BETWEEN LUXURY AND NECESSITY: A SOCIOECONOMIC EVALUATION OF ANIMAL PROTEIN DEMAND ELASTICITY IN NORTH SUMATRA

Selsa Juita Nababan[1*], Sri Fajar Ayu[1]
[1]Universitas Sumatera Utara, Jalan Dr. T. Mansur No.9, Medan 20222, Indonesia

*Correspondence E-Mail: juitasellsa@gmail.com
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ABSTRACT

This study evaluates the demand elasticity of animal protein in North Sumatra Province, focusing on the relationship between price, income, and consumption patterns across four major commodities: beef, chicken, fish, and eggs. North Sumatra was purposively selected due to its status as the most populous province in Sumatra and its significant contribution to regional protein demand. The study utilizes secondary time-series data from Q1 2014 to Q4 2024, obtained from official government sources. The Linear Approximation Almost Ideal Demand System (LA/AIDS) model is applied to estimate price elasticity, income elasticity, and substitution-complementarity relationships among commodities. The results indicate that beef and chicken are price-elastic, while fish and eggs are price-inelastic. The strongest substitution effect is observed between beef and chicken. In terms of income elasticity, beef and chicken are considered luxury goods, whereas fish and eggs are classified as normal goods. These findings highlight segmented consumption patterns driven by purchasing power disparities. The study's novelty lies in its long-term elasticity mapping of animal protein demand in a densely populated, non-Java province. Policy recommendations include price stabilization for beef and chicken, and targeted food assistance or subsidies for low-to-middle-income households to improve equitable access to quality protein. The findings enrich social science and humanities literature, particularly in food economics, public policy, and region-based food security studies.

Keywords*: Consumption Inequality, Food Policy, Food Security, Income Elasticity, Socioeconomic Stratification*

INTRODUCTION

The availability and affordability of nutritious food, particularly animal-based protein, are essential elements in maintaining food security and public health (Cattaneo et al., 2023; Eng et al., 2022). Amid increasing population and income inequality, the consumption of animal protein in Indonesia shows diverse patterns across regions, social groups, and economic classes. North Sumatra Province, as the most populous province outside Java, occupies a strategic position in the national protein consumption landscape. However, despite its significant contribution to animal protein demand, the distribution of consumption among commodities—such as beef, chicken, fish, and eggs—does not fully reflect an equitable fulfillment of nutritional needs across all societal segments (Darus & Lindawati, 2023). Beneath the aggregate consumption data lie

demand elasticity dynamics that reveal deeper socio-economic disparities. This phenomenon offers a crucial entry point for understanding whether animal protein consumption in North Sumatra represents a basic necessity or a social status symbol (Khusun, Monsivais, et al., 2022; Santarita, 2022).

This issue becomes increasingly relevant given the vulnerability of animal protein commodity prices in Indonesia to market and policy fluctuations. Beef, for instance, often remains an expensive item accessible only to certain segments of society, while fish and eggs serve as more common alternatives among low-income households. A study by Anindita et al. (2022) reveals that household expenditure on food still dominates the national consumption structure, yet allocations for animal protein vary considerably depending on income levels. Such disparities raise fundamental questions: to what extent do people respond to changes in prices and income regarding animal protein consumption? Are beef and chicken considered luxury goods for most of the population, or have they become staple necessities?

Various studies have attempted to address these questions from the perspective of consumer economics. For instance, research by Suresti et al. (2024) and Wibowo et al. (2025) indicates high price elasticity of beef in the Sumatra region, highlighting substantial sensitivity to price fluctuations. Conversely, Ali et al. (2024) and Nofal et al. (2024) found that fish consumption tends to be more stable even amidst price increases, suggesting an inelastic nature typical of essential goods. Other studies—such as those by Anyanwu et al. (2022), Najib et al. (2022), and Neilson (2022)—emphasize the importance of linking consumption patterns to sociocultural contexts and social class dynamics. Meanwhile, Baladina et al. (2024), Khoiriyah, Forgenie, et al. (2023), and Rozi et al. (2023) demonstrate that income elasticity of demand for animal protein diminishes among higher-income groups, whereas for lower-income groups, increases in income are directly proportional to increases in protein consumption, indicating a significant gap in nutritional access.

Demand estimation methods such as the Linear Approximation Almost Ideal Demand System (LA/AIDS) have been widely used to measure elasticity in various food contexts. For example, Permatasari et al. (2025) in South Kalimantan showed that this method can capture substitution relationships between chicken and eggs, as well as the complementarity between fish and rice. Additionally, Ignanga et al. (2025) and Wongmonta (2022) adopted similar approaches to examine changing consumption patterns in developing countries amid urbanization and rising income. These findings enrich our understanding that demand elasticity is not merely a matter of statistical coefficients but also a reflection of preferences, access, and structural constraints.

Nevertheless, most existing studies remain focused on Java or at the national level, which often obscures interregional complexities. Research on demand elasticity outside Java—particularly in densely populated and multiethnic North Sumatra—remains limited. Moreover, few studies have employed long-term approaches using consistent time-series data over a decade. Yet, mapping elasticity over extended periods is crucial to capturing structural dynamics

and long-term consumption trends that are not visible in short-term snapshots. This represents a research gap that remains underexplored.

This study adopts an evaluative approach to assess the demand elasticity of animal-based protein in North Sumatra over a ten-year period, from 2014 to 2024, using the LA/AIDS method, which has proven effective in modeling substitution and complementarity between commodities. While most literature focuses on Java or short-term snapshots, this research offers a broader and deeper demand landscape, capturing the tension between necessity and luxury in animal protein consumption amid North Sumatra's social heterogeneity.

The objectives of this study are to measure and analyze the price and income elasticity of four key animal protein commodities—beef, chicken, fish, and eggs—in North Sumatra Province from a socio-economic perspective. In addition, the study aims to map substitution and complementarity relationships among these commodities to identify consumer preferences based on purchasing power. The findings are expected to provide input for food policy formulation that is more responsive to consumption inequalities and better protects vulnerable groups.

RESEARCH METHOD

This study employs a quantitative approach using elasticity estimation methods based on econometric models that have proven relevant in household consumption studies, particularly within the context of animal-based food. The research location was deliberately selected (purposive sampling) in North Sumatra Province. This choice is not without reason. As the most populous province in Sumatra, North Sumatra naturally serves as a gravitational center in the dynamics of animal protein demand outside Java. Its population density, socio-economic diversity, and complex local markets make it a representative area for observing consumption patterns that are shaped not only by physiological needs but also by social class structures and household purchasing power.

The research was conducted from November 2024 to January 2025. The data used in this study are secondary time-series data covering the period from the first quarter of 2014 to the fourth quarter of 2024. The data were collected from various official sources, including the Provincial Plantation and Livestock Office of North Sumatra, the Provincial Marine and Fisheries Office of North Sumatra, and the National Food Agency (BPN) of North Sumatra Province. In addition, various academic literatures such as journals, books, theses, and dissertations were used to support the analysis and interpretation of the study's main findings.

The research focuses on four major animal protein commodities: beef, chicken meat, fish, and eggs. The primary objective is to analyze the interrelationships between price, income, and the proportion of consumption of each of these commodities. The data analyzed include average retail prices, per capita consumption levels, and total household expenditures on each type of animal protein.

To estimate demand elasticity, the study adopts the Linear Approximation Almost Ideal Demand System (LA/AIDS) approach (Basílio et al., 2022; Zopounidis & Doumpos, 2022). This model is a simplified version of the Almost Ideal Demand System (AIDS) developed by Deaton & Muellbauer (1980), widely used in consumption economics due to its flexibility in modeling inter-commodity interactions. The LA/AIDS model is preferred for its computational simplicity via a linear approximation while maintaining accuracy in explaining demand pattern changes in response to price and income variations.

Formally, the LA/AIDS model is expressed as follows:

$$Wi = \alpha i + \Sigma j \gamma ij \, \log Pj + \beta i \, \log \left(\frac{x}{p^*} \right) + ui$$

In this model, Wi represents the budget share allocated to commodity i in percentage, while Pj is the price of commodity j in rupiah. The Stone price index (p^*) is calculated using the formula:

$$\log p^* = \Sigma \, wi \, \log P_i$$

which represents the aggregated price level across all commodities. The variable x denotes total household expenditure on animal protein sources, and α, β, and γ are the regression parameters to be estimated. The symbols i and j refer to different commodity types, and ui is the residual or error term of the model.

RESULTS AND DISCUSSION

Prices and Consumption of Beef, Chicken, Fish, and Eggs in North Sumatra

Over the past ten years (2014–2024), the prices of all major animal protein commodities in North Sumatra Province—namely beef, chicken meat, fish, and eggs—have exhibited a consistent upward trend, though with varying degrees of fluctuation across commodities. These price increases are not occurring in a vacuum, but are instead the result of complex interactions involving production dynamics, input costs, distribution systems, and government intervention policies. For example, beef, which is still largely dependent on supplies from other regions or imports, tends to have higher and more volatile prices compared to chicken or eggs, which are more localized in their production chains. Fish, on the other hand, remains a leading local commodity with relatively stable prices, although still subject to seasonal changes and rising fishing operational costs. This trend is significant, as changes in price directly affect people's ability to purchase and access quality sources of animal protein.
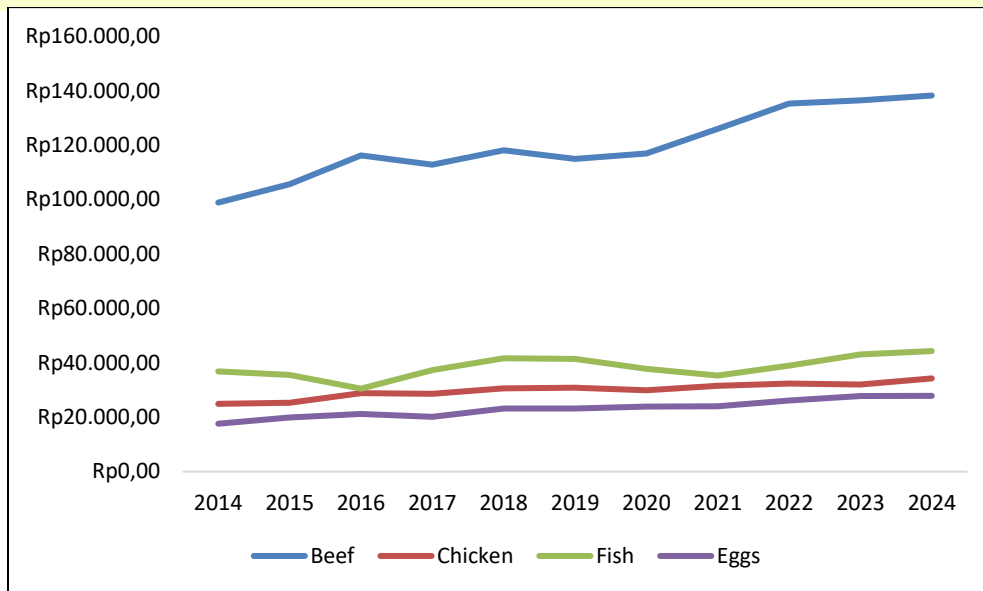
Gambar 1 Prices of Animal Protein Commodities in North Sumatra (Rp/kg)
Source: Processed data from the North Sumatra Food Security Agency and BPS, 2025

This rising price trend has had a tangible impact on consumption patterns. Consumption data indicate that beef, while traditionally viewed as a symbol of status and household economic strength, has experienced a decline in its consumption share relative to total animal protein intake. Conversely, consumption of chicken and eggs has increased significantly. Both are considered more affordable, practical, and versatile alternatives in terms of preparation. Meanwhile, fish continues to be the most consumed animal protein commodity in North Sumatra. In addition to its relatively stable availability, fish consumption is deeply embedded in the dietary habits of both coastal and inland communities. This phenomenon reflects a shift in consumer preferences influenced by economic factors (purchasing power), supply availability, and evolving lifestyles and perceptions of nutrition.

Table 1 Average Annual Per Capita Consumption of Animal Protein in North Sumatra (kg)

Year	Beef	Chicken	Fish	Eggs
2014	4,2	8,5	18,9	5,3
2016	3,9	9,1	19,5	6,0
2018	3,5	10,2	20,3	6,9
2020	3,1	11,5	21,1	7,6
2022	2,8	12,3	22,0	8,2
2024	2,6	13,0	22,7	8,7

Source: Processed data from the North Sumatra Livestock and Fisheries Office, 2025

As shown in Table 1, beef consumption has declined by more than 1.5 kg/capita over the past decade, while chicken and egg consumption have each increased by nearly 5 kg/capita. Fish consumption has also continued to rise gradually. This shift reflects the rational consumption behavior of households adapting to changes in price and income. Among lower-middle-income

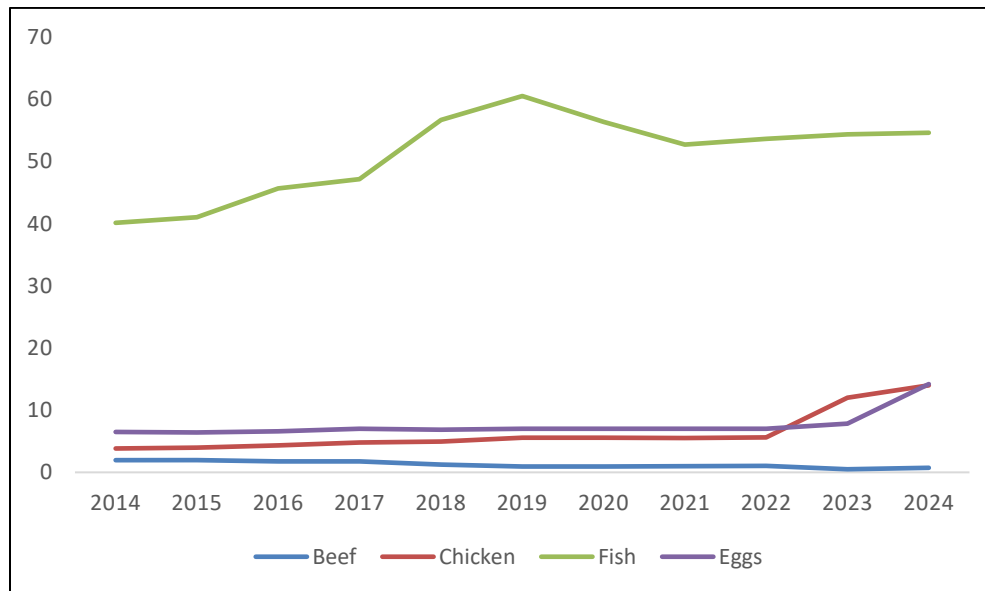households, affordability plays a more dominant role in purchase decisions than preference or taste alone.

Figure 2 Per Capita Animal Protein Consumption in North Sumatra (kg/capita/year)
Source: Processed data from the North Sumatra Livestock and Fisheries Office, 2025

These consumption changes align with findings in the literature on consumer responses to price dynamics and economic constraints. Studies by de Pee et al. (2021) and Khusun, Februhartanty, et al. (2022) demonstrate that Indonesian households tend to adjust their consumption structure by shifting to more affordable protein sources when faced with price pressures. On the other hand, research by Mariyono (2024) and Nurhasan et al. (2022) highlights the importance of fish as the primary provider of animal protein in local food systems outside Java, particularly due to its accessibility and strong cultural acceptance. In the context of North Sumatra, these consumption patterns reflect a local value system that continuously adapts to economic realities.

Household Demographic Changes in North Sumatra

Household demographic changes in North Sumatra over the past decade have shown intriguing and significant trends, particularly related to the average number of family members. Between 2014 and 2018, the average household size typically ranged from 4.1 to 4.3 individuals. However, beginning in 2019, this trend gradually declined. By 2024, the average household size had decreased to approximately 3.5 persons per household. This decline reflects broader social dynamics such as reduced birth rates, increased urbanization, shifting family values, and rising female participation in education and the workforce.
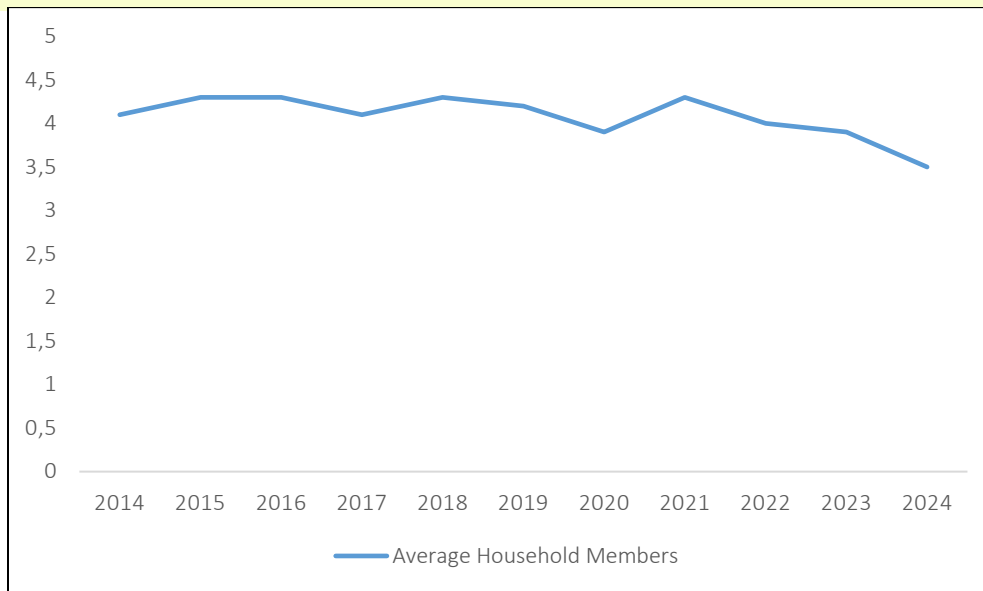
Figure 3 Average Household Size in North Sumatra (persons/year)
Source: Processed data from the Department of Animal Husbandry and Fisheries of North
Sumatra, 2025

The shrinking household size has direct implications for household consumption, including that of animal protein. On one hand, a smaller family size may reduce the total food consumption per household. On the other hand, it can lead to an increase in per capita consumption, especially when accompanied by rising income levels and more individualistic consumption preferences. For instance, smaller families consisting of two parents and one child tend to focus more on food quality and diversity compared to larger families, which are more concerned with quantity and efficiency (Mehraban & Ickowitz, 2021).

Table 2 Average Household Size in North Sumatra, 2014–2024

Year	Average Household Members
2014	4.2
2016	4.1
2018	4.3
2020	3.9
2022	3.6
2024	3.5

Source: Processed data from the Department of Animal Husbandry and Fisheries of North
Sumatra, 2025

This demographic trend is closely related to demand elasticity for food, especially animal protein. Small households with middle-income levels are often more flexible in allocating food expenditure toward chicken, eggs, or even beef. In contrast, larger households tend to be more sensitive to price changes, particularly for high-cost commodities like beef. Therefore, household

size is a crucial variable for understanding consumption patterns, inseparable from price, income, and preference factors.

Research by Khoiriyah, Apriliawan, et al. (2023) supports this, showing that household size has a negative relationship with per capita animal protein consumption. The larger the household, the lower the per capita protein intake, as families attempt to minimize food expenses. Conversely, smaller households are more likely to maintain or even increase their individual animal protein consumption. Thus, the decreasing average household size in North Sumatra signals a structural shift in consumption—not only in volume but also in the types of commodities consumed.

Almost Ideal Demand System (AIDS) Analysis

The Almost Ideal Demand System (AIDS) model employed in this study aims to understand how consumers in North Sumatra allocate their expenditures across four main types of animal protein commodities—beef, chicken, fish, and eggs—between 2014 and 2024. This model allows the identification of the relative influence of each commodity's price, total household expenditure, and household size on the budget share allocated to each type of animal protein.

Table 3 Budget Share Estimation (AIDS Model) for Animal Protein in North Sumatra, 2014–2024 2014-2024

Independent Variables	Beef		Chicken		Fish		Eggs	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Constant	0.793	0.000	0.115	0.726	-0.181	0.724	0.272	0.268
Beef Price (Rp/kg)	-0.007	0.723	0.048	0.048	-0.045	0.004	0.003	0.807
Chicken Price (Rp/kg)	0.048	0.048	-0.015	0.676	-0.045	0.100	0.018	0.502
Fish Price (Rp/kg)	-0.045	0.004	-0.045	0.100	0.044	0.003	0.017	0.005
Egg Price (Rp/kg)	-0.005	0.759	0.017	0.550	-0.061	0.195	0.017	0.007
Total Expenditure	-0.202	0.000	0.066	0.037	0.157	0.002	0.019	0.265
Household Size	-0.047	0.115	-0.232	0.000	0.461	0.000	0.756	0.000
R-square	0.910	-	0.664	-	0.527	-	-	-

Source: Processed data from the Department of Animal Husbandry and Fisheries of North Sumatra, 2025

Generally, the estimation results indicate that each protein source responds differently to the independent variables. For beef, the model shows that an increase in fish prices significantly reduces the budget share allocated to beef (p-value 0.004). Similarly, increases in total household expenditure and household size also negatively affect beef's budget share, although the effect of household size is statistically insignificant (p-value 0.115). Meanwhile,

demand for chicken responds positively to rising beef prices (p-value 0.048), suggesting substitution. Interestingly, an increase in household size significantly reduces the budget share for chicken (p-value 0.000), indicating a shift toward more economical consumption patterns as household size grows.

In contrast, for fish, the model reveals a significant positive relationship with household size (p-value 0.000) and total expenditure, indicating that fish is the primary choice for larger households seeking affordable yet nutritious protein options. For eggs, a positive response is observed across nearly all price variables, though only the prices of fish and eggs themselves are statistically significant (p-value < 0.01). Household size also positively and significantly influences the budget share for eggs, supporting the notion that eggs are a favored choice in larger households due to their availability, stable price, and cooking versatility.

To better interpret the above coefficients, the AIDS model was transformed into elasticity values. These elasticities indicate the sensitivity of demand to changes in price and income. For instance, the own-price elasticity of beef is -2.055, indicating that a 1% increase in beef price results in an approximate 2.06% decrease in beef consumption, classifying it as an elastic good. Meanwhile, a positive cross-price elasticity of 3.935 for chicken relative to beef suggests that chicken is the main substitute when beef prices rise.

Fish and eggs also act as substitutes for beef, although with more moderate elasticity levels. On the other hand, the expenditure elasticity of beef is -2.172, meaning that as total household expenditure rises, the budget share for beef declines. This suggests that consumers may shift toward alternatives perceived as offering better value or aligning more closely with health and nutrition preferences.

Table 4 Elasticity of Demand for Animal Protein in North Sumatra, 2014–2024

Commodity	Beef	Chicken	Fish	Eggs
Own-Price Elasticity				
Beef Price	-2,055	3,935	2,471	3,099
Chicken Price	-0,241	-2,089	-1,501	-0,661
Fish Price	-0,256	-0,256	-0,219	-0,277
Egg Price	-0,353	-0,472	-0,408	-0,022
Expenditure Elasticity				
Expenditure	-2,172	1,889	1,199	0,696

Source: Processed data from the Department of Animal Husbandry and Fisheries of North Sumatra, 2024

These findings confirm the prominent roles of fish and chicken as the most adaptable commodities in response to market and household economic conditions. Chicken serves as the strongest substitute when beef prices rise, while fish proves to be flexible in response to increasing household size and expenditure. Eggs, despite having lower elasticity, continue to play a vital role due to their affordability and versatility.

Considering the previously discussed demographic trends—especially the declining average household size—it can be concluded that the consumption patterns of animal protein in North Sumatra are shifting. Smaller households tend to prefer commodities with high nutritional value, stable prices, and easy preparation, such as chicken and eggs. Conversely, larger households are more flexible with fish, which is already culturally integrated into the diets of coastal communities. Meanwhile, beef is increasingly excluded from preference due to its high elasticity with respect to price and expenditure and its waning symbolic value in contemporary households.

Own-Price Elasticity Values

The value of own-price elasticity reflects how much the demand for a particular good changes in response to a change in its own price. In the context of animal protein consumption in North Sumatra, the estimation results indicate that beef and chicken meat have negative own-price elasticity values greater than one, at -2.055 and -2.089 respectively. These figures suggest that the demand for both commodities is elastic, meaning consumers are highly responsive to price changes. In other words, a 1% increase in the price of beef would reduce its demand by 2.055%, and for chicken meat, by 2.089%. This high sensitivity reflects not only the characteristics of luxury or semi-luxury goods but also highlights the limited purchasing power of many households. The elastic response to beef and chicken also suggests that consumers tend to seek substitutes—such as fish or eggs—when prices surge. This finding aligns with Jin & Gil (2025), who assert that goods with high substitutability tend to exhibit greater price elasticity, especially in household food markets that are price-sensitive.

In contrast, fish and eggs exhibit inelastic demand characteristics, with own-price elasticity values of -0.219 and -0.022 respectively. These values indicate that price changes have little effect on the quantity demanded. For instance, a 1% increase in the price of fish would reduce demand by only 0.219%, and for eggs, by just 0.022%. This inelastic demand reflects the role of fish and eggs as basic necessities that are routinely consumed and remain relatively affordable across social classes. From the perspective of household consumption, this aligns with the concept of "necessity goods" as described in the study by Meenakshi & Quisumbing (2025), which suggests that staple foods such as fish and eggs tend to have low price elasticity due to their essential role in meeting minimum household nutritional needs.

These price elasticity dynamics also reinforce the narrative that the structure of animal protein consumption in North Sumatra is heavily influenced by purchasing power and perceived utility of each commodity. On one hand, beef and chicken are more susceptible to demand fluctuations because they are considered optional and replaceable. On the other hand, fish and eggs continue to be consumed even when prices increase, as they are perceived as indispensable components of daily diets. In the long term, understanding these elasticity patterns is crucial for designing policies related to price stabilization, food distribution, and strengthening food security with equitable access—especially in volatile economic conditions.

Cross-Price Elasticity Values

Cross-price and income elasticity values for various animal protein commodities in North Sumatra provide rich insights into the dynamics of household consumption, which is highly responsive to changes in both prices and income. The analysis reveals that the cross-price elasticity of beef relative to chicken is 3.935—positive and highly elastic—indicating a strong substitution relationship between the two. When beef prices increase by 1%, the demand for chicken rises by nearly 4%. This indicates that chicken acts as the main substitute for beef among consumers. This phenomenon aligns with Marshallian demand theory, which posits that if two goods are substitutes, a price increase in one will lead to a demand increase for the other (Masruroh et al., 2021; Vahabi, 2025). This elastic response also highlights that consumer preferences are quite flexible and highly sensitive to price fluctuations in the animal protein market.

Moreover, the cross-price elasticity of beef with respect to fish and eggs is also positive, at 2.471 and 3.099 respectively. These figures indicate that fish and eggs also serve as alternatives when beef prices increase, although culturally, fish tends to have a distinct consumption status in North Sumatra. A similar, though more moderate, response is observed in the cross-price elasticity of chicken relative to fish and eggs, at 0.611 and 0.821 respectively. This means that a 1% increase in chicken prices leads to a 0.611% and 0.821% increase in demand for fish and eggs, respectively. These values confirm that fish and eggs function as secondary substitutes for both beef and chicken, although their substitutability is not as strong as that between beef and chicken. This suggests a hierarchy of animal protein consumption preferences based not only on price but also on nutritional value, habitual consumption, and social perceptions associated with each commodity (Deaton & Muellbauer, 1980).

Meanwhile, the income elasticity of demand for beef and chicken is 2.172 and 1.889, respectively, indicating that both commodities are income-elastic. This means that a 1% increase in household income in North Sumatra would increase the demand for beef by 2.172% and for chicken by 1.889%. These findings classify beef and chicken as normal goods with a tendency toward luxury status, particularly for beef. Consumers allocate additional income toward increasing consumption of commodities perceived as higher quality and more prestigious. According to Manannalage et al. (2023), goods with high income elasticity tend to be consumed more as economic welfare improves, reflecting upward social mobility through more "modern" and nutritionally rich diets.

These findings are essential for policy formulation in pricing, food distribution, and social welfare planning. Policymakers must understand that animal protein consumption dynamics are influenced not only by price but also by income structures and the availability of substitutes. Enhancing access to affordable, nutritious animal protein for low-income groups is key to maintaining household consumption quality and food security.

Income Elasticity Values

The income elasticity values for fish and eggs in North Sumatra indicate that these two types of animal protein are classified as normal goods, yet are income-inelastic. The income elasticity for fish is 0.899, meaning that if income increases by 1%, demand for fish only increases by 0.899%. Similarly, the income elasticity for eggs is 0.696, suggesting that each 1% rise in income results in only a 0.696% increase in egg demand. Although consumption increases with income, the proportional increase is smaller than the income growth itself. In other words, fish and eggs do not experience a significant surge in consumption as purchasing power improves.

This finding aligns with established consumption theories by Engel and Houthakker. Engel's Law posits that as income rises, the proportion of expenditure on basic needs (including food) tends to decline, even if nominal spending remains the same or increases slightly (Deaton & Muellbauer, 1980; Manannalage et al., 2023). In this context, fish and eggs are basic necessities whose consumption remains relatively stable in household spending patterns, making their demand relatively unaffected by income changes. Fish, for example, has long been a staple in the daily diets of North Sumatran communities due to geographic and cultural factors, so income increases are more likely to drive diversification toward other protein sources like beef or chicken, which are perceived as more premium.

Furthermore, the low-income elasticity of eggs also suggests that this commodity exhibits characteristics of a moderately inferior good—meaning it is consumed by all income groups, but its consumption does not increase drastically with rising income. This could be attributed to the public perception of eggs as a practical and efficient protein source, but not a luxury item. Therefore, as welfare improves, people often seek more "elite" food options, while egg consumption remains steady or increases only marginally.

Animal Protein Consumption: A Reflection of Social Inequality and Food Security

Animal protein consumption in North Sumatra, as reflected in the price and income elasticity values in this study, reveals underlying social inequalities in accessing nutritious food. When commodities such as beef and chicken display high income elasticity—indicating that consumption increases significantly with rising income—while commodities such as fish and eggs show lower elasticity, this suggests the existence of social strata lacking the economic flexibility to access diverse protein sources. This pattern confirms that animal protein consumption remains heavily influenced by economic capability and is unevenly distributed across income groups.

The interpretation of these elasticities holds important implications for regional food security. As defined by the FAO, food security encompasses not only food availability but also physical and economic access to sufficient and nutritious food. Therefore, when the consumption of animal protein—particularly beef—is significantly concentrated among high-income groups, it highlights structural barriers that prevent vulnerable populations from fulfilling their nutritional needs. Such inequalities in protein consumption may contribute to broader nutritional and health

disparities, particularly among children and working-age groups who are central to regional development. This situation calls for intervention strategies that go beyond market mechanisms and are oriented toward social justice.

In this context, various forms of government intervention—such as subsidies for nutritious food, strengthening distribution systems with stable prices, and implementing food policies targeting vulnerable groups—become increasingly relevant. These interventions not only help stabilize prices but also ensure that households with limited purchasing power maintain access to high-nutrient food. Furthermore, well-targeted subsidized food programs can reduce nutritional gaps and strengthen the foundations of local food security.

This idea aligns with the Food Justice and Equity Theory as proposed by Hochedez (2022), which asserts that access to nutritious food should be regarded as a fundamental citizen right rather than a mere economic commodity. The theory emphasizes that food justice is a prerequisite for inclusive social development, and that inequality in food access directly affects community health, productivity, and resilience. Therefore, the approach to interpreting the elasticity of animal protein consumption should extend beyond statistical figures and be recognized as a crucial indicator of structural inequality and sustainable food security.

CONCLUSION

Based on the elasticity evaluation of animal protein demand in North Sumatra Province, it can be concluded that household consumption patterns for beef, chicken, fish, and eggs are not solely determined by nutritional preferences or cultural habits but are strongly influenced by price structures and household income levels. The high price and income elasticity of beef and chicken underscore their status as luxury goods for most residents, whereas the relatively inelastic demand for fish and eggs reflects their role as more affordable staple foods. These findings address the research objective of uncovering how the relationships among price, income, and animal protein consumption reflect socio-economic segmentation in North Sumatran society. They also highlight the strong substitution pattern between beef and chicken as an adaptive household strategy in response to price pressures. The novelty of this study lies in its mapping of long-term elasticity in a region outside Java, which has been underrepresented in national food policy research. Thus, understanding elasticity is not only relevant to microeconomic analysis but also crucial as a tool for evaluating socially just food security. This underscores the need for policy interventions targeting vulnerable groups, such as subsidies for nutritious food and strategic price controls on key protein commodities at the regional level.

ETHICAL STATEMENT AND DISCLOSURE

This study was conducted in accordance with established ethical principles, including informed consent, protection of informants' confidentiality, and respect for local cultural values. Special consideration was given to participants from vulnerable groups to ensure their safety,

comfort, and equal rights to participate. No external funding was received, and the authors declare no conflict of interest. All data and information presented were collected through valid research methods and have been verified to ensure their accuracy and reliability. The use of artificial intelligence (AI) was limited to technical assistance for writing and language editing, without influencing the scientific substance of the work. The authors express their gratitude to the informants for their valuable insights, and to the anonymous reviewers for their constructive feedback on an earlier version of this manuscript. The authors take full responsibility for the content and conclusions of this article.

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