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Protein Consumption and Socioeconomic Determinants in Indonesia: An Empirical Analysis of the Lowest-Income Households

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Abstract

Adequate protein consumption is essential for improving nutritional outcomes in developing countries, yet empirical evidence on the determinants of protein consumption among the poorest households in Indonesia remains scarce. This study investigates the socioeconomic determinants of protein consumption among the lowest-income households using nationally representative data from the 2023 Survei Sosial Ekonomi Nasional (Susenas), focusing on 67,918 households in the lowest income quintile (Q1). Protein-rich foods were classified into ten categories: eight animal-sourced foods (fish, seafood, beef, mutton, poultry, eggs, milk, and other meats) and two plant-based proteins (tofu and tempeh). A binary probit model was applied to examine the influence of household income, household size, and the relative prices of protein-rich foods on the probability of consumption. Marginal effects were calculated to interpret the change in probability associated with a one-unit change in each explanatory variable. The results reveal contrasting patterns across protein sources. Beef consumption is strongly influenced by all three socioeconomic factors — income, household size, and price — reflecting its status as a luxury protein largely inaccessible to the poorest households. In contrast, eggs emerge as a stable and affordable protein source consumed by nearly 79% of Q1 households, remaining largely insensitive to own-price changes and unaffected by household size. Household income significantly increases the probability of consuming nearly all protein categories, while price sensitivity drives poor households to rely more heavily on tofu and tempeh as affordable alternatives. This study provides novel empirical evidence on the probability-based determinants of protein consumption among Q1 households, offering practical insights for food subsidies, local production support, and nutrition education programs in Indonesia.

Keywords

Protein consumption, low-income households, socioeconomic determinants, household nutrition, food security, Indonesia.

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Introduction

Adequate protein consumption is essential for improving nutritional outcomes and reducing inequality in developing countries (Akter et al., 2025; Bayati et al., 2025; Singha et al., 2025). However, in Indonesia protein intake remains uneven, with low-income households particularly vulnerable to deficiency due to limited access and affordability (Al Hasan et al., 2022; Khusun et al., 2022). This issue aligns directly with Sustainable Development Goal 2, which targets the elimination of hunger and the improvement of nutrition worldwide (Sporchia et al., 2024). Understanding the socio-economic determinants of protein consumption among the poorest households is therefore critical for designing effective nutritional policies.

Indonesia is characterized by one of the lowest levels of protein consumption in the ASEAN region. As illustrated in Figure 1, at 67 grams per capita, average protein intake falls well below Malaysia (159 grams), Thailand (141 grams), and the Philippines (93 grams), despite Indonesia being the fourth most populous country in the world. This low intake reflects nutritional imbalances associated with stunting, malnutrition, and developmental disorders in children (Budzulak et al., 2022). The Government of Indonesia, through Ministry of Health Regulation No. 75 of 2013, officially sets the daily minimum protein requirement at 57 grams per capita, yet many low-income households remain unable to meet this threshold. Consumption of animal-sourced protein such as fish, meat, eggs, and milk is limited by high prices, while plant-based sources such as tofu and tempeh — though affordable — are often consumed without sufficient dietary diversification (Forgenie, Khoiriyah, Mahase-Forgenie, et al., 2023). This imbalance reflects both economic and educational barriers to achieving nutritional adequacy in poor households.

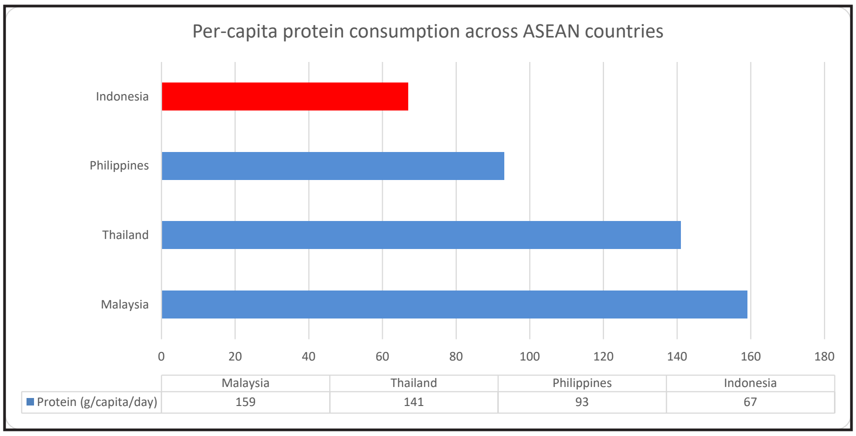
The lowest income quintile (Q1) represents the 20% of the population with the lowest income and the highest vulnerability to poverty and nutritional deficiencies (Khoiriyah et al., 2020). Although previous studies have analyzed food consumption in Indonesia using probit and related approaches (Cele and Mudhara, 2024; Kolog et al., 2023), empirical evidence specifically focused on protein consumption patterns among Q1 households remains scarce. Existing work tends to treat the population in aggregate or compare across income groups without isolating the nutritional behavior of the poorest segment. Furthermore, the joint effects of protein prices, household income, and household size on the probability of consuming specific protein sources have not been systematically examined for this group. Addressing this gap is essential for designing subsidy, production, and nutrition education policies that directly target Indonesia's most economically disadvantaged households.

This study therefore investigates the socio-economic determinants of protein consumption among the lowest-income households in Indonesia. Specifically, it analyzes how the prices of protein-rich foods, household income, and household size influence the probability of consuming ten categories of protein sources — eight animal-sourced foods (fish, seafood, beef, mutton, poultry, eggs, milk, and other meats) and two plant-based proteins (tofu and tempeh). By providing new empirical evidence on Q1 households, the study contributes to the understanding of nutritional inequality in developing countries and offers practical insights for food and nutrition policy in Indonesia.

Material and methods

Specification of the demand function: Probit model

This research employs a binary probit regression model to analyze the probability of households consuming particular varieties of protein-rich foods. The dependent variable is binary, indicating whether a household consumes a specific protein source ($Y_i = 1$) or does not ($Y_i = 0$). The model incorporates several independent variables, including the prices of protein sources, household size, and household income. This model is appropriate for the analysis



Source: FAO Food Balance Sheets, adapted from Al Hasan et al. (2022)

Figure 1: Per-capita protein consumption across ASEAN countries.

of cross-sectional data with a dichotomous dependent variable (Nandiroh et al., 2024; Wen et al., 2025).

The probit model was selected over the logit model based on both theoretical and empirical considerations. Theoretically, the probit model assumes that the latent propensity of households to consume protein-rich foods follows a normal distribution, which is consistent with the distributional properties of socio-economic variables such as income and household size observed in large nationally representative surveys (Greene, 2012). Empirically, the probit specification has been widely adopted in food consumption studies in Indonesia and comparable developing-country contexts, providing a basis for methodological consistency and comparability with prior work. Furthermore, given the large sample size of 67,918 households, the choice between probit and logit has negligible practical impact on the estimated marginal effects, as both models converge asymptotically with sufficient observations.

The probit model is a statistical probability model based on the cumulative normal probability distribution (Allam, 2026). The binary dependent variable Y_i takes on values of 0 and 1, where 1 indicates that a household consumes the protein source and 0 indicates otherwise (Jose et al., 2020). The probability of household consumption can be expressed as follows (Greene, 2012; Jahan and Kamruzzaman, 2022) (Equation 1):

$$P_i = prob\,[Y_i = 1|X] =$$

$$= \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt = \Phi(x_i'\beta) \qquad (1)$$

Where Φ represents the cumulative distribution function of a standard normal random variable, x'_i is a vector of explanatory variables (price of each protein source, household size, and household income), and β is a vector of parameters to be estimated. The unobserved random variable ε_i is assumed to be independently and identically distributed according to a standard normal distribution, that is $\varepsilon_i \sim N\,(0,1)$.

Since probit coefficients reflect effects on the latent index rather than direct changes in the observed probabilities, marginal effects must be calculated for meaningful interpretation (Busenbark et al., 2021). The marginal effect for continuous explanatory variables X_k on the probability $P\,(Y_i = 1 \mid X)$, holding all other variables constant at their sample mean values, is derived as (Equation 2):

$$\frac{\delta y_i}{\delta x_{ik}} = \phi(x_i'\beta)\beta_k \qquad (2)$$

Where ϕ represents the probability density function of the standard normal distribution. For dummy or discrete variables, the marginal effect is instead estimated as the discrete change in predicted probability (Equation 3):

$$\Delta = \Phi(x\beta, d = 1) - (\bar{y}\beta, d = 0) \qquad (3)$$

Marginal effects provide insights into how explanatory variables shift the probability of protein consumption among low-income households (Jahan and Kamruzzaman, 2022). In this study, marginal effects were calculated for each variable while holding all other variables constant at their sample mean values. Overall model significance was evaluated using the Wald chi-square test, while the significance of individual coefficients was assessed using z-statistics and their corresponding p-values. The pseudo R-square (McFadden) was used as a measure of goodness of fit for each of the ten protein consumption models.

Data and data source

This study uses secondary data sourced from the results of the National Socio-economic Survey (Susenas) in 2023, conducted by the Central Bureau of Statistic (BPS) Indonesia. The data was chosen because of its wide availability, national representation, and comprehensive coverage of information related to household socioeconomic conditions. This survey covers various aspects, such as demographic conditions, education, health, and consumption patterns, and records household income data. The data used in this study are household consumption and expenditure data in Indonesia. The process begins with the division of the region into strata that reflect geographical diversity, such as provinces, cities or districts, sub-districts, and villages, as well as considering urban and rural characteristics. The sample frame is obtained from the last Population Census, and within each stratum, census blocks are randomly selected using the Probability Proportional to Size method, which determines the probability of selecting census blocks based on the number of households. Furthermore, within each selected census block, sample households were randomly selected. In collecting the data, BPS used the multistage random sampling technique, which is sampling conducted in several stages to ensure that the selected samples represent various social and economic characteristics in Indonesia. In addition, BPS also applied stratified sampling to ensure that the sample included socioeconomic variations, such as differences between urban and rural areas or household income levels.

The data in this study are of the cross-section type. In simple terms, the concept of cross-sectional data is data that has many objects in the same year or data collected at one time on many objects. This study examined ten sources of protein, consisting of eight animal-sourced foods (fish, seafood, beef, mutton, poultry, eggs, milk, and other meats) and two plant-based proteins (tofu and tempeh). The data used are quantity consumption and expenditure data in Indonesia. Unit prices were calculated by dividing expenditure by the quantity consumed, as the Susenas dataset does not provide the actual prices paid by households. Moreover, (Nsabimana, 2024; Vu, 2020) said common practice has been to calculate unit values dividing expenditures by corresponding quantities and use them as a direct substitute for market prices. To examine how price and income influence protein consumption, household income data is divided into five quintiles: Q1 (lowest 20%), Q2 (20%-<40%), Q3 (40%<60%), Q4 (60%-<80%), and Q5 (highest 20%). Special attention is directed toward Q1 households, which represent the poorest segment of the population. A total of 67,918 households fall into this lowest income quintile. By analyzing this group, the study investigates the probability that low-income households consume different types of protein foods, offering valuable insights into food accessibility, consumption patterns, and nutritional vulnerability among Indonesia's most economically disadvantaged households. In this study, the classification of protein sources follows the groupings used in Susenas to make the analysis more standardized and in line with official data. This grouping is important for understanding variations in household protein consumption and distinguishing between animal and plant-based protein sources. The protein category in Susenas is presented in Table 1. This classification was used as the basis for analyzing protein consumption in the study.

Groups	Protein source-food group	Foods
1	Fish	Yellow tail, cob, tuna, cakalang dencis, mackerel, selar, mackerel, lema or tatare, banyar or banyara, wet anchovies, milkfish, cork, mujaer, goldfish, tilapia, catfish, snapper, catfish, other wet fresh fish, pomfret, gourami, baronang, preserved buffalo or peda, preserved mackerel, preserved cob, tuna or skipjack, preserved anchovies, preserved selar, preserved sepat, preserved milkfish, preserved cork, canned fish, canned tuna, etc.), other preserved fish, preserved shrimp (ebi, rebon), squid, cuttlefish, preserved, preserved shrimp and other aquatic animals, and cooked fish
2	Seafood	Shrimp, lobster, squid, cuttlefish, octopus, clams, octopus, snails, snails, mussels, preserved shrimp, and other freshwater animals.
3	Beef	Beef
4	Mutton	Mutton, lamb, and sheep
5	Poultry	Purebred chicken meat and free-range chicken meat
6	Eggs	Purebred chicken eggs, free-range chicken eggs, duck or manila duck eggs
7	Milk	Factory liquid milk, sweetened condensed milk, powdered milk, baby milk powder, other milk, and other milk products
8	Tofu	Tofu
9	Tempeh	Tempeh
10	Other meat	Other fresh meat, other cured meat, other (liver, offal, ribs, legs, oxtail, head, etc.), cutlets, and brisket

Source: Own summary based on data from SUSENAS 2023

Table 1: Protein source-food groups in Indonesia.

Results and discussions

Testing probit models

The results from ten probit models analyzing Indonesian household consumption of various protein sources are presented in Table 2. These models cover the consumption of fish, seafood, beef, mutton, poultry, milk, eggs, tofu, tempeh, and other meats. All models demonstrate strong statistical validity, with highly significant Wald chi² test results ($p < 0.01$ for all models), indicating that the explanatory variables—household size, income, and prices—simultaneously contribute to predicting consumption decisions. The models also showed varying levels of explanatory power, as reflected in the pseudo-R^2 values. Beef (0.6344), mutton (0.5998), and seafood (0.4685) consumption models exhibited the highest pseudo-R^2, suggesting these protein choices are more strongly influenced by the selected household and economic factors. In contrast, relatively low pseudo R^2 values for eggs (0.0355), tofu (0.118), and tempeh (0.1384) suggest that variables beyond income, price,

Protein model	Wald Chi^2	p-value (Wald Chi^2)	Log-likelihood	Pseudo R^2
Fish	26560.70	0.000	-29186.568	0.3127
Seafood	5591.26	0.000	-3171.325	0.4685
Beef	894.24	0.000	-257.665	0.6344
Mutton	85.36	0.000	-28.479	0.5998
Poultry	13986.89	0.000	-18604.282	0.2732
Eggs	7182.42	0.000	-22108.077	0.1397
Milk	2899.72	0.000	-39343.898	0.0355
Tofu	10941.57	0.000	-40894.896	0.1181
Tempeh	12838.39	0.000	-39975.361	0.1384
Other meat	3441.89	0.000	-5327.182	0.2442

Source: Own summary based on data from SUSENAS

Table 2: Probit model analysis of protein consumption.

and household size significantly influence their consumption. Indeed, cultural preferences strongly shape consumption as Indonesians perceive tempeh as part of their cultural heritage—a widely valued, nutritional staple consumed across generations (Anwar et al., 2023).

Log-likelihood values across the models also support these trends, with more negative values for frequently consumed items such as tofu (-40,894.90) and tempeh (-39,975.36), reflecting larger sample sizes and variability. This study includes all protein sources commonly consumed by households in Indonesia, excluding pork due to its limited consumption among the population (Hanifasari et al., 2024).

Protein consumption and socioeconomic determinants in Indonesia

The probit models investigate how protein prices, household size, and household income influence the probability of protein consumption (Anindita et al., 2022; Dogbe et al., 2024; Seo and Hwang, 2022). Table 3 presents the estimated probit coefficients, while Table 4 reports the corresponding marginal effects, which represent the change in the probability of consumption associated with a one-unit change in each explanatory variable, holding all others constant at their sample means. It is important to emphasize that probit coefficients and marginal effects reflect changes in the probability of consumption, not changes in the quantity consumed (Budzulak et al., 2022; McCabe et al., 2022; Silva et al., 2024). As shown in Tables 3 and 4, the prices of both animal-sourced and plant-based proteins significantly affect the probability of protein consumption in Indonesia.

Animal-sourced foods are a key group of nutrient-dense foods that provide highly bioavailable micronutrients such as iron, zinc, vitamin B12, vitamin A, vitamin D3, iodine, calcium, folic acid, and essential fatty acids (Scott et al., 2023). The price of food is one of the most important factors influencing what households choose to eat (Downs et al., 2022). Furthermore, Dana et al., (2021) note that prices are among the most important factors determining consumers' food choice decisions. When the price of a certain protein source rises, families may seek cheaper alternatives or adjust their diets by combining different foods to meet nutritional needs. This means that price changes do not only affect the consumption of one product, but can also influence the demand for other protein sources, depending on whether they act as substitutes or complements in the household menu. Animal-sourced foods like fish, meat, and poultry often compete with each other, while plant-based options such as tofu and tempeh can either replace or accompany these animal proteins.

Fish is the most widely consumed protein source in Indonesia, especially for low-income households, due to its relatively affordable price and high availability. The probit results confirm that fish price has a significant negative effect on the probability of fish consumption ($\beta = -2.122$, $p < 0.01$, Table 3), with a corresponding marginal effect of -0.849 (Table 4). This indicates that, holding other variables constant, a one-unit increase in fish price reduces the probability of fish consumption by approximately 0.849 percentage points. Substitution patterns are evident, as poultry and eggs act as alternatives when fish prices rise. In contrast, tofu and tempeh show negative coefficients, suggesting their role as complementary proteins commonly consumed alongside fish.

Independent variable	Dependent variable									
	Fish	Seafood	Beef	Mutton	Poultry	Eggs	Milk	Tofu	Tempeh	Other Meat
α_i (Constant)	11.833	-8.463	9.544	5.841	-1.761	-1.889	-8.780	1.555	0.109	-12.652
	(0.000)	**(0.000)**	**(0.000)**	**(0.443)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.780)**	**(0.000)**
Fish Price	-2.122	0.530	0.435	0.413	-0.089	-0.058	0.183	-0.510	-0.545	-0.312
	(0.000)	**(0.000)**	**(0.003)**	**(0.203)**	**(0.000)**	**(0.002)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Seafood Price	0.018	-0.724	0.011	0.036	0.032	0.033	0.031	0.047	0.025	-0.017
	(0.051)	**(0.000)**	**(0.861)**	**(0.682)**	**(0.002)**	**(0.000)**	**(0.005)**	**(0.000)**	**(0.002)**	**(0.319)**
Beef Price	0.020	-0.009	-0.186	0.087	0.008	0.006	0.016	-0.010	-0.004	0.037
	(0.000)	**(0.396)**	**(0.000)**	**(0.090)**	**(0.244)**	**(0.203)**	**(0.075)**	**(0.063)**	**(0.441)**	**(0.110)**
Mutton Price	-0.144	0.130	0.080	-0.211	0.038	0.015	0.041	0.022	0.036	0.091
	(0.000)	**(0.000)**	**(0.011)**	**(0.000)**	**(0.000)**	**(0.003)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Poultry Price	0.061	0.034	0.037	0.054	-0.261	-0.021	0.019	-0.053	-0.065	0.011
	(0.000)	**(0.000)**	**(0.095)**	**(0.337)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.148)**
Eggs Price	-0.421	-0.703	0.403	-0.390	-1.508	-0.015	0.221	-2.439	-3.061	-1.376
	(0.000)	**(0.000)**	**(0.055)**	**(0.800)**	**(0.000)**	**(0.712)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Milk Price	0.031	0.008	-0.003	0.016	0.001	-0.006	-0.134	-0.002	-0.007	-0.023
	(0.000)	**(0.158)**	**(0.888)**	**(0.679)**	**(0.623)**	**(0.001)**	**(0.000)**	**(0.462)**	**(0.001)**	**(0.000)**
Tofu Price	0.002	-0.010	-0.001	-0.071	-0.003	-0.008	-0.001	-0.049	-0.022	-0.022
	(0.464)	**(0.130)**	**(0.939)**	**(0.373)**	**(0.249)**	**(0.000)**	**(0.685)**	**(0.000)**	**(0.000)**	**(0.000)**
Tempeh Price	0.023	0.009	0.034	-0.063	-0.015	-0.020	-0.009	-0.020	-0.044	-0.012
	(0.000)	**(0.150)**	**(0.015)**	**(0.385)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.000)**	**(0.016)**
Other Meat Price	0.016	-0.016	0.040	0.036	0.004	-0.002	0.007	-0.024	-0.033	-0.297
	(0.007)	**(0.353)**	**(0.025)**	**(0.505)**	**(0.603)**	**(0.759)**	**(0.255)**	**(0.000)**	**(0.000)**	**(0.000)**
Households Size	-0.425	-0.066	-0.442	-0.563	-0.166	0.009	0.362	-0.134	-0.095	0.197
	(0.000)	**(0.023)**	**(0.000)**	**(0.073)**	**(0.000)**	**(0.390)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Income	0.007	0.003	0.004	0.005	0.006	0.003	0.002	0.003	0.003	0.003
	(0.000)	**(0.000)**	**(0.000)**	**(0.074)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**

Source: Own calculation based on data from SUSENAS

Table 3: Probit model analysis of protein consumption.

These findings reaffirm the central role of fish in the diet of low-income households and highlight the sensitivity of its consumption probability to price fluctuations. Seafood, while nutritionally important, remains less accessible to the lowest income quintile because of its relatively high price compared to fish. Seafood price significantly affects the probability of seafood consumption ($\beta = -0.724$, $p < 0.01$, Table 3), with a marginal effect of -0.290 (Table 4), indicating that an increase in seafood price substantially reduces the probability that a household consumes seafood. The substitution pattern suggests that fish, beef, poultry, and tempeh replace seafood when prices rise, while tofu, eggs, and milk act as complements. These findings suggest that the probability of seafood consumption is highly responsive to price in low-income groups, and households readily shift to cheaper proteins when prices increase. Consequently, seafood is often consumed only occasionally, rather than as a regular source of protein, in these households.

Beef is considered one of the most nutrient-dense animal proteins but is largely inaccessible to households in the lowest quintile due to its high price. Furthermore, Angeles-Agdeppa et al. (2021) note that moderate and severely food-insecure families have significantly lower mean consumption of meat. The regression analysis indicates a significant negative relationship between beef price and the probability of beef consumption ($\beta = -0.186$, $p < 0.01$, Table 3), with a marginal effect of -0.074 (Table 4), confirming its sensitivity to price fluctuations. When beef prices increase, low-income households tend to substitute it with fish, mutton, poultry, eggs, milk, and other meats, as reflected by their positive coefficients. This result is in line with research from Khoiriyah, Forgenie, et al., (2024), who reported that the price of beef leads to a relatively larger decrease

Independent Variable	Fish	Seafood	Beef	Mutton	Poultry	Eggs	Milk	Tofu	Tempeh	Other Meat
A. Price Variable										
Fish Price	-0.8488***	0.2120***	0.1740***	0.1652	-0.0356***	-0.0232***	0.0732***	-0.2040***	-0.2180***	-0.1248***
Seafood Price	0.0072*	-0.2896***	0.0044	0.0144	0.0128***	0.0132***	0.0124***	0.0188***	0.0100***	-0.0068
Beef Price	0.0080***	-0.0036	-0.0744***	0.0348*	0.0032	0.0024	0.0064*	-0.0040*	-0.0016	0.0148
Mutton Price	-0.0576***	0.0520***	0.0320**	-0.0844***	0.0152***	0.0060***	0.0164***	0.0088***	0.0144***	0.0364***
Poultry Price	0.0244***	0.0136***	0.0148*	0.0216	-0.1044***	-0.0084***	0.0076***	-0.0212***	-0.0260***	0.0044
Eggs Price	-0.1684***	-0.2812***	0.1612*	-0.1560	-0.6032***	-0.0060	0.0884***	-0.9756***	-1.2244***	-0.5504***
Milk Price	0.0124***	0.0032	-0.0012	0.0064	0.0004	-0.0024***	-0.0536***	-0.0008	-0.0028***	-0.0092***
Tofu Price	0.0008	-0.0040	-0.0004	-0.0284	-0.0012	-0.0032***	-0.0004	-0.0196***	-0.0088***	-0.0088***
Tempeh Price	0.0092***	0.0036	0.0136**	-0.0252	-0.0060***	-0.0080***	-0.0036***	-0.0080***	-0.0176***	-0.0048**
Other Meat Price	0.0064***	-0.0064	0.0160**	0.0144	0.0016	-0.0008	0.0028	-0.0096***	-0.0132***	-0.1188***
B. Household Characteristics										
Household Size	-0.1700***	-0.0264**	-0.1768***	-0.2252*	-0.0664***	0.0036	0.1448***	-0.0536***	-0.0380***	0.0788***
Income	0.0028***	0.0012***	0.0016***	0.0020*	0.0024***	0.0012***	0.0008***	0.0012***	0.0012***	0.0012***

Note: Statistical significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.10$.
Marginal effects were approximated at the mean using the standard normal density approximation ($\varphi \approx 0.4$), following (Greene, 2012). Marginal effects represent the change in probability of consumption associated with a one-unit change in each explanatory variable, holding all other variables constant at their sample means.

Source: Own calculation based on data from SUSENAS 2023

Table 4: Marginal effects of protein consumption determinants among lowest-income households in Indonesia.

in the quantity demanded, as consumers are more responsive to changes in the price of beef compared to other food items. Conversely, tofu and tempeh show negative coefficients, suggesting their complementary role alongside beef in household diets. These results illustrate that beef remains a luxury protein, consumed more frequently by higher-income groups, while low-income households prefer more affordable protein sources when beef prices rise.

Mutton and goat meat are among the least consumed protein sources in Indonesia, with average consumption below 0.001 kg per week and household expenditure of only IDR 40 per week in the lowest quintile. The regression results show that mutton price has a significant negative effect on the probability of mutton consumption (β = -0.211, $p < 0.01$, Table 3), with a marginal effect of -0.084 (Table 4). Affordability appears to be the main barrier, as households tend to prefer beef despite its slightly higher price, largely due to perceptions of greater nutritional value. Substitution patterns also appear, as households replace mutton with fish, poultry, milk, and other meats when prices rise, while eggs, tofu, and tempeh act as complements. These findings underscore the position of mutton as a luxury food consumed primarily during religious or cultural events, rather than as part of daily diets in low-income households.

Poultry remains an important source of animal protein for Indonesian households, with rural consumption averaging 0.106 kg per week and expenditures of IDR 4,745. The analysis shows that the prices of fish, seafood, mutton, poultry itself, eggs, and tempeh significantly affect the probability of poultry consumption. Notably, the negative coefficient for poultry price (β = -0.261, $p < 0.01$, Table 3), with a marginal effect of -0.104 (Table 4), indicates that price increases reduce the probability of poultry consumption. This prompts households — particularly those in the lowest income quintile — to shift toward substitute proteins such as fish, seafood, and milk. Conversely, tofu and tempeh function as complements, often consumed alongside poultry.

In contrast, eggs represent a more central and stable protein source for low-income households. Field data indicate an average expenditure per household of IDR 3,998 per week, equivalent to approximately 2-3 eggs per household, underscoring their affordability and accessibility. In Ethiopia, eggs were consumed one to two times per week by 20% and one to two times per month by 19% of households (Daba et al., 2021). The regression results further reveal that the probability of egg consumption is not significantly affected by its own price ($p = 0.712$, Table 3), confirming that eggs are price-inelastic and categorized as a normal good (Khoiriyah, Forgenie, et al., 2024). Daba et al., (2021) also noted that availability, positive attitudes toward quality, relative affordability, the limited effort needed to prepare and cook, storage, and favorable beliefs about health benefits were found to be facilitators of egg consumption. Furthermore, Forgenie, Khoiriyah and Elbaar (2023) also reported that eggs were the least responsive to changes in prices, since they are a relatively cheap source of protein compared to other sources of animal protein. Nevertheless, eggs exhibit a substitutive role when the prices of seafood, beef, and mutton rise, and act as complements to fish, poultry, milk, tofu, and tempeh. This finding suggests eggs are a substitute for higher-priced proteins like mutton, while also being consumed alongside staples such as fish and poultry. Taken together, these findings highlight eggs as a reliable and flexible protein choice for the poorest households, less vulnerable to price volatility compared to other animal protein sources.

For low-income households in Indonesia, milk consumption is largely in the form of baby formula, powdered milk, and sweetened condensed milk, rather than fresh milk. The regression results show that the prices of fish, seafood, mutton, eggs, and tempeh significantly affect the probability of milk consumption ($p < 0.05$), while beef and other meats do not ($p > 0.05$). Importantly, milk price itself has a significant negative effect on the probability of milk consumption ($\beta = -0.134$, $p < 0.01$, Table 3), with a marginal effect of -0.054 (Table 4), meaning that higher milk prices reduce the probability of household milk consumption. This confirms earlier findings by Headey, (2023) and Muhammad, (2017), who reported that rising milk prices lead to reduced intake, especially in economically vulnerable groups. Moreover, the positive coefficients for fish, seafood, mutton, poultry, and other meats suggest that milk functions as a substitute protein source when the prices of these items increase. By contrast, tofu and tempeh act as complements, reflecting their role in mixed dietary patterns where plant- and animal-based proteins are consumed together. These results emphasize that milk, despite its relatively high price compared to eggs and tempeh, remains an important alternative protein choice, particularly when the affordability of other animal protein sources is constrained.

Other meats — such as liver, offal, ribs, feet, tail, head, meat slices, and brisket — remain relatively popular protein sources in Indonesia, especially among low-income households. These cuts are cheaper than prime beef or mutton, yet still provide important nutritional value and are often chosen as affordable alternatives. Khoiriyah et al. (2024) also emphasize that other meats play a key role for households with limited purchasing power because they are more accessible compared to premium animal proteins. The analysis shows that the prices of fish, mutton, eggs, milk, tofu, and tempeh significantly affect the probability of other meat consumption ($p < 0.05$). By contrast, beef, poultry, and seafood do not have significant effects on the probability of other meat consumption ($p > 0.05$). The price coefficient for other meats is significantly negative ($\beta = -0.297$, $p < 0.01$, Table 3), with a marginal effect of -0.119 (Table 4), indicating that when their prices rise, the probability of consuming other meats decreases. Furthermore, fish, seafood, eggs, milk, tofu, and tempeh also have negative coefficients, suggesting they function as complements to other meats in household diets. In contrast, beef, mutton, and poultry show positive coefficients, indicating their role as substitutes. Thus, when the prices of these prime proteins increase, low-income households are more likely to shift toward consuming other meats as a more affordable option.

Household size plays an important role in shaping protein consumption patterns. While parents may have control over how and where they feed their children, the fundamental issue for low-income households is poverty, food prices, and access to food outlets (Ravikumar et al., 2022). Larger households naturally require greater expenditure on food, as also emphasized by Rashid et al., (2024), who found that food expenditure increases significantly with household size in developing country contexts. In this study, data from 67,918 households in the lowest income quintile show that the average household size is 2-3 members. The analysis confirms that household size significantly affects the probability of consuming fish, seafood, beef, poultry, milk, tofu, tempeh, and other meats. For example, larger household size significantly reduces the probability of fish consumption ($\beta = -0.425$, $p < 0.01$, Table 3; marginal effect = -0.170, Table 4) and beef consumption ($\beta = -0.442$, $p < 0.01$, Table 3; marginal effect = -0.177, Table 4). By contrast, household size does not significantly influence the probability of mutton or egg consumption. The insignificant result for mutton is likely due to its high price and very low consumption rate, with only 0.1% of the sample reporting consumption. Conversely, the insignificant effect on eggs may stem from their affordability and widespread accessibility, making them the most consumed protein source, with 78.9% of the 67,918 households reporting egg consumption. This suggests that while household size matters for most protein sources, it has little influence on the extremes: very expensive items like mutton and very cheap staples like eggs.

Income is another central determinant of protein consumption. Income directly influences food purchasing power and allocation. Increase in income stimulates household expenditures, which are one of the most important components directly influenced by the income level of individuals. Lévay et al. (2021) says richer household spend higher shares from richer households spend a higher portion than poorer households. Additionally, Olufemi-Phillips et al. (2024) state that income levels directly influence purchasing power and the ability of households to access food. Households in the lowest income quintile were found to have an average monthly income of IDR 1,603,544. The analysis shows that income has a significant positive effect on the probability of consumption for nearly all protein groups, with significance values of $p < 0.05$ for fish, seafood, beef, poultry, eggs, milk, tofu, tempeh, and other meats. Although the marginal effects of income are numerically small (for example, a marginal effect of 0.003 for fish), they are statistically significant, indicating that even modest income gains meaningfully raise the probability that poor households consume protein-rich foods. The only exception is mutton ($p = 0.074$, Table 3), reflecting its low consumption level among poor households. When income increases, households are more inclined to purchase beef rather than mutton, which explains the lack of statistical significance. These findings align with the theoretical view that higher incomes reduce the share of food expenditures while increasing the capacity for dietary diversification (Mehraban & Ickowitz, 2021; Rashid et al., 2024b). In practice, however, protein choices among the poorest households remain highly sensitive to income changes, except in the case of very low-demand items like mutton.

Policy implications

The findings of this study carry important implications for food and nutrition policy in Indonesia's lowest-income households. First, improving household purchasing power through targeted food subsidies, conditional cash transfers, and price stabilization is essential, as income significantly raises the probability of consuming nearly all ten protein categories. Second, larger households experience markedly lower probabilities of consuming beef (marginal effect = -0.177) and fish (-0.170), highlighting the need for family-size-calibrated nutrition assistance. Third, the high price sensitivity for fish (marginal effect = -0.849) and beef calls for stronger supply chains, local production support, and maintained accessibility of plant-based proteins such as tofu and tempeh as critical substitutes. Fourth, eggs — consumed by 78.9% of Q1 households and statistically insensitive to own-price — represent an ideal vehicle for nutritional interventions such as school feeding and maternal nutrition programs. Finally, policy targeting must explicitly prioritize the lowest-income quintile through means-tested subsidies and integration with existing social protection schemes such as Family Hope Program. Together, these strategies can reduce nutritional inequality, prevent malnutrition, and strengthen public health outcomes for Indonesia's most vulnerable populations.

Conclusion

This study provides novel empirical evidence on the socioeconomic determinants of protein consumption among Indonesia's lowest-income households. Using a binary probit model applied to 67,918 Q1 households in the 2023 Susenas, the analysis confirms that household income significantly raises the probability of consuming nearly all protein categories, while household size reduces it for most animal-sourced foods. Price sensitivity varies substantially across proteins, revealing two contrasting patterns: beef consumption is strongly constrained by all three socioeconomic factors, positioning it as a luxury protein inaccessible to the poor, whereas eggs emerge as a stable and affordable staple consumed by nearly 79% of Q1 households and largely insensitive to price and household size. These findings underscore the persistence of nutritional inequality and the central role of tofu and tempeh as affordable protein substitutes. Effective policy responses must therefore combine targeted food subsidies, supply chain and local production support for animal-sourced proteins, nutrition education promoting dietary diversification, and explicit Q1 targeting through existing social protection programs. Together, these strategies can strengthen food security, reduce malnutrition, and improve public health outcomes in Indonesia and comparable developing countries.

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