IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

Price and income elasticities of selected fish commodities in Indonesia: a multi stage budgeting framework

To cite this article: Sonny Koeshendrajana *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **860** 012059

IOP Conf. Series: Earth and Environmental Science **860** (2021) 012059 doi:10.1088/1755-1315/860/1/012059

Price and income elasticities of selected fish commodities in Indonesia: a multi stage budgeting framework

Sonny Koeshendrajana[1], Freshty Yulia Arthatiani[1] and Fitria Virgantari[2]

[1]Research Center for Marine and Fisheries Socio-Economics, Ministry of Marine Affairs and Fisheries, Jl. Pasir Putih 1, Ancol Timur Jakarta, Indonesia
[2]Faculty of Mathematics and Natural Science, Pakuan University, Bogor

E-mail: skoeshen@gmail.com

Abstract. Price and income elasticities are considered the main important parameters in analyzing demand for fish in Indonesia. This study was estimated price and income elasticities of selected fish commodities in Indonesia. A quadratic almost ideal demand system (QUAIDS) model was used to estimate those elasticities. A multistage budgeting framework approach was applied in the model. *SUSENAS* (National Social Economic Survey) data of 2019 were used in this study. The selected fish commodities were *Tuna-Tongkol Cakalang* (Tunas), *Kembung* (mackerel), *Mas-Nila* (Carps –Tilapia) *Lele* (Catfish), *Bandeng* (Milkfish), *Udang* (Shrimp), *Olahan* (Processed fish) and other fresh fish. National elasticities of selected fish commodities were illustrated in terms of different income groups, that is, low, mediun and high. Study revealed that price elasticities were ranging of -0.7088 – -1.1686 (low income group), -0.8550 - -1.5119 (medium income group) and -0.6933 - -1.1745 (high income group). Income price elasticities were ranging of 1.1167 – 1.9561 (low income group), 0.9497-1.2963 (medium income group) and 0.6538 – 0.8559 (high income group). Elasticity is greater than 1 indicating elastics, whereas less than 1 indicating inelastic.

1. Introduction

Price and income elasticities are considered the main important parameters in analyzing demand for fish. Having that figures, dynamic change in price of particular fish species or/and income received by households will lead to change in the quantity demand of that particular fish species. Theoretically, quantity demand for fish of each household will be depended on its fish price, price of the substitute or/and compatible food price, households' income, taste and other social, economic and demographical background [1–7]. Basically, the relationship between quantity demand for commodity and various type of variables were followed consumer behaviour theory [8]. Demand for fish in Indonesia keep increasing from year to year due to increase in population as well as welfare status of the households. In this case [9] pointed out that dynamic food demand for households tends to increase both in quality and quantity of food menu toward consumption on animal protein, including fish in the future.

FAO through global consumption reported that fish is considered play important role, provided about 3.3 billon people with almost 20 percent of their average per capita intake of animal protein. It is also reported that fish accounted for about 17 percent of total animal protein, and 7 percent of all proteins, consume domestically. In 1917 pointed out that Indonesia can potentially produce high amount of fish [10]; however, data show that among Southeast Asia countries fish consumption in Indonesia is rank 6th out of 8 countries [10]. National fish consumption of Indonesia can be illustrated by *Angka Konsumsi Ikan*/AKI (Fish Consumption Figure) of which consists of household fish consumption, non-household

fish consumption as food away from home and non-recorded consumption. MMAF [11] reported that growth rate of AKI during 2010-2014 was increased by1.53 percent, while during 2015-2019 was 2.68. In other words, AKI was increased from 30.48 kg/capita (2010) to 54.50 kg/capita (2019) as shown in Figure 1.

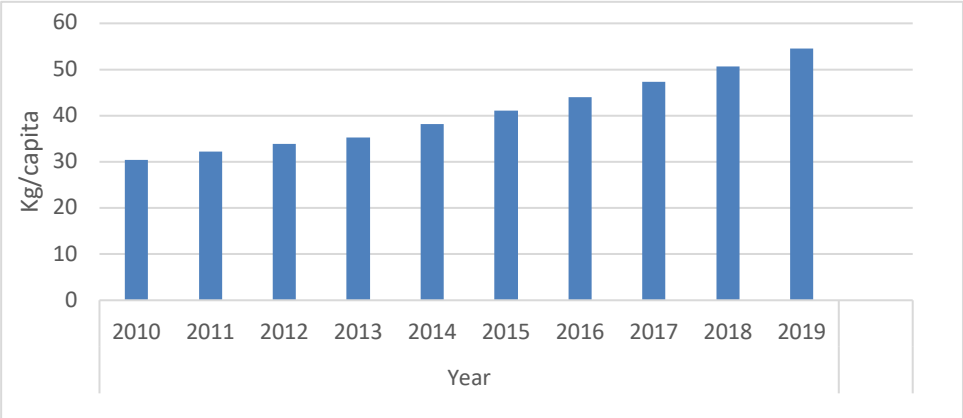

Figure 1. Fish Consumption Figure during 2010-2019 [11].

Food is considered a basic need for human being to life and do their daily activity. National regulation No. 18/2012 regarding food stated that food program must be carried out to meet basic requirement of human being to ensure providing benefits wisely, equally distributed and sustainably manner based on national food security and self-sufficiency. A bigger proportion household expenditure on food indicates that particular household is still at low level of food security.

Consumption pattern of society is always increasing. It gradually grows depending many various factors, such as level of welfare, preference, taste, availability of other substitute of compensated food, prices and social economic and demographic background [1,12]. Studies on fish consumption in Indonesia was relatively rare. Expenditure on food consumption was also depended on income class groups. A different level of income group was usually consume food differently. This will leads to a difference type of food to be consumed [13]. Consumption pattern according to Deaton and Muellbauer (1980) [14] will illustrate many various information of food as well as their quantity needed based on specific social and economic background of consumers. Research on fish consumption pattern was carried out in Indonesia by Virgantari and Arthatiani [5,8] using National Social Economic Surveys data conducted by Central Bureau of Statistic of Indonesia in 2008 and 2016, respectively.

Previous studies on food demand were mostly applied limited budget framework in the demand systems and employed an Almost Ideal Demand System. Virgantari (7) in her study applied a multi stage budgeting framework in the demand system model and employed a Quadratic Almost Ideal Demand System (QUAID) using NSES data of 2008. She differentiates fish consumption to be four selected species group, namely fresh fish, fresh shrimp, processed fish and processed shrimp. Her study was differentiated 8 group of household income. However, this studies were criticized in terms of number of selected species to be considered. Other variant demand system model was carried out by Arthatiani (2018) [8]. She used NSES data of 2016 and employed LA/AIDS model. Five different selected fish group were used in her study, namely: marine fish, fresh-coastal water fish, fresh shrimp, and processed fish. (1) *kelompok ikan air laut* (marine fish), (2) *ikan air tawar/payau* (fresh and coastal fish), (3) *udang segar* (fresh shrimp), and (4) *ikan olahan* (processed fish). However, dynamic household fish consumption was still interested to be study. This especially deals with how much quantity of fish demand will be consumed whenever price of related selected fish species was change and how much response of quantity specific fish will be consumed whenever household income increase in three different household income group.

2. Methods

2.1. Data and Source of Data

National Social Economic Survey data of 2019 [9] was used in this study. Sample size in the national survey was accounted for 315,672 household. The data were organized in such away so that a simple descriptive statistic can be applied to illustrate pattern of fish consumption in Indonesia. Then, using SAS package program, three budgeting framework approach was employed and Quadratic Almost Ideal Demand Systems (QUAIDS) model was estimated. Based on the estimated variables obtained, elasticity of price and income or expenditure of different household income groups were calculated.

2.2. Analytical Methods

A multistage budgeting framework was used in this paper to model the fish consumption behaviour of Indonesia households. The study built on the framework developed by Deaton and Muellbauer in 1980 [14], Blundell *et al.* in 1994 [15], Heien and Wesseils in 1990 [16] which extended the idea of exhaustive expenditure system to different levels or stages. The multistage budgeting technique addresses a common problem in empirical estimation of system demand models requiring a sizeable number of equations, given the wide variety of consumption goods jointly purchased by households [15,17,18]. 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. Similar approach has been employed by [5,9] in the case of deriving demand for selected fish species in Indonesia. A multi budgeting approach in this study can be illustrated in Figure 2.

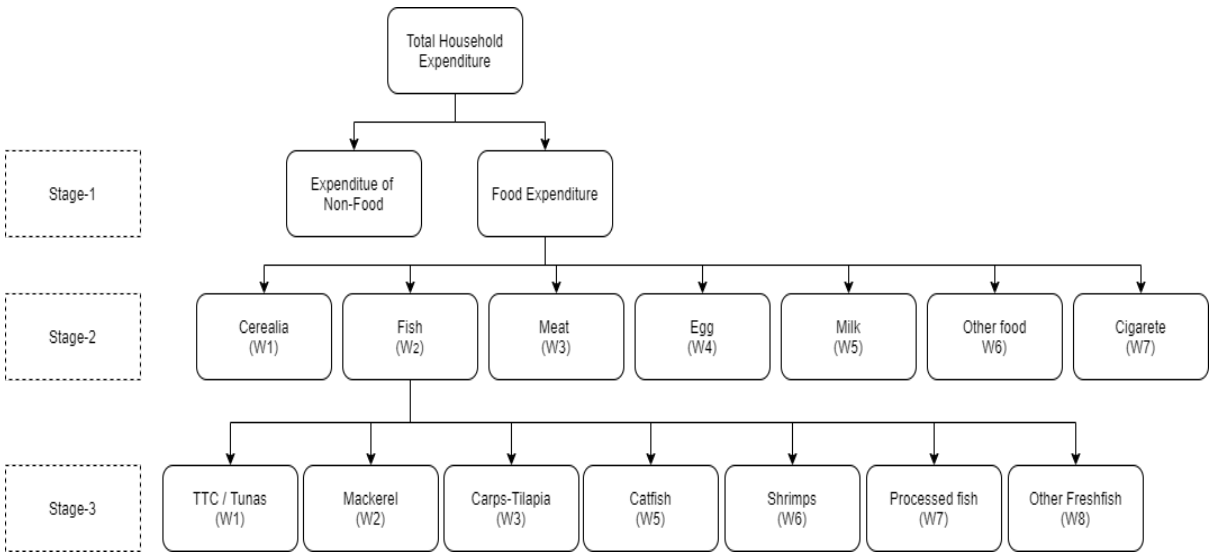

Figure 2. Three Stage-Budgeting Framework used in this study.

Stage 1 of the model assumes that households allocate consumption expenditures to broad groupings such as food and non-food commodities which in turn are affected by income and some demographic characteristics of the household. Specification of the model can be expressed in terms of Working-Lesser demand model as follows.

$$w_i = \alpha_0 + \alpha_i \log x + \sum_j \beta_{ij} \log p_j + \sum_k \gamma_{ik} Z + \varepsilon_i \quad \text{.....} (1)$$

Where, w_i = *share* food expenditure of i to the total household expenditure
p_j = food price of commodity of -j^{th}

x = total food expenditure in the model
Z = demographic variables
ε_i = error terms
This model can be estimated using Ordinary Least Square (OLS) estimator. Expenditure elasticity for Working Lesser model can be calculated as follows.

$$e_i = 1 + \left(\frac{\alpha_i}{w_i}\right) \quad \text{(2)}$$

While price elasticity can be calculated as follows.

$$e_{ij} = -\delta_{ij} + \left(\frac{\beta_{ij}}{w_i}\right) \quad \text{(3)}$$

Where, $\delta_{ij} = \begin{cases} 1, \text{if i = j} \\ 0, \text{if i} \neq \text{j} \end{cases}$

Relationship between price elasticity (e_{ij}) and expenditure elasticity (e_i) can be written as follows

$$e_{ij} = \left(\frac{\delta_{ij}}{w_i}\right) - \delta_{ij} \quad \text{(4)}$$

In the second and third stages, grouping the commodity being consumed in the model demand system will lead to the possibility of zero expenditure. This, in turn, will lead to bias estimation results of the limited dependent variable in the model of demand system [14,16]. Deaton [19] reported that the main problem in the estimating demand for food based on household consumption survey was zero expenditure on specific food or zero consumption. Later, Dey [3] pointed out that zero expenditure or zero consumption was exist due to various reason, such as the existence of consumer preference on food, price of that particular food commodity was to high, limited budget to buy food and incorrect recorded data. OLS estimator will be appropriate in the case of assumption normality data distribution, fredom and homogeneity of their variance were held. Therefore the demand system model at the second and third levels must consider the zero expenditure that can be above using consistent two-step estimation procedures as suggested by Shonkwiler and Yen (1999) [20].

The first step in two-step estimation is to estimate the probit model to find the probability magnitude of a particular food group. The independent variables are total expenditure and demographic variables. The probit model is as follows:

$$\boldsymbol{prob}\ (\boldsymbol{y_{it}} = \mathbf{1}|\mathbf{Z_h}) = \boldsymbol{\phi}(\boldsymbol{Z_h \tau_i}) \quad \text{(5)}$$

$$\boldsymbol{prob}\ (\boldsymbol{y_{it}} = \mathbf{0}|\mathbf{Z_h}) = \mathbf{1} - \boldsymbol{\phi}(\boldsymbol{Z_h \tau_i}) \quad \text{(6)}$$

The above probit model will produce a PDF normal probability density function (standard normal probability density function / probability distribution function = φ) and a normal cumulative distribution function CDF (cumulative distribution function = Φ). The PDF and CDF generated will be added to the Quadratic Almost Ideal Demand System (QUAIDS) function used in the second and third levels of the demand system model used. Therefore, the QUAIDS model used is as follows:

$$wi = \{\acute{\alpha}_i + \Sigma\, \gamma ij \ln pj + \beta \ln\left(\frac{x}{a(p)}\right) + \frac{\lambda i}{b(P)}\left(\left[\frac{x}{a(p)}\right]\right)^2 + \upsilon_i +) \Phi(.) + \lambda_i\, \varphi\,(.) + \varepsilon i\,\} \ldots\ldots (7)$$

where 'Φ' and 'φ' are considered a CDF (*Cumulative Distribution Function)* and a PDF (Probability Distribution Function).

Following [21], formula to calculate expenditure and price elasticity of QUAIDS model are as follows.

$$\mu_i = \frac{\partial W_i}{\partial \log X} = \beta_i + \frac{2\lambda_i}{b(p)}\left\{\log\left[\frac{X}{a(p)}\right]\right\} \ldots\ldots (8)$$

$$\mu_{ij} = \frac{\partial W_i}{\partial \log P_j} = \gamma_{ij} - \mu_i\left[\alpha j + \sum_k \gamma_{ij} \log P_i\right] - \frac{\lambda_i \beta_j}{b(p)}\left\{\log\left[\frac{X}{a(p)}\right]\right\}^2 \ldots\ldots (9)$$

Considered equation (13) dan (14) formula of expenditure or income elasticity can be calculated as follows.

$$e_i = 1 + \frac{\mu_i}{W_i} \ldots\ldots (10)$$

and uncompensated price elasticity (Marshallian) [22] is:

$$e_{ij}^M = \frac{u_{ij}}{w_i} - \delta_{ij} \ldots\ldots (11)$$

To maintain integrity in the demand system equation, restriction on adding-up, homogeinity and symetry are applied.

a) Adding up : $\sum_5^i \acute{\alpha} i = 1, \sum_0^i \gamma ij = 0, \sum_0^i \beta i = 0, \sum_0^i \theta i = 0$ ..... (12)
b) Homogeneity : $\sum_0^j \gamma ij = O$ .....(13)
c) Simetry : $\gamma ij = \gamma ji$ ..... (14)

3. Result and Discussion

Social and economic characteristic of household and average fish consumption of household was illustrated in Figure 1. The descriptive statistic of the NSES data of 2019 showed that average fish consumption were 53.38 kg/capita/year (high), 25.60 kg/capita/year (medium) and 8.20 kg/capita/year (low). Average number of person in the household were 3.52 person (high), 4.03 person (medium) and 3.90 person (low). Educational background of household's wife shows 8.35 yr (high), 8.01 (medium), and l7.37 (low). Considered high expenditure data illustrate IDR 1,516,137 (total), IDR 735,049 (food) and IDR 78,088 (non-food); while for low expenditure were IDR 1,056,383 (total), 529,301 (food) and 527,082 (non-food). Noted that income or expenditure group in this study was classified into three different group as the following: (1) high (20 percent highest household income group), (2) medium (40 percent household income/expenditure group below of the highest), and (3) low (40 percent lowest household income/expenditure group).

Table 1. Social Economic characteristic of household, expenditure and fish consumption.

Variable	Fish consumption (kg/capita/yr)		
	High	Medium	Low
Average fish consumption (Kg/cap/yr)	53.38	25.60	8.70
Number of family household (person)	3.52	4.03	3.90
Average age of household's head (yr)	49.52	48.64	48.35
Educational background of wife (yr)	8.35	8.01	7.37
Food expenditure (IDR/capita/Month)	735,049	574,081	529,301
	(48.48%)	(49.85%)	(50.11%)
Non-food expenditure (IDR/cap/Month)	78,088	578,492	527,082
	(51,52%)	(50.15%)	(49.89%)
Total expenditurel (IDR/cap/Month)	1,516,137	1,153,572	1,056,383

Source: NSES data of 2019 Processed (BBRSE, 2020).

Various studies indicated that those the variables have a positive impact on the household consumption as reported by Yanti and Murtala (2019) [23], Vidiawan and Tisnawati (2015) [24], Hattas (2011) [6]. According to Mantra (2003) [25] number of person in the household was considered all the person daily consumed in that particular household. Meanwhile, Adiana and Karmini (2012) pointed out that number of household directly related to increase consumption in that particular household [26].

Estimated parameters of demand system in first stage so-called Lesser Working Model using OLS method was reported in the Table 2. Result of the estimated showed that all parameters were significantly influence to household demand for food with α = 1% except parameter of wife educational background in the low group of household income level. This indicates that educational wife background will not influence pn quqntity fish consumed in the poor household group. In the reality, household wife is relatively dominant influencing in the daily food consumption pattern of the household [27].

Tabel 2. Estimated parameter model of the food demand system in the 1st stage.

Variabel	Nasional	Households income group		
		Low	Medium	High
Intercept	1.830***	0.593***	2.525***	3.253***
Expenditure on food	-0.100***	-0.046***	-0.086***	-0.170***
Food price	-0.042***	-0.029***	-0.051***	-0.030***
Non-food price	0.111***	0.183***	-0.038***	0.050***
Avergae age household	0.089***	0.058***	0.084***	0.142***
Number of household	-0.024***	-0.004***	-0.026***	-0.052***
Wife educational backgtound	-0.018***	-0.013	-0.022***	-0.025***

*Signifikan at α = ***1%; **5%, *10%*
Source: NSES data of 2019 processed (BBRSEKP, 2020)

This study applied multi budgeting framework approach, consequently, elasticity generated in each stage will be important to calculated elasticity in final stage. A working Laser model in the first stage was only consider two type of household expenditure, that is food and non-food expenditure. Parameter estimator to be use in this case was am OLS. The model consid ered at different level, national, Java and outside Java and different house hold group of income. In general, price elasticities of all household income group showed a negative sign indicating that it is in line with the economic theory. It is also indicating that the lower household income group was more sensitive to the other group with respect to the change in food price.

In the 2nd stage, QUAIDS model were constructed by inclusion of PDF dan CDF in the selected model. Food demand system in second stage was differentiated to be 7 type of food. This model parameters, in turn, were estimated using a *Full Information Maximum Likelihood* (FIML) with

restriction on homogeinity and symmetry. All estimated variables PDF were significant, except for consumption of milk in the lower income group of the household. In this case, lower income group of household can be treated as a relatively poor of society. Those results were depicted in Table 3. The results later were calculated their elasticity in terms of different household income group. In general, for all household income group, their price elasticity ware negative and for fish and other food commodity were relatively elastic (more than 1). Income elasticities are a positive value, meaning that all commodities were considered a normal good.

Table 3. Estimated parameters in the 2nd stage of QUAIDS model.

Variable	Serealia	Fish	Meat	Egg	Milk	Other type of food	Cigarete
Intercept	0.2939***	0.0099***	0.0181***	-0.0099***	-0.0066***	0.6743***	0.0222***
household member	0.0655***	0.0056***	0.0009***	0.0022***	0.0009***	-0.0768***	0.0021***
Age	0.0129***	0.0026***	0.0008***	0.0009***	0.0006***	-0.0116***	-0.0052***
Wife education	-0.0012***	0.0008***	0.0002***	0.0004***	0.0000***	0.0016***	-0.0018***
Price of Serealia	-0.0027***	0.0035***	0.0009***	0.0032***	-0.0003***	-0.0048***	0.0004***
Fish price	0.0035***	-0.0030***	0.0003***	0.0009***	-0.0002***	-0.0008***	-0.0006***
Meat price	0.0009***	0.0003***	-0.0008***	0.0003***	-0.0005***	-0.0002***	
Egg price	0.0032***	0.0009***	0.0003***	-0.0043***	0.0008***	-0.0011***	0.0003***
Milk price	-0.0003***	-0.0002***	-0.0005***	0.0008***	-0.0003***	0.0007***	-0.0002***
Other food price	-0.0048***	-0.0008***	-0.0002***	-0.0011***	0.0007***	0.0049***	0.0013***
Cigarete price	0.0004***	-0.0006***	-0.00002*	0.0003***	-0.0002***	0.0013***	-0.0011***
Expenditure	-0.0646***	-0.0082***	-0.0097***	0.0076***	0.0027***	0.0661***	0.0037***
Expenditure	0.0031***	0.0011***	0.0011***	-0.0009***	-0.0004***	-0.0040***	0.0001***
Error	0.0247***	-0.0009***	0.0006***	-0.0009***	0.0003***	-0.0204***	-0.0019***
PDF	0.0923***	0.0086***	0.0010***	0.0100***	-0.0001	0.6727***	0.0187***

*Signifikanat α = ***1%; **5%, *10%*
Source: NSES data of 2019 processed (BBRSEKP, 2020)

In the 3rd stage, fish were disaggregate to be 8 species, namely: *Tuna-Tongkol Cakalang* (Tunas), *Kembung* (mackerel), *Mas-Nila* (Carps –Tilapia) *Lele* (Catfish), *Bandeng* (Milkfish), *Udang* (Shrimp), *Olahan* (Processed fish) and other fresh fish. Almost all variables estimated from fish demand system model were significant at α= 1%, 5% and 10%. Variables use in the model is considered economic variable as a proxy of purchasing power amount of expenditure and expenditure quadrat and fish prices. Social and economic aspect and demographic background can be treated as variable influencing in the demand for fish. In this study number of household member, average age of household head as well as educational background of wife may influence on fish demand of the household. Those are illustrated in the Table 4. Noted that the parameters estimated result were only be reported in the case of national level and different household income group.

Table 4. Estimate variable of fish demand model for national household.

Variables	Tunas	Mackerel	Carp-Tilapia	Catfish	Milkfish	Shrimp	Processed fish	Other fresh fish
Intercept	0.8972***	1.25491***	0.67316***	0.37069***	0.05098***	0.05098***	0.30266***	0.9551***
Number of household member	-0.0531***	-0.1568***	-0.0957***	-0.0257***	-0.0738***	-0.0738***	0.05827***	-0.06***
Average	-0.0305***	-0.0857***	-0.0124***	0.00994***	-0.0373**	-0.0373***	-0.0196***	-0.0155***
Educational	-0.0294***	0.06923***	0.01306***	0.00321***	0.0242***	0.0242***	-0.0091***	0.01831***
Tunas price	-0.0146***	-0.106***	0.03742***	0.06306***	-0.0946***	-0.0946***	0.02766***	0.02795***
Mackerel	-0.106***	-0.2017***	-0.0337***	-0.0299***	0.09653***	0.09653***	0.03482***	0.01932***
Carp-tilapia	0.03742***	-0.0337***	0.02303***	0.0796***	0.0167***	0.0167***	-0.0776***	-0.0876***
Catfish	0.05906***	0.22061***	0.04207***	-0.082***	0.03442***	0.03442***	-0.1294***	-0.1033***
Milkfish	0.06306***	-0.0299***	0.0796***	-0.2241***	0.04618***	0.04618***	0.0122***	0.13496***
Shrimp	-0.0946***	0.09653***	0.0167***	0.04618***	-0.154***	-0.154***	0.06408***	-0.0093***
Processed fish price	0.02766***	0.03482***	-0.0776***	0.0122***	0.06408***	0.06408***	0.12602***	-0.0578***
Othe fresh	0.02795***	0.01932***	-0.0876***	0.13496***	-0.0093***	-0.0093***	-0.0578***	0.07577***
Expenditure	0.02021***	0.11467***	-0.0262***	0.02657***	-0.082***	-0.082***	0.1179***	0.0578***
Expenditure	-23.603***	145.974***	-66.064***	-5.1952***	-113.09***	-113.09***	153.936***	2.47279***
PDF	0.06783***	-0.0381***	-0.0839***	-0.0405***	-0.02***	-0.02***	0.22071***	-0.0488

*Signifikan at α= ***1%; **5%, *10%*
Source: NSES data of 2019 processed (BBRSEKP, 2020)

Table 5. Estimate variables of fish demand system model of the household low income group (40%),

Variables	Tunas	Mackerel	Carp-Tilapia	Catfish	Milkfish	Shrimp	Processed fish	Other fresh fish
Intercept	1.07204***	1.37798***	0.87063***	-0.7827***	0.74949***	-0.4939***	0.35032***	1.09213***
Number of household member	-0.1587***	-0.0144***	-0.2635***	-0.1119***	-0.1604***	-0.0781***	0.10288***	-0.0938***
Average age of household	-0.0206***	-0.1189***	-0.0162***	0.24041***	-0.0048	0.04303***	-0.0245***	-0.0634***
Wife educational background	0.00223	0.04937***	0.04478***	0.11419***	0.05891***	-0.0024	-0.0223***	0.0249***
Tunas price	-0.0246***	-0.0078***	0.06546***	0.0256***	0.05951***	-0.1292***	-0.0161***	0.0271***
Mackerel	-0.0078***	-0.6057***	0.0483***	0.34983***	-0.0259***	0.2021***	0.02512***	0.01408***
Carp-tilapia	0.06546***	0.0483***	-0.0894***	0.08968***	0.0206***	-0.0165***	-0.0495***	-0.0686***
Catfish	0.0256***	0.34983***	0.08968***	-0.1333***	-0.108***	-0.0124***	-0.1008***	-0.1105***
Milkfish	0.05951***	-0.0259***	0.0206***	-0.108***	-0.1191***	0.10211***	-0.0272***	0.098***
Shrimp	-0.1292***	0.2021***	-0.0165***	-0.0124***	0.10211***	-0.2768***	0.11468***	0.01607***
Processed fish price	-0.0161***	0.02512***	-0.0495***	-0.1008***	-0.0272***	0.11468***	0.10705***	-0.0532***

Other fresh fish	0.0271***	0.01408***	-0.0686***	-0.1105***	0.098***	0.01607***	-0.0532***	0.07701***
Expenditure	0.03761***	0.12608***	-0.046***	0.04112***	0.03057***	-0.0944***	0.13608***	0.03892***
Expenditure	-13.89***	158.276***	-80.538***	-6.2202***	-13.061***	-89.121***	129.634***	-17.563***
Error	-0.0395***	-0.1627***	0.06911***	0.0143***	-0.0223***	0.09449***	-0.1465***	-0.001
PDF	0.0011	0.09918******	-0.0887***	-0.088***	-0.0934***	0.12775***	0.22934***	-0.0374***

*Signifikan at α= ***1%; **5%, *10%*
Source: NSES data of 2019 processed (BBRSEKP, 2020)

Table 6. Estimate variables of fish demand system model of the household middle income group (40%).

Variables	Tunas	Mackerel	Carp-Tilapia	Catfish	Milkfish	Shrimp	Processed fish	Other fresh fish
Intercept	0.86621***	1.19158***	0.49099***	-0.4653***	0.3056***	0.20539***	0.37621***	0.90754***
Dummy Java	-0.0607***	0.08562***	0.16876***	0.1953***	0.04394***	0.12464***	0.07688***	-0.0756***
Dummy city	-0.0558***	-0.0876***	-0.017***	0.01162***	0.01736***	0.03464***	-0.019***	-0.0759***
Number of household	-0.1207***	-0.0224***	-0.1656***	-0.0466***	-0.0637***	-0.1204***	0.11827***	-0.0725***
Average age of household	-0.0047***	-0.1272***	0.00794***	0.1479***	0.0188***	-0.0384***	-0.026***	-0.0235***
Wife educational background	-0.0021***	0.03161***	0.04931***	0.06378***	0.03903***	0.01609***	-0.0199***	0.0314***
Tunas price	0.07544***	-0.1436***	-0.0104***	0.03748***	0.10843***	-0.0653***	0.01069***	-0.0128***
Mackerel	-0.1436***	-0.1793***	-0.0087***	0.22912***	-0.033***	0.05284***	0.019***	0.06362***
Carp-tilapia	-0.0104***	-0.0087***	0.00973***	0.03185***	0.08256***	0.02681***	-0.0666***	-0.0653***
Catfish price	0.03748***	0.22912***	0.03185***	0.00234***	-0.1667***	0.07168***	-0.091***	-0.1148***
Milkfish	0.10843***	-0.033***	0.08256***	-0.1667***	-0.1561***	0.04171***	0.03054***	0.09256***
Shrimp price	-0.0653***	0.05284***	0.02681***	0.07168***	0.04171***	-0.1751***	0.03689***	0.01044***
Processed fish price	0.01069***	0.019***	-0.0666***	-0.091***	0.03054***	0.03689***	0.14663***	-0.0862***
Other fresh fish	-0.0128***	0.06362***	-0.0653***	-0.1148***	0.09256***	0.01044***	-0.0862***	0.11236***
Expenditure	0.02088***	0.11623***	-0.0202***	0.05118***	0.03431***	-0.1048***	0.12649***	0.0565***
Expenditure quadrat	-9.4386***	161.326***	-45.414***	8.37635***	11.3319***	-155.89***	174.061***	-15.765***
Error	-0.0379***	-0.145***	0.0495***	0.02563***	-0.0413***	0.10777***	-0.1586***	-0.0001***
PDF	0.05724***	0.06027***	-0.0283***	-0.0261***	-0.0624***	-0.0217***	0.11848***	-0.0435***

*Signifikan at α= ***1%; **5%, *10%*
Source: NSES data of 2019 processed (BBRSEKP, 2020)

Table 7. Estimate variables of fish demand system model of the household high income group (20%).

Variables	Tunas	Mackerel	Carp-Tilapia	Catfish	Milkfish	Shrimp	Processed fish	Other fresh fish
Intercept	-1.0961***	-0.2484***	-0.3735***	-1.6055***	-0.1975***	0.0627***	0.95753***	-0.5428***
Dummy	0.07645***	-0.0807***	0.03091***	-0.0234***	-0.0316***	0.20565***	-0.0273***	0.01172***
Dummy	0.06297***	0.00928***	0.02328*	0.0159***	0.01202***	0.03889***	-0.0434***	-0.0347***

No of average household	-0.0121***	0.0384***	0.02274***	0.03678***	-0.0141***	-0.0882***	0.00845***	-0.0577***
Average age	-0.3561***	-0.1126***	0.01704***	0.09026***	0.07503***	0.13915***	-0.0028***	0.15001***
Wife educational background	-0.1126***	-0.2667***	0.14407***	0.19984***	0.0088***	-0.0655***	0.05207***	0.04003***
Tunas'	0.01704***	0.14407***	-0.2389***	0.00472	0.08924***	-0.0196***	-0.0289***	0.03226***
Mackerel	0.09026***	0.19984***	0.00472	-0.4559***	0.02433***	0.11181***	-0.1215***	0.1465***
Carp-tilapia	0.07503***	0.0088***	0.08924***	0.02433***	-0.3892***	0.0868***	0.05138***	0.05361***
Catfish	0.13915***	-0.0655***	-0.0196***	0.11181***	0.0868***	-0.2201***	0.01378***	-0.0464***
Milkfish price	-0.0028	0.05207***	-0.0289***	-0.1215***	0.05138***	0.01378***	0.02283***	0.01313***
Shrimp	0.15001***	0.04003***	0.03226***	0.1465***	0.05361***	-0.0464***	0.01313***	-0.3892***
Processed	0.02646***	-0.0222***	-0.007***	0.02861***	-0.0128***	0.00425***	-0.069***	0.04267***
Other fresh	-3.9897***	5.28178***	7.79867***	-6.5167***	2.0994***	1.71485***	10.9661***	4.47749***
Expenditure	-0.0512***	-0.0339***	0.00295**	-0.0216***	-0.0655***	0.01249***	0.04619***	-0.0156***
Quadratic expenditure	0.80171***	0.90658***	0.24738***	0.6984***	0.34837***	0.02462***	0.72357***	1.216***

*Signifikan at α= ***1%; **5%, *10%*
Source: NSES data of 2019 processed (BBRSEKP, 2020)

Based on the above parameters estimated results, demand elasticities of food can be calculated and depicted in the Table 8.

Table 8. Demand Elaticities of food with respect to price and income/expenditure in 1st stage.

Tipe	Own Price	Income or expenditure
Nasional	-0.9466	0.8294
Income/Expenditure group		
- Low	-0.9850	0.9247
- Medium	-0.9640	0.8458
- High	-0.8556	0.6030

All elasticity was on the correct sign and the figures showed less than 1. This indicated that they are in elastic. Figures according to the level of household expenditure group indicating that the lowest the household income group the highest the elasticity would be. In other word, lowest household income group tends to consume higher proportion of food whenever their income increase by one unit in the same direction. However, whenever food price increase by one unit, proportion of food consume decrease in the lowest household income group will be greater than in the middle and higher household income group but less than one unit.

In the second stage, demand Elasticities of selected food group were calculated and shown as in Table 9. In the 2nd stage, expenditure on food were disaggregate to be commodity of serealia, fish, meet, egg, milk, other food and cigarete. All income or expenditure elasticity of household were positive sign, indicating that all commoditity consumed were considered a normal good. In the relatively poor household, fish, meat, milk and cigarete were considered a luxury commodity. These indicated by their elasticity were greater than 1. In the national level, elasticity were inelastic and in average food was considered a basic need.

Table 9. Price and income elasticity of corresponding selected food group and income group of the model.

Selected food price and Food group	Price elasticity				Income elasticity			
	Nasional	Income group of household			Nasional	Income group of household		
		Low	Medium	High		Low	Medium	High
Serealia	-0.8459	-1.5019	-1.7522	-0.8967	0.6604	0.5608	0.3151	0.1122
Fish	-1.0184	-1.0594	-1.0519	-1.1554	0.8483	1.1312	1.0285	0.8458
Meat	-0.9651	-0.6086	-0.7367	-0.7503	0.8332	1.0955	0.9491	0.7746
Egg	-1.0608	-1.1219	-1.1296	-0.4177	0.8194	0.8421	0.7663	0.4457
Milk	-0.9770	-0.6736	-0.8052	-0.6825	0.8202	1.2689	1.0819	0.6249
Other food	-1.0295	-0.9358	-0.9273	-0.9544	0.8713	0.9225	0.8369	0.5875
Cigarete	-0.9981	-1.0054	-1.0008	-0.6399	0.8429	1.1393	1.0165	0.8316

In the third stage, fish were group into selected species group as *Tuna-Tongkol Cakalang* (Tunas), *Kembung* (mackerel), *Mas-Nila* (Carps –Tilapia) *Lele* (Catfish), *Bandeng* (Milkfish), *Udang* (Shrimp), *Olahan* (Processed fish) and other fresh fish. From the parameter estimated, the elasticity was calculated and reported as shown in the Table 10. Price elasticity were shown a negative value, meaning that as price increase, the consumption of commodity will respectively decrease. The income or expenditure elasticity of household were on the positive sign indicating that as income increase, consumption of the respective fish species will be increased in same direction. Table 10 showed that poor household (household low income group) was more elastic than the rich household (household high income level) group.

Table 10. Calculated elasticity of price and income according to selected fish group and different level of household income or expenditure group.

Selected fish	Price elasticity				Incone/Experditure elasticity			
	Nasional	Household income group			Nasional	Household income group		
		Low	Medium	High		Low	Medium	High
Tunas	-1.0078	-1.1648	-0.9276	-1.1712	0.8481	1.1362	1.0553	0.8547
Mackerel	-1.0556	-1.1686	-1.5119	-1.1745	0.8874	1.1924	1.2963	0.8370
Carp-tilapia	-0.9985	-1.1354	-0.9773	-1.1444	0.8421	1.1167	0.9979	0.8459
Catfish	-1.0038	-1.0488	-1.0074	-1.0520	0.8499	1.1328	1.0380	0.8478
Milkfish	-1.0023	-1.0092	-1.1014	-1.0126	0.8484	1.1313	1.0492	0.8457
Shrimp	-1.0008	-1.0034	-1.1077	-1.0024	0.8483	1.1311	0.9497	0.8458
Processed fish	-0.6624	-0.7088	-0.8550	-0.6933	1.6423	1.9561	1.2586	0.6538
Other fresh fish	-1.0072	-1.1131	-0.9188	-1.1393	0.8513	1.1328	1.1176	0.8559

4. Conclusion

Price elasticities were ranging from -0.7088 – -1.1686 (low income group), -0.8550 - -1.5119 (medium income group) and -0.6933 - -1.1745 (high income group). Price elasticity of tunas and mackerel was sensitively responden to the household lower income group. As the price of that particular commodity increase, this group tend to decrease their consumption. For medium household income group, mackerel and shrim were the most sensitive, while for high household income group, tunas and mackerel were the most sensitive. Interestingly that processed fish was considered the least sensitive to all the consumer's household income.

Income elasticities were ranging from 1.1167 – 1.9561 (low income group), 0.9497-1.2963 (medium income group) and 0.6538 – 0.8559 (high income group). Elasticity is greater than 1 indicating elastics, whereas less than 1 indicating inelastics. All income elasticities were positive, indicating that all fish considered a normal good.. Income elasticity for selected group was still considered that fish was a luxurious good for household lower income group. Further study is still needed to explore inside the findings.

References

[1] Rachmat M 2016 Pendugaan Permintaan Pangan Utama di Indonesia: Penerapan Model Almost Ideal Demand System (AIDS) dengan Data Susenas 1990 *J. Agro Ekon.* **12** 24–38
[2] Dey M M, Garcia Y T, Praduman K, Piumsombun S, Haque M S, Li L, Radam A, Senaratne A, Khiem N T and Koeshendrajana S 2008 Demand for fish in Asia: a cross-country analysis *Aust. J. Agric. Resour. Econ.* **52** 321–38
[3] Dey M M 2000 Analysis of demand for fish in Bangladesh *Aquac. Econ. Manag.* **4** 63–81
[4] Virgantari F, Daryanto A, Harianto H and Kuntjoro S U 2017 Analisis Permintaan Ikan di Indonesia: Pendekatan Model Quadratic Almost Ideal Demand System (Quaids) *J. Sos. Ekon. Kelaut. dan Perikan.* **6** 191–203
[5] Virgantari F 2012 *Analisis Permintaan Produk Perikanan di Indonesia: Suatu Studi Cross-Sectional* (Institut Pertanian Bogor)
[6] Hattas Z 2011 Pola Konsumsi Masyarakat
[7] Wijayanti M 2011 *Analisis Preferensi Konsumen dalam Membeli Daging Sapi di Pasar Tradisonal Kabupaten Karanganyar* (Universitas Sebelas Maret)
[8] Arthatiani F Y, Kusnadi N and Harianto H 2018 Analisis pola konsumsi dan model permintaan ikan menurut karakteristik rumah tangga di indonesia *J. Sos. Ekon. Kelaut. dan Perikan.* **13** 73–86
[9] Koeshendrajana S, Apriliani T, Arthatiani F Y, Wardono B and Luhur E 2020 *Kajian Permintaan Ikan Rumah Tangga Dengan Pendekatan Multi Stage Budgeting : Analisis Data SUSENAS 2019* (Jakarta)
[10] Yee C, Tran N, Dao C D, Sulser T B, Phillips M J, Batka M, Wiebe K and Preston N 2017 *Fish to 2050 in the ASEAN region* (Washington, D.C)
[11] Ministry of Marine Affairs and Fisheries 2020 *Ministry of Marine Affairs and Fisheries in figures* (Jakarta: Ministry of Marine Affairs and Fisheries)
[12] Adli P E 2019 *Analisis Permintaan Daging Sapi, Daging Unggas dan Ikan Pada Rumahtangga di Propinsi Sumatera Barat (Penerapan Model Almost Ideal Demand System)* (Universitas Andalas)
[13] Central Bureau of Statistics Indonesia 2016 Persentase Pengeluaran Rata-rata per Kapita Sebulan Menurut Kelompok Barang di Indonesia Tahun 2010-2014
[14] Deaton A and Muellbauer J 1980 An almost ideal demand system *Am. Econ. Rev.* **70** 312–26
[15] Blundell R, Browning M and Meghir C 1994 Consumer demand and the life-cycle allocation of household expenditures *Rev. Econ. Stud.* **61** 57–80
[16] Heien D and Wesseils C R 1990 Demand systems estimation with microdata: a censored regression approach *J. Bus. Econ. Stat.* **8** 365–71
[17] Piumsombun S and Dey M M 2002 Analysis of demand for fish consumed at home in Thailand
[18] Quang C L 2005 *An Empirical Study of Food Demand in Vietnam* (Kansas State University)
[19] Deaton A 1998 Getting prices right: what should be done? *J. Econ. Perspect.* **12** 37–46
[20] Shonkwiler J S and Yen S T 1999 Two-step estimation of a censored system of equations *Am. J. Agric. Econ.* **81** 972–82
[21] Banks J, Blundell R and Lewbel A 1994 *Quadratic Engel curves, indirect tax reform and welfare measurement* (London: University College London, Department of Economics)
[22] Nicholson W and Synder C 2010 *Intermediate Microeconomics and Its Application Eleventh Edition* (Ohio: Cengage Learning)
[23] Yanti Z and Murtala M 2019 Pengaruh Pendapatan, Jumlah Anggota Keluarga dan Tingkat Pendidikan Terhadap Konsumsi Rumah Tangga di Kecamatan Muara Dua *Ekon. Indones.* **8** 72–81
[24] Vidiawan E and Tisnawati N M 2015 Analisis Pengaruh Pendapatan, Jumlah Anggota Keluarga dan Pendidikan Terhadap Jumlah Konsumsi Rumah Tangga Miskin Di Desa Batu Kandik Kecamatan Nusa Penida Kabupaten Klungkung *E-Journal Ekon. Pembang.* **4** 220–348

[25] Mantra I B 2003 *Demografi Umum* (Jakarta: Pustaka Raja)
[26] Adiana P P E and Karmini N L 2012 Pengaruh Pendapatan, Jumlah Anggota Keluarga dan Pendidikan Terhadap Pola Konsumsi Rumah Tangga Miskin di Kecamatan Gianyar *E-Jurnal Ekon. Pembang. Univ. Udayana* **1** 39–48
[27] Astuti F D and Sulistyowati T F 2013 Hubungan tingkat pendidikan ibu dan tingkat pendapatan keluarga dengan status gizi anak prasekolah dan sekolah dasar di Kecamatan Godean *Kes Mas J. Fak. Kesehat. Masy. Univ. Ahmad Daulan* **7** 24831