Economics Development Analysis Journal Vol. 12 (2) (2023)

Economics Development Analysis Journal

http://journal.unnes.ac.id/sju/index.php/edaj

Estimation and Analysis of Food Demand Patterns in North Kalimantan

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Article Information

History of Article
Received January 2023
Accepted March 2023
Pusblished May 2023

Keywords:
Food Consumption Pattern, A linear approximated Almost Ideal Demand System, North Kalimantan, Elasticity, SUSENAS

Abstract

North Kalimantan Province is in the top five provinces with Indonesia's highest percentage of food-insecure populations in 2018. Meanwhile, of the five provinces, only North Kalimantan Province has the status of a newly expanded province. As a province that is still relatively new, this is a challenge for the local government to ensure the availability of food for its people. Therefore, this research aims to analyze the factors that influence patterns and changes in food consumption due to prices, income, and socio-demographic characteristics of households in North Kalimantan Province. This study uses A Linear Approximated Almost Ideal Demand System (LA/AIDS) for 13 food commodity groups using Susenas data in 2018. The results show that the prices of each commodity group and other commodities significantly influence the proportion of food expenditure. In addition, the number of household members, household residences, and head of household education substantially affects the pattern of household food consumption. Price elasticity provides a positive value for 11 commodity groups, and only two commodities are negative, namely vegetables and fruits, while cross elasticity is quite varied. The policy implications that the government can carry out are to ensure food availability by using this research information to create work programs and strategic policies to ensure the fulfillment of food needs.

ISSN 2252-6560

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INTRODUCTION

Food and non-food expenditures are fundamentally intertwined. In situations of limited money, addressing food demands will take precedence, resulting in low-income groups spending most of their income on food. Along with an increase in income, there will be a progressive shift in spending habits, characterized by a drop in food consumption and an increase in non-food expenditures (Kharisma, et al., 2021). One variable that may be used to measure a population's economic welfare level is expenditure patterns, whereas shifts in the expenditure composition can indicate changes in economic welfare (Jumah, Dipeolu, Ayinde, & Adebayo, 2008). Because the elasticity of demand for food is generally low, while the elasticity of demand for non-food demands is relatively high, the expenditure composition and pattern fluctuate. In population groups whose food intake has reached a saturation point, extra money is used to cover the needs for non-food commodities, while the remainder of the income is saved as savings (BPS, 2019).

Access to reliable, comprehensive, and well-organized food security information is required to predict, prevent, and solve food insecurity and malnutrition challenges. Information on food security can be utilized to manage food crises within the context of short, medium, and long-term initiatives to protect/avoid food and nutrition crises. Law No. 18 of 2012, Article 114 regarding Food, and Government Regulation No. 17 of 2015, Article 75 regarding Food Security and Nutrition mandates that the central and regional governments are required to build, compile, and develop an integrated Food and Nutrition Information System, which can be used for planning, monitoring, evaluating, stabilizing food supply and prices, as well as an early warning system for food problems and food and nutrition emergencies (BKP, 2018).

Table 1. Top Five Provinces with the Highest Rate of Food Insecurity Rates (Consumption of Calories/Capital/Day <1,400 KKal)

Rank	Year			
	2015	**2016**	**2017**	**2018**
1	North Maluku	North Maluku	Papua	Papua
2	West Papua	Papua	North Maluku	Maluku
3	North Kalimantan	West Papua	West Papua	North Maluku
4	Papua	Maluku	Maluku	North Kalimantan
5	Maluku	North Kalimantan	North Kalimantan	Kaltim

Source: The Food Security Agency (BKP) of the Ministry of Agriculture, 2018

The Food Security Agency (BKP) of the Ministry of Agriculture ranks North Kalimantan Province among the top five provinces with the highest food insecurity rates. This data is derived from the 2018 Center for Food Availability and Insecurity Performance Report. A population that consumes less than 1,400 Kcal per day per person is considered to have a high food insecurity rate. Since 2015, North Kalimantan Province has been one of the three provinces with the highest rates of food insecurity, ranking third behind North Maluku and West Papua (Kementan, 2019). In addition, North Kalimantan Province moved to fifth place in 2016 and 2017 but fell back to fourth place in 2018. More details can be seen in Figure 1.

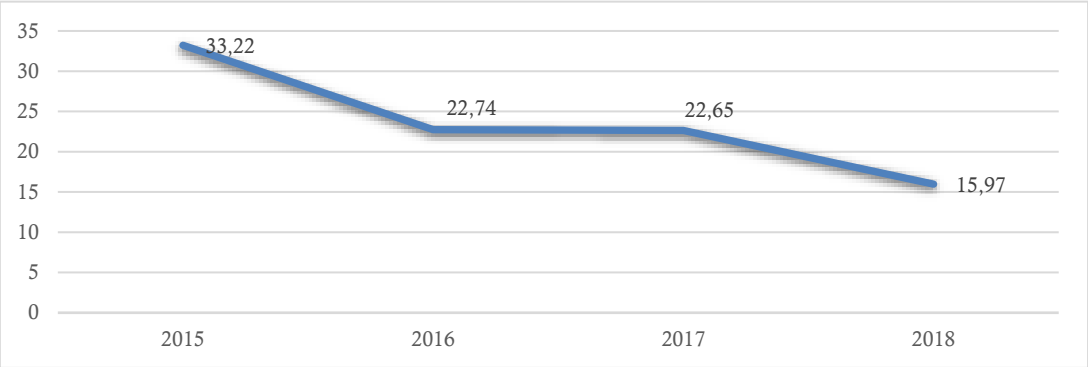

Figure 1. Food Insecurity Rate in the Population of North Kalimantan Province 2015-2018
Source: The Food Security Agency (BKP) of the Ministry of Agriculture, 2018

Meanwhile, the food insecurity rate in North Kalimantan Province tended to decline. According to the Directory of Food Consumption Development issued by the Food Security Agency of the Ministry of Agriculture, the most significant food insecurity rate in North Kalimantan Province was 33.22% in 2015 and fell to 15.97% in 2018. The trend of these alterations is depicted in Figure 1.

Table 2. Average Monthly Per Capita Expenditure by Food & Non-Food Group by Residential Area (Rupiah), 2018

Expense	Urban	Rural	North Kalimantan
Food	699,406	633,018	671,612
Not Food	837,432	611,784	742,961

Source: Central Bureau of Statistics, 2018

There are disparities in food and non-food expenditures based on residential location, split into urban and rural areas. In urban areas, expenditures on non-food products exceed expenditures on food. In 2018, the average food spending per capita in urban areas was 699,406 IDR, while non-food expenditures were 837,432. The average per capita food and non-food expenditures in rural areas are IDR 633,018 and IDR 617,848, respectively (see Table 2).

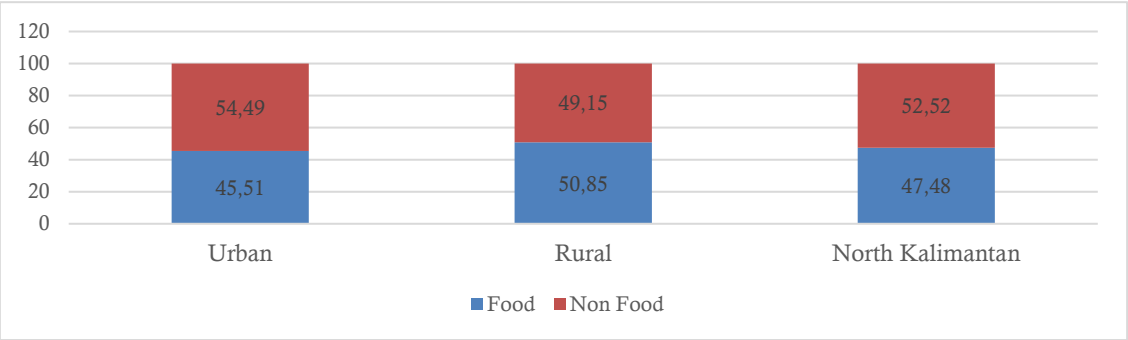

Figure 2. Percentage of Monthly Per Capita Expenditures on Food and Non-Food Groups by Residential Location, 2018
Source: Central Bureau of Statistics, 2018

In urban areas, food expenditures account for 45.51% of per capita expenditures, whereas non-food expenditures account for 54.49%. The structure of per capita population expenditures in rural areas differs from that of urban areas, with food expenditures accounting for 50.85% and non-food expenditures accounting for 49.15%. More details can be seen in Figure 2.

Table 3. Average Monthly Expenditure per Capita by Food Commodity Group, 2018

Food Group Details	Rupiah (IDR)	Percentage (%)
a. Grains	76,820	11.44
b. Tubers	5,668	0.84
c. Fish/Shrimp/Squid/Shellfish	83,846	12.48
d. Meat	28,261	4.21
e. Eggs and milk	44,431	6.62
f. Vegetables	49,136	7.32
g. Nuts	11,787	1.75
h.Fruits	23,601	3.51
i. Oil and Coconut	14,739	2.19
j. Beverage Ingredients	21,489	3.20
k. Spices	15,106	2.25
l. Other Consumption	13,337	1.99
m. Processed Food/Beverages	208,954	31.11
n. Cigarettes and tobacco	74,438	11.08
Total Food	**671612,17**	**100.00**

Source: Central Bureau of Statistics, 2018

Table 3 reveals that in the food group, the commodity group for Processed Food/Beverage consumption had the highest Expenditure at 31.11%, followed by the commodity group for Fish/Shrimp/Squid/Shellfish at 12.48%, Grains at 11.44%, and Cigarettes and Tobacco at 11.08%. Other commodity groups account for less than 10% of overall food expenditures. In addition, socio-demographic factors influence people's food consumption patterns in various ways (Park SY, 2005). Consequently, the socio-demographic features of North Kalimantan Province examined in this study include population size, household composition, and community education. North Kalimantan Province's Central Statistics Agency (BPS) has projected a population of 716.4 thousand people for 2018, with 161.3 thousand homes distributed over five regencies/cities (BPS, 2020). Tarakan City continues to rank first in terms of population, with 262 thousand people, surpassing Bulungan Regency, which holds the title of Provincial Capital City with 138,9 thousand inhabitants. More details can be seen in Table 4.

Table 4. Total Population, Households, and Average Number of Household Members of North Kalimantan Province, 2018

Counties/Cities	Total Population (Thousand Inhabitants)	Number of Households (Thousand)	Average Number of Household Members (Soul)
Malinau	87	18	4.8
Bulungan	139	32	4.3
Tana Tidung	27	6	4.7
Nunukan	202	45	4.4
Tarakan	262	60	4.4
Kaltara	716	161	4.4

Source: Central Bureau of Statistics, 2018

In 2018, the North Kalimantan Province population aged 15 and over was dominated by high school graduates (SMA) or equivalents, totaling 176,132 persons. With 171,767 people, the population that did not graduate from high school and had only an Elementary School (SD) diploma or equivalent still ranked second. In order to improve the quality of Human Resources (HR) in education, the local government must continue to play a significant role (See Table 5).

Table 5. Population Aged 15 and Older by Highest Education Completed in the Province of North Kalimantan, 2018

Education completed	Number
<= Elementary School/Madrasah Ibtidaiyah	171,767
Junior Secondary School/Madrasah Tsanawiyah	95,108
Senior Secondary School/Vocational School/ Madrasah Aliyah	176,132
College	60,140
Total	**503,147**

Source: Central Bureau of Statistics, 2018

Several empirical studies on household food consumption trends have yielded different findings, especially the influence of socio-economic characteristics on food demand patterns. Saputra, Firdaus, & Novianti (2019) found that the income and food diversification level in food-secure provinces is higher than in food-insecure provinces in Indonesia. In addition, price change in carbohydrate sources has been proven more influential on the food demand in food-insecure provinces. Mayasari, Satria, & Noor (2018) show that, in general, socio-economic characteristics significantly contribute to determining household food consumption patterns. Based on their elastic value, food commodities in East Java are price inelastic and more responsive to changes in income. Arthatian, et al., (2018) shows that household consumption patterns in Indonesia are grouped into the consumption of marine fish at 22.10 kg/capita/year, freshwater/ brackish fish at 16.75 kg/capita/year, fresh shrimp at 9.58 kg/capita/year, and processed fish amounted to 4.22 kg/capita/year. The estimation of the demand model gives quite good results, with 82,15% of all variables having a significant effect on the demand function of fish groups, and the coefficient of determination is 27.06%. The value of income elasticity showed that all fish groups are normal goods and were negatively related to prices. The cross elasticities showed a variation relationship between fish groups.

Mustafa, et al., (2022) show that the findings are based on Marshallian elasticity as it provides more accurate images of substitutes and complements than Hicksian elasticity. Moreover, the findings of expenditure elasticity (uncompensated own price elasticity) reveal that vegetables and pulses are normal (inelastic) goods, whereas meat and fruits are luxury (elastic) goods. The results of uncompensated cross-price elasticities reveal that vegetables, meat, and vegetables and fruits are substitutable commodities. In addition, pulses and vegetables and pulses and meat are complementary goods.

Aziz et al., (2011) shows increased consumption of vegetables, fruit, dairy, and meat with higher incomes. The elasticity of spending is more significant in rural areas than in urban areas, and spending on most food groups increases at a decreasing rate as income increases. Expenditure elasticities for all food groups were positive, and less than one, except for fruit, meat, and dairy, were identified as luxury foods. Cereals tend to have the lowest expenditure elasticity of demand. The uncompensated self-price elasticity of demand for all food groups is negative. The absolute quantity is lower than one; that is, demand reacts inelastically to changes in its price, except for meat (elastic). Only substitution relationships were observed according to cross-price elasticity values and at the level of all selected food groups. The high price elasticity of demand for many foods emphasizes the importance of changes in food prices for households.

Widarjono & Rucbha (2016) show that price and income elasticities become less elastic from poor to affluent households. Demand by urban households in Java is more responsive to price but less responsive to income than urban households outside of Java. Simulation policies indicate that an increase in food prices would have more adverse impacts than a decrease in income levels. Low-income families would suffer more than affluent families from rising food prices and decreasing incomes. More importantly, urban households in Java are more vulnerable to an

economic crisis and would respond by reducing their food consumption.

Fujii (2013) suggested that the pattern of food consumption among poor households was different because socio-economic conditions and characteristics of the area of residence influenced it. Baharumshah & Mohamed (1993) shows that own-price elasticity was negative, statistically significant, and in the inelastic range except for chicken. In general, the cross-price elasticities were positive. The demand for pork, chicken, mutton, and fish were all found to be elastic concerning Expenditure.

Based on previous empirical studies, household food consumption produces different findings, especially the effect of socio-economic characteristics on food demand patterns. In addition, North Kalimantan Province has a high level of food insecurity. Therefore, this study aims to analyze the factors that influence food consumption patterns and changes in food consumption due to prices, income, and socio-demographic characteristics of households in North Kalimantan Province. This study includes a significant empirical contribution. First, it analyzes household food consumption using the LA-AIDS analysis test kit. Second, this research was conducted in North Kalimantan Province, which, according to Law No. 20 of 2012, is Indonesia's youngest province with high food insecurity. Research has yet to be conducted on household food consumption habits.

RESEARCH METHODS

This study uses Susenas data for 2018 because, during that period, North Kalimantan Province was included in the top five provinces with the highest percentage of food insecure population (Kementan, 2019). This study will primarily utilize secondary data from the March 2018 National Socio-economic Survey (SUSENAS) results collected by the Central Bureau of Statistics for North Kalimantan Province. The 2018 SUSENAS consumption data on household expenditure is separated into two categories: food and non-food. The food group contains 222 items separated into 14 commodity groups, whereas the non-food group contains 116 items. This study will utilize 13 food commodity groups and 169 commodities.

The core data, the consumption or Expenditure module, and household income are collected by SUSENAS. The core data collects information on household members, health, education, housing, and other socio-economic circumstances. At the same time, the SUSENAS consumption module comprises the quantity and value of food consumption, which includes 215 commodities and 14 commodity groups. The commodity groups include Grains, Tubers, Fish/Shrimp/Shellfish, Meat, Eggs and Milk, Vegetables, Nuts, Fruits, Oils and fats, Beverage Ingredients, Spices, Other Goods, Processed Food/Beverages, and Cigarettes and Tobacco. Household expenditure/consumption for non-food items includes 108 expenditure items with six commodity groups of items, including housing and household facilities, goods and services, clothing/footwear and headgear, durable goods, taxes and insurance, and party and ceremonial needs, as well as non-consumption income, receipts, and expenses.

The unit of analysis was the SUSENAS 2018 sample of 2,034 households distributed across five regencies/cities in the province of North Kalimantan. Sample of March 2018 SUSENAS homes was used for estimating purposes down to the level of regency/city. The LA AIDS model estimates household consumption patterns by including explanatory variables. Model estimation is performed by assigning each household a value so that the sample of households can accurately represent the population. The variables used are (1) the value of monthly expenditure proportion for each selected product per capita and per family (interval). The coverage of the selected commodity groups is based on the consumption of North Kalimantan's staple foods. Additional products, such as additional non-rice carbs, fish, salted fish, chicken meat, eggs, milk, vegetables, fruit, and noodles, are used to examine complementary goods of the main staple diet. The selection of commodity groups for the study was based on frequently consumed food groups representing food, carbohydrate, and protein sources. These are the 13 commodities: Grains,

Tubers, Fish, Shrimp, Squid, Shellfish, Meat, Eggs and milk, Vegetables, Nuts, Fruits, Oil and Coconut, Beverage Ingredients, Spices, Other Consumption, and Processed Food/Beverages; (2) The price of each item is implicitly approximated by the expenditure value divided by the quantity consumed (interval); (3) The total value of monthly food expenditures per capita as a proxy for monthly income per capita (interval). This is predicated on the assumption that each month's salary is wholly used without any savings; (4) Number of household members (interval), Household Members (ART) are all people included in the household; (5) A dummy variable that indicates the residential area, with rural = 0 and urban = 1 (nominal) and The level of education of the head of the household, precisely: Elementary School/Madrasah Ibtidaiyah =0, > Elementary School/Madrasah Ibtidaiyah =1 (nominal).

This study uses descriptive analysis and econometric analysis using the LA AIDS model. Data processing was carried out using Microsoft Excel and STATA 17. Descriptive analysis is a straightforward style of analysis that aims to describe and facilitate interpretation using tables and graphs. The LA AIDS model can be analyzed to examine consumption functions with socio-demographic variables. This model is utilized to achieve the primary study objective. This aim is based on the estimation of the coefficients of the LA AIDS system of equations and employs the elasticity value derived from the estimator coefficients of the model. The LA AIDS model is a development of the Engel Curve and the uncompensated demand function derived from the utility maximization theory.

The LA AIDS model used in this study is a demand function model developed by Sengul & Tuncer (2005) and Deaton & Muellbauer (1980), incorporating many socio-demographic factors. The Seemingly Unrelated Regression (SUR) approach is used to implement the LA AIDS model, a system of equations. This is because the SUR method consists of many unrelated equations, each variable (dependent or independent) stored within a separate system. SUR correlates the errors of the various systems such that a system of linear equations with several regression equations can be reduced to a single set of equations.

A Linear Approximated Almost Ideal Demand System (LA AIDS) demand model must satisfy numerous fundamental characteristics, including symmetry and homogeneity, while the model has to meet the primary demand function characteristic, namely, adding up (Deaton & Muellbauer, 1980). The concept of symmetry is drawn from the utility theory, which demonstrates customer conformity with economic rationality in consumption. Homogeneity demonstrates the adaptability of consumers in planning and rearranging their consumption budgets in response to changes in their total consumption cost budget. When data discrepancies exist, meeting homogeneous and symmetrical restriction properties is challenging. A limitation test is required to establish the model's effectiveness. Next, use the demand equation model with homogeneous and symmetrical constraints. This is because the homogeneity and symmetry assumptions are features of a demand function. This research modifies previous research but distinguishes by adding several socio-demographic characteristics (Sengul & Tuncer, 2005). It includes instrumental variables and Inverse Mills Ratio (IMR) to overcome endogeneity problems and zero Expenditure. The IMR variable was added to account for households not consuming certain commodity groups. IMR is obtained by two-step estimation from the Heckman test (Bushway, Johnson, & Slocum, 2007; Taljaard, Alemu, & Van Schalkwyk, 2004; Singh, Dey, & Thapa, 2011). Meanwhile, the instrumental variable used the total household income proxy with the total Expenditure of poor households. The models used in this study are:

$$w_i = \alpha_i + \sum_j (\gamma_{ij} \ln p_j) + \beta_i \ln(y/I) + \mu_i ln\,\text{agt} + \theta_i \text{wil} + \delta_i \text{pnd} + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, i, j is 1, 2, …, 13 (commodity or group of commodities), w_i is expenditure proportion on the i^{th} commodity group, p_j is price of the j^{th} commodity group, y is total household food expenditure, I is stone price index ($\ln I = \Sigma\, w_i \ln p_j$), agt is number of household members, wil is Dummy area (rural=0, urban=1), pnd is dummy

education of household head (≤elementary school =0,> elementary school =1), ε_i is error term on the i[th] commodity group and α_i, γ_{ij}, β_i, μ_i, δ_i, θ_i is parameter of demand model. The income variable in this study was approached with the total household food expenditure value. The price variable uses the unit value by dividing the commodity price by the quantity purchased. The unit value will provide biased results caused by measurement errors, quality effects, and household expenditure on demand patterns.

Cox & Wohlgenant (1986) explained that using cross-section data in estimating demand systems causes price variations which might be unsuitable in estimating price elasticity. Unit values will be corrected by the differential price method, modified by the Cox & Wohlgenant (1986) methods. The unit value is corrected by adding the district/city median value and the estimated residual regression difference in the mean value of each district/city with socio-demographic factors. At the same time, the price is obtained from the central unit value per district/city per corrected commodity group. Households in the same district/city can be assumed to face the same price per commodity from this method.

In this study, commodity groups were selected based on the food groups consumed by households in the province of North Kalimantan. The concept of elasticity, which is derived from the coefficients of the LA AIDS model estimator, is utilized to determine the extent to which household food consumption responds to price and income changes. The following is the formula for calculating elasticity according to (Deaton & Muellbauer, 1980) :

Own price elasticity: $E_{ii} = \frac{\gamma_{ii} - \beta_i w_i}{w_i} - 1$ .....(2)

Cross-price elasticity: $E_{ij} = \frac{\gamma_{ij} - \beta_i w_j}{w_i}$; i≠.....(3)

Income elasticity: $\eta_i = 1 + \frac{\beta_i}{w_i}$.....(4)

The own price elasticity reveals the percentage change in the quantity demanded of goods from a 1 percent price increase (Frank, 2008). The calculation will provide the following pattern:

Where $E_{ii} = 0$, 0, it shows that the demand for these commodities is perfectly inelastic, meaning that price changes do not affect the quantity demanded (vertical curve). If $E_{ii} < 1$, it shows that the demand for these goods is inelastic, where the number of goods demanded due to a price change is smaller than the change in the own price. If $E_{ii} = 1$, shows that the demand for these goods is unitary elastic, meaning that the percentage change in the number of goods demanded = the percentage change in price. Lastly, if $E_{ii} = \sim$, indicates that the demand for the item is perfectly elastic, where a price increase will cause demand to fall to 0.

The value of cross elasticity reveals the link between the two goods, and its value might be negative or positive. If Eij < 0 (negative), the two items are complementary; an increase in the price of one good produces a drop in demand for the other good and vice versa. If Eij > 0, it shows that the two commodities are substitutes, such that an increase in the price of one item will lead to an increase in demand for the other item and vice versa. Meanwhile, income elasticity indicates the percentage change in the number of demands for every one percent rise in income. It is favorable for a normal good when an increase in income leads to increased purchases. In exceptional circumstances, such as purchasing defective items, the value will be negative, implying that a rise in income decreases the quantity of goods consumed. In contrast, commodities with income elasticity greater than one are known as normal luxury goods. Parameter estimates can be skewed if families do not consume food commodities or the enumeration period is so brief that these households are not consuming specific commodities. Households not classified as consuming this commodity in the estimate will produce biased parameter estimates. During the observation period, the SUSENAS data used to analyze demand can identify households with no expenditures on a single commodity (Zero Expenditure). This issue can manifest in two

ways: the quantity side and the amount of money households spend on a product (Yuliana, 2013).

It is possible to avoid biased parameter estimates by grouping commodities to increase the size of the investigated group. Suppose there are still empty values after aggregation. In that case, the zero Expenditure in this study is overcome by adding the Inverse Mills Ratio (IMR) variable for each commodity or commodity group as an independent variable. The purpose of including the IMR variable is to account for households that did not consume the commodity or group of commodities in issue at the time of the survey (Berges ME,Casellas KS, 2002).

RESULTS AND DISCUSSION

In 2018, the average monthly per capita food expenditure in North Kalimantan Province increased by 0.65% from Rp. 667,280 in 2017 to Rp. In nearly all regencies/cities, the proportion of the average monthly per capita expenditure on food products increased when examined more closely.

The average nominal Expenditure North Kalimantan incurred for food and non-food consumption. Recorded with this figure is the fifth highest nationally (BPS, 2018). The rate of change in each regency/city varies (See Table 6). Malinau Regency witnessed the most considerable increase of 4.20%, while Bulungan Regency experienced a 7.20% decrease.

Table 6. Average Monthly Food Expenditure per Capita By Regency/City, 2017 – 2018

Districts/Cities	Average Food Expenditure (IDR)		Percentage Change (%)
	2017	2018	
Malinau	661,649	689,469	4.20
Bulungan	678,849	629,961	-7.20
Tana Tidung	695,434	744,155	7.01
Nunukan	601,849	626,626	4.12
Tarakan	710,079	715,001	0.69
North Kalimantan	667,280	671,612	0.65

Source: Central Bureau of Statistics, 2018

All regencies or cities showed an increase in expenditures for non-food products. The average Expenditure on non-food items in North Kalimantan Province increased by 16.73% between 2017 and 2018, from IDR 636,486 to IDR 742,966. The regency with the most growth, 37.70%, is the Tana Tidung Regency. Bulungan Regency experienced the smallest rise compared to other regencies, at 9.79%. Table 7 displays the rate of change for each municipality /regency. (See Table 7).

Table 7. Average Monthly Non-Food Expenditures by Regency/City, 2017 – 2018

Districts/Cities	Average Food Expenditure (IDR)		Percentage Change (%)
	The year 2017	The year 2018	
Malinau	657,852	767,746	16.70
Bulungan	664,726	729,789	9.79
Tana Tidung	567,267	781,137	37.70
Nunukan	483,924	563,437	16.41
Tarakan	737,458	875,807	18.76
North Kalimantan	636,486	742,961	16.73

Source: Central Bureau of Statistics, 2018

Meanwhile, the highest average per capita expenditure growth per month per district in North Kalimantan Province in 2017 and 2018 was Tana Tidung Regency with 20.80%, followed by Malinau Regency with an increase of 10.44% (See Figure 3).

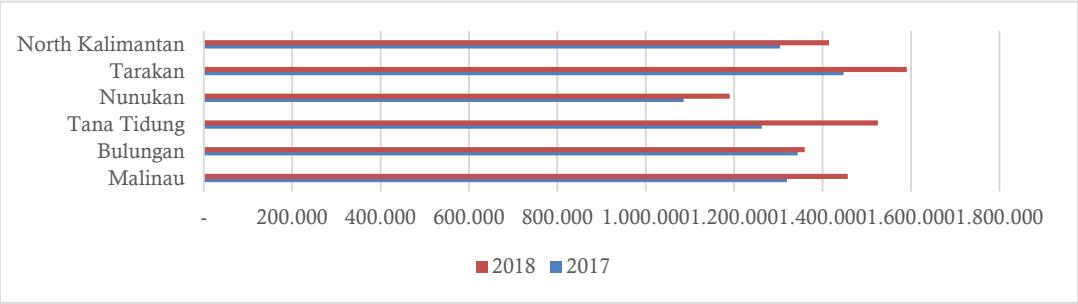

Figure 3. Average Per Capita Expenditure a Month By District/City, 2017 – 2018
Source: Central Bureau of Statistics, 2018

In 2018, the average monthly household expenditure in the province of North Kalimantan was 5,768,583 Rp. The highest proportion, 52.46%, comprised non-food expenditures, while the remainder, 47.54%, comprised food expenditures. In residential areas, urban areas allocate 55.13% of their typical household expenditures to non-food expenses, which amounts to Rp 3,467,977, or 5.81% more than rural areas. The percentage of monthly household expenditures on food in rural areas is 50.68%, which is still more significant than the percentage in urban areas, which is 44.87%. These results can help us comprehend that household welfare in North Kalimantan Province is still greater in urban areas than rural areas.

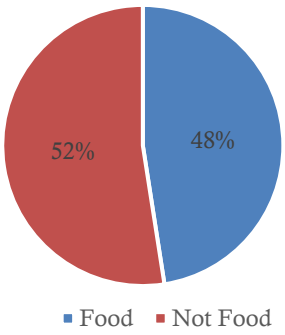

Figure 4. Average Monthly Household Consumption (Rp) by Region in North Kalimantan Province, 2018
Source: Central Bureau of Statistics, 2018

Referring to the 13 studied food commodity groups, the average monthly household expenditure in North Kalimantan Province in 2018 was highest for the Processed Food/Beverages commodity group at Rp. 623,578. This was followed by Grains at Rp. 271,146 and Fish, Shrimp, Squid, and Shellfish at Rp. 256,740,- (See Table 8). Tubers rank last out of thirteen commodity groups consumed by households in the province of North Kalimantan, with an average household spend of Rp 13,891. This phenomenon is uniformly distributed throughout North Kalimantan's urban and rural areas. Compared to the consumption of Tubers as an alternative staple food, these data demonstrate that the consumption of grain commodities (rice) as a staple diet continues to predominate among the population.

Table 8. Average Consumption Expenditure (IDR) of Food Commodity Groups per Month by Region In North Kalimantan Province, 201

Commodity Food	Region		North Kalimantan
	Rural	Urban	
1. Grains	260,804	281,651	271,146
2. Tubers	9,091	18,768	13,891
3. Fish, shrimp, squid, and shellfish	237,003	276,769	256,730
4. Meat	109,531	111,266	110,392
5. Eggs and milk	173,168	191,312	182,169
6. Vegetables	174,386	188,718	181,496
7. Nuts	40,812	52,539	46,630
8. Fruits	39,890	99,093	69,259
9. Oil and Coconut	67,599	55,839	61,766
10. Beverage Ingredients	112,635	75,804	94,364
11. Spices	62,634	59,974	61,315
12. Other Consumption	61,015	51,076	56,084
13. Processed Food/Beverages	478,209	771,252	623,578

Source: Central Bureau of Statistics, 2018

In urban areas, consumption of the Processed Foods/Beverages commodities group is nearly double that of rural areas. This has a big contrast when compared to the consumption of Grains as a commodity and the consumption of Fish, Shrimp, Squid, and Shellfish, which are relatively similar between rural and urban areas. In contrast, households in rural areas allocate more each month to four food categories: Oil and Coconut, Beverage Ingredients, Spices, and Other Consumption. This disparity might be attributed to the fact that people in rural areas prefer to prepare their food to suit their household's daily consumption requirements. Rural communities' comparatively low consumption of Processed Foods/Beverages may also be attributable to the availability of commodities. This result is in line with research by Chikobola & Edriss (2016), where there are differences in consumption patterns between rural and urban areas and between strata implying that changes in consumption patterns will be influenced not only by growth in aggregate income but also by changes in the distribution of this income to promote food security in households. In 2018, Urban areas had the most significant standard deviation of expenditures at Rp 3,866,404, which is valid for food products (See Table 9).

Table 9. Standard Deviation of Monthly Consumption (Rp) by Region in North Kalimantan Province, 2018

Standard Deviation Expenditure	Region		North Kalimantan
	Rural	Urban	
Food	1,437,041	1,529,579	1,485,425
Non Food	1,847,745	2,909,645	2,471,694
Total	2,893,140	3,866,404	3,449,039

Source: Central Bureau of Statistics, 2018

The most significant monthly expenditure standard deviation for the food commodity group in North Kalimantan Province occurs in the Processed Food/Beverages commodity group worth Rp. 594,567,-. Based on residential location, Processed Food or Beverage commodities expenditures in urban and rural areas are likewise substantial, with a value of Rp. 474,297 and Rp. 664,179,-. More details can be seen in Table 10.

Table 10. Standard Deviation of Expenditures (Rp) Consumption Against Food Commodity Groups Per Month by Region In North Kalimantan Province, 2018

Commodity	Region		North
Food	Rural	Urban	Kalimantan
1. Grains	234,194	171,640	205,770
2. Tubers	25,542	39,630	33,627
3. Fish, shrimp, squid, and shellfish	261,677	261,373	262,217
4. Meat	168,087	188,829	178,636
5. Eggs and milk	219,548	239,565	229,819
6. Vegetables	130,444	131,483	131,124
7. Nuts	53,434	54,850	54,444
8. Fruits	98,118	152,255	131,223
9. Oil and Coconut	38,818	35,511	37,667
10. Beverage Ingredients	75,881	60,466	71,080
11. Spices	46,613	45,690	46,165
12. Other Consumption	74,862	53,527	65,331
13. Processed Food/Beverages	474,297	664,179	594,567

Source: Central Bureau of Statistics, 2018

A probable reason for this outcome is the significant household food consumption in urban and rural areas for the Processed Food/Beverages commodities group. Other food commodities with the most significant expenditure standard deviation in rural areas are Fish/Shrimp/Squid/Shellfish for Rp. 261,677, - and Grain commodities worth Rp. 234,194,-. Similar to rural areas, the standard deviation of Expenditure for Fish, Shrimp, Squid, or Shellfish commodities is similarly high, namely Rp. 261,373, followed by eggs and milk commodities worth Rp. 239,565,-. Tubers still represent the lowest place with a standard deviation value of spending in rural areas of Rp. 25,542 and Rp. 39,630 for the urban areas.

Wardhani (2017) shows that the proportion of rural household food expenditure is sometimes different from the results of previous studies because rural households still depend on their production to meet their family's food needs. As a result, even though the proportion of food expenditure is large, they are not necessarily food insecure because their food needs often come from their production.

According to the Education Level of the Head of the Household (HOH) in North Kalimantan Province, the consumption expenditure of households with an Elementary School HOH education level and below (<=Elementary School), on average, allocates 52.13% for non-food Expenditure, amounting to Rp. 2,513,705 and 47.87% for food expenses, amounting to Rp. 2,307,869, -. 55.18% of households with an HOH education level higher than Elementary School (>Elementary School) spend Rp 3,600,222 monthly on non-food expenses. In contrast, 44.82% spend Rp 2,924,611 monthly on food (See Table 11). It can be demonstrated that there is a correlation between education and spending habits, such that the more education a person has, the greater his or her consumption expenditures. Education has a strong, positive influence on the consumption patterns of households (Cheng, 2021).

Table 11. Average Monthly Household Consumption Expenditure (Rp) by Education Level of the Head of the Household (HOH) in North Kalimantan Province, 2018

Average	Level of Education	
Expenditure	<=Elementary	> Elementary
Food	2,513,705	2,924,461
Non Food	2,307,869	3,600,222
Total	4,821,574	6,524,683

Source: Central Bureau of Statistics, 2018

In North Kalimantan Province in 2018, households with HOH Elementary School education or less spent the most on Processed Food/Beverages (Rp. 495,276), followed by Grains Rp. 266,179, and the third place is occupied by the Fish/Shrimp/Squid/Shellfish commodity group worth Rp. 206,271. The Tubers commodity continues to rank last among the 13 commodity groups consumed by families in the province of North Kalimantan. This pattern of food consumption is also observed in households when the HOH has completed schooling higher than the elementary level. These results demonstrate that the difference in education level in the province of North Kalimantan has no influence on the consumption of Grains (rice) as a staple diet compared to the consumption of Tubers as a substitute staple food. Consumption in the Processed Food/Beverages commodity group is nearly twice that for households with a head of household education level above Elementary School compared to households with an HOH education level at or below the Elementary School.

In contrast to consumption in the Grains commodity group and Fisher Shrimp or Squid or Shellfish, which are relatively similar, the other commodity groups have two food commodity groups with a higher average monthly household expenditure for households with the education level of HOH at or below Primary School, namely the Beverage Ingredients commodity group and the Other commodity group. This result is in line with previous research that the education of the head of the household has a positive effect on food expenditure (Cheng, 2021; X. Zhang & He, 2007). More details can be seen in Table 11.

Table 11. Average Consumption Expenditure (IDR) of the Food Commodity Group per Month by Education Level of the Head of the Household (HOH) in North Kalimantan Province,2018

Commodity	Level of Education	
Food	<=Elementary	> Elementary
1. Grains	266,179	275,111
2. Tubers	8,789	17,965
3. Fish, shrimp, squid, and shellfish	206,271	297,017
4. Meat	76,150	137,731
5. Eggs and milk	136,971	218,255
6. Vegetables	159,324	199,198
7. Nuts	37,729	53,736
8. Fruits	36,930	95,070
9. Oil and Coconut	60,949	62,418
10. Beverage Ingredients	99,690	90,112
11. Spices	55,833	65,691
12. Other Consumption	56,933	55,407
13. Processed Food/Beverages	495,276	726,015

Source: Data Processed, 2020

The standard deviation of monthly household consumption expenditure in North Kalimantan Province in 2018 is Rp 3,752,885 for families with an HOH education level above Elementary School and Rp 2,742,273 for households with an HOH education level of Elementary School or less. The standard deviation of monthly food consumption expenditures for households with an HOH with an education level above Elementary School is Rp 1,500,403, compared to Rp 1,434,016 for households with a head of household with an education level below the Elementary School. This disparity may be attributable to the number of commodity groups consumed by each family. More details can be seen in Table 12.

Table 12. Standard Deviation of Monthly Consumption Expenditure (IDR) by Education Level of the Head of the Household (HOH) in North Kalimantan Province, 2018

Standard Deviation Expenditure	Level of Education	
	<=Elementary	<=Elementary
Food	1,434,916	1,500,403
Non Food	1,722,345	2,807,350
Total	2,748,273	3,752,885

Source: Data Processed, 2020

In North Kalimantan Province, the Processed Food/Beverages commodity group has the highest expenditure standard deviation for the food commodity group per month, at Rp. 508,136, - for households with HOH with Elementary School education or lower and Rp. 637,371, - for households with heads of household with HOH education or higher. Fish/Shrimp/Squid/Shellfish with a value of Rp. 214,218 and Grain commodities with a value of Rp. 217,738 had the most significant standard deviation of family consumption expenditure for those with an elementary school education level or below. In contrast to households with an HOH with an education level above Elementary School, the Fish/Shrimp/Squid/Shellfish commodity group had the most significant standard deviation of consumption expenditure at Rp 288,815, followed by the Eggs and Milk commodity group at Rp 261,153,-. The Tubers, Oil, and Coconut commodities group continue to have the lowest spending standard deviation for households with an HOH education level at or below the elementary school and for households with an HOH education level higher than the elementary school (See Table 13).

Table 13. Standard Deviation of Monthly Food Commodity Group Expenditure (IDR) by Household of Head Education Level in North Kalimantan Province, 2018

Standard Deviation Expenditure	Level of Education		North Kalimantan
	<=Elementary	<=Elementary	
1. Grains	217,738	195,697	205,770
2. Tubers	26,092	38,125	33,627
3. Fish, shrimp, squid, and shellfish	214,218	288,815	262,217
4. Meat	140,628	199,851	178,636
5. Eggs and milk	172,988	261,153	229,819
6. Vegetables	121,713	135,653	131,124
7. Nuts	52,279	55,112	54,444
8. Fruits	98,677	147,327	131,223
9. Oil and Coconut	38,324	37,138	37,667
10. Beverage Ingredients	75,224	67,320	71,080
11. Spices	43,086	48,055	46,165
12. Other Consumption	67,685	63,411	65,331
13. Processed Food/Beverages	508,136	637,371	594,567

Source: Data Processed, 2020

According to the Susenas data utilized in the LA AIDS model, several households do not yet have expenditures on the consumption of a particular commodity.Consumption expenditure still zero for these products can arise in two ways: quantity and value of goods (Dey et al., 2011). This situation must be addressed so that the LA AIDS model formed is not biased. Zero Expenditure can be eliminated by incorporating the Variable Inverse Mills Ratio (IMR) for each commodity. Data processing in Table 14 determined that most IMR factors for each commodity had a negative influence, and only two commodities, namely Tubers and Nuts, had positive IMR values. As for the degree of significance, it indicates that all IMR variables for each commodity are significant, with each commodity's P-Value falling below five percent.

Several expert theories have described threshold-based consumer behavior that can

result in Zero Expenditures for various goods at various income or welfare levels. Lexicographic preferences are hierarchical from discrete choices based on needs, with early selections based on immediate needs. The phenomenon of consumer psychological thresholds explains price stickiness by considering consumer demand behavior based on fundamental hierarchical needs (Xu et al., 2020) and using consumer demand behavior based on irreducible hierarchical demands to explain the phenomenon of price stickiness resulting from consumer psychological thresholds. It is hypothesized that consumers satisfy a threshold level of their primary needs before attempting to satisfy other needs sequentially, according to a given priority pattern for distinct categories of demands.

Consequently, unless the consumer can surpass the threshold of their primary needs, they will not purchase things connected to their secondary needs if they behave optimally. Zero Expenditure is a natural consequence of consumer behavior patterns based on such a barrier for certain commodities (Drakopoulos, 1992). By employing the Instrumental Variable (IV), the endogeneity problem of household expenditure variables for food consumption for each product can be resolved. In this study, the LA AIDS model employs IV, specifically the total household expenditure variable, which also estimates household income. The LA AIDS modeling demonstrates that IV ten commodities have a negative and substantial effect (P-Value <0.05) on the commodity group's expenditure proportion. Two commodities exhibited little IV, namely Eggs and Milk and Beverage Ingredients. On the other hand, a product that exhibits IV with a positive effect was Processed Food/Beverages. This indicates that the expenditure proportion for food commodities is independent of household income.

Instrumental variables, as a solution to the endogeneity problem, can be utilized to generate consistent parameter estimates. The endogeneity problem occurs naturally in simultaneous equation models such as supply-demand systems in economies, where price and quantity are determined jointly in the market for goods or services. Although the IV technique was first designed to solve endogeneity issues in concurrent systems, correlations between regression and error may occur for other reasons (Baum, 2007). Anticipating this selection bias can be done by combining or grouping commodities or enlarging the analyzed commodity groups. This study aggregates commodities into eight groups: grains, tubers, animal-sourced foods, vegetables, fruits, beans, processed foods, et cetera. If there is an empty value, zero Expenditure is overcome by adding each commodity or commodity group's group's Inverse Mills Ratio (IMR) as an independent variable (Heien & Wessells, 1990). Adding the IMR variable help consider households withholding consumption of a commodity or commodity group.

Using the LA AIDS Modeling in Table 14 and a significance level of 95% (P-Value 0.05), the proportion of Grains expenditure (w1) is positively affected by the prices of the Fruits commodities group. Several product groupings, such as Fish/Shrimp/Squid/Shellfish, Meat, and Vegetables, have a negative effect on the market. The number of household members (HM) and the residential location has a positive effect. On the other hand, the factors of total household food spending, HOH education, and the Inverse Mills Ratio (IMR) have a negative effect on the proportion of grain expenditure. This result is in line with Nghiem, Teng, Cleghorn, McKerchar, & Wilson (2022), where education has a negative effect on the proportion of grain expenditure.

Table 14. Coefficient of Estimating the Parameters of the LA AIDS Model for the Expenditures Expenditure for Grains, Tubers, Fish/Shrimp/Squid/Shellfish in North Kalimantan Province,2018

Variable	w_ Grains		w_ Tubers		w_ Fish	
	coefficient	P-Value	coefficient	P-Value	coefficient	P-Value
p_Grains	0.04058	0.0000	-0.0019096	0.0000	0.000135	0.9520
p_Tubers	-0.00191	0.0000	0.0069109	0.0000	-0.00116	0.0010
p_Fish	0.00014	0.9520	-0.0011602	0.0010	0.012186	0.0000
p_Meat	0.00192	0.0790	-0.0006651	0.0000	-0.00622	0.0000
p_Eggs	-0.00438	0.0000	-0.0006656	0.0000	-0.00176	0.0760
p_Vegetables	0.00052	0.7890	-0.000234	0.3530	0.007179	0.0000
p_Nuts	0.00107	0.0890	-0.0000503	0.6050	-0.00187	0.0030
p_Fruits	0.00157	0.0040	-0.0002037	0.0290	0.000822	0.1560
p_Oil coconut	-0.00349	0.0000	0.0002077	0.0430	0.000506	0.4490
p_Beverage	-0.01544	0.0000	-0.0007699	0.0000	0.000611	0.5530
p_Spices	-0.00515	0.0000	0.0000629	0.5770	0.001897	0.0090
p_Other	-0.00258	0.0520	-0.000456	0.0050	-0.00287	0.0110
p_Processed	-0.01283	0.0000	-0.001067	0.0000	-0.00946	0.0000
IV	-0.00542	0.0000	-0.0007035	0.0000	-0.00773	0.0000
Household Size	0.01519	0.0000	-0.002211	0.0000	-0.00047	0.9090
Region	0.03937	0.0000	-0.0120984	0.0000	-0.00316	0.4490
HH education	-0.00934	0.0020	0.0020189	0.0000	-0.00234	0.4730
IMR	-0.00672	0.0000	0.0026783	0.0000	-0.03966	0.0000

Source: Data Processed, 2020

The price of the Oil & Coconut commodity group positively affects the expenditure proportion of Tubers (w2). Prices of Fish/Shrimp/Squid/Shellfish, Meat, Eggs, Milk, Fruit, Beverage Ingredients, and Prepared Foods/Beverages have a negative effect. The four commodity groupings, such as Vegetables and Nuts, show no significance. All socio-demographic variables have a substantial effect on the consumption proportion of Tubers. Together, total household food spending and IMR have a positive effect. The expenditure proportion in the Fish/Shrimp/Squid/Shellfish (w3) commodity group was positively affected by the pricing of the Vegetables and Spices commodity group. Several commodity group prices have a negative effect, while others, such as Egg & Milk, Fruit, Oil & Coconut, and Beverage Ingredients, have no significant effect. All socio-demographic variables do not have a meaningful effect. On the other hand, total household food expenditure and IMR factors had a positive effect.

The prices of Vegetables, Oil & Coconut, Beverage Ingredients, and Spices positively affected the proportion of meat-related expenditures (w4). Prices of Tubers, Fish/Shrimp/Squid/Shellfish, Nuts, Other Consumption items, and Processed Foods/Beverages have a negative effect. The three commodity categories, including the Grains group, had no significant effect. Only one socio-demographic variable, the HOH education, does not significantly affect the proportion of meat expenditures. This result aligns with Zhang et al., (2018), where education is not significantly related to each portion of meat expenditure. The total household food expenditure variables and IMR significantly and negatively affect the meat expenditure proportion. More details can be seen in Table 15.

Table 15. Coefficient of Estimating Parameters of the LA AIDS Model for the Expenditure Proportion of Meat, Eggs & Milk, and Expenditures in North Kalimantan Province, 2018

Variable	w_Meat		w_ Eggs		w_ Vegetables	
	coefficient	P-Value	coefficient	P-Value	coefficient	P-Value
p_Grains	0.00192	0.0790	-0.0043791	0.0000	0.000517	0.7890
p_Tubers	-0.00067	0.0000	-0.0006656	0.0000	-0.00023	0.3530
p_Fish	-0.00622	0.0000	-0.0017566	0.0760	0.007179	0.0000
p_Meat	0.001597	0.0710	-0.0012143	0.0540	0.002912	0.0000
p_Eggs	-0.00121	0.0540	0.014244	0.0000	0.00044	0.4920
p_Vegetables	0.002912	0.0000	0.0004398	0.4920	-0.00637	0.0020
p_Nuts	-0.00146	0.0000	-0.0007216	0.0170	-0.00194	0.0000
p_Fruits	-0.00122	0.0020	0.0003873	0.3460	0.000574	0.1200
p_Oil coconut	0.00346	0.0000	-0.0000409	0.8660	0.003025	0.0000
p_Beverage	0.005592	0.0000	0.0008989	0.0200	0.001074	0.3140
p_Spices	0.001872	0.0000	0.0006301	0.0200	-3.4E-05	0.9650
p_Other	-0.00224	0.0000	-0.0022704	0.0000	-0.00195	0.0710
p_Processed	-0.00433	0.0000	-0.0055516	0.0000	-0.0052	0.0000
IV	-0.00312	0.0000	-0.001545	0.0090	-0.00378	0.0000
Household Size	-0.00672	0.0030	0.0078905	0.0170	-0.01571	0.0000
Region	-0.01091	0.0000	-0.0095946	0.0020	0.003295	0.2950
HH education	-0.00134	0.5720	0.0157496	0.0000	0.002268	0.2470
IMR	-0.00882	0.0000	-0.0229696	0.0040	-0.07084	0.0000

Source: Data Processed, 2020

Table 16 reveals that the price variable for the Beverage Ingredients and Spices commodity group positively affects the expenditure proportion of the Egg & Milk commodity group (w5). Numerous commodity group prices have a negative effect, while others, such as Vegetables and Fruits, do not substantially impact. All socio-demographic variables have a significant effect. In contrast, total household food spending and IMR have a negative effect.

The price of Fish / Shrimp / Squid / Shellfish, Meat, Oil, and Coconut positively affects the expenditure proportions of the Vegetable commodity group (w6). Nuts and Processed Foods/Beverages are two commodity groups whose price factors have a negative effect. The seven commodity groupings, including Grains, Tuber, and Fruits, had no significant effect. Only one socio-demographic variable, the number of household members, significantly affects the expenditure proportion of Vegetables. Total household food expenditures and IMR significantly negatively affect the expenditure proportion of the vegetable commodities group. These results are consistent with previous studies (Hafizah, Hakim, Harianto, & Nurmalina, 2020).

Table 16. Coefficient of Estimating the Parameters of the LA AIDS Model for the Expenditure Proportion of Nuts, Fruits, and Oil & Coconuts in North Kalimantan Province, 2018

Variable	w_ Nuts		w_ Fruits		w_ Oil coconut	
	coefficient	P-Value	coefficient	P-Value	coefficient	P-Value
p_Grains	0.0010666	0.0890	0.001568	0.0040	-0.0034937	0.0000
p_Tubers	-0.0000503	0.6050	-0.0002	0.0290	0.0002077	0.0430
p_Fish	-0.0018684	0.0030	0.000822	0.1560	0.0005062	0.4490
p_Meat	-0.0014604	0.0000	-0.00122	0.0020	0.0034596	0.0000
p_Eggs	-0.0007216	0.0170	0.000387	0.3460	-0.0000409	0.8660

Variable	W_Nuts		W_Fruits		W_Oil Coconut	
	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
p_Vegetables	-0.0019372	0.0000	0.000574	0.1200	0.0030246	0.0000
p_Nuts	0.0099256	0.0000	-0.00046	0.0080	-0.0001711	0.3540
p_Fruits	-0.0004616	0.0080	-0.00333	0.0000	-0.0001899	0.1750
p_Oil coconut	-0.0001711	0.3540	-0.00019	0.1750	0.0064838	0.0000
p_Beverage	-0.0010408	0.0000	-1.7E-05	0.9380	-0.0048508	0.0000
p_Spices	-0.0001154	0.5690	0.000418	0.0070	-0.0042796	0.0000
p_Other	9.63E-06	0.9740	-0.00056	0.0150	0.000717	0.2730
p_Processed	-0.003175	0.0000	0.002211	0.0030	-0.0013729	0.0030
IV	-0.0014237	0.0000	-0.00184	0.0000	-0.0008137	0.0000
Household Size	0.0072769	0.0000	-0.00534	0.0020	0.0011471	0.3230
Region	0.0085207	0.0000	0.011914	0.0000	-0.0102886	0.0000
HH education	0.0062056	0.0000	0.003499	0.0570	0.0025463	0.0000
IMR	0.0030293	0.0000	-0.00452	0.0000	-0.0132666	0.0000

Source: Data Processed, 2020

Table 17 reveals that most prices of the food commodity group have a negative effect on the expenditure proportion for the Nuts commodity group (w7). Five price variables do not significantly affect commodity groups like the Grains and Tubers commodity group. All socio-demographic variables and IMR have a strong and positive effect. In contrast, the variable total household food expenditures have a negative effect. The price variable for the Grains, Spices, and Processed Food/Beverages commodity group positively affects the Fruits commodity group's expenditure proportion (w8). The Tubers, Meat, and Nuts commodity groupings are negatively affected by prices. Five commodity groups, including the Vegetables and Beverage Ingredients commodity groups, had no significant influence. One socio-demographic indicator, HOH education, does not have a statistically significant effect on the expenditure proportion of fruit. Total household food expenditure and inflation-adjusted price level have a considerable negative effect on the expenditure proportion of Fruits. The expenditure proportion to the Oil & Coconut commodity group (w9) was positively affected by the Tubers, Meat, and Vegetables commodity groups. Four commodity groups, including Beverage Ingredients and Spices, had a negative effect. Five commodity group pricing variables do not significantly affect commodity groups such as Nuts and Fruits. A single socio-demographic variable has no substantial impact. In contrast, total household food expenditure and IMR factors show a considerable negative effect.

Table 17. Coefficient of Estimating the LA AIDS Model Parameters for the Expenditure Proportions of Beverage Ingredients, Spices, and Other Consumption in North Kalimantan Province, 2018

Variable	w_ Beverage		w_ Spices		w_ Other	
	coefficient	P-Value	coefficient	P-Value	coefficient	P-Value
p_Grains	-0.01544	0.0000	-0.0051502	0.0000	-0.0025824	0.0520
p_Tubers	-0.00077	0.0000	0.0000629	0.5770	-0.000456	0.0050
p_Fish	0.000611	0.5530	0.001897	0.0090	-0.0028695	0.0110
p_Meat	0.005592	0.0000	0.0018724	0.0000	-0.0022393	0.0000
p_Eggs	0.000899	0.0200	0.0006301	0.0200	-0.0022704	0.0000
p_Vegetables	0.001074	0.3140	-0.0000339	0.9650	-0.0019524	0.0710
p_Nuts	-0.00104	0.0000	-0.0001154	0.5690	9.63E-06	0.9740

Variables	w_Beverages		w_Spices		w_Other	
	coefficient	P-Value	coefficient	P-Value	coefficient	P-Value
p_Fruits	-1.7E-05	0.9380	0.0004181	0.0070	-0.000561	0.0150
p_Oil coconut	-0.00485	0.0000	-0.0042796	0.0000	0.000717	0.2730
p_Beverage	0.023556	0.0000	-0.0045672	0.0000	-0.0017	0.0460
p_Spices	-0.00457	0.0000	0.0119313	0.0000	-0.0002071	0.7450
p_Other	-0.0017	0.0460	-0.0002071	0.7450	0.017186	0.0000
p_Processed	-0.00335	0.0000	-0.0024585	0.0000	-0.0030746	0.0000
IV	-7,00E-05	0.7750	-0.0014528	0.0000	-0.0009668	0.0000
Household Size	-0.01484	0.0000	0.0012913	0.2880	0.0117038	0.0000
Region	-0.02821	0.0000	-0.01504	0.0000	-0.0035887	0.0700
HH education	-0.00242	0.0390	0.0004553	0.5740	-0.0046054	0.0000
IMR	-0.04126	0.0000	-0.0157143	0.0000	-0.0033779	0.0010

Source: Data Processed, 2020

The Meat, Egg, and Milk commodity group's price variable positively affects the expenditure proportion for the Beverage Ingredients commodity group (w10). The price variables that have a negative effect are the Grains, Tubers, and Nuts commodity groups. The three commodity categories, including the Fish/Shrimp/Squid/Shellfish, Vegetable, and Fruit commodity groups, had no substantial influence. All socio-demographic characteristics, as well as IMR, have a negative effect on the expenditure proportion of Beverage Ingredients. In contrast, total household food spending had no significant effect on the expenditure proportion of the Beverage Ingredients. The four commodity groups of Fish/Shrimp/Squid /Shellfish, Meat, Eggs, Milk, and fruit all positively affected Spices expenditure proportion (w11). Four commodity groups, such as Grain and Oil & Coconut commodities, have a negative effect. Four commodity group price factors, such as the Tubers and Vegetables commodity group, have no substantial effect. One socio-demographic indicator, HOH education, does not have a significant influence. In contrast, total household food expenditure and IMR show a considerable negative impact. More details can be seen in Table 18.

Table 18. Estimating Coefficient of LA AIDS Model Parameters for Proportion of Processed Food & Beverage Expenditure in North Kalimantan Province, 2018

Variable	w_ Processed		Description
	Coefficient	P-Value	
p_Grains	-0.01283	0.0000	=Price of Grains
p_Tubers	-0.00107	0.0000	= Price of Tubers
p_Fish	-0.00946	0.0000	= Price of Fish, shrimp, squid, shellfish
p_Meat	-0.00433	0.0000	= Price of Meat
p_Eggs	-0.00555	0.0000	= Price of Eggs and milk
p_Vegetables	-0.0052	0.0000	= Price of Vegetables
p_Nuts	-0.00318	0.0000	= Price of Nuts
p_Fruits	0.002211	0.0030	= Price of Fruits
p_Oil coconut	-0.00137	0.0030	= Price of Oil Coconut
p_Beverage	-0.00335	0.0000	= Price of Beverage Ingredients
p_Spices	-0.00246	0.0000	= Price of Spices
p_Other	-0.00307	0.0000	= Price of Other Consumption
p_Processed	0.049662	0.0000	= Price of Processed Food/Beverages
IV	0.028863	0.0000	=*Instrumental Variabel*

Variable	w_Processed		Descriptions
	Coefficient	P-Value	
Household Size	-0.14551	0.0000	= number of household members
Region	0.068198	0.0000	= Household Residential Area
HH education	0.000686	0.9300	= Education level of household
IMR	-0.54047	0.0000	= *Inverse Mills Rasio*

Source: Data Processed, 2020

The majority of food commodity groups have a negative effect on the expenditure proportion of the Other commodity (w12). Five commodity groups, including Grains and Vegetables, had no significant influence. Residential location does not significantly affect the expenditure proportion of the Other commodity. Total household food expenditure and IMR considerably have a negative effect on the expenditure proportion of the Other commodity group. Only one commodity group, Fruits, positively affected the expenditure proportion of Processed Food & Beverages (w13). Most food commodity groups have a negative effect, and no commodity group price variable has a significant effect. One socio-demographic indicator, HOH education, did not have a significant influence.

On the other hand, the total household food expenditure has a positive effect, while the IMR has a significantly negative effect. Most food groups have a positive effect on own-price elasticity. A positive effect suggests that as the price of the food group increases, the expenditure proportion for that food group increases; conversely, for a negative effect. Both of these effects (positive and negative) can occur, bearing in mind that the expenditure proportion is the division between the total rupiah expenditure for a particular food group and the total rupiah expenditure for food, where the rupiah expenditure for a specific food group is the multiplication of the unit value (proxy of price) by the amount consumed. If the price increase is more significant than the decrease in the amount consumed, the proportion will grow (positive direction); conversely, if the price increase is smaller than the decrease in the amount consumed, the proportion will fall (negative direction). The elasticity of demand is the best way to measure the influence of own price and cross price on the amount required (Yusdianto, 2016). The Inverse Mills Ratio (IMR) has a considerable effect at 5% to 10% for numerous commodity groups. This demonstrates that sample selectivity bias is a concern in these commodities groups. The estimation parameters will be unbiased using the IMR in the budget-sharing equation for the commodity group. Then, the influence of the IMR is not substantial for other commodity groupings. This shows that the problem of selection bias does not occur for this commodity category (Sinaga, Hutagaol, Hartoyo, & Nuryartono, 2022).

The results of the elasticity of demand for own-price for opposing commodity groups (Eii = negative), such as Eii Vegetables = -0.09, means that in the 2018 period, the Vegetable commodity group is inelastic goods. This data reveals that food commodities are still primary needs for households (Faharuddin, Yamin, Mulyana, & Yunita, 2022) in North Kalimantan Province. Cross-price elasticity (Eij) can be positive (substitutes), negative (complementaries), or zero (neutral) (perfectly inelastic). If an analysis is conducted for one commodity group, for example, Grains (K1), then the vertical column, K1, will show seven commodity groups complementary to Grains, while other commodities are substitutes.

Complementary commodities include Tubers (K2), while substitutes include Meat (K4) (K4). This relationship suggests that a 1% increase in rice prices will be followed by a 0.01% fall in demand for Tubers (K2). Vice versa for commodities that are substitutes, if there is a rise in the rice price by 1%, it will be followed by an increase in demand for Meat (K2) by 0.02%. More details can be seen in Table 19.

Table 19. Own and Cross-Price Elasticities by Commodities, 2018

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13
K1	0.39	-0.42	0.01	0.06	-0.07	0.01	0.06	0.07	-0.14	-0.40	-0.21	-0.12	-0.09
K2	-0.01	1.52	0.00	-0.02	-0.01	0.00	0.00	-0.01	0.01	-0.02	0.00	-0.02	-0.03
K3	0.01	-0.25	0.14	-0.17	-0.03	0.11	-0.10	0.04	0.02	0.02	0.08	-0.13	-0.07
K4	0.02	-0.15	-0.06	0.05	-0.02	0.05	-0.08	-0.05	0.14	0.14	0.08	-0.10	-0.05
K5	-0.04	-0.15	-0.01	-0.03	0.22	0.01	-0.04	0.02	0.00	0.02	0.03	-0.10	-0.05
K6	0.01	-0.05	0.09	0.09	0.01	-0.09	-0.11	0.03	0.12	0.03	0.00	-0.09	-0.05
K7	0.02	-0.01	-0.01	-0.04	-0.01	-0.02	0.57	-0.02	-0.01	-0.03	0.00	0.00	-0.04
K8	0.02	-0.04	0.02	-0.03	0.01	0.01	-0.02	-0.15	-0.01	0.00	0.02	-0.02	-0.02
K9	-0.03	0.05	0.01	0.10	0.00	0.05	-0.01	-0.01	0.25	-0.12	-0.18	0.03	-0.04
K10	-0.14	-0.17	0.01	0.16	0.02	0.02	-0.06	0.00	-0.19	0.61	-0.19	-0.08	-0.04
K11	-0.04	0.01	0.03	0.06	0.01	0.00	-0.01	0.02	-0.17	-0.12	0.49	-0.01	-0.04
K12	-0.02	-0.10	-0.02	-0.06	-0.03	-0.02	0.00	-0.02	0.03	-0.04	-0.01	0.79	-0.04
K13	-0.12	-0.23	-0.10	-0.12	-0.08	-0.07	-0.18	0.10	-0.05	-0.09	-0.10	-0.14	0.20

Source: Data Processed, 2020

Where K1 is Grains, K2 is Tubers, K3 is Fish, shrimp, squid, and shellfish, K4 is Meat, K5 is Eggs and Milk, K6 is Vegetables, K7 is Nuts, K8 is Fruits, K9 is Oil and Coconut, K10 is Beverage Ingredients, K11 is Spices, K12 is Other Consumption, and K13 is Processed Food and Beverages.

The commodity has an elasticity value of zero, indicating it is not perfectly elastic. This condition is present in various commodities, including Vegetables (K6) and Tubers (K2). Thus, an increase in the price of Vegetables (K6) will not affect the demand for Tubers (K2).

Table 20 shows that almost all food commodities are included in the category of normal goods. These results align with research conducted by Faharuddin, Yamin, Mulyana, & Yunita (2022) that the food group has a positive income elasticity value, which is included in the category of normal goods and luxury goods. Meanwhile, only one commodity group has an income elasticity value of more than one, namely Processed Food/Beverages, with a value of 1.13.

Table 20. Income elasticity by commodity (Eiy), 2018

No.	Commodity	E_{iy}
1	Grains	0.95
2	Tubers	0.85
3	Fish, shrimp, squid, and shellfish	0.92
4	Meat	0.91
5	Eggs and milk	0.98
6	Vegetables	0.95
7	Nuts	0.92
8	Fruits	0.92
9	Oil and Coconut	0.97
10	Beverage Ingredients	1.00
11	Spices	0.94
12	Other Consumption	0.96
13	Processed Food/Beverages	1.13

Source: Data Processed, 2020

CONCLUSION

Several conclusions can be derived from the study's findings and discussion, as follows: LA AIDS modeling demonstrates that the own prices of commodity groups and the prices of other commodity groups have a considerable effect, either positively or negatively, on the proportion of North Kalimantan Province's food

expenditure. In North Kalimantan Province, socio-demographic characteristics, such as the number of household members, residential area, and the level of education of the head of household, significantly impact household food expenditures. In North Kalimantan Province, the variables of total household food expenditure and IMR have a negative effect on the proportion of household food expenditure. Price elasticity is positive for eleven commodity groups and negative for just two commodity groups: Vegetables and Fruits. Cross-price elasticity has a wide range of positive, negative, and zero values. Only one food commodity group, Processed Food/Beverages, has multiple income elasticity values.

As the party responsible for ensuring food availability, the government can use this information to create work programs and strategic policies to fulfill people's food needs. The high proportion of household food consumption expenditure for certain commodity groups can be a reference in finding other food alternatives so that they can become an economical solution for underprivileged households. Programs to improve the quality of Human Resources are carried out continuously because they can have implications for improving people's welfare, which can directly increase the quality and quantity of household food consumption. Further research on household non-food consumption patterns in North Kalimantan Province needs to be carried out so that a household consumption pattern can be described as a unified whole. The addition of social demographic variables can be an alternative for further research so that it can further explore the factors that significantly influence food consumption patterns. More broadly, it allows for comparing household food consumption patterns between provinces on the island of Kalimantan.

Finally, the weakness of this study is that the research period only lasted until 2018 because it is a relatively new province, so it is experiencing difficulties in data availability. In addition, the research data used has not considered the impact of the COVID-19 pandemic. Thus, further research should be carried out within a time frame considering the impact of Covid-19, especially during and after the Covid-19 pandemic. It must be done considering that consumption patterns will differ before and after the Covid-19 pandemic.

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