Examining Indonesian protein consumption patterns and factors: a probit model

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Abstract. Understanding the factors influencing Indonesian households' protein consumption needs has received little study attention. This study examines the factors that influence Indonesian households' need for protein consumption, emphasizing ten key protein categories: fish, seafood, eggs, dairy, tofu, tempeh, beef, mutton, and other meats with the help of a probit model using data from SUSENAS 2022, which includes about 327,795 households. This study attempts to determine the variables affecting Indonesian household protein consumption patterns, particularly seafood. The results emphasize the importance of sociodemographic factors as significant determinants of seafood consumption, including household size and income. The consumption of seafood in households is positively impacted by higher household income, suggesting a market for high-end goods targeted at wealthy consumers. Policymakers must thoroughly understand the factors influencing household seafood intake as a source of protein demand in Indonesia to effectively establish policies encouraging sustainable and healthful foods. In addition, targeted programs and initiatives aiming at enhancing food security, nutrition, and public health outcomes at a regional level can be informed by the findings about the impact of socio-demographic characteristics and regional variances.

1 Introduction

The price of animal-source food has been steadily growing in Indonesia, which significantly impacts households' capacity to purchase and eat sources of animal protein [1-3]. The consumption of animal-based foods in Indonesia falls below the global criteria for protein adequacy, according to empirical data from various sources, including national surveys and

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market reports. This raises questions about food security and nutritional status [4]. The Indonesian government has mandated that the daily per capita protein consumption should be around 57 grams. However, consumption is far below this number, especially in rural areas [3]. Many Indonesian households now have less purchasing power since livestock feed costs have increased faster than household wages. As a result, it is becoming more difficult for households to buy and consume food high in animal protein, which is a vital source of vitamins, iron, and protein. Reduced demand and consumption of foods high in animal protein can have detrimental effects on household nutrition, especially for vulnerable populations, including the elderly, pregnant women, and children [5-8].

The inability of households to purchase and eat animal-based protein sources is significantly impacted by the ongoing problem of growing animal food prices in Indonesia. The consumption of animal-based foods in Indonesia is below the global standards for protein adequacy, which raises potential concerns about food security and nutritional status. Empirical data from a variety of sources, including national surveys and market reports, have indicated this. The daily recommended intake of protein per person in Indonesia is 57 grams, according to government regulations; nevertheless, consumption is far lower than this amount, particularly in rural regions. Many Indonesian households now have less purchasing power since the cost of livestock feed has increased faster than household wages. As a result, it is becoming more difficult for households to buy and consume food high in animal sources of protein, which is a vital source of vitamins, iron, and protein. Reduced demand and consumption of foods high in animal protein can have detrimental effects on household nutrition, especially for vulnerable populations, including the elderly, pregnant women, and children.

There are a few reasons for Indonesia's growing animal food pricing problem. These could include rising production costs, problems in the supply chain, shifts in the prices of essential feed ingredients on the international market, and changes in policy, including export limitations or taxes on imports. A growing number of variables have contributed to the rising cost of animal feed, making it more expensive for households, especially those with lower incomes and vulnerable populations. It is critical to comprehend Indonesian home consumption patterns for animal protein foods and to calculate the elasticity of household demand to address this issue. The quantity demand's elasticity of demand quantifies how sensitive it is to price fluctuations. Determining the elasticity of demand for foods high in animal protein can reveal important information about how sensitively households' consumption patterns respond to shifts in costs, income, and other sociodemographic variables. Numerous studies have employed this methodology [3], [9]. This information can assist in informing the creation of successful policy interventions to address Indonesia's diminishing demand for and consumption of foods high in animal protein [10].

To tackle the above-described problem, this study will examine Indonesian household consumption patterns of animal protein foods using data from the 2022 Indonesian National Socio-Economic Survey (SUSENAS). A valuable source of data for research is the SUSENAS data, which offers comprehensive details on household consumption, spending, income, and sociodemographic traits. Two primary analytical techniques will be employed in the study. First, the expenditure share approach will be used to calculate the proportion of household expenditure allocated to animal protein food and how it has changed over time, providing insights into household budget allocation for animal protein food by the Probit model. Second, the Almost Ideal Demand System (AIDS) model by Deaton and Muellbauer [11], [12] will be used to calculate the own-price, cross-price, and income elasticities of the demand for food containing animal protein. Understanding how sensitive household demand is to shifts in prices and income levels will be made easier with the aid of these elasticities.

A policy simulation analysis will also be carried out to investigate potential measures to increase household consumption of animal protein foods. Policy scenarios involving changes

in income, prices, and other socio-demographic parameters will be simulated using the predicted demand elasticities to evaluate their effects on household consumption patterns and the affordability of animal protein foods. The goal of the study is to offer evidence-based policy recommendations to alleviate the difficulties Indonesian households have in affording and eating animal protein foods. These recommendations may include targeted subsidies, income support programs, and price stabilization measures to improve the affordability and accessibility of animal protein food, particularly for households with limited purchasing power. By employing a data-driven and policy simulation approach, this research can contribute to the development of effective strategies to enhance household consumption of animal protein food, ultimately improving the nutritional status and food security of households in Indonesia. The aim of this research is to analyze household consumption patterns and estimate demand elasticity for protein food in Indonesia using data from the 2022 Indonesian National Socio-Economic Survey (SUSENAS) and develop evidence-based policy recommendations to address the challenges of declining household consumption and demand for animal protein food due to increasing food prices. Food demand systems for protein sources reveal significant insights and gaps. Previous studies have primarily focused on animal sources of proteins, with findings indicating high price elasticity for beef and chicken, while eggs remain inelastic [13], [14]. The Quadratic Almost Ideal Demand System (QUAIDS) has been effectively utilized to model these demands, highlighting the complementary relationship between seafood and terrestrial meat [15]. However, there needs to be more comprehensive analysis of emerging protein sources, such as plant-based alternatives, which are crucial for sustainable food systems [16], [17]. Results of previous research found that demand for animal sources of proteins is generally elastic, with beef showing the highest elasticity [14], and seafood consumption is influenced by health consciousness, indicating a potential market for health-oriented marketing strategies [15]. Research Gaps in this research include limited exploration of alternative protein sources like insects and microbial proteins, which could address sustainability concerns [16], [17], and insufficient data on consumer preferences for these novel protein sources. The novelty of Current Research **is** to bridge these gaps by integrating ten groups of protein sources into a unified demand system, not only animal sources of protein but also plant-based protein, providing a holistic view of protein consumption trends and sustainability implications. There are three main goals for the study: 1) To examine the patterns of household consumption of protein foods; 2) To assess the elasticity of household demand for protein foods; and 3) To create policy scenarios to meet household protein food consumption. The first goal is the main subject of this paper.

The research adds to the body of knowledge by analyzing household consumption patterns using the Probit model, which offers a thorough and adaptable framework for estimating demand responses to price changes. The current state of knowledge indicates that the price of animal sources of food has been rising globally, including in Indonesia. However, there needs to be more research on the impact of increasing food prices on household consumption patterns and demand for animal-source protein food in the Indonesian context. Additionally, the use of the probit model in estimating the household demand for animal food sources has yet to be thoroughly explored in previous research in Indonesia. The results of this study should offer fresh perspectives on the variables affecting household consumption of foods high in animal-source food and protein and possible policy options to increase consumption in Indonesia.

2 Material and Method

2.1 The Probit Model

The study's objective, to determine the factors influencing protein consumption, was estimated using the Probit model. There are only two possible values for the qualitative dependent variable of consumption (dichotomous values), namely 0 and 1. Households that consume protein (Protein) are 1, and those that are not consumed are zero. The use of the Probit Model is the most appropriate. The general model of the Probit model regression is as follows [18], [19], [20]:

$Pi=E(Y=1\beta Xi)=\beta_1+\beta_2 Xi$.....(1)

$i=E(=1\beta X_i)=\frac{1}{1+e-(\beta 1+\beta 2Xi)}$.....(2)

$Pi=\frac{1}{1+e-zi}$.....(3)

The above equation is a Probit distribution function (Probit),

$Zi=\beta_1+\beta_2 Xi$.....(4)

Furthermore, the form of equation (1) can be changed to:

$\frac{Pi}{1-Pi}=\frac{1+e\,Zi}{1+e-zi}=Ez$.....(5)

Pi/(1 – Pi) is the odds ratio in terms of household to consume protein. Furthermore, by using the natural logarithm (natural log), the equation can be obtained:

$Li=Ln(\frac{Pi}{1-Pi})\ Zi=\beta_1+\beta_2 Xi$.....(6)

L is the log of the odds ratio, which is not only linear concerning variable X but also linear concerning parameters. L is called Probit, later called Probit. This general model is then made a model of the factors that influence households to consume protein as follows:

Protein = $\ln Pi/(1-Pi) =\beta_0 + \beta_1 P_{fish} + \beta_2 Pseafood + \beta_3 Pbeef + \beta_4 mutton + \beta_5 Ppoultry + \beta_6 Peggs + \beta_7 Pmilk + \beta_8 Ptofu + \beta_9 Ptempeh + \beta_{10} Pother\ meat + \beta_{11} HHsize + \beta_{12} income + \varepsilon$, when Protein=1 if household consumed protein, and protein=0 if household not consumed protein β_0 = Constant β_1, β_2, β_3, ... $ß_{12}$ = probit regression coefficient (parameters) ε = Error term, while Pfish is the price of fish, Pseafood is the price of seafood, Pbeef is the price of beef, Pmutton is the price of mutton, Ppoultry is the price of poultry, Peggs is the price of eggs, Pmilk is the price of milk Ptofu is the price of tofu, Ptempeh is the price of tempeh, and Pothermeat is the price of other meat, HHsize is a number of a household member, and income is the income of the household. To find out how much the independent variable (Xi) affects the dependent variable (Protein), the model is tested simultaneously using the Goodness of fit test based on the likelihood ratio test, as follows:

1. Chi-Square Test, which is to test how important the independent variable is in predicting the dependent variable in the model.
2. The Goodness of fit test is to compare the results of the Goodness of fit value with respect to the $\chi 2$ table.
3. Compare the observed likelihood value (-2log likelihood d1) with χ 2 table (0.01;345.000).

If two of the three model test results are significant, then the model is significant. To find out how the independent factors are able to explain the opportunity to decide whether to consume protein or not, the following formula is used [21], [22]:

$$R_{2L}=\frac{-2\log L_0-(-2\log L_1)}{-2\log L_0}$$

To find out the influence of each independent factor on the opportunity to consume protein or not, use a partial test ($_{count}$) as follows:

$t_{count}= ß_i/se\ ß_i$

Where: ßi is the probit regression coefficient of the i-variable and ßi = standard error of the probit regression coefficient of the i-variable or variant (se) $ß_i$.

2.2 Data and data source

SUSENAS data refers to the data collected from the National Socio-economic Survey (*Survei Sosial Ekonomi Nasional*) conducted in Indonesia. SUSENAS is a large-scale household survey carried out periodically by the Indonesian Central Bureau of Statistics (*Badan Pusat Statistik,* namely BPS) to collect data on various socio-economic aspects of Indonesian households and individuals. SUSENAS data provides valuable information on a wide range of topics, including household income and expenditure, employment, education, health, housing, agriculture, and other social and economic indicators. The data collected through SUSENAS is used for policymaking, planning, monitoring, and evaluation of various government programs and policies at the national, regional, and local levels in Indonesia. SUSENAS data is widely used by researchers, policymakers, academics, and other stakeholders for conducting socio-economic research, policy analysis, and evidence-based decision-making. It serves as a crucial source of data for understanding the socio-economic dynamics and trends in Indonesia and informing policy interventions to address socio-economic challenges and promote inclusive development.

This study uses the SUSENAS household data for 2022. The total data expected to be used is 327,795 households, which would consist of both rural and urban households. The research uses data from eight animal sources of protein (fish, seafood, beef, mutton, poultry, eggs, milk, and other meat) and two plant-based sources of protein (tofu and tempeh). Based on the SUSENAS questionnaire 2022, the 1) Fish group consists of 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 octopus, preserved shrimp, and other aquatic animals, and cooked fish. 2) The seafood group consists of shrimp, lobster, squid, cuttlefish, octopus, clams, snails, snails, mussels, shrimp, and other freshwater animals. 3) Beef consists only of beef. 4) Mutton consists of mutton, lamb, and sheep. 5) Poultry consists of Purebred chicken meat and free-range chicken meat. 6) The eggs group consists of purebred chicken eggs, free-range chicken eggs, duck or manila duck eggs, and other eggs (quail eggs, raw or cooked salted eggs, turtle eggs, goose eggs, etc.). 7) The milk group consists of factory liquid milk, sweetened condensed milk, powdered milk, baby milk powder, other milk, and other milk products. 8) and 9) Tofu only tofu and tempeh only tempeh, a dn 10) Other meat group consist of other fresh meat, other cured meat, other (liver, offal, ribs, legs, oxtail, head, etc.), cutlets, and brisket.

3 Results and discussion

3.1 Testing Probit model of seafood consumption of protein

Households in Indonesia typically consume two types of protein foods: animal protein source foods and plant-based protein foods [23], [24], [25]. This study examined every food source containing animal-source protein, except for pork, which is only consumed by a small percentage of Indonesian households. Tofu and tempeh are the plant-based protein sources included in this study since most Indonesian households eat these two types of protein. Ten

protein costs are used to create the protein consumption model for Indonesian households: the price of fish, seafood, beef, mutton, poultry, eggs, milk, tofu, tempeh, and other meat alternatives. In addition to the price of the item food, there are other price relationships, such as those for complementary and alternative goods [26], [27], [28]. Household socioeconomic characteristics, such as household income, are also included in this model [29], [30] and household size [31]. Ten models of household protein consumption are used in this study. Since the model of seafood consumption is highly significant, one may use it to determine the relative contributions of each factor to seafood consumption.

3.2 Factors Affecting Protein Consumption Patterns of Seafood in Indonesia

Each of the protein-related dietary groups' influencing variables is thoroughly explained in this section. Ten dietary groups consisting of proteins have been identified. Table 1 displays the data analysis outcomes for the protein consumption models utilizing the Probit model technique. These variables are the price of fish, the price of seafood, the price of beef, the price of mutton, the price of poultry, the price of eggs, the price of milk, the price of tofu, the price of tempeh, and the price of other meat.

Table 1. Determinants of protein consumption patterns of seafood in Indonesia.

Protein food groups	Coefficient	Robust std. error	z	P> | z |	[95% conf.	interval]
Price of fish	0.0003	9.22e-06	30.663	0.000	0.0002	0.0003
Price of seafood	-0.0005	1.93e-06	-15.211	0.000	-0.0000	-0.0000
Price of beef	-0.0001	6.56e-07	-9.223	0.000	-7.33e-06	-4.76e-06
Price of mutton	0.0004	1.11e-06	16.932	0.000	-0.0000	0.0000
Price of poultry	-0.0006	9.45e-07	-14.470	0.000	-0.0000	-0.0000
Price of eggs	-0.0012	0.0000	-24.032	0.000	-4.9e-06	-0.0000
Price of milk	-0.0003	4.84e-07	-27.910	0.000	1.44e-06	-0.0000
Price of tofu	-0.0007	9.87e07	-3.023	0.003	-1.36e-06	-1.05e-06
Price of tempeh	0.0006	9.15e-06	3.541	0.000	-4.91e-06	5.03e-06
Price of other meat	0.0003	1.37e-06	0.972	0.334	-1.36e-06	4.00e-06
Expenditure	0.0004	6.46e-08	73.13	0.000	4.60e-06	4.85e-06
HHsize	-0.0162	0.0033	-4.933	0.000	-0.0228	-0.0098
Constant	-1.8961	0.0925	-20.50	0.000	-2.0774	-1.7149

Source: Author's computation, 2023.

In Indonesia, fish species include or consist of 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 octopus, preserved shrimp and other aquatic animals, and cooked fish. Consumption of seafood is heavily influenced by fish costs. Put another way, the price of fish has a significant impact on how much seafood is consumed in Indonesian homes. Based on

data analysis, the fish price coefficient is positive, indicating that rising seafood prices translate into higher fish prices.

Seafood is a pricey source of animal protein. Because seafood is a staple in both high-end and low-end cooking—it is often found in star hotels, for instance—the cost of processed seafood varies widely. Although seafood is produced in large quantities in Indonesia, it is also imported in large quantities from other nations, such as China, Norway, and others. The data analysis's findings indicate that the fall in seafood consumption is significantly impacted by rising seafood prices. Indonesian households will lower the cost of seafood if it increases. This is consistent with the idea in economic theory that demand for commodities will decline as prices rise.

Beef is a crucial product in Indonesia. Beef is the most expensive protein source available. In Indonesia, national guidelines for protein adequacy only permit non-poor households to afford beef eating. The top quintile (Q5, highest income) is the only one that can afford to eat beef. Elastic beef is only found in homes in the top percentile of income. This suggests that the amount of beef consumed was unaffected by changes in the price of beef for the wealthiest quintile of families. According to the study's findings, people eat less seafood when beef costs rise. The negative coefficient value for beef serves as evidence of this. As a result, beef and shellfish go well together or complement each other.

Mutton is a highly preferred animal source of protein in Indonesian homes. One popular method to eat mutton is mutton satay. Mutton satay is a common domestic animal dish in Indonesia, especially on Java Island. The capital of Indonesia and the island with the largest population is Java Island, which is situated in West Java. The prices of food containing all sources of animal protein, plant-based proteins (such as tempeh and tofu), and socioeconomic characteristics (like family income and number of members) all have a significant influence on the Indonesian household mutton consumption model. The rise in mutton prices is one of the main factors contributing to the fall in mutton consumption. Seafood consumption rises in response to price hikes for mutton, according to an examination of the most recent Susenas data from Indonesia. This suggests that households will switch from consuming seafood to mutton if the price of seafood rises, proving that both seafood and mutton are substitutes.

One of the best sources of animal protein is poultry, which has the widest variety of processed foods. Breeds, including broiler chickens, ducks, and free-range chickens, are included in this category. The protein food group is highly valued in almost all Indonesian households, regardless of age, especially for children, teenagers, and college students. Due to the extensive range of flavors and shapes available in processed chicken cuisine, fowl is also quite popular among the elderly. Although homeowners can farm chicken, especially free-range chicken, broiler or domestic chicken are raised on small to large industrial proportions. Poultry is exported to other Asian countries because of Indonesia's high level of production. The consumption of chicken declines when seafood costs rise. These are the findings from the analysis of the data in Table 1. The cost of poultry is typically less than that of fish. This implies that households purchase poultry—a less expensive source of protein—because of the rising price of seafood. There are substitutes for seafood and poultry.

Eggs are the most straightforward food source of animal protein. In Indonesia, households are limited to eating boiled eggs; all other animal proteins need additional spices, time, and effort to prepare. However, over the previous five years, there has been a noticeable increase in the price of eggs. Eggs are also a source of raw components for a variety of processed culinary products. Everyone in Indonesia, regardless of age, adores eggs. The egg group used in the study consisted of free-range, domestic, duck, and quail eggs. Price rises for eggs lead to higher egg consumption. The market for eggs is driven up by rising egg prices. The study's findings are fascinating because they go against the grain of economic theory, which holds that a good's price increase results in a drop in demand for it. The results of this study are supported by Khoiriyah's research from 2022, which discovered that eggs

are a normal good, inelastic, and the primary source of protein for Indonesian households. The results of this study are supported by the findings of the [1] and [3] studies, which found that eggs are the primary source of protein for Indonesian households and that they are a normal good that keeps their price constant despite rising eggs prices, support the findings of this study.

Since milk comes from animals, it is considered a premium food in Indonesia. Homes in Indonesia are obligated to eat milk because it is a component of the government's "four healthy five perfect foods" (local term: *empat sehat lima sempurna*) meal policy. The sixth food that we discuss is milk. However, many Indonesian households do not drink milk because of its high cost. Milk is an elastic luxury good; therefore, price increases significantly reduce demand. The examination of the new Susenas data for 2022 reveals that consuming seafood decreases as milk prices rise. Therefore, if milk prices increase, Indonesian households will consume less seafood and drink less milk. The price of food derived from all animal sources significantly affects the Indonesian family milk consumption model. The cost of meals high in plant-based protein, including tempeh and tofu, is also influenced by the size of the household and household income. However, there are three things that do not affect how much milk is consumed: the cost of eggs, tofu, tempeh, and substitute meat. Generally speaking, meats like tempeh, tofu, and others are less expensive than milk. Therefore, changes in the cost of tofu, tempeh, and other animal products have little effect on the quantity of milk eaten in Indonesian homes. This type of milk comprises sweetened condensed milk, powdered milk, newborn formula, and factory-produced liquid milk. Households usually prefer powdered milk and baby milk for children under five because of their high cost. Wealthy families are the only ones that provide milk to their adult children hogshead. Milk is an elastic luxury good; therefore, price increases significantly reduce demand.

Tofu is one dietary item that contains protein derived from plants. Compared to goods containing animal-source protein, tofu is significantly less expensive. Previous studies only looked at meals rich in protein from animal sources food. In this study, we looked at the point at which households became unable to afford to continue consuming meals high in protein from animal sources and began to consume foods high in protein from plants. The cost of all meals containing protein and the socioeconomic standing of the household both have a significant influence on the tofu consumption model in homes. However, the demand for and consumption of tofu remains relatively independent of tempeh pricing. This suggests that Indonesian households' consumption of tofu is completely unaffected by the price of tempeh. Families buy tofu whenever they feel like it, regardless of the cost of tempeh. Protein-rich foods like tofu can be bought for as cheap as IDR 1000. Using this strategy, households in Indonesia can have tofu protein foods. When tofu is prepared simply by frying it, for example, it becomes a widely consumed snack for people of all ages. In addition, tofu can be turned into a variety of meal preparations, such as vegetables or snacks that go well with Indonesian white rice, the country's main dietary staple. The data analysis's findings indicate that people eat less seafood when tofu is more expensive. Stated differently, households in Indonesia will likewise consume less seafood if the price of tofu rises. Seafood and tofu, in particular, have a relationship that is sometimes referred to as complementary.

Protein-based plant sources such as tempeh are inexpensive, popular, and appealing to both adults and small children. Tempeh is utilized as a raw component in processed dishes in several regions of Indonesia. A processed treat produced from tempeh, "tempeh chips" are very well-liked in Indonesia. Another readily digested protein source that can be used as a vegetable or side dish in family meals is tempeh. All it takes to make it tasty with rice, an essential meal, is to fry it. Like tofu meals, tempeh is incredibly affordable and notable. Like tofu meals, tempeh is incredibly affordable and notable. Put another way, the amount consumed increases along with the price of tempeh. The findings of the study indicated that

consumers were consuming more tempeh as a response to rising fish prices. This implies that if the cost of seafood rises, Indonesian households switch to tempeh, a vegetable protein source, in place of seafood. As supplementary data in the field, tempeh is typically substantially less expensive than fish. As a result, if the price of seafood rises, households will be able to buy fewer animal protein meals and will eventually turn to cheaper plant protein foods like tempeh. This study adds credence to the notion that middle-class and lower-class households view fish as pricey. In Indonesia, there are still many households with lower-middle incomes. Ultimately, tempeh and seafood are related in a way that involves mutual replacement or substitution.

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Other meat dietary sources of protein mentioned in this study are animal protein-containing foods that are not found in beef or poultry but are nevertheless a part of those animals. The other meat group includes cutlets, brisket, liver, offal, ribs, legs, oxtail, and other meats, as well as other fresh and cured meats. Other meat can be a source of animal protein for households with low or moderate incomes because it is typically less expensive than beef or poultry. Low-income households can afford to buy liver, offal, ribs, legs, oxtail, skull, etc. because their cost can be at most 25% to 70% of the prices of beef or chicken. Therefore, among other animal meals, other meats are the most affordable source of animal protein.

The effect of socio-demographics on protein consumption pattern. Showed that the level of household welfare is reflected in household income. The welfare of the household increases with income. Affluent households have more purchasing power, enabling them to meet their food needs. The results of data analysis on the socioeconomic features of homes show that the amount of money and the number of household members significantly influence the amount of seafood consumed. As household income rises, so does the amount of protein consumed. As income rises, there will be a greater demand for foods high in protein, both from animal sources and plant sources. The number of household members has a significant impact on seafood consumption in the seafood animal protein source food consumption model. As a result, as the number of family members increases, so does the household's purchasing power, which causes the intake of protein to decline. The household model's final conclusion about seafood consumption is that as individuals eat more meats such as tempeh, mutton, and other meats, as prices rise, seafood can be substituted with any of these three protein food groups. Conversely, seafood enhances the six dietary protein groups—beef, chicken, eggs, milk, and tofu. Finally, it is different with income. Meanwhile, there is an inverse relationship between the number of household members and protein consumption.

4. Policy Implications

The results of the study show that the amount of seafood consumed in Indonesian families is significantly influenced by price, income, and the number of household members. The prevalence of foods high in protein has a significant impact on how much plant-based and animal-based protein Indonesian families consume. In seafood models of protein

consumption, the effect of price on protein surpasses the effect of income. This method makes pricing policy more effective, and maintaining price stability requires government action. This suggests that the greatest way to increase household protein consumption is to cut the price of protein. The Indonesian government and police officials have the power to give producers subsidies in order to encourage breeders and tofu or tempeh manufacturers to offer their protein-source meals to consumers at a discounted price and to minimize production expenses. Fish has the most significant influence on consumption. This suggests that when the cost of seafood increases, Indonesian households respond swiftly. Therefore, to encourage higher fish consumption among families, the government and policymakers can utilize pricing tactics like ceiling prices, where the fish can be sold at the greatest price to enable households to attain adequate consumption.

Therefore, increasing household income is recommended to encourage seafood consumption. Food assistance programs and social welfare initiatives can be used to improve the well-being of Indonesian households. The terrible family economic factor that has a significant and negative impact on the consumption of food derived from animals is the number of people living in the household. It is suggested that the government launch a grant program for foods high in protein, especially those that come from animal sources, in order to encourage the use of these foods. This program may raise the amount of protein consumed in households, improve food security, and fortify food security in Indonesian society.

5. Conclusions

The findings highlight the significance of the level of the seafood consumption model. Apart from other meat prices, all food sources of protein, both animal and vegetable, have a significant impact on patterns of seafood intake. Price increases for protein-rich foods, such as fish, mutton, and tempeh, have a favorable impact on seafood consumption. Fish, mutton, and tempeh are therefore consumed more frequently because of rising seafood prices, replacing seafood in diets. The prices of protein-rich foods, such as milk, tofu, eggs, chicken, and cattle, have an adverse impact on the consumption habits of seafood. The rising cost of seafood is causing consumers to consume less beef, poultry, eggs, milk, and tofu in addition to less seafood. These results demonstrate the complementarity between seafood and beef, poultry, eggs, milk, and tofu by confirming that rising seafood prices lower household purchasing power for protein, including cheap plant-based protein like tofu and animal sources.

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