Demand analysis of beef, poultry, and fish at household in West Sumatera Province (application of Almost Ideal Demand System Model)

A P Ermanda, Jafrinur and J Hellyward

Faculty of Animal Husbandry Andalas University

Corresponding author: adliputraermanda@gmail.com

Abstract. This study aims to determine: (1) pattern of consumption of beef, poultry, and fish in households in West Sumatera Province (2) 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 are 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, education 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 very important. 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 held on July 3, 2018 has determined that the calorie consumption adequacy benchmark and protein per capita per day that is equal to 2,100 kcal and 57 g/capita/day are fully explained in the table below

Nationally the mean calorie and protein consumption of the Indonesian population of 1,868.77 kcal and 54.16 g 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 per capita days that is equal to 1,922.08 kcal and 51.67 g/capita/day, which also means that it is still below the WNPG standard and the mean national consumption of calories and protein.

Table 1. Comparison of calorie and protein consumption in West Sumatra and national provinces with Widyakarya Nasional Pangan dan Gizi

Area	Calories (kcal/capita/day)	Protein (g/capita/day)
WNPG	2.150	57
National	1.868,77	54.16
West Sumatera	1.922,08	51.67

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.

Where in this study besides incorporating economic variables will also include non-economic variables in the form of sociodemographic variables as variables which 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:

1. To determine patterns of consumption of beef, poultry and fish in households in West Sumatra Province.
2. To find out the factors that influence the demand for beef, poultry and fish in households in the Province of West Sumatra.

So that academically this research can be input in the form of data and information donations for researchers, students and parties who need especially information about beef, poultry and fish to be used as references and further research discourse in more depth and in practice this research can be taken into consideration for the government and parties involved in the distribution and agribusiness system of beef, poultry and fish to find out what consumers want and need and to make a series of improvements needed in the field of consumption, especially beef, poultry meat and fish in the household in West Sumatra Province.

2. Material and methods

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 uses raw data (raw data) which is the result of the Survey Sosial Ekonomi Nasional (SUSENAS) 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 data that has been collected is 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. With a population that is too large then the amount of data to be used as a research sample needs to be reduced by using the Slovin Formula, the Slovin Formula is used to calculate the sample size because the study 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:

$$n = \frac{N}{1 + N(e)^2}$$

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 are:

$$n = \frac{10.000}{1 + 10.000(0.01)} = 100$$

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/RT/week)
2. Total of poultry consumption (kg/RT/week)
3. Total of fish consumption (kg/RT/week)
4. Price of beef (IDR/kg)
5. Price of poultry meat (IDR/kg)
6. Price of fish (IDR/kg)
7. Household income (IDR/month)

Based on non-economic factors
1. Number of household members (people)
2. Mother's age (years)
3. Mother's education level
4. Educational Dummy;
   1: Higher education (graduated college)
   0: Low education (not graduating college)
5. The area of residence of the household
   1: urban area
   0: rural areas

2.4. Research methods

This study is a desk study because this study uses secondary data obtained from the results of the 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 [3], as follows:

$$W_i = \alpha_i + \sum \gamma_{ij} \log P_j + \beta_i \log \left({}^x/_{p} * \right) + \theta_a \log JK + \theta_b \log U + \theta_c \log Pddk + \theta_d \log W + u_i$$

Wi   = Share / Proportion of i-th meat expenditure to total expenditure meat (i = 1,2,3,)
Pj   = 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 * = Σ wi log pi)
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
α, β, γ = Consecutive regression parameters for intercept, expenditure and aggregate prices for each commodity
θa, θb, θc, θd = successive regression parameters for the number of household members, mother's age, housewife's education dummy, and housewife's employment dummy.
ui   = error factor

3. Results and discussion

3.1. Patterns of animal food consumption in households in West Sumatra Province
To see the consumption patterns of the three types of meat seen from the variables that influence them, namely:

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 the table 2.

Table 2. Patterns of meat consumption based on meat prices

Types of meat commodities	Consumption (kg/RT/week)	Price (IDR/kg)	Total expenditures (IDR/week)
Beef	*0,669*	**115.000**	**68.800**
Poultry	**2,118**	29.000	52.423
Fish	1,117	*22.370*	*18.893*

Bold: the highest value Italic: the lowest value

It can be seen through the table above that the biggest household expenditure is beef (68,800 IDR/week) with a total consumption of 0.669 kg/RT/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 is in accordance with the opinion of [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 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 IDR 1,255,583, the high-income group is the highest 20% of income with an Mean expenditure of IDR 8,300,424 and

the rest of them (40%) is moderate income group with an Mean expenditure of IDR 2,863,430. In the analysis, the level of income is proxied by the level of household expenditure shown in the following table.

Table 3. Mean total expenditures, food and non-food expenditures and share of food and non-food expenditures to total household expenditure for a month by revenue strata

Revenue strata	Expenditures mean (IDR/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

Bold: the highest value Italic: the lowest value

From Table 3 above it is shown 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 so as to improve living standards or social status in front of others.

3.1.3. Number of household members. In this study the number of household members are grouped into table 4. Based on information from the table above, it can be seen that for households with members <3 people per household are 41 households (41%), for households with members 4-5 people per household are 42 households (42%) and for households with members <¬> 6 people per household are 17 households (17%).

Table 4. Meat Demand Based on Number of Household Members

No	Member of Household (Person)	Number of households	Share of expenditures (%)		Mean meat consumption (g/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*

Bold: the highest value Italic: the lowest value

From the above data it can be concluded that the greater the number of household members also increasingly influences the increase in the share of expenditures spent on food needs, 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 actually higher than that of households with a large number of household members because the amount of meat purchased is only consumed by a small number of household members.

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 -> 61 years, and can be grouped into five age groups, as in the following table:

Table 5. Demand for Meat by Mother's Age

No	Age (years)	Number of households	Share of expenditures (%)		Mean meat consumption (g/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

Bold: the highest value Italic: the lowest value

In the table above we can see 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 <30 years. prepare meat for consumption in the household because we can see the higher the age of the mother, 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, for mothers with high education are limited to mothers who graduate or complete tertiary education, while for mothers with low education are limited to mothers who graduate or only complete education below the tertiary level and this can be seen in the following table:

Table 6. Meat Demand Based on Mother's Education Level

No	Level of education	Number of households	Share of expenditures (%)		Mean meat consumption (g/capita/week)
			Food	Non food	
1	Higher	42	53	47	**77,34**
2	Lowest	58	64	36	46,04

Bold: the highest value Italic: the lowest value

Based on the table above the data shows that the majority of housewives in West Sumatra Province still have a low level of education, as many as 58 households (58%) and households with highly educated housewives are 42 households (42%). For the amount of meat consumption in housewives with high education is much greater at 77.34 g/RT/week compared to housewives with low education amounting to 46.04 g/RT/week.

Similar research was also carried out by which stated that the better education level of a wife or woman in the household would have a positive impact on increasing income and consumption.

3.1.6. Household residential area. The residential areas in this study are divided into urban and rural areas, the phenomenon is explained in the following table:

Table 7. Demand for meat by household residential area

No	Areal of residence	Number of households	Share of expenditures (%)		Mean meat consumption (g/capita/week)
			Food	Non food	
1	Urban	40	47	53	**79,13**
2	Rural	60	64	36	45,89

Bold: the highest value Italic: the lowest value

On the above table, we can see that the highest Mean meat consumption is found in households in urban areas which is 79.13 g/capita/week while in households in rural areas it is only 45.89 g/capita/week. For the share of expenditure it can also be concluded that households in rural areas use 64% of household income to meet food needs and only use 36% of total expenditure for non-food needs, in contrast to households in urban areas of expenditure for food needs only 47% of total expenditure and the remainder is allocated for non-food needs by 53%.

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 how the model can be accepted in this study is to pay attention to the value of the determination coefficient R^2 system obtained from the estimation of the model with the Ordinary Least Squares (OLS) method of 0.8233, meaning 82.33% diversity in the proportion of expenditure each animal food that can be explained by the independent variables in the model, namely the variables of fish prices, beef prices, poultry meat prices, total household expenditure, number of household members, age of housewives, housewife education dummy (highly educated, low educated), dummy variable region (urban, rural). In addition, 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 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 9 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

Variabel	Fish	Beef	Poultry
Intercept	0.331455*	0.090702*	0.149252*
Price of fish	0.063453*	-0.01101*	-0.01554*
Price of beef	-0.01101*	0.027165*	-0.00867*
Price of 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 education	-0.00518	-0.00382*	-0.00128
Households areal	-0.01078	0.007857	0.027293

*significant at 10% level, **: significant at 5% level*

3.3. Model significance test (Statistical Test F)

Statistical Test F 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. Significant F test shows 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:

$$w_1 = 0.3315 - 0.0369 \log\ p_1 + 0.0635 \log\ p_2 - 0.0110 \log\ p_3 - 0.0155 \log\ p_3$$
$$- 0.0393 \log \left(\frac{x}{p}\right) - 0.0108W - 0.0052Pddk + 0.000047U + 0.0190J + 5.00E\text{-}10T$$
$$- 1.20E\text{-}08PM$$

$$w_2 = 0.0907 - 0.0075 \log\ p_1 - 0.0110 \log\ p_2 + 0.0272 \log\ p_3 - 0.0087 \log\ p_3$$
$$+ 0.0158 \log \left(\frac{x}{p}\right) + 0.0076W - 0.0038Pddk + 0.00055U - 0.0040J + 1.36E\text{-}08T$$
$$+ 1.08E\text{-}08PM$$

$$w_3 = 0.1493 - 0.0106 \log\ p_1 - 0.0155 \log\ p_2 - 0.0087 \log\ p_3 + 0.0348 \log\ p_3$$
$$+ 0.0122 \log \left(\frac{x}{p}\right) + 0.0273W - 0.0013Pddk + 0.00042U - 0.0114J - 1.25E\text{-}08T$$
$$+ 4.23E\text{-}08PM$$

with:

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 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 of research that has been done, it can be concluded that:

The model of demand for beef, poultry and fish is marked with R2 of 0.8233, meaning 82.33%. The factors that influence the demand for meat in this study are divided into three levels of significance, namely:

 a. 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).
 b. The significant variable at 5% is the number of household members.
 c. Variables that do not affect the demand for meat are the age of housewives and the area of residence of households (urban and rural).

References

[1]   Jafrinur, J Yusri and R Wati 2009 *Pengembangan model fungsi konsumsi untuk komoditi pangan hewani* (Kasus Kota Padang Provinsi Sumatera Barat) Laporan hasil penelitian fundamental. DP2M Dikti (Padang: Universitas Andalas)
[2]   Badan Pusat Statistik Provinsi Sumatera Barat 2018 *Sumatera Barat dalam Angka Tahun 2017* (Padang: BPS Provinsi Sumatera Barat)
[3]   Deaton M and J Muellbauer 1980 *American Economic Review* **70** 312–326
[4]   Hardjosworo and Rukminasih 2000 *Peningkatan Produksi Ternak Unggas* (Jakarta: Penebar Swadaya)
[5]   Ariningsih E 2004 *ICASERD Working Paper* **56** 1–21
[6]   Budiwinarto K 2011 *Smooting* **6** 27–39