0.53
Malaysia	–1.08	1.94	–1.08	2.34	–1.08	1.18
Philippines (Tilapia)	–1.58	0.56	–1.87	0.49	1.40	0.48
Thailand						
Tilapia	–0.74	0.05	–0.74	0.30	–0.66	0.001
Catfish	–0.96	0.12	–0.95	0.43	–0.95	0.03
Vietnam						
Carp	–1.28	0.98	–1.21	0.99	–1.20	0.98
Catfish	–1.04	1.01	–1.05	1.01	–1.03	1.01
Tilapia	–6.08	0.94	–12.84	0.07	–2.82	0.98

Continued on next page

Price and income elasticities (ξ) of various fish species belonging to major fish groupings, by country and income group, 2004

Fish species	All income groups		Low income group		High income group	
	Price ξ	Income ξ	Price ξ	Income ξ	Price ξ	Income ξ
High-value marine fish						
Bangladesh	–1.92	1.56	–2.78	3.07	–1.49	1.00
China				0.55		
Hairtail	–0.44	0.90	–	0.61	–	0.27
Yellow croker	–	1.26	–	1.04	–	0.64
Marine fish	–	1.08	–		–	1.09
India			–0.62	1.14	–0.97	1.37
Pelagic high-value fish	–0.99	1.62	–	–	–	–
Demersal high-value fish	–0.95	1.62	–	–	–	–
Indonesia	–1.40	1.46	–1.45	3.05	–1.35	0.53
Malaysia	–0.91	0.52	–0.58	0.69	–0.91	0.40
Philippines	–1.61	1.89	–1.48	2.14	–1.73	1.54
Sri Lanka						
Large pelagic fish	–0.95	0.99	–0.89	0.96	–0.96	1.00
Demersal fish	–1.02	0.98	–1.04	1.42	–1.01	0.99
Thailand						0.35
Indo-Pacific mackerel	–0.41	0.66	–0.48	0.90	–0.52	
Other high-value fish	–0.78	0.62	–0.74	0.93	–0.76	0.38
Vietnam	–1.04	1.06	–0.94	1.14	–1.09	1.04
Low-value marine fish						
Bangladesh	–0.88	1.05	–1.04	1.25	–0.80	0.85
China	–0.95	0.95	–	0.52	–	0.47
India	–	–	–0.96	1.65	–0.94	1.35
Pelagic low-value fish	–1.05	1.62	–	–	–	–
Demersal low-value fish	–0.88	1.62	–	–	–	–
Indonesia	–0.27	1.46	–0.37	3.05	–0.10	0.53
Malaysia						
Anchovy	–0.88	0.82	–	1.03	–0.88	0.48
Other low-value fish	–1.12	1.13	–1.12	0.01	–1.12	0.76
Philippines						
Anchovy	–1.52	0.70	–1.34	1.04	–1.78	0.34
Roundscad	–1.31	0.63	–1.29	0.84	–1.42	0.33
Sri Lanka						
Small pelagic fish	–0.69	0.93	–0.63	–	–0.57	–
Other marine fish	–1.01	1.07	–1.04	0.86	–1.01	1.01
Thailand	–1.28	0.62	–1.20	0.77	–1.32	0.35
Non-finfish – shrimp						
Bangladesh	–1.00	0.68	–0.98	0.80	–1.04	0.47
China	–0.46	1.36	–	0.93	–	0.99
India	–0.99	1.61	–0.96	1.14	–1.00	1.39
Indonesia	–1.04	–	–1.06	3.05	–1.02	0.53
Malaysia	–0.89	–	–1.24	–	–0.89	–
Philippines	–0.95	1.78	–0.92	2.66	–1.00	0.89
Thailand	–0.64	0.66	–0.66	1.00	–0.74	0.35
Vietnam	–4.25	0.94	–2.21	0.98	–3.06	0.96
Crustaceans/molluscs						
India	–1.00	1.66	–1.01	3.75	–0.99	1.12
Indonesia	–	1.46	–	–	–	–
Malaysia	–0.99	0.73	–1.08	0.92	–0.99	0.45
Philippines						
Squid	–1.30	1.61	–1.47	2.41	–1.17	0.92
Shells and crabs	–0.45	1.23	–0.47	1.58	–0.39	0.87
Dried fish						
Bangladesh	–	1.06	–0.40	1.38	–0.40	0.78
Indonesia	–0.72	1.46	–0.84	3.04	–0.56	0.53
Philippines	–1.33	1.01	–1.19	1.08	–1.51	0.39
Sri Lanka	–0.85	1.01	–0.86	1.03	–0.83	1.00
Thailand	–0.66	0.62	–0.62	0.88	–0.71	0.33

Data are based on ADB-RETA 5945 study, country reports.