Asian Economic and Financial Review
ISSN(e): 2222-6737
ISSN(p): 2305-2147
DOI: 10.55493/5002.v14i9.5158
Vol. 14, No. 9, 695-711.

URL: www.aessweb.com

Do income levels affect the food consumption pattern of households? Evidence from Indonesia

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Article History
Received: 1 February 2024
Revised: 26 June 2024
Accepted: 18 July 2024
Published: 15 August 2024

Keywords
Consumption behavior
Expenditure elasticity
Food demand
Income level
Indonesia
Price elasticity
QUAIDS.

JEL Classification:
D12; D31; Q11; Q18.

ABSTRACT

Prior studies have proven that income significantly affects household food consumption patterns. However, there is little research on the impact of different income levels on household food demand in Indonesia. This research aims to estimate the elasticity of household food demand at different income levels using the Quadratic Almost Ideal Demand System (QUAIDS) model with a two-step budgeting estimation approach. The data is from the Indonesian National Socio-Economic Survey (SUSENAS) 2020, which surveyed 328,801 households. The findings indicate that the income level of households has a significant effect on household demand for carbohydrate and animal protein source foods. The lowest- and low-income households have the highest proportion of food expenditure. However, in absolute terms, their expenditure on food is the lowest. All commodities exhibit positive expenditure elasticity and negative own-price elasticity across all income levels. The consumption of rice, fish, and chicken are more responsive to policies aimed at increasing household income. Conversely, the consumption of corn, flour, cassava, beef, and eggs are more responsive to price control policies. It is crucial for food policy in Indonesia to prioritize the needs of the lowest- and low-income households, ensuring that they have access to improved food consumption patterns.

Contribution/Originality: This study uses the QUAIDS model to analyze how income levels affect household demand for eight food commodities of carbohydrate and animal protein sources. To describe the income effect, households are classified into five income groups. These results contribute as a resource on household food demand behavior by income level in developing countries. It is also an important reference for food policy decision making, especially to ensure that food availability and access are appropriately targeted.

1. INTRODUCTION

Food expenditure is often utilized as an indicator to measure the level of economic welfare in a society (Korir, Rizov, & Ruto, 2020; Naz, Ahmad, & Arif, 2018; Rehman, Jian, & Runqing, 2014; Umaroh & Pangaribowo, 2020). If the proportion of food expenditure is smaller than non-food expenditure, it indicates that the economic level of the population is more well-off (Ansah, Marfo, & Donkoh, 2020; Rasyid, Kristina, Sutikno, & Yuliani, 2020). Engel's law suggests that there is a close relationship between income and the proportion of household expenditure on food. As income increases, the percentage allocated to food consumption tends to decrease (Cirera & Masset, 2010; Fukase &

Martin, 2020). In 2020, the proportion of household expenditure in Indonesia as a developing country, changed in comparison to the previous decade. Household expenditure in 2020 was dominated by non-food at 50.78%, while ten years earlier, it was the dominated by food consumption at 51.43% (BPS, 2010, 2020). From 2016 to 2020, the food consumption pattern of the Indonesian population primarily dominated by consuming carbohydrate source foods, particularly rice and flour (35.32%). However, the consumption of tubers and sago remained relatively low (4.36%). The average consumption of high protein food is 61.91 grams/capita/day, with most of the composition (66.80%) derived from vegetable protein. In contrast, the consumption of animal protein was relatively low (33.20%) (Kementan, 2021). Several factors contribute to the low consumption of animal protein source food. One of these factors is the relatively higher price of animal protein source food compared to other food groups. As a result, people are more likely to consume it after their basic food needs are satisfied (Nendissa, Anindita, Khoiriyah, & Sa'diyah, 2021; Nikmatul, Ratya, Nuhfil, & Wahib, 2020; Umaroh & Pangaribowo, 2020). Food consumption patterns of households in several Asian countries have changed significantly in recent decades. The rapid economic growth in the Asian region has increased people's incomes and living standards, and as a result, there is an increased demand for highly nutritious foods (Rathnayaka, Selvanathan, & Selvanathan, 2022). Several studies conducted in China (Lei, Zhai, & Bai, 2021; Ren, Zhang, Loy, & Glauben, 2018); Pakistan, India and Sri Lanka (Kumar, Kumar, Shinoj, & Raju, 2011; Naz et al., 2018; Pallegedara, 2019); Vietnam and the Philippines (Bairagi, Mohanty, Baruah, & Thi, 2020; Valera, Mayorga, Pede, & Mishra, 2022); and Japan (Huang & Bouis, 2001) provide evidence of a declining trend in the consumption of cereals or grains as a staple food, shifting to animal protein foods as people's incomes increase.

As a developing country, income among households in Indonesia varies widely. When examined by expenditure quintiles, data from BPS (2020) shows that the largest expenditure of households in the first to fourth quintiles is on food consumption, while in the fifth quintile, the largest expenditure is on non-food items. This difference is thought to be due to the disparity in income distribution between households in the fifth quintile and households in the first to fourth quintiles. Therefore, it is interesting to investigate whether differences in income levels affect household demand for carbohydrate and animal protein source foods in Indonesia, as Bennet hypothesized. According to Bennet's law, as income rises, there is a shift in household food consumption patterns. The consumption of carbohydrate source foods will decrease, while the consumption of animal protein source foods will increase (Cirera & Masset, 2010; Fukase & Martin, 2020). Understanding how households respond to changes in food demand is crucial for making food policy decisions, particularly concerning food availability and affordability, which will impact food security and community nutrition. This article is organized into multiple sections. An introduction is presented in the first section, which is followed by an overview of existing literature. The third section describes the methodology, comprising the data description and empirical model used in this study. The research findings are presented in the fourth section, followed by a scientific explanation based on relevant theories and previous research in the fifth section. In the final section, conclusions and policy implications are presented.

2. LITERATURE REVIEW

Prior research on household food demand systems have been conducted in different countries using various modeling approaches, such as LES (Linear Expenditure System), Rotterdam, Indirect Translog System (ITS), AIDS (Almost Ideal Demand System), and QUAIDS (Quadratic Almost Ideal Demand System) as the most popular model introduced by Banks, Blundell, and Lewbel (1997). QUAIDS is considered the most capable demand model to describe the Engel curve's curvature (Banks et al., 1997; Valera et al., 2022). Therefore, this model has been extensively implemented in empirical studies to estimate household food demand in developing countries, including Ansah et al. (2020) in Ghana, Elzaki, Sisman, and Al-Mahish (2021) in Sudan, Fashogbon and Oni (2013) in Nigeria, Korir et al. (2020) in Kenya, Hoang (2018) in Vietnam, Mittal (2010) in India, Akram (2020) in Pakistan, and Ren et al. (2018) in China. The findings of these studies indicate that household demand for carbohydrate source foods is inelastic, while demand for animal protein source foods is elastic to income changes. Research on food demand systems uses the

QUAIDS model also has been intensively conducted in Indonesia, as demonstrated by Hafizah, Hakim, Harianto, and Nurmalina (2020); Nikmatul, Ratya, Nuhfil, and Wahib (2019) and Nendissa et al. (2021) all using SUSENAS 2016 data. However, the research does not differentiate household groups based on specific categorizations. Several researchers have examined food demand by considering variations in household characteristics. These characteristics include urban or rural areas as analyzed by Allo, Satiawan, and Arsyad (2018) and Faharuddin, Mulyana, Yamin, and Yunita (2017) using SUSENAS 2014 data, Kharisma, Alisjahbana, Remi, and Praditya (2020) using SUSENAS 2017 data, Pangaribowo and Tsegai (2011) using Indonesian Representative Data from 1993, 1997, 2000, and 2007, and Umaroh and Pangaribowo (2020) using Indonesian Representative Data from 2007 and 2014. Additionally, Widarjono and Rucbha (2016) used SUSENAS 2011 data to study the differences in food demand between Java Island and outside Java Island, while Mulyana and Yamin (2019) used SUSENAS 2013 data to focus on the source of income in agricultural or non-agricultural households. Nevertheless, there are few food demand studies using the QUAIDS model to examine the effect of income level on household food consumption patterns in Indonesia. Pangaribowo and Tsegai (2011) and Umaroh and Pangaribowo (2020) have differentiated the analysis according to poverty status (rich or poor households), whereas Kharisma et al. (2020) and Widarjono and Rucbha (2016) categorized according to low-, middle-, and high-income levels. Only one study by Nikmatul et al. (2020) using SUSENAS 2016 data, differentiated the analysis by expenditure quintiles. However, the restricted scope of their study on just five food commodities of animal protein sources did not compare the consumption patterns of various food groups, such as carbohydrates and animal protein source foods. To address the existing research gap, this study aims to examine the impact of income level variation on the food consumption patterns of Indonesian households, particularly on eight commodities of carbohydrate and animal protein source foods, utilizing the most recent data. This study also provides a better illustration of the effect of income level effect on food consumption patterns, because household income is classified into specific expenditure quintiles. This study also contributes to the existing literature as a reference on household food demand behavior based on income levels in developing countries.

3. METHODOLOGY

3.1. Data Sources

This study utilized cross-sectional data from the Indonesian National Socio-Economic Survey (SUSENAS), conducted by the Central Bureau of Statistics (BPS) in March 2020. SUSENAS is a survey that records household expenditures on food for a week and non-food for a month before the survey. The sample analyzed included 328,801 households from 34 provinces in Indonesia. The study classified households into five income categories: very low, low, middle, high, and very high. This study uses total household expenditure data as a proxy for income because not all household income data is available in SUSENAS (Moeis, 2003; Widarjono & Mumpuni Ruchba, 2021). The commodities categorized for analysis in this study are shown in Table 1.

Table 1. Groups of food commodities as sources of carbohydrates and animal protein.

Food group	Food commodities
Rice	Rice (Local, medium, premium, and imported rice)
Corn	Wet corn with husk skin, shelled corn/corn rice
Flour	Wheat flour
Cassava	Cassava
Fish	Various fresh/wet fish, fresh shrimp, fresh squid, fresh shellfish (Not preserved)
Beef	Beef
Chicken	Broiler/breed chicken meat, free-range chicken meat
Eggs	Broiler/breed chicken eggs, free-range chicken eggs

Source: Classifications of SUSENAS 2020.

3.2. The Empirical Model

The QUAIDS model was utilized in this study to address the research objectives. This model was chosen because it is better able to accommodate the nonlinearity of Engel's curve, allowing for changes in commodity types if income changes (Banks et al., 1997; Onyeneke et al., 2020; Widarjono & Rucbha, 2016). It is also able to provide a better explanation with a larger number of parameters than other models, such as the AIDS model (Mulyana & Yamin, 2019; Valera et al., 2022). QUAIDS is the best model to predict the food demand function in Indonesia (Allo et al., 2018). The data was analyzed using STATA 17.0.

One of the limitations of using household survey data is the lack of information on the prices of consumed commodities. The price of each commodity is based on its unit value rather than its market price. The unit value (price) is determined by dividing the expenditure value with the quantity purchased. This approach can be utilized when the research is conducted within a limited geographic area and involves demographic factors that are relatively homogenous. If the unit value approach is used in research conducted in a large area, such as Indonesia, with diverse demographic factors, it can lead to inaccuracies, including biased measurement (Zheng & Henneberry, 2010). In order to address this issue, the unit value is adjusted using the price differential approach and was thereafter adopted as the price variable in this research, as applied by Kharisma et al. (2020) and Majumder, Ray, and Sinha (2012). The unit value is adjusted by adding the middle value of each region and estimating the difference of the residual regression on the middle value of each region, considering the socio-demographic factors. This study uses seven socio-demographic variables: urban/rural classification, household size, age of household head, gender of household head, main occupation of household head, length of household head's formal education, and household income level classification. This approach can be expressed mathematically as follows:

$$v_i - v_{median} = \alpha_0 + \alpha_1 dloc_i + \alpha_2 hsize_i + \alpha_3 age_i + \alpha_4 dgender_i + \alpha_5 djob_i + \alpha_6 educ_i + \alpha_7 inc_i + \varepsilon_i \quad (1)$$

The adjusted prices are derived by summing the mean value per unit of a commodity group, both at commodity and residual levels:

$$(p_i)_{median} = (v_i)_{median} + (\hat{e}_i)_{median} \quad (2)$$

The resulting price correction assumes that each household within the same region faces the identical market price for each commodity. Therefore, the price is not impacted by the endogeneity issue due to the difference in quality purchased between households within a group (Majumder et al., 2012). The QUAIDS model requires that all household samples consume each commodity analyzed. However, since the SUSENAS data collection period is only seven days, there is a possibility that the sample of households used as respondents do not consume these food commodities or possibly consume them outside the survey period. To anticipate zero consumption, the data can be processed by aggregating or grouping several food commodities into a larger group (Moeis, 2003). If there is still zero consumption after aggregation, it can be anticipated by adding the Inverse Mills Ratio (IMR) as an independent variable in the demand system model. The IMR variable is obtained through a two-stage estimation process using the Heckman test (Kharisma et al., 2020; Widarjono & Rucbha, 2016). According to Heien and Wesseils (1990) the first step is a probit model to calculate the probability of households consuming the analyzed commodities outside the survey period. This probit model generates both the Probability Distribution Function (PDF) and the Cumulative Distribution Function (CDF). The second step is to calculate the IMR as a ratio of the PDF to the CDF. The estimating equation in this research is the model derived from Poi (2012) and Ray (1983) with the following QUAIDS equation:

$$w_i = \alpha_i + \sum_{j=1}^{n} y_{ij}\, lnp_j + \beta_i ln\left\{\frac{x}{a(p)}\right\} + \frac{\lambda_i}{b(p)}\left[ln\left\{\frac{x}{a(p)}\right\}\right]^2 + \alpha_{i1} dloc_i + \alpha_{i2} hsize_i + \alpha_{i3} age_i + \alpha_{i4} dgender_i + \alpha_{i5} djob_i + \alpha_{i6} educ_i + \alpha_{i7} inc_i + \alpha_{i8} IMR + \varepsilon_i \quad (3)$$

Where:

w_i = Expenditure share of food commodity group i (rice, corn, flour, cassava, fish, beef, chicken and eggs).

lnp_j = Aggregate price of food commodity groups.

x = Household expenditure on the consumption of food commodities.
$\ln (a/p)$ = Price index.
$b(p)$ = Aggregate price.
$dloc$ = Location (urban = 1; rural = 0).
$hsize$ = Number of household members.
age = Age of the household head.
$dgender$ = Gender of the household head (male = 1).
$djob$ = Main occupation of the household head (agriculture = 1).
$educ$ = Length of formal schooling of the household head.
inc = Classification of household income level (lowest income = 1, low income = 2, middle income = 3, high income = 4, highest income = 5).
IMR = Inverse Mills Ratio.

The QUAIDS model is capable of generating the three different forms of demand elasticity, which are:

1. Income elasticity

$$\mu_i = 1 + \frac{1}{w_i}\left[\beta_i + \frac{2\lambda_i}{b(p)}\left\{ln\left(\frac{x}{a(p)}\right)\right\}\right] \tag{4}$$

2. Marshallian price elasticity (uncompensated price elasticity)

$$\varepsilon_{ij}^{NC} = \frac{1}{w_i}\left[\gamma_{ij} - \mu_i\left(\alpha_j + \sum_{k=1}^{n}\lambda_{jk} ln\, p_k\right) - \frac{\lambda_i\beta_j}{b(p)}\left\{ln\left(\frac{x}{a(p)}\right)^2\right\}\right] - \delta_{ij} \tag{5}$$

3. Hicksian price elasticity (compensated price elasticity)

$$\varepsilon_{ij}^{c} = \varepsilon_{ij} + \mu_i w_j \tag{6}$$

Where:

ε_{ij} = Price elasticity.
γ_{ij} = Parameters of food commodity prices.
β_i, λ_i = Linear and quadratic income parameters.
w_i = Average expenditure share of food commodities.
δ_{ij} = Delta Kronecker is zero for own price (i = j) and 1 for cross price (i ≠ j).

4. RESULTS

4.1. Descriptive Statistics

Table 2 displays the summary statistics of the socio-economic and demographic variables utilized in the QUAIDS model. The majority of household heads are male (84.29%), with an average age of 49.2 years, and most of them are employed in the non-agricultural sector (61.37%). Based on the level of education, 5.25% of household heads lack a formal education. Among the educated cohort, only 9.83% possessed tertiary education, while the majority (43.34%) were limited to primary school education. Approximately 59.28% of households are located in rural areas, and these households have an average family size of four individuals.

4.2. Distribution of Household Expenditure by Income Level in Indonesia

The study categorizes households into five distinct income tiers, ranging from the lowest income to the highest income. Table 3 indicates that the lowest- to high-income household groups in Indonesia primarily allocate a significant portion of their household expenditure to food (54.80%–61.18%), and the highest household group only spends 42.26% of their expenditure on food. Households with the lowest- and low-income levels designate the highest proportion of their budget for food consumption, but the absolute value of their food expenditure is the lowest among the other household groups.

Table 2. Summarized statistics of socio-economic demographic variables.

Variable	Answer options	Mean	Standard deviation	Observations	Percentage (%)
Household members	Individuals	3.80	1.70	-	-
Age	Years	49.19	13.37	-	-
Gender	Male			277,146	84.29
	Female			51,655	15.71
Occupation	Agriculture			127,032	38.63
	Others			201,769	61.37
Education level	No formal education			17,258	5.25
	Elementary school			142,509	43.34
	Junior high school			51,265	15.59
	High school seniors			85,430	25.98
	Vocational school			311	0.09
	Diploma/bachelor's degree			29,767	9.05
	Master's degrees			2,058	0.63
	Doctoral degrees			203	0.06
Location	Urban			133,878	40.72
	Rural			194,923	59.28
Income level	Lowest			65,427	19.90
	Low			65,751	20.00
	Middle			65,767	20.00
	High			65,872	20.03
	Highest			65,984	20.07

Source: SUSENAS 2020.

Table 3. Average distribution of household expenditure by income level in Indonesia.

Income level	Household expenditure					
	Food		Non-food		Total expenditure	
	Value (IDR/Month)	%	Value (IDR/Month)	%	Value (IDR/Month)	%
Lowest	880,860.80	61.18	558,949.90	38.82	1,439,811.00	100.00
Low	1,469,147.00	59.86	985,006.70	40.14	2,454,154.00	100.00
Middle	1,969,889.00	57.90	1,432,608.00	42.10	3,402,497.00	100.00
High	2,607,188.00	54.80	2,150,084.00	45.20	4,757,273.00	100.00
Highest	4,020,036.00	42.26	5,491,712.00	57.74	9,511,748.00	100.00

Source: SUSENAS 2020.

Table 4 displays a high dependence of households in Indonesia on rice as a carbohydrate source food. Within the lowest- to middle-income households, rice consumption represents the highest proportion of food expenditure (13.99%–19.83%), whereas beef consumption has the lowest proportion (0.14%–0.25%).

In households with the highest income level, the largest portion of food expenditure is on fish (8.61%), while the smallest portion is spent on flour (0.26%) and corn (0.27%).

Meanwhile, the data presented in Table 5 illustrates that as household income rises, the average per capita consumption of carbohydrate source foods declines, except for flour, which increases. Conversely, the average per capita consumption of animal protein source foods increases.

4.3. Estimating Parameters of the Food Commodities Demand System Model

Table 6 displays the parameter estimation results of the QUAIDS model. The coefficient of alpha or intercept is statistically significant and has a positive value for all food commodities, except for rice, chicken, and eggs, which are also significant but have negative value.

The coefficients of both the linear and quadratic expenditure parameters are also statistically significant for all food commodities, with the coefficient value of quadratic expenditure being consistently smaller than linear expenditure. It is evident that the demand for eight commodities examined in this study is sensitive to food expenditure. Price variables also significantly affect the demand for all food commodities, except for flour, which is not impacted by its own price.

Table 4. Household expenditure and the share of food expenditure by income level in Indonesia.

Expend group	Household income level									
	Lowest		Low		Middle		High		Highest	
	Value (IDR/Month)	%	Value (IDR/Month)	%	Value (IDR/Month)	%	Value (IDR/Month)	%	Value (IDR/Month)	%
Rice	174,643.41	19.83	243,394.11	16.57	275,610	13.99	299,821.20	11.50	327,820	8.15
Corn	5,514.41	0.63	6,734.04	0.46	6,820	0.35	7,562.49	0.29	10,662	0.27
Flour	2,970.94	0.34	4,857.85	0.33	6,024	0.31	7,633.12	0.29	10,363	0.26
Cassava	5,705.07	0.65	8,115.89	0.55	9,012	0.46	9,996.52	0.38	12,381	0.31
Fish	63,961.07	7.26	109,522.84	7.45	154,893	7.86	215,620.80	8.27	346,158	8.61
Beef	1,241.21	0.14	2,646.50	0.18	4,906	0.25	10,587.50	0.41	40,447	1.01
Chicken	18,076.90	2.05	36,037.66	2.45	55,133.01	2.80	79,788.47	3.06	134,631.69	3.35
Eggs	28,315.51	3.21	41,595.64	2.83	51,662.19	2.62	63,246.60	2.43	85,067.01	2.12
Other foods	580,432.28	65.89	1,016,242.45	69.17	1,405,828.46	71.37	1,912,931.30	73.37	3,052,506.91	75.93
Total	880,860.80	100.00	1,469,147.00	100.00	1,969,889.00	100.00	2,607,188.00	100.00	4,020,036.00	100.00

Source: SUSENAS, 2020.

Table 5. Average consumption per capita per year of food commodities sources of carbohydrates and protein according to household income level.

Food commodity	Entire sample	Food consumption according to income level (kg/person/year)				
		Lowest	Low	Middle	High	Highest
Rice	84.95	91.75	87.54	86.26	83.42	75.78
Corn	3.86	4.78	3.99	3.54	3.34	3.65
Flour	2.40	1.82	2.18	2.38	2.66	2.93
Cassava	6.31	7.83	6.70	6.21	5.75	5.05
Fish	23.40	18.26	20.18	22.87	25.87	29.81
Beef	0.37	0.08	0.12	0.20	0.36	1.07
Chicken	6.21	3.10	4.40	5.83	7.50	10.17
Eggs	7.00	6.27	6.31	6.76	7.34	8.32

Source: SUSENAS data, 2020.

Demographic variables, such as the number of household members, the age of household head, and the main occupation of household head, are statistically significant for all food commodities. More demographic variables, such as the gender of household head has a statistically significant effect on the demand for each food commodity, with the exception cassava and beef.

The formal education of household heads has a significant influence on the demand for every food commodity, except flour. The income level of the household also has a notable influence on all food commodities, except flour and beef. While the variable of residence area is significant for all food commodities, most parameters are significant at the 1% level, and some are significant at the 5% and 10% levels. The IMR variable is appended to eliminate the bias of the estimated parameters in the equation.

4.4. Elasticity of Expenditure, Own Price, and Cross Price

The expenditure elasticity values at various levels of household income are presented in Table 7. All food commodities of carbohydrate and animal protein sources analyzed have positive expenditure elasticities, with elasticity values varying between income groups. It can be concluded that the eight commodities analyzed are normal goods across all income groups. The implication is that if total household expenditure (a proxy for income) increases, then consumption of these eight commodities will also increase, assuming ceteris paribus. As household income levels increase, the expenditure elasticity value for each food commodity of carbohydrate sources, except rice, becomes more inelastic. Conversely, the expenditure elasticity of animal protein source foods, except eggs, becomes more elastic as income rises.

Table 6. Estimation results of the quadratic almost ideal demand system (QUAIDS).

Variable	Rice	Corn	Flour	Cassava	Fish	Beef	Chicken	Eggs
Constant	-0.198*** (0.019)	0.778*** (0.011)	0.158*** (0.007)	0.604*** (0.010)	1.013*** (0.013)	1.223*** (0.016)	-2.499*** (0.017)	-0.079*** (0.017)
Expenditure	0.117*** (0.003)	0.149*** (0.002)	0.017*** (0.001)	0.070*** (0.002)	-0.029*** (0.003)	0.120*** (0.002)	-0.457*** (0.003)	0.011*** (0.003)
Quadratic expenditure	0.009*** (0.000)	0.006*** (0.000)	0.001*** (0.000)	0.004*** (0.000)	-0.008*** (0.000)	0.005*** (0.000)	-0.022*** (0.000)	0.005*** (0.000)
Rice price	0.237*** (0.003)	0.031*** (0.002)	-0.005*** (0.001)	0.027*** (0.001)	-0.206*** (0.002)	-0.092*** (0.002)	-0.206*** (0.007)	0.030*** (0.002)
Corn price		-0.089*** (0.002)	0.050*** (0.001)	0.108*** (0.001)	-0.014*** (0.002)	0.111*** (0.002)	-0.268*** (0.003)	0.071*** (0.002)
Flour price			0.001 (0.001)	-0.012*** (0.001)	-0.010*** (0.001)	0.003*** (0.001)	-0.043*** (0.002)	0.017*** (0.001)
Cassava price				0.019*** (0.001)	0.007*** (0.001)	0.034*** (0.001)	-0.217*** (0.003)	0.033*** (0.001)
Fish price					0.218*** (0.002)	0.040*** (0.002)	0.040*** (0.005)	-0.074*** (0.002)
Beef price						0.067*** (0.003)	-0.399*** (0.004)	0.052*** (0.002)
Chicken price							1.215*** (0.008)	-0.123*** (0.004)
Egg price								-0.006* (0.003)
Household size	-0.002*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.000*** (0.000)	-0.001*** (0.000)	0.002*** (0.000)
Head age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Head male	-0.002*** (0.000)	0.003*** (0.000)	0.000*** (0.000)	0.000 (0.000)	0.000** (0.000)	0.000 (0.000)	-0.003*** (0.000)	0.002*** (0.000)
Head job	-0.007*** (0.000)	0.004*** (0.000)	-0.001*** (0.000)	0.003*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	-0.003*** (0.000)	0.001*** (0.000)
Head education	0.000*** (0.000)	0.000* (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
imr_rice	0.096*** (0.001)	-0.006*** (0.000)	0.000 (0.000)	-0.054*** (0.001)	0.032*** (0.001)	0.006*** (0.000)	-0.053*** (0.002)	-0.020*** (0.001)
imr_corn	-0.002*** (0.000)	-0.040*** (0.000)	0.007*** (0.000)	0.012*** (0.000)	-0.005*** (0.000)	-0.005*** (0.000)	0.024*** (0.000)	0.008*** (0.000)
imr_flour	-0.015*** (0.001)	0.014*** (0.000)	-0.003*** (0.000)	-0.001*** (0.000)	-0.005*** (0.000)	0.013*** (0.000)	0.007*** (0.001)	-0.011*** (0.000)
imr_cassava	-0.007*** (0.001)	0.024*** (0.001)	-0.006*** (0.000)	0.001* (0.000)	0.003*** (0.001)	0.002*** (0.001)	-0.037*** (0.001)	0.020*** (0.001)
imr_fish	-0.019*** (0.001)	0.014*** (0.000)	-0.001*** (0.000)	0.008*** (0.000)	0.016*** (0.000)	0.003*** (0.000)	-0.017*** (0.001)	-0.004*** (0.000)
imr_beef	0.001 (0.000)	0.003*** (0.000)	-0.001*** (0.000)	-0.006*** (0.000)	0.004*** (0.000)	0.011*** (0.000)	-0.011*** (0.001)	0.000 (0.000)
imr_chicken	-0.011*** (0.001)	-0.002*** (0.000)	0.004*** (0.000)	0.010*** (0.000)	-0.012*** (0.001)	-0.020*** (0.000)	0.025*** (0.001)	0.006*** (0.001)
imr_egg	0.057*** (0.001)	-0.015*** (0.000)	-0.002*** (0.000)	-0.033*** (0.001)	-0.003*** (0.001)	-0.007*** (0.001)	-0.017*** (0.001)	0.020*** (0.001)
q_exp	0.001*** (0.000)	0.000*** (0.000)	0.000 (0.000)	0.000*** (0.000)	-0.001*** (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000*** (0.0000)
d_urban	0.003*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000* (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are in parentheses.
Source: SUSENAS data, 2020.

The carbohydrate source food that has the largest expenditure elasticity value is corn, with values ranging from 1.345–1.421, followed by flour with values from 1.006–1.015. Expenditure elasticity values greater than one indicate that corn and flour are considered luxury goods. Meanwhile, rice and cassava serve as carbohydrate source foods that are included as necessities in all household income groups (lowest to highest) because the expenditure elasticity value is less than one. Animal protein commodities, such as fish, beef, and chicken, are classified as luxury items due to their expenditure elasticity values being positive and greater than one at all income levels. Egg is the only commodity classified as a necessity good, as its expenditure elasticity is positive and less than one. Among the four animal protein commodities examined, egg has the smallest expenditure elasticity. The elasticity value of beef expenditure is the largest among the commodities analyzed.

Table 7. The expenditure elasticity of commodities in Indonesian households by income level.

Commodity	Lowest	Low	Middle	High	Highest
Rice	0.728	0.723	0.727	0.731	0.737
Corn	1.421	1.450	1.396	1.362	1.345
Flour	1.015	1.019	1.015	1.011	1.006
Cassava	0.460	0.458	0.458	0.454	0.444
Fish	1.595	1.574	1.595	1.617	1.644
Beef	3.112	2.855	2.899	3.078	4.603
Chicken	1.244	1.216	1.250	1.283	1.327
Eggs	0.370	0.370	0.369	0.369	0.369

Source: SUSENAS data, 2020.

Table 8 displays the own-price elasticity values, both Marshallian (uncompensated) and Hicksian (compensated), based on household income level. The own-price elasticity values of the eight commodities analyzed are all negative in each income group. This result is consistent with the theory of demand law, that an increase in the price of a commodity will reduce demand for that commodity, ceteris paribus. The own-price Marshallian and Hicksian elasticity values, which are inelastic, are found for chicken and fish commodities for animal proteins, and rice for carbohydrates. It can be inferred that a 1% increase in the price of chicken, fish, and rice will result in a decline in demand for these commodities by less than 1%. The other commodities including corn, flour, cassava, beef, and eggs are elastic because their own-price elasticity values, both uncompensated and compensated, are greater than one. This indicates that household demand for these five commodities is strongly influenced by price changes. The commodities that are most responsive to price changes are corn for carbohydrate source foods and beef for animal protein foods. It means that if the price of corn and beef increases, the decrease in consumption of these commodities will be greater than the decrease in consumption of other carbohydrate and animal protein source foods.

Table 8. Uncompensated (Marshallian) and compensated (Hicksian) own-price elasticities of food commodities.

Food Group	Lower		Low		Middle		High		Higher	
	U	C	U	C	U	C	U	C	U	C
Rice	-0.613	-0.255	-0.604	-0.258	-0.612	-0.256	-0.620	-0.252	-0.630	-0.245
Corn	-16.656	-16.638	-16.909	-16.891	-16.346	-16.328	-16.060	-16.042	-16.164	-16.146
Wheat	-1.033	-1.022	-1.033	-1.022	-1.034	-1.022	-1.034	-1.023	-1.033	-1.022
Cassava	-1.594	-1.586	-1.622	-1.615	-1.592	-1.584	-1.571	-1.563	-1.553	-1.546
Fish	-0.750	-0.339	-0.758	-0.339	-0.753	-0.341	-0.745	-0.341	-0.734	-0.338
Beef	-3.726	-3.687	-3.366	-3.326	-3.466	-3.426	-3.735	-3.698	-5.811	-5.779
Chicken	-0.255	-0.138	-0.282	-0.162	-0.265	-0.147	-0.239	-0.123	-0.191	-0.08
Egg	-1.307	-1.267	-1.305	-1.267	-1.307	-1.269	-1.309	-1.271	-1.310	-1.271

Note: U = Uncompensated elasticity, C = Compensated elasticity.
Source: SUSENAS data, 2020.

Cross-price elasticity represents the proportionate change in the quantity of a commodity consumed in response to a 1% change in the price of another commodity, ceteris paribus. A negative sign on the cross-price elasticity value signifies a complementary relationship between the commodity and other commodities, whereas a positive sign suggests a substitution relationship with other commodities. If the value of cross-price elasticity is zero, the commodity is independent, which implies that increasing the price of one commodity will not cause a change in the consumption of another commodity. Marshallian (uncompensated) and Hicksian (compensated) cross-price elasticity values according to household income levels are presented in Tables 9 and 10.

Table 9. Uncompensated own and cross-price elasticities of food commodities.

Quantity of demand	Price of food commodities							
	Rice	Corn	Flour	Cassava	Fish	Beef	Chicken	Eggs
Lowest income								
Rice	-0.613	-0.042	-0.017	-0.009	-0.133	0.117	0.002	-0.034
Corn	-1.917	-16.656	3.078	4.047	-0.023	0.577	6.765	2.709
Flour	-0.900	3.535	-1.033	-1.540	-0.767	-0.577	-0.919	1.186
Cassava	-0.133	3.136	-1.031	-1.594	1.558	-1.047	-2.096	0.746
Fish	-0.681	-0.002	-0.039	0.081	-0.750	0.145	-0.207	-0.142
Beef	3.516	0.579	-0.542	-1.441	2.621	-3.726	-5.847	1.726
Chicken	-0.248	0.918	-0.111	-0.380	-0.469	-0.742	-0.255	0.043
Eggs	0.015	0.344	0.134	0.120	-0.038	0.238	0.124	-1.307
Low income								
Rice	-0.604	-0.043	-0.018	-0.009	-0.138	0.120	0.004	-0.034
Corn	-1.977	-16.909	3.133	4.121	-0.040	0.599	6.841	2.781
Flour	-0.909	3.562	-1.033	-1.550	-0.775	-0.581	-0.928	1.196
Cassava	-0.157	3.280	-1.077	-1.622	1.613	-1.096	-2.188	0.790
Fish	-0.656	-0.002	-0.038	0.078	-0.758	0.139	-0.199	-0.139
Beef	3.038	0.515	-0.471	-1.253	2.253	-3.366	-5.087	1.516
Chicken	-0.223	0.872	-0.106	-0.363	-0.436	-0.710	-0.282	0.031
Eggs	0.010	0.347	0.134	0.122	-0.036	0.243	0.115	-1.305
Middle income								
Rice	-0.612	-0.042	-0.017	-0.009	-0.133	0.118	0.004	-0.035
Corn	-1.887	-16.346	3.016	3.963	-0.005	0.568	6.646	2.649
Flour	-0.906	3.552	-1.034	-1.548	-0.770	-0.581	-0.919	1.191
Cassava	-0.138	3.112	-1.024	-1.592	1.555	-1.040	-2.069	0.737
Fish	-0.678	-0.001	-0.039	0.081	-0.753	0.144	-0.208	-0.141
Beef	3.186	0.529	-0.492	-1.308	2.392	-3.466	-5.301	1.562
Chicken	-0.243	0.920	-0.110	-0.378	-0.477	-0.743	-0.265	0.046
Eggs	0.013	0.343	0.134	0.119	-0.035	0.238	0.127	-1.307
High income								
Rice	-0.620	-0.041	-0.017	-0.009	-0.128	0.115	0.003	-0.034
Corn	-1.828	-16.060	2.954	3.881	0.017	0.547	6.556	2.571
Flour	-0.907	3.565	-1.034	-1.555	-0.770	-0.584	-0.919	1.193
Cassava	-0.119	3.007	-0.990	-1.571	1.520	-1.003	-2.000	0.703
Fish	-0.703	0.000	-0.040	0.084	-0.745	0.150	-0.218	-0.145
Beef	3.555	0.576	-0.547	-1.449	2.689	-3.735	-5.877	1.712
Chicken	-0.269	0.968	-0.115	-0.396	-0.515	-0.777	-0.239	0.061
Eggs	0.016	0.339	0.133	0.117	-0.036	0.234	0.137	-1.309
Highest income								
Rice	-0.630	-0.038	-0.016	-0.008	-0.122	0.111	0.000	-0.034
Corn	-1.797	-16.164	2.966	3.894	0.033	0.521	6.645	2.557
Flour	-0.891	3.521	-1.033	-1.536	-0.757	-0.578	-0.908	1.176
Cassava	-0.092	2.924	-0.963	-1.553	1.497	-0.979	-1.952	0.674
Fish	-0.737	0.000	-0.042	0.089	-0.734	0.159	-0.229	-0.149
Beef	6.253	0.948	-0.957	-2.533	4.742	-5.811	-10.196	2.951
Chicken	-0.315	1.043	-0.124	-0.425	-0.569	-0.824	-0.191	0.078
Eggs	0.024	0.334	0.132	0.115	-0.039	0.228	0.147	-1.310

Source: SUSENAS data, 2020.

Regarding carbohydrate source foods, the uncompensated cross-price elasticity value for rice indicates that it has a complementary relationship with corn, flour, and cassava. Meanwhile, the compensated cross-price elasticity reveals that rice is complementary to corn and flour, and a substitute for cassava across all income groups. The cross-price elasticity values of rice, both uncompensated and compensated, against other carbohydrate source foods such as corn, flour, and cassava, tend to be constant, with highly inelastic values (0.002%–0.043%) at all income levels. Other substitution relationships in carbohydrate source foods occur between flour and corn, and cassava and corn, with uncompensated and compensated cross-price elasticity values ranging between 2.954% and 3.578%, and 2.924% and 4.144%, respectively. This highlights that there is a strong substitution relationship between flour and corn, and cassava and corn if one of these commodities experiences price changes.

Table 10. Compensated own and cross-price elasticities of food commodities.

Quantity of demand	Price of food commodities							
	Rice	Corn	Flour	Cassava	Fish	Beef	Chicken	Eggs
Lowest income								
Rice	-0.255	-0.032	-0.009	0.003	0.054	0.126	0.071	0.041
Corn	-1.218	-16.638	3.093	4.070	0.343	0.594	6.899	2.856
Flour	-0.401	3.548	-1.022	-1.523	-0.505	-0.565	-0.823	1.291
Cassava	0.093	3.142	-1.026	-1.586	1.677	-1.041	-2.052	0.793
Fish	0.104	0.019	-0.022	0.107	-0.339	0.164	-0.056	0.023
Beef	5.047	0.619	-0.508	-1.390	3.424	-3.687	-5.554	2.049
Chicken	0.363	0.934	-0.097	-0.360	-0.148	-0.727	-0.138	0.172
Eggs	0.196	0.348	0.138	0.126	0.058	0.243	0.159	-1.268
Low income								
Rice	-0.258	-0.034	-0.010	0.002	0.054	0.131	0.075	0.041
Corn	-1.283	-16.891	3.149	4.144	0.346	0.620	6.983	2.932
Flour	-0.422	3.574	-1.022	-1.534	-0.504	-0.566	-0.827	1.302
Cassava	0.062	3.285	-1.072	-1.615	1.735	-1.089	-2.143	0.837
Fish	0.097	0.018	-0.021	0.103	-0.339	0.161	-0.044	0.024
Beef	4.404	0.551	-0.439	-1.208	3.012	-3.326	-4.806	1.812
Chicken	0.359	0.888	-0.093	-0.343	-0.113	-0.693	-0.162	0.157
Eggs	0.187	0.352	0.138	0.127	0.063	0.248	0.151	-1.267
Middle income								
Rice	-0.256	-0.033	-0.009	0.003	0.055	0.128	0.072	0.041
Corn	-1.203	-16.328	3.031	3.986	0.355	0.587	6.777	2.794
Flour	-0.409	3.565	-1.022	-1.532	-0.508	-0.567	-0.824	1.296
Cassava	0.087	3.118	-1.019	-1.584	1.673	-1.034	-2.026	0.785
Fish	0.103	0.020	-0.022	0.107	-0.341	0.166	-0.058	0.024
Beef	4.606	0.566	-0.460	-1.260	3.140	-3.426	-5.029	1.862
Chicken	0.369	0.936	-0.097	-0.358	-0.154	-0.726	-0.147	0.176
Eggs	0.193	0.347	0.138	0.126	0.060	0.243	0.162	-1.269
High income								
Rice	-0.252	-0.031	-0.009	0.004	0.055	0.124	0.068	0.042
Corn	-1.144	-16.042	2.969	3.905	0.358	0.564	6.678	2.713
Flour	-0.399	3.578	-1.023	-1.538	-0.517	-0.572	-0.828	1.298
Cassava	0.109	3.013	-0.985	-1.563	1.633	-0.998	-1.959	0.750
Fish	0.109	0.021	-0.023	0.112	-0.341	0.170	-0.072	0.023
Beef	5.101	0.616	-0.513	-1.397	3.459	-3.698	-5.601	2.032
Chicken	0.376	0.985	-0.101	-0.374	-0.194	-0.761	-0.123	0.194
Eggs	0.202	0.344	0.137	0.124	0.056	0.238	0.170	-1.271
Highest income								
Rice	-0.245	-0.028	-0.008	0.005	0.055	0.116	0.062	0.043
Corn	-1.095	-16.146	2.981	3.918	0.357	0.530	6.758	2.697
Flour	-0.366	3.535	-1.022	-1.519	-0.515	-0.571	-0.823	1.281
Cassava	0.140	2.930	-0.958	-1.546	1.604	-0.976	-1.915	0.721
Fish	0.121	0.022	-0.024	0.117	-0.338	0.170	-0.091	0.022
Beef	8.655	1.009	-0.906	-2.451	5.850	-5.779	-9.809	3.431
Chicken	0.378	1.061	-0.109	-0.402	-0.249	-0.815	-0.080	0.216
Eggs	0.216	0.339	0.137	0.122	0.050	0.230	0.178	-1.271

Source: SUSENAS data, 2020.

For animal protein foods, the uncompensated and compensated cross-price elasticity values indicate that a complementary relationship exists between chicken and beef, and chicken and fish. On the other hand, there is substitution relationship between beef and fish, beef and eggs, and chicken and eggs across all income groups. This substitution relationship implies that a 1% increase in the price of fish and 1% increase in the price of eggs will result in a demand increase for beef ranging from 2,253%–5,850% and 1,516%–3,431%, respectively. Conversely, a 1% rise in beef pricing will only increase the demand for fish by 0.139%–0.170% and eggs by 0.228%–0.248%.

5. DISCUSSION

Indonesian households at the lowest- and low-income levels are especially susceptible to changes in purchasing power when income decreases or food prices increase, as illustrated in Table 3. This finding is consistent with the research of Korir et al. (2020), Rehman et al. (2014) and Valera et al. (2022) that a high proportion of food expenditure indicates a low level of food security. If there is a minor economic shock, such as rising food prices or falling income, it will affect the ability of households to access sufficient food. Therefore, social assistance policies, such as safety nets that boost income, will be more appropriate for the lowest- and low-income households and will improve their access to food with higher quality food consumption patterns. Households and individuals in Indonesia are highly reliant on rice as a staple food for carbohydrates, as shown in Table 4 and Table 5. This finding is similar to other studies in Indonesia (Faharuddin et al., 2017; Rasyid et al., 2020), China (Ren et al., 2018), Vietnam (Vu, 2020), the Philippines (Valera et al., 2022), Zimbabwe (Murendo, Chirongwe, & Sisito, 2022), and Ghana (Ansah et al., 2020). These studies demonstrate that impoverished households spend more on cereals and grains but spend less on animal protein than wealthier households. According to data published by OECD/FAO (2021), Indonesia's per capita consumption of beef and chicken is relatively lower compared to Vietnam and the Philippines in terms of animal protein food consumption. The average per capita consumption in Indonesia is 1.87 kg/year for beef and 10.13 kg/year for chicken. In contrast, the per capita consumption in Vietnam is 4.89 kg/year for beef and 11.44 kg/year for chicken, while consumption in the Philippines is 2.72 kg/year for beef and 12.73 kg/year for chicken. The per capita income of the Indonesian population in 2020 will be $3,932.33 higher than the per capita income of the Vietnamese ($3,548.89) and Philippine populations ($3,325.84) (IMF, 2023). Referring to Bennet's Law, the demand for beef and chicken in Indonesia still has the opportunity to rise as people's income level increases. Thus, it is imperative to establish a highly efficient supply system for beef and chicken in the future in order to guarantee price stability within the country.

The expenditure elasticity values for various household income levels presented in Table 7 reveal the changing trend of carbohydrate-source food consumption in Indonesia. Cassava and corn are not regarded as inferior food commodities by Indonesians. The research results by Jensen and Manrique (1998) using SUSENAS data from 1981, 1984, and 1987, stated that secondary crops in poor households were inferior commodities, whereas Mulyana and Yamin (2019) and Wijayati, Harianto, and Suryana (2019) used SUSENAS 2013 and SUSENAS 2017 data to explain that rice, corn, cassava, and flour are normal goods and basic necessities. The research implementing SUSENAS 2020 data indicates that corn and flour have turned into luxury goods This means that carbohydrate food consumption will shift to corn and flour if household income increases, requiring a good supply mechanism in the future. According to data from Kementan (2019) and Kementan (2021) there was a significant increase in the consumption of flour, corn, and cassava from 2013 to 2020. However, the consumption of rice showed a decline during this period. The growth rates for these commodities were 8.75%, 1.97%, 6.31%, and -0.32% respectively. The food diversification program launched by the Indonesian government is perceived to have succeeded in growing public demand for various local non-rice foods. However, the increasing demand for flour can trigger problems of food insecurity because wheat as the basic material for flour is an imported product. Among the four animal protein commodities examined, eggs have the smallest expenditure elasticity. This is since eggs are a low-cost, convenient and easily processed animal protein commodity that contains high quality protein. As a result, eggs are consumed by the majority of Indonesian households (BPS, 2021; Kharisma et al., 2020). The elasticity value of beef expenditure is the largest among the commodities analyzed due to the relatively high price of beef. Consequently, beef becomes the commodity of preference when household income increases (Kharisma et al., 2020). Overall, it can be inferred that the expenditure elasticity for carbohydrate source foods is smaller than for animal protein foods at all income levels. This result is similar to the findings of Faharuddin et al. (2017) and Yuliana, Hartoyo, and Firdaus (2019) in Indonesia, Bairagi et al. (2020) in Vietnam, Akram (2020) in Pakistan, Siddique, Salam, and Rahman (2020) in Bangladesh, Pallegedara (2019) in Sri Lanka, and Mittal (2010) in India. This phenomenon demonstrates the implementation of Bennet's Law in Indonesia. As income levels rise, people will reduce the consumption of carbohydrate source foods and will expand the consumption of animal protein source foods. Based on the data presented in Table 8, the absolute value of own-price elasticity for the eight commodities analyzed is greater for uncompensated (Marshallian) than compensated (Hicksian). The difference in results is in accordance with economic theory. According to Ansah et al. (2020), Bairagi et al. (2020) and Pindyck and Rubinfeld (2013), the compensated price elasticity provides a more accurate representation since it solely considers the substitution impact, while the uncompensated price elasticity combines the substitution effect and the income effect. Chicken is the most commonly consumed animal protein food among all household income groups. This phenomenon occurs due to the relatively affordable price of chicken, its high nutritional value, tender and thick texture, and its ease of processing into various dishes. Consequently, chicken has become a main choice for Indonesian households to fulfill their animal protein needs, particularly in the form of meat (Kementan, 2022). Meanwhile, rice has the lowest own-price elasticity value among carbohydrate source foods in all income groups. This suggests that Indonesian households, at any income level, try to maintain the quantity of rice consumed even if the price rises. Studies in Indonesia conducted by Deaton (1990); Faharuddin et al. (2017); Moeis (2003); Widarjono (2013) and Yuliana et al. (2019) also demonstrate similar results, that the own-price elasticity of rice is inelastic, so price changes have little effect on rice consumption. This is because rice is the staple food of the Indonesian people and is one of the strategic commodities that is closely monitored and controlled by the government for its price stability. Since 1998, Indonesian households categorized as poor and vulnerable have received social protection from the government in the form of rice subsidies (Raskin) (Gupta & Huang, 2018; Mustofa, Sugiyanto, & Susamto, 2023). The cross-price elasticity values in Table 9 and Table 10 suggest that fluctuations in the pricing of complementary or substitute commodities do not significantly impact the demand for rice. The findings of this study are consistent with previous research conducted by Miranti and Syaukat (2016) and Wijayati et al. (2019) which prove that rice is still the staple food of Indonesian households and cannot be replaced by other carbohydrate source foods. For animal protein foods, the rise in demand for beef resulting from an increase in fish and egg prices is greater than the increase in fish and egg demand caused by the rise in beef prices. This is because beef is considered a luxury good, making the absolute cross-price elasticity value of beef the most elastic compared to other animal protein foods (Wahyuni, Purnastuti, & Mustofa, 2016).

6. CONCLUSION AND POLICY SUGGESTION

This study analyzes the impact of different levels of household income on the food consumption patterns of Indonesian households, specifically focusing on eight food commodities of carbohydrate and animal protein sources. The data utilized was sourced from the Indonesian National Socio-Economic Survey (SUSENAS) conducted in March 2020, with a sample size of 328,801 households. The QUAIDS model utilizes a two-step budgeting estimation approach to address the issues of zero consumption and endogeneity of total expenditure, thus obtaining the values of expenditure elasticity and price elasticity of household food demand at various income levels.

The analysis results indicate that the expenditure elasticity values are positive for all income groups. As income levels increase, households tend to reduce consumption of carbohydrates and increase consumption of animal protein; however, the consumption of rice and eggs remains relatively constant. Households with the lowest- and low-income levels have the highest proportion of expenditure on food but the lowest absolute value of food expenditure. Consequently, these households are the most vulnerable to economic shocks, such as a reduction in income or an increase in food prices. These findings suggest that one-size-fits-all policies in developing countries tend to disadvantage poor and vulnerable households. Therefore, it is essential for food policies in Indonesia to prioritize households with the lowest and low incomes to guarantee improved food consumption patterns. In addition, government aid for low-income households should be accompanied by counseling on healthy food consumption patterns with balanced nutrition. The own-price elasticity analysis revealed that all commodities have negative values across income groups. Chicken and rice are the commodities most inelastic to price changes. This phenomenon indicates that households at all income levels in Indonesia strive to maintain their consumption of chicken and rice even if the prices increase. Beef and corn have the highest absolute value of expenditure elasticity and own-price elasticity. Therefore, these commodities will be the main choices when household income increases or prices decrease. In the future, mechanisms must be devised to ensure adequate distribution and supply for rice, chicken, beef, and corn in order to preserve affordable food prices. The expenditure elasticity values for rice, fish, and chicken are higher than their own-price elasticity values. This suggests that consumption of these three commodities is more responsive to changes in income. In contrast, the own-price elasticity values for corn, flour, cassava, beef, and eggs are higher than their expenditure elasticity values. This shows that consumption of these five commodities is more responsive to price changes. To promote higher consumption of animal protein foods, policies aimed at increasing household income, such as direct cash transfers (BLT), prove to be more effective. Conversely, to increase the consumption of beef and eggs, affordable price control policies are more effective. Likewise, price policies are more effective to control the demand for flour as an imported commodity with increasing consumption. The cross-price elasticity value for animal protein foods revealed that chicken and beef, and chicken and fish, have a complementary relationship. Conversely, beef and fish, beef and eggs, and chicken and eggs, all exhibit substitution relationships in all income groups. Regarding carbohydrate source foods, rice has a complementary relationship with corn and flour and a substitution relationship with cassava. Rice remains the staple food of Indonesian households because the demand for rice tends to be unaffected by changes in the price of its complementary or substitute commodities. Thus, the Indonesian government's policy of maintaining rice price stability and providing social protection to the lowest- and low-income households through rice subsidies (Raskin) is deemed appropriate. However, in the future, policymakers must ensure that the distribution of this social safety net is truly targeted to poor households. There are some limitations to this study. First, we employed cross-sectional data, which lacks the ability to capture the dynamic impact of varying income levels on food consumption patterns of households. In order to obtain a more accurate estimation of the causal relationship, the utilization of panel data is advised. Second, the research continued to utilize national aggregate data and made no distinction between rural and urban households. As a result, further studies are required to investigate how urban and rural households responded to income and price shocks caused by the Covid-19 pandemic. Lastly, it is crucial to analyze the impact of the economic shock caused by the pandemic on the consumption patterns of carbohydrate and animal protein sources in households with different income levels.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: The corresponding author can provide the supporting data of this study upon a reasonable request.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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