The Analysis of Protein Consumption Pattern in Indonesia: A Case of Own-produced Commodities

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Abstract

Recently, the indicator of food security in Indonesia has improved, covering not only food availability but also food utilization. The household consumption pattern has shifted from carbohydrates to other nutrients including protein, though the change is relatively insignificant. One of the ways for the households to meet their needs for protein is by farming their protein sources. Households having own-produced food will prefer their food crops especially when the foodstuff price increases. This study aims to analyze the protein food consumption pattern from either plants or animals. It applies the Quadratic Almost Ideal Demand System (QUAIDS) to estimate households' responses towards price and expenditure changes, especially for own-produced food commodities. The results reveal that when the price of animal-based protein increases, households will likely to consume cheaper protein from plants. The value of the own price elasticity is more inelastic in rural and poor households. This indicates that when there is price upsurge, those households tend to consume self-grown protein sources. It is also suggested that the small scale farming can act as a household strategy to improve their food security.

Keywords: protein, food consumption, QUAIDS, own-produced food

1. Introduction

The analysis of food consumption has been a subject of researchers in recent decades. It is conducted particularly in developing countries where most expenditure is spent on food commodities. Understanding food consumption in a country is important to determine socio-economic conditions such as food security, poverty, and the standard of living (1). Regarding food security, World Bank (2016) reports that Indonesia has a fairly good indicator. Even though the food availability has been maintained, the rest indicators such as food access and utilization still need to be improved.

In response to these problems, the Indonesian Government through the Ministry of Agriculture and Ministry of Health continues to promote the national food security program. This program is targeted at farmer production as well as food diversification. Currently, food consumption in Indonesia has been escalated with a decline in staple food consumption and shifted to other diets which have more vital nutrition. One of the essential nutrients for the human body is protein, a substance containing nitrogen formed by the amino acid. Besides water, protein is the most substantial nutrient for the body. In fact, protein consumption in Indonesia is considered low as Statistics Indonesia (2) accounts that the main protein consumption in Indonesia has been about a quarter of the grains'. However, sources for animal-based protein have not been fulfilled and are lower than those in other countries.

As a developing country, where agricultural sector still takes a large portion in GDP and is the second biggest source of employment, Indonesia should be of a great advantage to meet their food needs especially those apart from carbohydrates. However, the Indonesian people who usually consume large amount of carbohydrates, along with their habit and culture, have perhaps ignored the advantage of nutrient-dense foods. About one-third of Indonesians do not meet the minimum meal frequency; one-quarter do not attain minimum dietary diversity, and almost half do not meet the recommended diet quality (3).

The household foodstuff can be obtained from either the market or their farm. According to IFLS, the imputed value of own-produced food consumed by household in Indonesia was accounted for around 19% and 15% in 2007 and 2014 respectively. In fact, most of these home-grown products are obtained from small-scale farming which in Indonesia becomes one of the sources of household livelihood. It is accounted that 93% of the total number of farmers work in small family farms (4). Interestingly, small-scale farming tends to benefit directly to the household. It is assumed to be pro-poor and can reduce poverty and inequality. In addition, it is believed to create sustainable livelihoods, improve food security, and increase employment (5). According to Sabo, Isah, Chamo, & Rabiu (2018), the greater own-produced food from small-scale farming may lead to better access to a larger food supply. Consequently, it can improve the quality and quantity of dietary diversity among household members. However, small-scale farming face several limitations such as climate change, narrow field, pest, and lack of technology.

There are several previous research studies on food consumption pattern (1,7,8) and especially on protein food consumption (10–12). However, a specific study on own-produced food consumption is limited. Thus, this study aims to analyze food consumption pattern, especially protein sources from self-produced food by families in Indonesia. As the previous research, this study adopts the Quadratic Almost Ideal Demand System (QUAIDS) model to obtain price and expenditure elasticities. Those elasticities are used to explore how households respond to changes in prices and expenditures. This paper is organized as follows. The first chapter is an introduction and followed by the research methods describing the data and model

of the data interpretation. The chapter three presents the results, and the last chapter provides the conclusions.

2. Methods

2.1. Data

The data used in this study are those of Indonesian Family Life Survey (IFLS). IFLS is the biggest and longest longitudinal survey in Indonesia which is the sample size represents almost 93% of Indonesia population in 13 provinces. In addition, the IFLS is a socioeconomics and health survey which was conducted in 1993, 1997, 2000, 2007, and 2014. The data were collected from individuals, families, households, communities where people live with, as well as education and health facilities. The sample included in IFLS was around 10,000 households and 50,000 individuals. This study used data from 2007 IFLS and 2014 IFLS. The number of observations conducted in households is 3,264, in which there are approximately 1,600 observations for each wave.

To assess the protein source food consumption, this study used a module of the household consumption expenditure questionnaire. Furthermore, the price dataset also needed to estimate in a demand system. Fortunately, IFLS provides price market data particularly in the household enumeration area. The protein food analyzed in this study involved beans, tofu, and tempeh as a the plant-based protein and meat, chicken, fish, and milk as the animal-based protein. In addition, this study also took account of household and community characteristics to capture household behavior. The estimation is disaggregated by the area (urban/rural) and income group (20% poorest and 20% richest households) to capture the sample heterogenity.

2.2. Model estimation

This study employed a basic complete model of consumption. A Quadratic Almost Ideal Demand System (QUAIDS) was selected because of its several features where the assumption of liniearity in expenditure is given away. QUADIS is an extended form of the AIDS model which is developed by Banks, Blundell, & Lewbel (1997). Several studies have confirmed that this is an approriate model to estimate household consumption and preferences (14–16). The QUAIDS model is presented below:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)} \left\{\ln \left[\frac{m}{a(p)}\right]\right\}^2 + \sum_{s=1}^{s} \delta_{is} D_{st}^h + u_{it}^h \quad (1)$$

Note:

w_i: share of total food expenditures

p_i : price of food commodities i

p_j : price of food commodities j

m : total of food expenditures

D : set of demographics characteristics namely household size, household head's sex, household head's age, household head's educational background, household size, distance to the tradisional market, farming ownership status, urban/rural area, in Java/outside Java.

Based on that equation, the elasticitiy of demand can be derived as follows:

Expenditure elasticity: $e_i = \frac{\mu_i}{w_i} + 1$.

Uncompensated price elasticit/Marshallian: $e_{ij}^{u} = \frac{\mu}{w_i} - \delta_{ij}$,

Compensated price elasticity/Hicksian: $e_{ij}^{c} = e_{ij}^{u} + w_j e_i$.

3. Results

3.1. QUAIDS Estimation Analysis

The average consumption of protein food from own-production show that fish dominates other commodities. Urban households tend to consume more protein food from tofu and tempeh, meat, fish, and milk. Meanwhile, other commodities like chicken and beans are favorable by the poorest households (Figure 1). The similar pattern is also found on the average consumption disaggregated by the income group. However, the poorests tend to consume self-produce food than the richest households do. The biggest difference is found in milk commodities where the poorest households likely consume less milk from own production commodity.

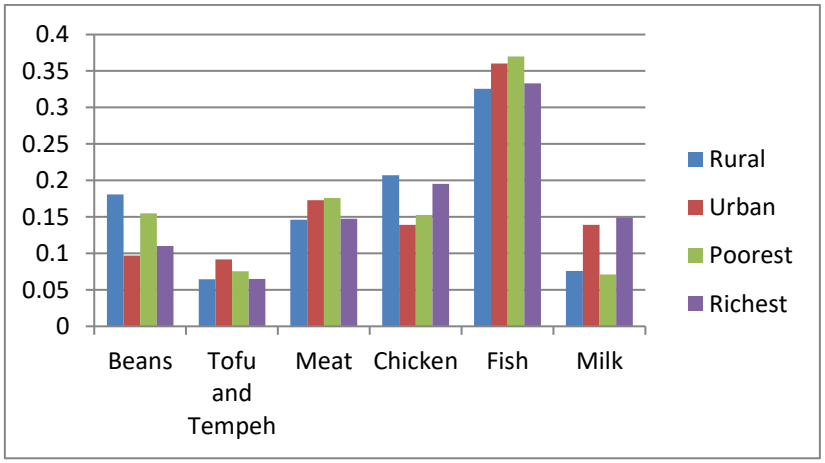

Figure 1. The average consumption of protein food by the selected household groups
Source: Stata output, (data processed)

The QUAIDS estimation result reveals that all expenditure and quadratic expenditure terms are significant except the fish commodity. It indicates that there is a nonlinear engel curve in the consumption pattern. If the sign of the expenditure parameter is positive and the quadratic expenditure is negative, the goods are considered normal on low amount of expenditure, and vice versa it will be inferior on higher amount of expenditure. However, goods with these characteristics are not found in this study. Nevertheless, tofu and tempeh show an opposite

pattern. Whereas, beans and meat are classified as normal goods at any level of expenditure. The result is presented in Appendix 1.

Based on the household characteristics, the age of head of household negatively affects the consumption of meat, chicken, and milk. Although whether the consumption from what is purchased increases or not is not known, this problem may occur because the older people tend to have more health risks, so that the consumption of those commodities must be reduced (17). In terms of educational level of the head of household, it is found that the higher the education level, the higher the level of fish consumption. Education is known as a promoter agent for implementing a healthy lifestyle, so that fish consumption will also increase along with the high educational level of the head of household (18). Households with self-owned farms consume more tofu and tempeh, fish and milk compared to those who do not have farms. It suggests that there is a role of small-farming scale to meet their needs of protein food (19). Based on the area, it turns out that the consumption in Java island is less than the consumption in areas outside Java. It probably occurs because of the decreasing farmland caused by the urbanization and industrialization in Java. Hence, the consumption from own production is limited.

3.2. Results of Price and Expenditure Elasticities

The analysis of own-price elasticity is used to capture how household consumption of each commodity responds to the price changes. The results show that all sign is negative. The negative sign means that all protein food commodities are engaged to the law of demand. It implies that if the price increases, the quantity demanded will decline. The results are presented in Table 1.

Meat commodity has the highest value of elasticity, and the lowest is beans. This implies that even small price changes will lead to a substantial decline in meat demands. The high-value of commodity is usually very sensitive to price changes (20). While beans are relatively cheaper than the other commodities, the price changes will not lead to a significant decline in its consumption. However, in the poorest households, tofu and tempeh become the most inelastic commodity which indicates that the poorest households tend to consume tofu and tempeh as a protein source rather than other commodities when the price increases.

The rural and poorest households have more inelastic values than urban and richest ones when computed with either Marshallian's or Hicksian's. These results indicate that own-produced food fulfill the the food needs of households that are vulnerable to shocks (1,21). It is also implied that the poorest households tend to live in rural areas (22).

Table 1.
The Own Price Elasticity

Commodities	Pooled Sample	Rural	Urban	Poorest	Richest
	Uncompensated				
Beans	-0.933	-0.847	-0.919	-1.191	-0.819
	(0.071)	(0.098)	(0.100)	(0.150	(0.194)
Tofu and Tempeh	-1.028	-1.010	-1.059	-0.960	-0.963
	(0.079)	(0.098)	(0.135)	(0.163	(0.215)
Meat	-1.420	-1.052	-1.796	-1.477	-1.138
	(0.124)	(0.169)	(0.187)	(0.296	(0.373)
Chicken	-1.106	-0.849	-1.148	-1.070	-1.734
	(0.109)	(0.151)	(0.160)	(0.240	(0.319)

Fish	-1.160	-1.026	-1.264	-1.164	-0.995
	(0.048)	(0.062)	(0.078)	(0.107	(0.153)
Milk	-1.058	-1.122	-1.048	-1.084	-0.898
	(0.079)	(0.102)	(0.123)	(0.127	(0.330)
		Compensated			
Beans	-0.882	-0.824	-0.837	-1.141	-0.744
	(0.071)	(0.098)	(0.100)	(0.151	(0.195)
Tofu and Tempeh	-0.987	-0.963	-1.028	-0.917	-0.932
	(0.079)	(0.098)	(0.135)	(0.162	(0.216)
Meat	-1.150	-0.811	-1.502	-1.196	-0.907
	(0.123)	(0.167)	(0.187)	(0.293	(0.372)
Chicken	-0.864	-0.578	-0.939	-0.834	-1.470
	(0.108)	(0.151)	(0.160)	(0.239	(0.317)
Fish	-0.848	-0.701	-0.953	-0.871	-0.647
	(0.048)	(0.062)	(0.077)	(0.108	(0.153)
Milk	-0.976	-1.030	-0.975	-0.987	-0.848
	(0.079)	(0.102)	(0.123)	(0.127	(0.330
N			**3.624**		

Note: Standard error in parentheses
Source: Stata Output (data processed)

Cross-price elasticity estimates how the response of household consumption to price changes of other commodities. The results are enclosed in Appendix 2. All positive signs of cross-price elasticity mean that the commodities might be substituted. Whereas negative sign indicates the complementary relationship among commodities. The most dominant complementary effects are found in tofu, tempeh, and fish. It is also found that tofu, tempeh, and meat have the highest substitution effects based on the pooled sample. Fish has the highest substitution effect of other commodities such as beans, meat, and fish with the range elasticity value of 0.13-0.294. It implies that if the prices of those commodities increase by 1%, the demand of fish commodity will increase by 0.13-0.294%. In Indonesia, fish is the main source of animal-based protein because of its cheaper price, and it is relatively easy to find.

Table 2.
Expenditure Elasticities

Commodities	Pooled	Rural	Urban	Poorest	Richest
Beans	0.361	0.161	0.582	0.358	0.532
	(0.030)	(0.044)	(0.038)	(0.069)	(0.073)
Tofu and Tempeh	0.533	0.614	0.397	0.556	0.403
	(0.043)	(0.054)	(0.066)	(0.093)	(0.105)
Meat	1.704	1.522	1.852	1.774	1.457
	(0.029)	(0.039)	(0.041)	(0.068)	(0.078)
Chicken	1.386	1.544	1.192	1.348	1.506
	(0.028)	(0.039)	(0.036)	(0.061)	(0.077)
Fish	0.914	0.953	0.911	0.856	1.017
	(0.018)	(0.024)	(0.026)	(0.039)	(0.045)
Milk	0.780	0.875	0.692	0.913	0.481
	(0.038)	(0.045)	(0.060)	(0.071)	(0.114)
N			**3.624**		

Note: Standard error in parentheses
Source: Stata Output (data processed)

Overall, the sign of expenditure elasticity of protein sources from self-production is positive. It means that all commodities are normal. Meat and chicken have higher values than other commodities. Those price commodities are higher than other commodities so that it likely has a higher value of expenditure elasticity (11). However, the elasticity values of the other commodities such as beans, tofu, tempeh, fish, and milk are under 1.00, indicating that those commodities are necessity goods. The detailed information is summarized in Table 2.

Additionally, the expenditure elasticity of food items is higher in rural households than in urban households. This result is in line with Mittal (2010) stating that rural households have larger budget to consume more food from self- production. A similar pattern is also found based on the income group. The poorest households have higher elasticity of expenditure. Generally, for all household groups, plant-based protein namely beans, tofu, and tempeh are more inelastic compared to animal-based protein foods. It implies that the consumption of those commodities is relatively stable and is not sensitive to expenditure changes, unlike the consumption of animal-based protein in Indonesia which, in fact, is low.

4. Conclusion

This paper aims to analyze the consumption of protein especially those of self-produced one in Indonesia. The results point out that plant-based protein commodities are more inelastic than those of animal-based protein particularly in rural and poorest households. It implies that those household groups tend to consume more plant-based protein than animal-based one. In addition, fish is found to be the most easily found source of animal-based protein from own production. This, definitely, is really good for Indonesian people because fish is one of the most complete protein sources for the human body. Thus, fish farming by households should be supported even for the small scale one.

The value of own price elasticity is lower in rural and poor households. This indicates that when there is a price increase, those households tend to consume own-produced food. It is also suggested that there is a role of the small-scale farming as a strategy to improve their food security. The value of own-price elasticity is higher than that of cross-price elasticity. It denotes that every price policy set by the government will have more impact on the consumption of those commodities. Moreover, most of the price elasticity values exceed the expenditure elasticity, which in other words, if the government changes the consumer preferences, the price policy will be more effective than that of expenditure's.

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Appendix

Appendix 1.
QUAIDS Estimation Results

Groups	Beans	Tofu and Tempeh	Meat	Chicken	Fish	Milk
Constant	0.4171	-0.1542	1.7615	-0.4393	-0.2425	-0.3425
Ln price						
Beans	0.1218***	0.0004	0.0633*	-0.1177***	-0.0329	-0.0349*
Tofu and Tempeh	0.0004	0.0022	0.0150	-0.0034	-0.0204**	0.0062
Meat	0.0633*	0.0150	0.2464***	-0.2022***	-0.0356	-0.0868***
Chicken	-0.1177***	-0.0034	-0.2022***	0.2069***	0.0713**	0.0451*
Fish	-0.0329	-0.0204	-0.0356	0.0713**	-0.0343	0.0519**
Milk	-0.0349*	0.0062**	-0.0868***	0.0451	0.0519**	0.0185
Ln expenditure	0.1338***	-0.0048***	0.1974***	-0.1854***	-0.0831***	-0.0580***
Ln expenditure^2	0.0093***	0.0015**	0.0039***	-0.0112***	-0.0017	-0.0019**
Distance to traditional market	-0.0010***	-0.0001	0.0003***	0.0000	0.0006***	0.0001
Java	-0.0011	-0.0023***	-0.0043***	0.0008	0.0091***	-0.0022**
Household size	-0.0007	0.0004	0.0005	0.0007	-0.0008	-0.0001
Sex (1 if male)	-0.0003	-0.0001	0.0007	0.0023	-0.0024	-0.0002
Age	0.0001	0.0000	-0.0001**	-0.0001**	0.0002***	-0.0001**
Education	0.0000	0.0001	-0.0001	-0.0003**	0.0007***	-0.0005***
Farms owning status	-0.0092***	0.0025**	-0.0012	-0.0029**	0.0072***	0.0036***

Note: *, **, & *** are significant level at 10%, 5% & 1%
Source: Stata output (data processed)

Appendix 2.
Cross-Price Elasticity

Commodities	Beans	Tofu and tempeh	Meat	Chicken	Fish	Milk
		Uncompensated				
Beans		-0,058	-0,017	0,387	0,206	0,053
Tofu and tempeh	-0,139		0,598	0,174	-0,194	0,056
Meat	-0,184	0,204		-0,369	0,130	-0,067
Chicken	0,164	0,007	-0,264		-0,063	-0,122
Fish	0,004	-0,074	0,186	0,053		0,077
Milk	0,002	0,020	0,051	-0,088	0,294	
		Compensated				
Beans		-0,030	0,040	0,450	0,330	0,091
Tofu and tempeh	-0,063		0,682	0,267	-0,012	0,112
Meat	0,058	0,336		-0,070	0,713	0,113
Chicken	0,360	0,114	-0,045		0,410	0,024
Fish	0,133	-0,003	0,331	0,213		0,173
Milk	0,112	0,080	0,174	0,049	0,561	
N			**3.624**			

Note: standard error in parenthess
Source: Stata output (data processed)