Agricultural Households' Food Demand: Evidence from Indonesia

Faharuddin[a], Yunita[b], Andy Mulyana[c], and Muhammad Yamin[d]

[a]Badan Pusat Statistik, Jakarta, Indonesia, fahar@bps.go.id; [b]Sriwijaya University, yunita.sep.unsri@gmail.com; [c]Sriwijaya University, Palembang, Indonesia, andy.sep.unsri@gmail.com; [d]Sriwijaya University, Indonesia, yaminsepunsri6@gmail.com

Abstract

This study analyzes the consumption patterns of agricultural households in Indonesia using the 2013 first quarter data of the Indonesian National Socioeconomic Survey (*Survei Sosial Ekonomi Nasional* [Susenas]) and the quadratic almost ideal demand system (QUAIDS) approach. Indonesian households' food expenditure is mostly on rice, vegetables, and fish. Rice expenditure is a top priority particularly in agricultural household spending in Indonesia. Agricultural households consume more calories and carbohydrates, but less protein and fat, than nonagricultural households do. The expenditure elasticities of agricultural and nonagricultural households are significantly different only in the following commodities: milk, other foods, meat, fruits, and rice. The differences in the price elasticities of the two household groups are found in non-rice staple, other foods, rice, and milk. The expenditure elasticity of nutrients of agricultural households tend to be higher.

Keywords: food demand analysis, agricultural households, QUAIDS, Indonesia

JEL Classification: D12, Q11, Q12

Contact Faharuddin ✉ fahar@bps.go.id

Introduction

Agricultural development has a strategic position in the economic development of Indonesia. Although the share of the agriculture sector in the nation's GDP is relatively small (only covering 15% of the national GDP), the population working in this sector has already reached 35 percent of the total working population.

The agriculture sector of Indonesia is closely associated with underdevelopment, lack of infrastructure, transportation difficulties, and poverty. In 2013, about 14.3 percent of the total population (17.74 million) in Indonesia was composed of poor rural people who are mostly farmers and have attained elementary or lower levels of education. As such, the government needs to prioritize agricultural development to improve the welfare of society as mandated by the 1945 Constitution. To this end, the government needs to integrate agricultural development into the country's macroeconomic development strategies. The agricultural households should be the subject of the main goals of various development and agrarian reform programs. Accordingly, this can be done by improving infrastructure, providing access to agricultural technology, and increasing investment in human resources in rural areas (Arifin 2013).

The agriculture sector plays an important role in maintaining national food security since it feeds the nation, significantly through the food produced by agricultural households. Nonetheless, not all agricultural households are food producers; thus, it would be interesting to look into their food consumption pattern and food security status.

Agricultural households refer to those whose main income come from agriculture. They are the food producers, farmers in non-food agriculture, and workers in the agriculture sector. Studying the Indonesian farming households' food consumption patterns is a noteworthy endeavor for several reasons. For one, Engel's law states that the share of food consumption is a proxy measure for household welfare. Moreover, only a few Indonesian households are food (i.e., rice) producers, whereas most are rice consumers (McCulloch 2008). Thus, the question arises: Are there differences between the food consumption patterns of agricultural households and nonagricultural households in Indonesia?

The research on farming households' food consumption patterns is a relatively new subject; to the best of our knowledge, no studies have been done to explore this topic using Indonesian data. Therefore, this study is expected to provide useful information on the topic to benefit the stakeholders and the research field.

Literature Review

The earliest studies conducted by Kakwani (1977), using the data of the Indonesian National Socioeconomic Survey (*Survei Sosial Ekonomi Nasional* [Susenas]) in 1969, estimated the expenditure demand elasticity of eight food and five non-food commodity groups. In particular, Kakwani (1977) compared seven functional forms of the Engel curve, and found that expenditure elasticity varies according to the shape of the Engel curve. The author then used the distance function criteria to select the most appropriate functional form, and concluded that elasticity of almost all food groups decreases as household income increases. Grains and tubers are inelastic, whereas eggs, milk, and meat are the most elastic. However, Kakwani (1977) did not calculate price elasticity.

Meanwhile, Timmer and Alderman (1979) used a regression model for the 1976 Susenas data to compute for the income and price elasticities of rice and tubers in four income groups (low, low-mid, high-mid, and high). The results obtained by Timmer and Alderman (1979) are consistent with those by Kakwani (1977); rice and tubers are income-inelastic except in the low and low-mid income groups, with expenditure elasticity close to 1. Timmer and Alderman (1979) also found that the own-price elasticity of rice is greater than 1.

Teklu and Johnson (1987) used the almost ideal demand system (AIDS) and a linear multinomial logit (LML) model to estimate the expenditure elasticities of seven groups of food commodities. In their study, both AIDS and LML provided that fish and meat have expenditure elasticities higher than 1, whereas the expenditure elasticity of rice is lower than 1. Rice, pulses, and fruits and vegetables are inelastic with respect to expenditure, and all own-price elasticities are negative in the seven food groups. They further found that all food groups respond to the changes in the price of rice, albeit the changes in the other food group prices have little effect on rice. Deaton (1990) used the 1981 Susenas data and found similar results; all own-price elasticities of 11 food groups were negative, and the price elasticity of rice was inelastic. However, the cross-price elasticity between tubers and rice is lower than that obtained from previous studies.

Jensen and Manrique (1998) investigated the food demand patterns in urban Indonesia using the linear approximation of AIDS (LA/AIDS) model and used Susenas data 1981, 1984, and 1987. The authors divided the models by income groups and concluded that the different income groups in the urban areas have different food demand patterns. In the higher income group, demand is highly responsive to price, income, and demographic variables, whereas the food demand of the middle- and low-income groups respond only to price and income. The results also show that the lower the income, the lower the absolute value of own-price elasticity would be. Only crops have elastic price among the income groups, whereas rice is elastic only in the low-income group.

Kusumastanto and Jolly (1997) and Hutasuhut et al. (2001) conducted a food demand study for more specific food commodities. The former study used regression models to estimate the elasticity of demand for fish in Indonesia, and found that expenditure and the own-price elasticities of fish are inelastic. On the other hand, the latter study used the LA/AIDS model to analyze the demand for beef in Indonesia based on Susenas data 1990, 1993, and 1996. The study then concluded that beef and chicken are both substitutes. The demand for beef is also inelastic in terms of income and price elasticities; otherwise, chicken is elastic in terms of price and income elasticities. Hutasuhut et al. (2001) also found out that time and location can affect the variation in the demand for beef.

The present study also found some regional analysis of food demand patterns in Indonesia (Rachman 2001; Suharno 2002). Rachman (2001) conducted a study on the food consumption patterns and food demand of households in eastern Indonesia. In particular, the author applied the LA/AIDS model to the Susenas 1996 data. The results showed that the food demands of rural households respond more to the changes in prices and incomes than those of urban households'. Moreover, results showed that the higher the income, the lower the price and income elasticities would be. Rachman (2001) also concluded that the demographics variables (e.g., household size and education level of household heads) significantly impact food demand. Meanwhile, Suharno (2002) analyzed the food demand of the households in East Java province and applied the AIDS model to Susenas data of 1990, 1993, 1996, and 1999. The results showed that all of the food groups have negative and inelastic own-price elasticity, except for eggs and milk, oils and fat, and spices. The change in the prices of rice and prepared food has the most effect on the demand for the other food groups.

Other studies have discussed the impact of the Indonesian economic crisis in 1997 and 1998 on the nation's food demand (Moeis 2003; Fabiosa, Jensen, and Yan 2005). Moeis (2003) assessed the impact of the economic crises on nutrient consumption and applied the AIDS model to the Susenas 1996 and 1999 data. The author found that nutrient consumption responds to household expenditure. When the crisis ended in 1999, the expenditure elasticity of those nutrients that had been higher before the crisis decreased, except for the price elasticity of calories from rice. Moeis (2003) also conducted policy simulations and suggested implementing short-term (e.g., safety nets) and long-term programs (e.g., strengthening food security). Fabiosa, Jensen, and Yan (2005) also studied the effects of the 1997/1998 economic crisis in Indonesia on household welfare using Susenas 1996 and 1999 data. They applied LinQuad, and found that grains are the least responsive to expenditure, whereas eggs and milk, meat, and fish are the most responsive.

Pangaribowo and Tsegai (2011) and Widarjono (2012) recently conducted studies on food demand. Pangaribowo and Tsegai (2011) analyzed the pattern of household food demand in Indonesia using panel data models of QUAIDS for the Indonesian Family Life Survey (IFLS) 1997–2007 data. They found that alcohol and tobacco spending is highly elastic in poorer households, whereas expenditure on dairy products is the most elastic in the wealthier households. Widarjono (2012), using the QUAIDS model on Susenas 2011 data, found that demographic variables (e.g., number of household members, education, and gender) and geographic factors also affect food demand.

Rice is a staple food in Indonesia and is the most unresponsive to changes in price and expenditure. This commodity is even more inelastic in urban areas. Meat demand is the most responsive to price changes; meat expenditure is more elastic in rural areas than in urban areas. Meanwhile, higher-priced foods (e.g., meat, eggs and milk, fruits, and prepared food) are more elastic to price and expenditure in rural areas than in urban areas; they are also more elastic than lower-priced foods.

Methodology

We used the Susenas data in this study, specifically, the first quarter 2013 survey data conducted in March 2013. Susenas is a household survey that collects data on Indonesians' household consumption of over 200 food commodities. Several studies in the literature review section on the food demand of Indonesian households also used Susenas data (Kakwani 1977; Timmer and Alderman 1979; Deaton 1990; Jensen and Manrique 1998; Hutasuhut et al. 2001; Rachman 2001; Suharno 2002; Moeis 2003; Fabiosa, Jensen, and Yan 2005; Widarjono 2012).

In this study, we assume that households allocate their income on consumption expenditure through a two-stage budgeting system. In the first stage, households allocate its income to food and nonfood commodities. In the second step, the household allocates its food expenditure to the more specific commodities, such as rice, fish, meat, and so on. These are then aggregated into a number of groups of food commodities. We also assume at this stage that there are relationships between the food commodity groups; thus, food expenditure is a system.

We used QUAIDS proposed by Banks, Blundell, and Lewbel (1997) in this study. QUAIDS emerged at the same time as the AIDS model, and was first popularized by Deaton and Muelbauer (1980). Basically, both AIDS and QUAIDS are models of the Engel curve (i.e., the share of food expenditure). Compared with the AIDS model, QUAIDS models have more advantages because the latter can accommodate the nonlinearity of the Engel curve. Here, QUAIDS models are formulated as follows (Poi 2012):

$$w_i = \propto_i + \sum_j \gamma_{ij} \ln p_j + (\beta_i + \eta_i{}'D) \ln \left[\frac{x}{\bar{m}_0(D)a(p)}\right] + \frac{\lambda_i}{b(p)c(p,D)} \left\{\ln \left[\frac{x}{\bar{m}_0(D)a(p)}\right]\right\}^2 + u_i \quad (1)$$

where:

w_i = budget share of the ith food group;

p_j = jth food group;

x = total of household food expenditure;

D = vector of demographic variables;

p = vector of price;

$\bar{m}_0(D) = 1 + \rho' D$, $c(p,D) = \prod_j p_j^{\eta_j{}'D}$, and = price index;

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln + \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j$$

$b(p) = \prod_{i=1}^{n} p_i^{\beta_i}$ = Cobb-Douglas price aggregator; and

$\alpha_i, \gamma_{ij}, \beta_i, \lambda_i, \eta_i, \rho_i$ = unknown parameters.

We included six demographic variables in the model to control the variation of preference due to the differences in the demographic characteristics of the household as follows: household size; number of children under five years old; urban/rural classification; educational attainment of household head (completed senior high school or not); income groups (40% lowest income, 40% medium income, and 20% highest income); and employment sector of household head (agriculture or nonagriculture). We then simplify the estimation of the demand model by aggregating all food commodities into the following 14 groups: rice, non-rice staple, tubers, fish, meat, eggs, milk, vegetables, pulses, fruits, oil and grease, beverage ingredients, spices, and other foods, following Faharuddin et al. (2017).

We estimated the price of the commodities using the unit value and the ratio of food commodities expenditure (in Indonesian Rupiah [IDR]) to quantity of the food commodities consumed. However, Deaton (1987) and Cox and Wohlgenant (1986) cited that the unit value approach needs to be justified first in order to overcome the problem of quality variation. Accordingly, we used the method proposed by Cox and Wohlgenant (1986), as modified by Hoang (2009), to address this issue:

$$v_i = \overline{v_i} + \varphi_i x + \theta D + \varepsilon_i \qquad (2)$$

$$p_i = \overline{\overline{v_i} + \widehat{\varepsilon_i}} \qquad (3)$$

where:

$v_i = \frac{1}{n_i} \sum_k \left[v_{ik} \frac{x_{ik}}{x_i} \right]$ and $v_{ik} = \frac{x_{ik}}{q_{ik}}$ = unit value of *i*th food subgroup and *k*th food commodity, respectively;

x_{ik}, x_i, and x = expenditure of *k*th food commodity, *i*th subgroup, and total food expenditure, respectively;

q_{ik} = quantity consumed of *k*th food commodity;

n_i = number of food commodity in *i*th food subgroup;

D = vector of demographic variables;

φ_i and θ = unknown parameters;

ε_i = residual;

$\overline{v_i}$ and $\overline{\overline{v_i} + \widehat{\varepsilon_i}}$ = mean of unit value and adjusted unit value in community level (census block), respectively; and

p_i = adjusted price of commodity to be used in the QUAIDS model.

The QUAIDS system has restrictions. Thus, the following conditions must be met in order to be consistent with the consumer demand theory:

1. adding-up ($\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \gamma_{ij} = 0$, and $\sum_{i=1}^{n} \beta_i = 0$);
2. homogenity ($\sum_{j=1}^{n} \gamma_{ij} = 0$); and
3. symmetry ($\gamma_{ij} = \gamma_{ji}$).

In the estimation process, we drop the last equation to avoid the singularity of covariance matrix of error term u_i. The nature of the restrictions and the nonlinearity of parameters of the QUAIDS model cannot be estimated using ordinary least square methods. Thus, we use iterative but feasible, generalized nonlinear least square estimation methods to get more efficient parameter estimates. We use the STATA code developed by Poi (2012) in all the estimation processes.

Expenditure elasticity (e_{ij}), uncompensated price elasticity (e_{ix}), and compensated price elasticity (e_{ij}^*) of the QUAIDS model are computed by using the following equations, respectively (Poi 2012):

$$e_{ix} = \frac{\mu_i}{w_i} + 1 \qquad (4)$$

$$e_{ij} = \frac{\mu_{ij}}{w_i} - \delta_{ij} \quad (5)$$

$$e_{ij}^{*} = e_{ij} + e_{ix} w_{j'} \quad (6)$$

Accordingly, $\mu_i \equiv \frac{\partial w_i}{\partial \ln x} = (\beta_i + \eta_i{'}D) + \frac{\lambda_i}{b(\boldsymbol{p})c(\boldsymbol{p},\boldsymbol{D})} \ln\left[\frac{x}{\overline{m}_0(\boldsymbol{D})a(\boldsymbol{p})}\right]$; δ_{ij} is Kronecker delta (δ_{ij}= 1 for $i = j$, and $\delta_{ij} = 0$ for $i \neq j$); and $\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i\left(\alpha_i + \sum_k \gamma_{jk} \ln p_k\right) - \frac{\lambda_i(\beta_i + \boldsymbol{\eta}_i{'}\boldsymbol{D})}{b(\boldsymbol{p})c(\boldsymbol{p},\boldsymbol{D})}\left\{\ln\left[\frac{x}{a(\boldsymbol{p})}\right]\right\}^2$.

We calculate nutrient elasticities (calories, proteins, fats, and carbohydrates) based on the works of Pitt (1983), Sahn (1988), Huang (1996), Ecker and Qaim (2011), and Widarjono (2012). Income/expenditure elasticity and price elasticity are then expressed as follows, respectively:

$$E_N = \frac{\sum_i \sum_k c_{ikN} q_{ik}\, e_{ix}}{\sum_i \sum_k c_{ikN} q_{ik}} \quad (7)$$

$$e_{Nj} = \frac{\sum_i \sum_k c_{ikN} q_{ik} e_{ij}}{\sum_i \sum_k c_{ikN} q_{ik}} \quad (8)$$

where:

E_N = nutrient elasticity concerning expenditure;

e_{Nj} = nutrient elasticity concerning price of food group *j;*

$c_{ik}N$ = coefficient of nutrient content (*N*) of food item *k* belonging to food group *i;*

q_{ik} = average consumed quantity of food item *k* belonging to food group *i;*

e_{ix} = income elasticity of food demand; and

e_{ij} = uncompensated price elasticity of food demand.

Results and Discussion

Share of Food in Household Expenditure

The share of food in the total expenditure of Indonesian households is still high, with more than 40 percent of the household budget allocated to meet the household's food needs. In accordance with Engel's law, the share of food consumption in household expenditure is often used as a proxy for household welfare. A household allocates less share of its income to food as income increases. Although the value of food expenditure increases as income rises, its share in the household budget declines because the increase in revenue is not proportional to the household's increased demand for food. Table 1 shows that the share of food expenditure in agricultural households is higher than that of the nonagricultural households. Therefore, the agricultural household's welfare level is higher than that of nonagricultural households.

By food groups, households spend mostly on rice, vegetables, and fish. Spending on rice is the top priority, with 22 percent of household food expenditure allocated to rice. Households spend more on rice because the average per capita consumption of this commodity is still high at 96.3 kg/year (BKP 2014). The share of vegetables in the household food consumption is 11.7 percent, whereas that of fish is 11.1 percent. In the food consumption pattern of Indonesian society in general, the third food group deemed "sufficient" proves to be the consumption of other food groups, which is much lower. These three food groups dominate the food expenditure in both household groups.

There are slight differences in the shares of rice, vegetables, and fish in the food expenditures of both household groups, with agricultural households having higher shares. Agricultural households who have access to the three food groups are physically larger than the nonagricultural households because the former are closer to the producers. Another difference is the expenditure on other foods (particularly prepared foods); the expenditure share of nonagricultural households on this food group is larger than that of the agricultural household.

Table 1. Household food expenditure share by food groups

Food Groups	Agricultural HH (%)	Nonagricultural HH (%)	Overall (%)
Households food groups expenditure share			
w1 (rice)	26.43	19.03	22.03
w2 (non-rice staple)	1.11	0.54	0.77
w3 (tubers)	3.24	0.93	1.86
w4 (fish)	11.99	10.48	11.09
w5 (meat)	2.71	3.62	3.25
w6 (eggs)	2.52	2.85	2.71
w7 (milk)	1.50	3.27	2.55
w8 (vegetables)	13.29	10.54	11.65
w9 (pulses)	2.76	2.92	2.85
w10 (fruits)	4.66	5.38	5.08
w11 (oils and greases)	5.07	4.03	4.45
w12 (beverage ingredients)	6.08	4.57	5.18
w13 (spices)	2.73	2.32	2.49
w14 (other foods)	15.91	29.54	24.02
Total	**100.00**	**100.00**	**100.00**
Monthly average of HH food expenditure (IDR)	1,001,340	1,375,963	1,224,214
HH food expenditure share (percent)	52.76	42.50	45.43

Notes: HH = household; IDR = Indonesian Rupiah; USD 1 = IDR 12,189 (2013)

Nutrient Content of Food Consumption

We evaluated the quality of food consumed by the two household groups based on their nutrient content. In this study, the nutrients include calories, protein, fat, and carbohydrates (Table 2). Based on the results, agricultural households tend to consume more calories and carbohydrates than the nonagricultural households; however, the former consume less protein and fat than the latter group. This shows that the quality of agricultural households' food consumption tends to be lower as their food sources are carbohydrate-based, which is less expensive. On the other hand, nonagricultural households are more capable of buying protein- and fat-based food sources, which are more expensive.

The national minimum calorie consumption requirement is 2,150 kcal per capita per day, whereas the minimum protein requirement is 57 g per capita per day. Based on the results shown in Table 2, the calorie consumptions of both household groups are below the minimum. Meanwhile, agricultural households' protein requirement per capita per day is below the minimum (53.6 g), whereas that of the nonagricultural household is above the minimum (58.6 g). This implies that the food of nonagricultural households have better nutritional content than that of agricultural households.

Both household groups' main sources of calories are rice, oils and greases, and beverage ingredients. Protein sources are rice and fish; consumption of fat mainly comes from oils and greases, whereas the main sources of carbohydrates are rice, beverage ingredients, and tubers. Both groups also have very low consumption of meat, milk, and fruits.

Agricultural households consume more calories from rice, non-rice staple, and tubers than nonagricultural households, with the latter getting more calories from meat and milk. The former group also has higher protein consumption from rice and fish; otherwise, protein consumption from other foods is higher in nonagricultural households. Consumption of carbohydrates derived from rice is higher in agricultural households than in nonagricultural ones. Nonetheless, carbohydrate consumption from other foods is higher in nonagricultural than in agricultural households.

Table 2. Average nutrient consumption per capita per day by food groups

Food Groups	Agricultural Households				Nonagricultural Households			
	Calorie (kcal)	Protein (gram)	Fat (gram)	Carb (gram)	Calorie (kcal)	Protein (gram)	Fat (gram)	Carb (gram)
Rice	977.43	22.87	3.91	209.27	835.55	19.55	3.35	178.90
Non-rice staple	38.65	1.00	0.34	8.34	22.03	0.57	0.13	4.91
Tubers	88.06	0.66	0.18	20.92	27.80	0.24	0.06	6.59
Fish	60.73	9.91	1.80	0.58	55.88	9.30	1.61	0.43
Meat	29.62	1.69	2.49	0.01	47.77	2.93	3.91	0.04
Eggs	21.20	1.68	1.50	0.09	28.32	2.25	2.00	0.12
Milk	14.78	0.50	0.52	2.07	34.07	1.34	1.40	4.13
Vegetables	45.62	3.20	0.73	8.12	36.24	2.35	0.62	6.34
Pulses	41.06	3.78	2.04	2.50	49.25	4.74	2.37	2.93
Fruits	43.68	0.49	0.30	10.48	45.41	0.53	0.36	10.86
Oils and greases	263.61	0.44	18.25	1.58	253.80	0.28	16.46	0.96
Beverage ingredients	113.49	1.17	0.21	28.80	101.07	1.11	0.21	25.78
Spices	13.90	0.57	0.63	1.69	14.97	0.62	0.70	1.80
Other foods	214.57	5.59	8.06	28.50	408.89	12.73	14.22	54.22
Total	**1,966.40**	**53.55**	**40.96**	**322.96**	**1,961.06**	**58.55**	**47.38**	**298.02**

Similarly, agricultural households have higher fat consumption from oils and greases, albeit fat consumption from other foods is higher in nonagricultural households (Table 2).

Expenditure Elasticity

We developed the demand models using the STATA code developed by Poi (2012). Although we did not include the model estimation results in this paper, they can be made available upon request.

By using 14 groups of commodities and 7 sociodemographic variables, the number of model coefficients reached 252. Based on the test results, 86 coefficients (73.81%) were highly significant at 1 percent test level and 206 coefficients (81.8%) were significant at 5 percent test level. If we change the test level to 10 percent, then the number of significant coefficients would reach 216 coefficients or 85.7 percent.

The food demand model can be more meaningful if we use income and price elasticities as the points of analysis. At the macro level, this information is very useful to the government as they can use it to determine the appropriate price stabilization policies and develop policies that would increase agricultural production and strengthen exports and imports. Expenditure elasticity can show the ratio of the percentage increase in food expenditure to the percentage increase in total income (as proxied by total expenditure).

Table 3 presents the expenditure elasticities of the two household groups as a proxy for income elasticities. Results show that all the elasticities are positive, which show that all food groups are normal goods. An increase in income would also increase food spending on all food groups. Four food groups (milk, meat, other foods, and fruits) under agricultural and nonagricultural households have expenditure elasticities greater than 1. Pangaribowo and Tsegai (2011) also found a similar result, in which milk had the highest expenditure elasticity. This means that to increase households' consumption of milk, meat, and fruits, the best way would be to increase their income.

When the expenditure elasticities of the two household groups are compared, we found

Table 3. Expenditure elasticity by food group

Food Groups	Agricultural Households		Nonagricultural Households	
	Elasticity	Standard Error	Elasticity	Standard Error
Rice	0.474	0.005	0.335	0.007
Non-rice staple	0.766	0.029	0.768	0.047
Tubers	0.718	0.026	0.717	0.038
Fish	0.964	0.011	0.970	0.012
Meat	1.600	0.027	1.454	0.021
Eggs	0.962	0.014	0.938	0.014
Milk	2.109	0.039	1.643	0.022
Vegetables	0.793	0.007	0.790	0.008
Pulses	0.909	0.014	0.905	0.015
Fruits	1.506	0.016	1.423	0.014
Oils and greases	0.743	0.007	0.722	0.009
Beverage ingredients	0.784	0.008	0.778	0.011
Spices	0.921	0.010	0.928	0.012
Other foods	1.627	0.013	1.321	0.008

significant differences in five commodity groups: milk, other foods, meat, fruits, and rice. Rice has the smallest expenditure elasticity in both agricultural (0.474) and nonagricultural (0.335) households because most people need rice for their daily consumption.

Teklu and Johnson (1988) also found that rice has low expenditure elasticity (0.43); thus, the demand elasticity of rice, as compared to expenditure, is relatively unchanged after a long period. Conversely, milk, other foods, meat, and fruits have the highest expenditure elasticity because the price of the four food groups is higher than that of the other food groups.

Price Elasticity

Price elasticity represents the percent change in food expenditure in relation to the percent change in price. In line with this theory, all compensated price elasticities (Hicksian) are lower than uncompensated price elasticities (Marshallian). Thus, the effect of rising food prices can be reduced by giving compensation. All of Marshallian and Hicksian own-price elasticities are negative, which is consistent with the theory that the negative effect of rising food prices is a decrease in food demand.

Our results show that there is not much difference between the price elasticities of agricultural and nonagricultural households' food expenditure. Six food groups have absolute uncompensated own-price elasticity close to 1 (0.9%–1.1%) (Table 4). These food groups are tubers, fish, eggs, vegetables, oils and greases, and beverage ingredients. The percentage increase in price of the six food groups is proportional to the percentage decrease in food expenditure, which indicates that household spending responds to the price changes of these six food groups.

The differences in the price elasticities of the food groups can be found in the most price-elastic food commodities, i.e., non-rice staple and other foods, and in the least price elastic, i.e., rice and milk. Non-rice staple and milk are more price elastic in nonagricultural households, whereas rice and other foods are more elastic in agricultural households (Table 5).

Non-rice staple is the most price elastic. As such, the price of non-rice staple should be lower than that of rice such that household consumption of this food group can increase, and thus offer a substitute for staple food. Pulses and fruits also have high absolute elasticity. As complementary foods, they are easily influenced

Table 4. Own-price elasticities by food groups

Food Groups	Uncompensated Own-Price Elasticity				Compensated Own-Price Elasticity			
	Agricultural HH		Nonagricultural HH		Agricultural HH		Nonagricultural HH	
	Elasticity	Standard Error	Elasticity	Standard Error	Elasticity	Standard Error	Elasticity	Standard Error
Rice	−0.602	0.009	−0.448	0.013	−0.491	0.009	−0.391	0.012
Non-rice staple	−1.484	0.025	−1.807	0.042	−1.475	0.025	−1.802	0.042
Tubers	−1.013	0.016	−1.022	0.024	−1.004	0.016	−1.015	0.024
Fish	−1.054	0.008	−1.061	0.009	−0.952	0.008	−0.969	0.009
Meat	−1.231	0.028	−1.184	0.022	−1.178	0.027	−1.124	0.022
Eggs	−0.934	0.011	−0.934	0.011	−0.906	0.011	−0.906	0.011
Milk	−0.611	0.017	−0.767	0.009	−0.563	0.017	−0.702	0.009
Vegetables	−1.106	0.006	−1.138	0.007	−1.002	0.006	−1.056	0.007
Pulses	−1.343	0.012	−1.380	0.014	−1.310	0.012	−1.351	0.014
Fruits	−1.291	0.013	−1.255	0.011	−1.214	0.013	−1.174	0.011
Oils and greases	−1.129	0.007	−1.166	0.008	−1.093	0.007	−1.139	0.008
Beverage ingredients	−1.013	0.006	−1.021	0.009	−0.966	0.006	−0.986	0.009
Spices	−0.901	0.008	−0.882	0.009	−0.875	0.007	−0.861	0.009
Other foods	−1.366	0.009	−1.206	0.006	−1.048	0.010	−0.794	0.007

Table 5. Price and expenditure elasticities of nutrients by food groups

Food Groups	Agricultural Households				Nonagricultural Households			
	Calorie (kcal)	Protein (gram)	Fat (gram)	Carb (gram)	Calorie (kcal)	Protein (gram)	Fat (gram)	Carb (gram)
Price elasticities								
Rice	−0.303	−0.272	−0.095	−0.399	−0.204	−0.188	−0.056	−0.287
Non-rice staple	−0.062	−0.056	0.003	−0.098	−0.051	−0.045	0.013	−0.093
Tubers	−0.045	−0.015	−0.007	−0.067	−0.034	−0.013	−0.005	−0.054
Fish	−0.044	−0.173	−0.046	−0.020	−0.052	−0.175	−0.040	−0.031
Meat	−0.045	−0.111	−0.213	0.022	−0.043	−0.108	−0.191	0.027
Eggs	−0.020	−0.050	−0.061	−0.003	−0.018	−0.047	−0.051	−0.002
Milk	−0.030	−0.040	−0.039	−0.028	−0.046	−0.058	−0.058	−0.043
Vegetables	0.011	−0.030	−0.042	0.036	0.018	−0.015	−0.039	0.050
Pulses	−0.011	−0.096	−0.070	0.020	−0.010	−0.103	−0.070	0.027
Fruits	−0.048	−0.014	0.018	−0.088	−0.051	−0.015	0.023	−0.104
Oils and greases	−0.109	0.008	−0.373	0.030	−0.109	0.014	−0.337	0.041
Beverage ingredients	−0.047	−0.012	−0.005	−0.077	−0.040	−0.008	−0.002	−0.072
Spices	−0.012	−0.015	−0.010	−0.015	−0.013	−0.014	−0.007	−0.019
Other foods	−0.092	−0.073	−0.200	−0.066	−0.148	−0.138	−0.244	−0.123
Expenditure elasticities	0.857	0.950	1.140	0.753	0.801	0.914	1.064	0.682

by price increase, especially with the seasonal factors that influence the availability of fruits. In the study of Teklu and Johnson (1988), their results showed that pulses have the highest absolute price elasticity in Indonesia.

In the agricultural and nonagricultural households, five food groups have expenditure elasticities that are much higher than the absolute value of uncompensated own-price elasticity, i.e., non-rice staple, pulses, oils and greases, vegetables, and tubers. This means that household food consumption of these food groups is more resilient to changes in income than to the changes in price. In contrast, the milk consumption is much more elastic to price change than to income change.

Most food groups have minimal absolute value of cross-price elasticity that is close to 0 (Appendix Table A1). Thus, most commodities are independent. This finding is also consistent with that of Suharno (2002) for the East Java province in Indonesia. The nature of the independence of this commodity group reflects those consumption patterns that are already established, and they tend to remain unchanged even when food prices increase. In agricultural households, only 29 absolute value of cross-price elasticity is greater than 0.1; in nonagricultural households, 30 absolute value of cross-price elasticity is greater than 0.1. Nevertheless, the nonagricultural households are likely to have greater cross-price elasticities.

In agricultural households, the price increases of rice, other foods, and vegetables have the most effect on the consumption of other food groups. In nonagricultural households, on the other hand, only the price increases in rice and other foods have the most influence on consumption. In contrast, non-rice staple is the food group most affected by the increasing prices of other foods.

Nutrient Elasticity

Table 5 also presents the nutrient elasticities of the two household groups' food consumption. Our results show that all of the expenditure elasticities of nutrients are positive in both household groups, whereas most of the price elasticities of nutrients are negative. Income increase causes nutrient consumption to increase, whereas rising food prices decreases nutrient intake, albeit not entirely. A few price elasticity values are positive because the nutrient content of the corresponding food groups is very small. For example, the elasticity of fat with respect to the price of fruit is positive because the fat content of fruits is very small; thus, the increase in fruit prices decreases the household's fruit consumption, whereas the consumption of other food groups that contain lots of fat increases.

The expenditure elasticities of the agricultural households' nutrient consumption tend to be higher than those of the nonagricultural households. In the former, expenditure elasticities range between 0.753 (of carbohydrates) and 1.140 (of fats), whereas the latter range between 0.68 (of carbohydrates) and 1,064 (of fats), whereas the latter range between 0.682 (of carbohydrates) and 1,064 (of fats). This means that an income increase will have greater effect on the nutrient consumption of agricultural households than that of nonagricultural households.

Calorie consumption is only affected by the price changes of rice under both agricultural and nonagricultural households. Protein consumption in agricultural households, on the other hand, is affected by the price changes of rice and fish; nonagricultural households are affected by the price of rice, fish, and other foods. In both household groups, the price changes in meat and oil and grease affect the households' fat consumption, although the absolute value elasticities in the nonagricultural households are smaller. Thus, the price of rice has an effect on the households' consumptions of calories, protein, and carbohydrates. The increase in the price of fish affects only the protein consumption of both agricultural and nonagricultural households.

Agricultural Households and Food Security

Food security is the state of having food that is available, accessible, and of quality for the consumption of households and the community. Normally, agricultural households are more food secure than nonagricultural households because they are closer to food production. Based on the

Table 6. Household food security status (%)

Food Security Status	Agricultural HH	Nonagricultural HH	All HH
Food secure	17.6	33.6	27.1
Vulnerable	43.6	27.7	34.1
Less food	10.8	21.6	17.2
Food insecure	28.1	17.2	21.6

results of Maxwell et al. (2000) and Faharuddin and Mulyana (2012) regarding the food expenditure share and adequacy of per capita calorie intake, the food security status of agricultural households in Indonesia is comparable with that of the nonagricultural households. The threshold used in this study is 60 percent of the share of food expenditure combined with 80 percent of minimum calorie requirement. Accordingly, the four categories of household food security status are (1) food secure (food share ≤60 percent and calorie intake ≥80 percent); (2) vulnerable (food share >60 percent and calorie intake ≥80 percent); (3) less food (food share ≤60 percent and calorie intake <80 percent); and (4) food insecure (food share >60 percent and calorie intake <80 percent).

The results in Table 6 show that 27.1 percent of households in Indonesia are food secure, 34.1 percent are vulnerable, 17.2 percent have less food, and 21.6 percent are food insecure. It is very surprising that nonagricultural households are less food secure than agricultural households. Only 17.6 percent of agricultural households are food secure, whereas the food security status of nonagricultural households reaches 33.6 percent. If we associate these values with those in Tables 1 and 2, the reason why nonagricultural households are less food secure could be because the welfare level of agricultural households is lower. Although the average calorie consumption of agricultural households tends to be higher than that of nonagricultural households, the former have limited expenditure budget. Thus, agricultural households allocate more of the budget to food. This implication is also indicated by the higher expenditure elasticity in agricultural households than in nonagricultural households (Table 3).

Conclusions

The share of food in the household expenditure in Indonesia is above 40 percent of the total household spending. This expenditure share is higher in agricultural households than in nonagricultural households. This is indirectly described in Engel's law, which states that the welfare level of agricultural households is higher than that of nonagricultural households. This also turns out to be closely related to the level of food security of agricultural households, which is generally lower than that of nonagricultural households.

By food groups, the household food expenditure is mostly spent on rice, vegetables, and fish; the expenditure on rice is a top priority in agricultural household spending. Agricultural households, as compared with nonagricultural households, consume more calories and carbohydrates but consume less protein and fat. The main sources of calories in both agricultural and nonagricultural households are rice, oils and greases, and beverage ingredients. Protein sources are rice and fish, consumption of fat mainly comes from oils and greases, whereas the main sources of carbohydrates are rice, beverage ingredients, and tubers. Thus, it can be said that the quality of food consumed by agricultural households is lower than that of nonagricultural households.

A significant difference in the expenditure elasticities of the two household groups can be seen in milk, other foods, meat, fruits, and rice. Rice has the lowest expenditure elasticity because rice is the commodity that most households need for their daily consumption. On the other hand, milk, other foods, meat, and fruit have the highest expenditure elasticity because the prices of the four food groups are more expensive than that of other food groups.

The price elasticities in the food expenditure of agricultural households and nonagricultural households are not much different. In both household groups, six food groups (tubers, fishes, eggs, vegetables, oils and greases, and beverage ingredients) have absolute uncompensated price elasticities close to 1 (between 0.9 and 1.1). Five food groups (non-rice staple, pulses, oils and greases, vegetables, and tubers) have expenditure elasticities that are much higher than the absolute value of uncompensated own-price elasticity. Most of the food groups have a very low absolute value of cross-price elasticity. The differences between the price elasticities under agricultural and nonagricultural households are found on the most price-elastic food groups, namely, non-rice staple and other foods, and on the least price-elastic food groups, namely, rice and milk.

The expenditure elasticity of nutrients of agricultural households tends to be higher than that of nonagricultural households; thus, an increase in the household's income will have greater impact on the food spending of agricultural households than that of nonagricultural households. However, both agricultural and nonagricultural households' consumptions of calories, protein, and carbohydrates are most affected by the price changes in rice, whereas the increases in fish prices only affect both households' protein consumption.

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Appendices

Appendix Table 1.1. Uncompensated cross-price elasticity (Marshallian), agricultural households

Food Groups	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
w1 (rice)		0.011	−0.007	−0.042	0.030	0.015	−0.020	0.052	0.042	−0.023	0.033	0.020	−0.016	0.033
w2 (non-rice staple)	0.147		−0.010	−0.011	0.080	−0.071	0.029	0.279	0.120	−0.285	0.229	−0.024	0.002	0.233
w3 (tubers)	−0.175	−0.008		0.101	−0.013	−0.043	−0.029	0.256	−0.019	−0.139	0.018	0.037	0.002	0.309
w4 (fishes)	−0.210	−0.003	0.009		0.009	−0.005	−0.034	0.054	0.020	0.036	−0.014	−0.014	−0.003	0.245
w5 (meat)	−0.054	0.018	−0.016	−0.040		−0.143	−0.063	−0.052	0.006	−0.023	−0.040	0.012	−0.016	0.041
w6 (eggs)	0.004	−0.030	−0.022	−0.017	−0.140		−0.050	0.033	0.065	0.080	0.037	−0.022	0.090	−0.056
w7 (milk)	−0.588	−0.001	−0.035	−0.279	−0.109	−0.099		−0.123	0.000	−0.028	−0.043	−0.103	−0.095	0.006
w8 (vegetables)	0.019	0.024	0.024	0.062	0.014	0.012	0.008		−0.028	0.057	−0.018	0.006	−0.002	0.136
w9 (pulses)	0.176	0.037	−0.009	0.064	0.028	0.055	0.027	−0.118		0.113	0.011	0.086	0.031	−0.066
w10 (fruits)	−0.348	−0.073	−0.046	0.018	−0.012	0.030	0.001	0.054	0.059		0.032	−0.020	0.029	0.061
w11 (oils and greases)	0.099	0.054	0.004	−0.007	0.001	0.029	0.010	−0.042	0.014	0.072		0.005	0.023	0.121
w12 (beverage ingredients)	0.005	−0.005	0.007	−0.005	0.033	−0.005	−0.009	0.013	0.056	0.019	0.002		0.014	0.103
w13 (spices)	−0.240	−0.001	−0.002	−0.007	0.003	0.098	−0.052	−0.026	0.040	0.083	0.033	0.023		0.029
w14 (other foods)	−0.232	0.004	0.009	0.062	0.006	−0.028	0.012	−0.018	−0.038	0.010	−0.013	−0.019	−0.015	

Appendix Table 1.2. Uncompensated cross-price elasticity (Marshallian), nonagricultural households

Food Groups	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
w1 (rice)		0.011	−0.007	−0.042	0.030	0.015	−0.020	0.052	0.042	−0.023	0.033	0.020	−0.016	0.033
w2 (non-rice staple)	0.147		−0.010	−0.011	0.080	−0.071	0.029	0.279	0.120	−0.285	0.229	−0.024	0.002	0.233
w3 (tubers)	−0.175	−0.008		0.101	−0.013	−0.043	−0.029	0.256	−0.019	−0.139	0.018	0.037	0.002	0.309
w4 (fishes)	−0.210	−0.003	0.009		0.009	−0.005	−0.034	0.054	0.020	0.036	−0.014	−0.014	−0.003	0.245
w5 (meat)	−0.054	0.018	−0.016	−0.040		−0.143	−0.063	−0.052	0.006	−0.023	−0.040	0.012	−0.016	0.041
w6 (eggs)	0.004	−0.030	−0.022	−0.017	−0.140		−0.050	0.033	0.065	0.080	0.037	−0.022	0.090	−0.056
w7 (milk)	−0.588	−0.001	−0.035	−0.279	−0.109	−0.099		−0.123	0.000	−0.028	−0.043	−0.103	−0.095	0.006
w8 (vegetables)	0.019	0.024	0.024	0.062	0.014	0.012	0.008		−0.028	0.057	−0.018	0.006	−0.002	0.136
w9 (pulses)	0.176	0.037	−0.009	0.064	0.028	0.055	0.027	−0.118		0.113	0.011	0.086	0.031	−0.066
w10 (fruits)	−0.348	−0.073	−0.046	0.018	−0.012	0.030	0.001	0.054	0.059		0.032	−0.020	0.029	0.061
w11 (oils and greases)	0.099	0.054	0.004	−0.007	0.001	0.029	0.010	−0.042	0.014	0.072		0.005	0.023	0.121
w12 (beverage ingredients)	0.005	−0.005	0.007	−0.005	0.033	−0.005	−0.009	0.013	0.056	0.019	0.002		0.014	0.103
w13 (spices)	−0.240	−0.001	−0.002	−0.007	0.003	0.098	−0.052	−0.026	0.040	0.083	0.033	0.023		0.029
w14 (other foods)	−0.232	0.004	0.009	0.062	0.006	−0.028	0.012	−0.018	−0.038	0.010	−0.013	−0.019	−0.015	

Appendix Table 1.3. Compensated cross-price elasticity (Hicksian), agricultural households

Food groups	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
w1 (rice)		0.016	0.000	0.008	0.046	0.029	−0.009	0.114	0.059	0.001	0.056	0.048	−0.003	0.125
w2 (non-rice staple)	0.328		0.000	0.070	0.105	−0.048	0.046	0.379	0.148	−0.247	0.266	0.022	0.023	0.383
w3 (tubers)	−0.006	0.000		0.176	0.011	−0.022	−0.013	0.350	0.007	−0.103	0.053	0.080	0.022	0.449
w4 (fishes)	0.017	0.008	0.022		0.041	0.024	−0.012	0.180	0.054	0.085	0.033	0.044	0.023	0.433
w5 (meat)	0.323	0.036	0.004	0.130		−0.096	−0.026	0.158	0.063	0.058	0.038	0.108	0.028	0.354
w6 (eggs)	0.230	−0.019	−0.010	0.085	−0.108		−0.028	0.158	0.100	0.129	0.084	0.036	0.116	0.131
w7 (milk)	−0.092	0.023	−0.007	−0.056	−0.040	−0.037		0.153	0.076	0.079	0.059	0.024	−0.037	0.418
w8 (vegetables)	0.205	0.033	0.035	0.146	0.040	0.036	0.026		0.000	0.097	0.020	0.053	0.020	0.291
w9 (pulses)	0.389	0.047	0.002	0.160	0.059	0.082	0.048	0.001		0.159	0.055	0.141	0.056	0.111
w10 (fruits)	0.006	−0.056	−0.026	0.177	0.038	0.075	0.035	0.251	0.113		0.106	0.070	0.070	0.355
w11 (oils and greases)	0.274	0.063	0.014	0.072	0.026	0.051	0.027	0.055	0.041	0.110		0.050	0.044	0.266
w12 (beverage ingredients)	0.189	0.004	0.017	0.078	0.059	0.018	0.009	0.116	0.084	0.059	0.040		0.036	0.256
w13 (spices)	−0.024	0.010	0.010	0.090	0.034	0.125	−0.031	0.095	0.073	0.130	0.077	0.078		0.208
w14 (other foods)	0.151	0.022	0.030	0.234	0.059	0.020	0.049	0.195	0.020	0.092	0.066	0.079	0.029	

Appendix Table 1.4. Compensated cross-price elasticity (Hicksian), nonagricultural households

Food Goups	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
w1 (rice)		0.016	−0.007	−0.037	0.050	0.029	−0.017	0.099	0.068	−0.022	0.056	0.037	−0.017	0.136
w2 (non-rice staple)	0.386		−0.013	0.037	0.150	−0.097	0.060	0.527	0.222	−0.450	0.405	−0.014	0.018	0.572
w3 (tubers)	−0.138	−0.010		0.201	0.000	−0.045	−0.025	0.437	−0.010	−0.182	0.049	0.077	0.015	0.647
w4 (fishes)	−0.068	0.003	0.018		0.048	0.024	−0.002	0.161	0.053	0.094	0.021	0.027	0.019	0.570
w5 (meat)	0.204	0.025	0.000	0.111		−0.071	0.008	0.112	0.052	0.069	0.025	0.077	0.022	0.491
w6 (eggs)	0.164	−0.023	−0.013	0.075	−0.098		−0.012	0.133	0.096	0.135	0.074	0.022	0.111	0.241
w7 (milk)	−0.073	0.011	−0.005	−0.004	0.007	−0.009		0.091	0.046	0.080	0.035	0.011	−0.018	0.532
w8 (vegetables)	0.163	0.035	0.037	0.147	0.044	0.039	0.034		−0.010	0.110	0.006	0.040	0.015	0.398
w9 (pulses)	0.361	0.048	−0.003	0.158	0.066	0.089	0.057	−0.034		0.176	0.049	0.138	0.056	0.190
w10 (fruits)	−0.065	−0.054	−0.028	0.156	0.049	0.071	0.056	0.200	0.099		0.085	0.048	0.060	0.499
w11 (oils and greases)	0.252	0.073	0.011	0.053	0.026	0.058	0.036	0.017	0.041	0.127		0.036	0.045	0.362
w12 (beverage ingredients)	0.144	−0.002	0.015	0.059	0.070	0.015	0.009	0.093	0.100	0.061	0.031		0.036	0.356
w13 (spices)	−0.122	0.005	0.006	0.077	0.039	0.144	−0.031	0.066	0.078	0.148	0.075	0.068		0.308
w14 (other foods)	0.074	0.013	0.018	0.173	0.064	0.023	0.068	0.133	0.020	0.091	0.044	0.051	0.023	