Influential factors of animal food consumption in West Sumatera Province [application of almost ideal demand system model]

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Abstract. This study was aimed to determine the pattern of consumption of beef, poultry, and fish in households in West Sumatera Province and the factors that influence the demand for beef, poultry, and fish in households in West Sumatera Province. This study used an econometric approach by building a model of the demand function for beef, poultry and fish commodities using raw data from the Survey Sosial Ekonomi Nasional [SUSENAS] for West Sumatera Province in 2018. The total sample was 100 households. Data were analyzed using the Almost Ideal Demand System [AIDS] analysis method. The consumption pattern of demand for beef, poultry meat and fish is characterized by R2 by 0.8233, meaning that 82.33% in the proportion of expenditure on animal foods can be explained by the variables used in the model. Variables that influence the demand for meat with a level of 95% are the prices of each commodity in the form of beef, poultry and fish, educational level of housewives [dummy for higher education and low education] and total household expenditure. Variables that influence the demand for meat with a level of 90% are the number of household members. Variables that influence the demand for meat with a level of 0% are the area of residence of the household [dummy for urban and rural] and the age of the household mother.

1. Introduction
The problem of food and nutrition adequacy is a very important thing; therefore, the development of agriculture and animal husbandry is directed to meet the adequacy of food and nutrition of the community which can be reflected from the adequacy of calories and protein. Calorie needs can be obtained from staple foods, while protein needs are more obtained from the consumption of animal foods such as meat, eggs, milk, and fish [1].

Widyakarya Nasional Pangan dan Gizi [WNPG] as a cross-stakeholder forum that can play a strategic role in efforts to bring together and synchronize various programs and policies on food and nutrition has held the XI meeting on 3rd of July, 2018 and has determined that the calorie consumption adequacy benchmark and protein per capita per day is equal to 2,100 kcal and 57 grams per capita per day are fully explained in the Table 1.
Table 1. Comparison of calorie and protein consumption in West Sumatera and national provinces with WNPG [Widyakarya Nasional Pangan dan Gizi]

| Area            | Calories [kcal/capita/day] | Protein [gr/capita/day] |
|-----------------|---------------------------|-------------------------|
| WNPG            | 2,150                     | 57                      |
| National        | 1,868.77                  | 54.16                   |
| West Sumatera   | 1,922.08                  | 51.67                   |

Source: The data is processed by researchers 2017

Nationally the mean calorie and protein consumption of the Indonesian population of 1,868.77 kcal and 54.16 grams is still below the standards set by WNPG and for the Province of West Sumatra itself. The mean number of calorie and protein consumption per capita days is equal to 1,922.08 kcal and 51.67 grams per capita per day, which also means that it is still below the WNPG standard and the mean national consumption of calories and protein.

The condition of meat consumption which is still low in West Sumatra Province turns out to be inversely proportional to the amount of beef production 23,782 tons/year and poultry meat as much as 40,895 tons/year if accumulated then the total of both types of meat amounts to 64,678 tons/year and fish production is 269,123 tons/year. It can be said that the amount of beef, poultry, and fish production is quite high. The high amount of meat production should have been able to meet the calorie and protein consumption target set by the WNPG because of the total population of the Province of West Sumatra which amounted to 5,259,528 people [2].

According to economic theory, many variables affect the consumption pattern of a commodity, including the price of the goods themselves, the prices of other related items, the level of income per capita, tastes or habits, population, estimated future prices, distribution of income and business, producer businesses increase sales. In the context of increasing public consumption of livestock commodities, information is needed about the factors that determine community consumption of livestock commodities.

Based on the above conditions, to uncover the phenomenon of low meat consumption in the province of West Sumatra it is deemed necessary to conduct research aimed at finding the variables that determine the pattern of meat consumption in the province of West Sumatra. In this study besides incorporating economic variables, it also includes non-economic variables in the form of sociodemographic variables as variables that are thought to determine the pattern of a person's consumption of meat and how the effects of variables on meat consumption if there is a change in the variables concerned.

The objectives of this study are to determine patterns of consumption of beef, poultry and fish in households in West Sumatra Province, to find out the factors that influence the demand for beef, poultry, and fish in households in the Province of West Sumatra, and this research can be a source of data and information for researchers, students and parties who need the information to be used as references and further research discourse in more depth about distribution and agribusiness system of beef, poultry, and fish to find out what consumers want and need and to make any improvements needed in a household at West Sumatra Province.

2. Material and method

2.1. Research sites
The study was conducted in the urban of Padang by visiting the West Sumatra Badan Pusat Statistik [BPS] office on Khatib Sulaiman Street, Padang City, West Sumatra Province.
2.2. Data types and sources

This study used raw data which is the result of the Survey Sosial Ekonomi Nasional in the March 2018 edition obtained from the Badan Pusat Statistik [BPS]. SUSENAS data itself is not published publicly, but must be obtained by taking data through a special forum on the official website of the Badan Pusat Statistik and must complete a series of requirements to obtain the data.

The collected data are then sorted according to the needs of the variables used in this study to obtain households that meet the characteristics for further use as a sample of this study. Data obtained from SUSENAS shows 10,067 households that have been surveyed by the Badan Pusat Statistik with the variables needed to conduct this study and are subsequently considered as populations.

Since the population is too large, then the amount of data was reduced by using the Slovin formula. The Slovin Formula is used to calculate the sample size because the population is considered to be homogeneous and the Badan Pusat Statistik as a data taking and processing agency is also considered to have carried out a sampling that well. The Slovin calculation formula is as follows:

\[ n = \frac{N}{1 + N [e]^2} \]

Where:
- \( n \) = Study sample size
- \( N \) = household population from SUSENAS data
- \( e \) = margin error [in this study used 10%]

Based on this formula, the number of respondents in this study were:

\[ n = \frac{10,000}{1 + 10,000 [0.01]} = 100 \]

Then in this study used 100 households which will then be used as research samples.

2.3. Research variable

To answer the research objectives, the variables used are as follows:

Based on economic factors
1. Total of beef consumption [kg / HOUSEHOLD / week]
2. Total of poultry consumption [kg / HOUSEHOLD / week]
3. Total of fish consumption [kg / HOUSEHOLD / week]
4. Price of beef [Rp / kg]
5. Price of poultry meat [Rp / kg]
6. Price of fish [Rp / kg]
7. Household income [Rp / month]

Based on non-economic factors
1. Number of household members [people]
2. Mother’s age [years]
3. Mother’s education level

Educational Dummy;
1. 1: Higher education [graduated college]
2. 0: Low education [not graduating college]

The area of residence of the household
1. 1: urban area
2. 0: rural areas
2.4. Research methods
This study was a desk study because this study used secondary data obtained from the results of the Survey Sosial Ekonomi Nasional [SUSENAS] conducted by the Badan Pusat Statistik. Desk study itself means the method of collecting data in the form of reports of previous studies, papers or papers, as well as secondary data needed in designing research, and analyzing study results. In this study computer assistance with SAS software and Microsoft Office Excel 2007 was used.

The mathematical model used is a linear approximation of the Almost Ideal Demand System [AIDS] model developed by Deaton and Muellbauer [3], as follows:

\[ W_i = \alpha_i + \sum y_{ij} \log P_j + \beta_i \log \left( \frac{x}{p*} \right) + \theta_a \log JK + \theta_b \log U + \theta_c \log Pddk + \theta_d \log W + u_i \]

Information:
- \( W_i \) = Share / Proportion of i-th meat expenditure to total expenditure meat [i = 1, 2, 3]
- \( P_j \) = Aggregate price of the jth animal food commodity [j = 1, 2, 3]
- \( X \) = total expenditure for household animal food
- \( P^* \) = stone price index [stone price index is searched by the formula: \( \log p^* = \sum w_i \log p_i \)]
- \( JK \) = Number of household members [people]
- \( U \) = Age of Housewife [year]
- \( Pddk \) = Dummy Education Housewife [years]
- \( 1 \) = if the mother is a university graduate
- \( 0 \) = if the mother is not a university graduate
- \( W \) = Dummy household area
  - \( 1 \) = Urban
  - \( 0 \) = Rural
- \( \alpha, \beta, \gamma \) = Consecutive regression parameters for intercept, expenditure and aggregate prices for each commodity.
- \( \theta_a, \theta_b, \theta_c, \theta_d \) = successive regression parameters for the number of household members, mother's age, housewife's education dummy, and housewife's employment dummy.
- \( u_i \) = error factor

3. Results and discussion
3.1. Patterns of animal food consumption in households in West Sumatra Province
To find out how the consumption patterns of beef, poultry, and fish, several variables are used to describe the consumption patterns of each household and these variables are as follows:

3.1.1. Beef prices, poultry prices, and fish prices
An illustration of the level of consumption of the three types of meat in households in West Sumatra Province can be seen in Table 2.

| Types of Meat Commodities | Consumption [kg/household/week] | Price [Rp/kg] | Total Expenditures [Rp/week] |
|---------------------------|---------------------------------|---------------|-----------------------------|
| Beef                      | 0.669                           | 115,000       | 68,800                      |
| Poultry                   | 2.118                           | 29,000        | 52,423                      |
| Fish                      | 1.117                           | 22,370        | 18,893                      |

Source: 2018 Research Results
Bold: the highest valueItalic: the lowest value
It can be seen through the table above that the biggest household expenditure is beef [Rp. 68,800/week] with a total consumption of 0.669 kg/household/week, but the amount of beef consumption is smaller when compared to the amount of consumption of poultry and fish. This is expected because beef prices tend to be more expensive than poultry meat and fish. This result is following the opinion of Hardjosworo [4] that one of the important factors causing the low consumption of animal protein is the high price of food from livestock when measured from the mean income most of the Indonesian people.

3.1.2. Household income

The income strata in this study were ranked using World Bank criteria, which grouped them into three income strata based on their distribution. After being ranked, the low-income household group is 40% of the lowest expenditure sample, with a mean expenditure of Rp 1,255,583 the high-income group is the highest 20% of income with a mean expenditure of Rp 8,300,424 and the rest of them [40%] is the moderate-income group with a mean expenditure of Rp 2,863,430. In the analysis, the level of income is proxied by the level of household expenditure shown in the following table.

| Revenue Strata | Expenditures Mean [Rp/Month] | Share of Expenditures [%] |
|----------------|------------------------------|--------------------------|
|                | Total | Food  | Non Food | Food | Non Food |
| Lowest         | 1,255,583 | 870,680 | 384,903 | 69 | 31 |
| Mean           | 2,863,430 | 1,740,136 | 1,123,294 | 61 | 39 |
| Highest        | 8,300,424 | 2,131,669 | 6,168,755 | 26 | 74 |
| West Sumatera | 3,630,939 | 1,717,716 | 1,913,224 | 47 | 53 |

Source: 2018 Research Results
Bold: the highest value Italic: the lowest value

Table 3 shows that the share of expenditure on food is higher in low-income households. The higher the income strata, the smaller the share of expenditure for food, and conversely the share of expenditure for non-food is higher in high-income households. In these high-income strata households, the need for food is fulfilled so that these households turn to other needs for lifestyle and pleasure, for example, to buy luxury goods to improve living standards or status in the society.

3.1.3. Number of household members

In this study, the number of household members is grouped as seen in Table 4. Based on that table, it can be seen that households with members <3 people per household are 41 households [41%], while the households with members 4-5 people per household are 42 households [42%] and the households with members ≥ 6 people per household are 17 households [17%].

The data shows that the greater the number of household members also the share of expenditures spent on food needs is increasing. This is because the money earned each month will be prioritized for the food fulfillment needs of each household member. However, households with a high share of food expenditure do not increase the amount of meat consumption per capita. This is because the amount of meat purchased will be consumed by a large number of household members.

Conversely, if there are few household members, then the share of expenditure between food and non-food also tends to be balanced, because the needs for food that have been met then the expenditure is diverted to meet non-food needs. But the Mean amount of meat consumed is higher than that of
Table 4. Meat demand based on the number of household members

| No | Member of Household [Person] | Number of Households | Share of Expenditures [%] | Mean meat consumption [gr / capita / week] |
|----|-------------------------------|----------------------|---------------------------|---------------------------------------------|
|    |                               |                      | Food    | Non Food |                      |
| 1  | ≤ 3                           | 41                   | 51       | 49       | 67.20                |
| 2  | 4 – 5                         | 42                   | 55       | 45       | 56.32                |
| 3  | ≥ 6                           | 17                   | 68       | 32       | 54.33                |

Source: 2018 Research Results

3.1.4. Age of housewife

Housewife's age is thought to influence household demand for meat as in previous studies that included the variable age of housewife [5]. Housewife age varies from <30 to ≥ 61 years and can be grouped into five age groups, as presented in Table 5.

Table 5. Demand for meat by mother's age

| No | Age [years] | Number of Households | Share of Expenditures [%] | Mean meat consumption [gr / capita / week] |
|----|-------------|----------------------|---------------------------|---------------------------------------------|
|    |             |                      | Food    | Non Food |                      |
| 1  | ≤ 30        | 7                    | 54       | 46       | 52                  |
| 2  | 31-40       | 34                   | 55       | 45       | 56                  |
| 3  | 41-50       | 44                   | 57       | 43       | 58                  |
| 4  | 51-60       | 11                   | 59       | 41       | 62                  |
| 5  | ≥ 61        | 4                    | 52       | 48       | 61                  |

Source: 2018 Research Results

Table 5 shows that the largest mean meat consumption is found in mothers with an age range of 51-60 years and the lowest is found in mothers with an age range of <30 years. Preparing meat for consumption in the household is seemed to depend on the mother’s age. The higher the age of the mother is, the higher the mean meat consumption.

3.1.5. Housewife's education

Indicators of housewife education in this study are shown by the latest education taken by mothers. The level of education is classified as highly educated and low-educated. Mothers with high education are limited to mothers who graduated or completed their tertiary education, while mothers with low education are limited to mothers who graduated or only completed their education below the tertiary level. The data can be seen in Table 6.

The data shows that the majority of housewives in West Sumatra Province still have a low level of education covers 58 households [58%], while households with highly educated housewives are 42 households [42%]. The amount of meat consumption in housewives with high education is much greater at 77.34 grams/household/week compared to housewives with low education amounting to 46.04 grams/household/week. Similar research was also found by Budiwinarto [6] which stated that households with a large number of household members because the amount of meat purchased is only consumed by a small number of household members.
the better education level of a wife or woman in the household would have a positive impact on increasing income and consumption.

Table 6. Meat demand based on the mother's education level

| No | Level of Education | Number of Households | Share of Expenditures [%] | Mean meat consumption [gr/capita/week] |
|----|-------------------|----------------------|---------------------------|--------------------------------------|
|    |                   |                      | Food | Non Food     |                                      |
| 1  | Higher            | 42                   | 53   | 47           | 77.34                                |
| 2  | Lowest            | 58                   | 64   | 36           | 46.04                                |

Source: 2018 Research Results

Bold: the highest value Italic: the lowest value

3.1.6. Household residential area

The residential areas in this study are divided into urban and rural areas. The phenomenon regarding that distribution is presented in Table 7.

The data shows that the highest mean meat consumption is found in households in urban areas which are 79.13 gr/capita/week while the households in rural areas are only 45.89 gr/capita/week. Based on the share of expenditure it can be concluded that households in rural areas use 64% of household income to meet food needs and only use 36% of the total expenditure for non-food needs. In contrast to households in urban areas, the expenditure on food needs is only 47% of total expenditure and the remainder is allocated for non-food needs by 53%.

Table 7. Demand for meat by household residential area

| No | Areal of Residence | Number of Households | Share of Expenditures [%] | Mean meat consumption [gr/capita/week] |
|----|--------------------|----------------------|---------------------------|--------------------------------------|
|    |                    |                      | Food | Non Food     |                                      |
| 1  | Urban              | 40                   | 47   | 53           | 79.13                                |
| 2  | Rural              | 60                   | 64   | 36           | 45.89                                |

Source: 2018 Research Results

Bold: the highest value Italic: the lowest value

Theoretically, regional factors are thought to influence consumption patterns, especially for animal origin commodities because urban communities are thought to have better income levels and education levels compared to people living in rural areas.

3.2. Factors affecting the demand for beef, poultry and fish in households in West Sumatra Province

In the Almost Ideal Demand System model to see whether the model can be accepted or not, attention has to be paid to the value of the determination coefficient R2 system obtained from the estimation of the model. The Ordinary Least Squares [OLS] method exhibited a value of 0.8233, meaning 82.33% diversity in the proportion of expenditure each animal food can be explained by the independent variables in the model, namely the fish prices, beef prices, poultry meat prices, total household expenditure, number of household members, age of housewives, housewife education dummy [highly educated, low educated], and dummy variable region [urban, rural]. Also, the statistical criteria that can be seen to evaluate the estimation results of the AIDS equation model are root-MSE. The root-MSE value obtained in this study is 0.1767, meaning that the error value that might occur in the model is 17.67%.

Furthermore, testing the demand model is also done individually [one by one of the independent variables] with the Seemingly Unrelated Regression [SUR] method to find out whether each large
variable significantly influences the dependent variable. Table 8 presents the estimated coefficients of the AIDS model variables for each animal food.

Table 8. Predicted coefficients for the AIDS model variables for each meat

| Variable                  | Fish            | Beef            | Poultry         |
|---------------------------|-----------------|-----------------|-----------------|
| Intercept                 | 0.331455*       | 0.090702*       | 0.149252*       |
| Price fish                | 0.063453*       | -0.011101*      | -0.01554*       |
| Price beef                | -0.01101*       | 0.027165*       | -0.00867*       |
| Price poultry             | -0.01554*       | -0.00867*       | 0.034777*       |
| Expenditure               | 5.00E-10        | 1.36E-08*       | -1.25E-08       |
| Member of household       | 0.019041**      | -0.00401        | -0.01144**      |
| Age of wifehouse          | 0.000047        | 0.000548        | 0.000422        |
| Level of mother’s education| -0.00518        | -0.00382*       | -0.00128        |
| Households area           | -0.01078        | 0.007857        | 0.027293        |

Source: 2018 Research Results Note: *significant at: 10% level, **: significant at: 5% level

3.3. Model significance test [statistical test F]
The F Statistical Test is a test of the significance of the model simultaneously which shows whether the independent variables on the model have a joint influence on the dependent variables. A significant F test shows that the model can be accepted and the elasticity value obtained is more accurate. Analysis of the Almost Ideal Demand System [AIDS] model using SAS software provides the following model:

\[
\begin{align*}
    w_1 &= 0.3315 - 0.0369 \log p_1 + 0.0635 \log p_2 - 0.0110 \log p_3 - 0.0155 \log p_2 \\
        &- 0.0339 \log \left( \frac{x}{p} \right) - 0.0108 W - 0.0052 Pdak + 0.000047 U + 0.0190 J + 5.00E-10 T \\
        &- 1.20E-08 PM
\end{align*}
\]

\[
\begin{align*}
    w_2 &= 0.0907 - 0.0075 \log p_1 - 0.0110 \log p_2 + 0.0272 \log p_3 - 0.0087 \log p_3 \\
        &+ 0.0158 \log \left( \frac{x}{p} \right) + 0.0076 W - 0.0038 Pdak + 0.00055 U - 0.0040 J + 1.36E-08 T \\
        &+ 1.08E-08 PM
\end{align*}
\]

\[
\begin{align*}
    w_3 &= 0.1493 - 0.0106 \log p_1 - 0.0155 \log p_2 - 0.0087 \log p_3 + 0.0348 \log p_3 \\
        &+ 0.0122 \log \left( \frac{x}{p} \right) + 0.0273 W - 0.0013 Pdak + 0.00042 U - 0.0114 J - 1.25E-08 T \\
        &+ 4.23E-08 PM
\end{align*}
\]
where:
\( w_1 \): Proportion of expenditure for fish commodities
\( w_2 \): Proportion of expenditure for beef commodities
\( w_3 \): Proportion of expenditure for poultry meat commodities
\( p_1 \): Price of the fish commodity [in Rupiah]
\( p_2 \): Beef commodity prices [in Rupiah]
\( p_3 \): Poultry meat commodity prices [in Rupiah]
\( x \): Total expenditure for eggs, fish, beef and poultry meat
\( P \): Stone price index
\( W \): Region [1 = urban, 0 = rural]
\( Pddk \): Education of housewives [1 = highly educated, 0 = low educated]
\( U \): Age of housewife
\( A \): Number of household members
\( Q \): Total Expenditures
\( PM \): Expenditures for food

4. Conclusion
Based on the results above, it can be concluded that the model of demand for beef, poultry, and fish are marked with \( R^2 \) of 0.8233 [82.33%]. The factors that influence the demand for meat in this study can be divided into three levels of significance, namely the significant variable at the 10% level is the price of each commodity in the form of beef, chicken, and fish, total household expenditure and the level of education of housewives [dummy higher education and low education], the significant variable at 5% is the number of household members, and variables that do not affect the demand for meat are the age of housewives and the area of residence of households [urban and rural].

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