International Journal of Horticulture, Agriculture and Food Science (IJHAF)
ISSN: 2456-8635
[Vol-6, Issue-2, Mar-Apr, 2022]
Issue DOI: https://dx.doi.org/10.22161/ijhaf.6.2
Article DOI: https://dx.doi.org/10.22161/ijhaf.6.2.3

Food Demand for Carbohydrate Sources: Linear Approximation-Almost Ideal Demand System/LA-AIDS Approach

Ratya Anindita[1], Faiqoh Amalina[2], Ana Arifatus Sa'diyah[3*], Nikmatul Khoiriyah[4], and Abdul Wahib Muhaimin[1]

[1]Departement of Socio-Economics, University of Brawijaya, Jl. Veteran, Malang 65145, Indonesia
Email : ratyaa@ub.ac.id; abd.muhaimin@ub.ac.id
[2]Departement of Socio-Economics, University of Brawijaya, Jl. Veteran, Malang 65145, Indonesia
Email : faiqohamalina@yahoo.co.id
[3]Departement of Agribusiness, University of Tribhuwana Tunggadewi, Jl. Telaga Warna Tlogomas, Malang 65144, Indonesia
Email: ana.arifatus@unitri.ac.id
[4]Departement of Agribusiness, Faculty of Agriculture, University of Islam Malang, Jl. MT Haryono 193 Malang, Indonesia
Email: nikmatul@unisma.ac.id

Received: 20 Mar 2022; Received in revised form: 08 Apr 2022; Accepted: 13 Apr 2022; Available online:19 Apr 2022
©2022 The Author(s). Published by AI Publications. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/)

***Abstract*— *The most suitable system demand model for food analysis is the LA-AIDS model. This study aims to analyze the estimated demand for carbohydrate sources of food, analyze the demand for carbohydrates from rural households, and analyze the food demand for carbohydrates from urban households. This study uses data from the 2016 National Socio-Economic Survey (Susenas). Data were analyzed using the Linear Approximation-Almost Ideal Demand System (LA-AIDS) model. The results of the analysis show that the demand for carbohydrate-sourced food differs between rural and urban households which are influenced by price, income, and number of household members. When viewed from the elasticity of demand, rice and corn are commodities that are inelastic to changes in household expenditure. Wheat is a superior commodity in both rural and urban areas. Meanwhile, sweet potato and cassava are elastic in terms of expenditure for rural households. However, each household allocates higher consumption expenditures for rice compared to other commodities. In line with the analysis of expenditure elasticity, rice has the most inelastic price elasticity compared to other commodities. In addition, the effect of changes in rice consumption on changes in prices of other commodities is lower than the effect of changes in rice prices on the consumption of other commodities. This condition explains that among other commodities, the demand for rice to meet the needs of carbohydrates in the body is the highest. So that efforts are needed from the government to maintain the stability of rice commodity prices in the market.*

***Keyword*— expenditure elasticity, price elasticity, rural households, urban households.**

I. INTRODUCTION

The food demand system has become an interesting research topic in recent decades (Hermanto et al., 2015; Lusk, 2017). The food demand system is an application of the economic theory of demand obtained through two approaches, namely the utility function approach and the cost function or demand duality approach (McLaren et al., 2000; Färe et al., 2008; Deaton, A., 1986). The demand system has several analytical models, including the Linear Expenditure System (LES) model introduced by (Stone, 1954), *Rotterdam* model by by (Theil, 1965) and by (Barten, 1965), *Indirect Translog System model (ITS)* by (Christensen, Jorgenson, and La, 1975), and *Almost Ideal Demand System (AIDS)* model by (Deaton, A., & Muellbauer, J., 1980), Each demand system model has strengths and weaknesses, so the application must be adapted to the needs of the analysis.

Analysis with the LES model cannot describe consumer demand behavior according to Engel's law (Nugroho & Suparyono, 2015). The LES model is only capable of analyzing normal and superior commodities (Maula et al., 2019). Meanwhile, the Rotterdam model is inconsistent with the utility maximization function (Delavar et al., 2020). So that neither the LES model nor the Rotterdam model is suitable for the analysis of food demand because both models do not meet the assumptions of the law of demand. One alternative demand system model that can be used for food analysis is the ITS and LA-AIDS models. Both of these models can explain the system demand flexibly and better describe the empirical conditions. However, the ITS model requires a relatively high number of independent parameters for analysis, so it is not suitable when applied to secondary data. The most suitable system demand model for food analysis is the LA-AIDS model. The LA-AIDS model is linear in parameters and simpler in analysis (Deaton, A., & Muellbauer, J., 1980; Sulgham, 2006; Liao and Chern, 2007).

Another advantage of the LA-AIDS model is that the resulting price coefficient can be used to calculate three kinds of elasticity, namely (1) own price elasticity, (2) cross-price elasticity, and (3) expenditure elasticity (Akinbode, 2015; Delport, M., et al, 2017; M.J.A. Van den Tillaart, 2019; Bett et al., 2012). Further information on the value of the elasticity of demand can be applied to the estimation of demand for staple food. Analysis of the estimated demand for staple food has been carried out by several researchers, such as the analysis of demand for rice and other commodities in the Philippines (Sombilla, M. A., Lantican, F. A., & Quilloy, K. P., 2013), demand for rice in Nigeria (Kassali, R., Kareem, R. O., Oluwasola, O., & Ohaegbulam, O. M., 2010; Erhabor, P. O. I., & Ojogho, O., 2011; Oyinbo, O., Omolehin, R. A., & Abdulsalam, Z., 2013). Analysis of staple food demand is also carried out in China (Zheng and Henneberry, S.R., 2010a; Zheng, Z., & Henneberry, S. R., 2010b), The results of the analysis explain that there are differences in household behavior based on social and demographic factors such as the number of household members and region. Therefore, each analysis is important to distinguish social and demographic factors in the analysis.

Food analysis, especially staple food in Indonesia, has been carried out by several researchers, such as food demand in East Java (Purwaningsih, Y., Hartono, S., Masyhuri, M., & Mulyo, J. H., 2014), National food demand (Pangaribowo, E.H. and Tsegai, D. W., 2011; Sa'diyah, A. A., Nendissa, D. R., & Sinaga, A. M., 2019), food demand in East Kalimantan (Sunaryati, R., 2016). The problem that is often faced by researchers is the value of zero consumption, thus causing biased results in econometric analysis. The zero consumption value solution can be solved by grouping the commodity with similar commodities (Cox dan Wohlgenant, 1986). Apart from grouping commodities, the problem of zero consumption can also be overcome using the Inverse Mill's Ratio (IMR) approach in the analysis. IMR is the ratio of the estimated value of the standard normal density function to the estimated value of the standard normal cumulative distribution function (Heien dan Wessells, 1990).

Currently, the analysis of staple foods is still needed (Muyanga et al., 2006). Staple food as a source of carbohydrates has an important role in human life, especially in developing countries such as Indonesia. According to Rachman and Ariani (2008); Amanto et al., 2019; Hafizah et al., (2020), food consumption in Indonesia is still dominated by food sources of carbohydrates, especially rice. The demand for rice will continue to increase in line with population growth in Indonesia which is increasing every year (Badan Pusat Statistik, 2017a; Bashir & Yuliana, 2018). This condition causes the price of rice to increase if it is not balanced with an increase in production. If rice production cannot be increased, the effort that can be done is to diversify local food products such as corn, cassava, and sweet potatoes. Analysis of staple foods with a demand system is expected to be able to provide information about the relationship between rising rice prices as the main staple food source and local diversified commodities. According to Ariani (2010), diversification of staple food commodities has started to occur, but what has happened is that rice diversification is more not with local commodities but with wheat flour which is a non-local food commodity. Diversification of rice to flour will cause other problems, namely the increase in the value of wheat flour imports. This condition causes the need for an analysis of the linkage of rice as the main food commodity with local and non-local commodities (wheat flour). This study aims to: (1) analyze the estimated demand for carbohydrate-sourced food, (2) analyze the demand for food-carbohydrate sources in rural households, (3) analyze the demand for food-carbohydrate sources in urban households.

II. METHODS

The research uses data from the 2016 National Socio-Economic Survey (Susenas). The Susenas data required includes the Consumption and Expenditure module at the household level in the province of Central Java for March 2016. The data is obtained from the Central Statistics Agency (BPS). Central Java Susenas data in 2016 consisted of 11,796 rural households and 10,994 urban households. The core data needed in this study include the status of residence (city/village) and the number of household members. Meanwhile, the consumption module data needed is a description of household expenditures for rice, corn, cassava, sweet potato, and wheat flour commodities.

Analysis of food demand for carbohydrate sources was carried out using the Linear Approximation/Almost Ideal Demand System (LA-AIDS) model. The LA-AIDS model is a linear demand model derived from Marshallian demand but in the proportion of expenditure or budget share (Deaton dan Muellbauer, 1980). The LA/AIDS model was estimated using the Seemingly Unrelated Regression /SUR (Siami-Namini, 2017; Essaten, S., Mekki, A. A. E., & Serghini, M., 2018). SUR is an estimate in a multivariate regression system that explains the value of each unrelated equation model. So that each equation model can be analyzed simultaneously without causing a correlation between the models (Zellner, 1962). Here are the similarities of LA-AIDS:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(x/p*) + \beta_i \log ART_j + \mu_i \quad (1)$$

The household consumption data from the Susenas is household consumption for one week. The short consumption time causes some households not to consume (zero consumption). This condition causes the results of the OLS analysis to be biased (Busway, et al, 2007). To avoid the problem of bias in the analysis, Heckman (1979) uses the predictive value of the probit model that produces the Inverse Mill's Ratio (IMR). IMR is the ratio of the estimated value of the standard normal density function to the estimated value of the cumulative standard normal distribution function. The IMR value is obtained from the following equation:

$$IMR_{ih} = \frac{\emptyset(x,\beta)}{\theta(x,\beta)} \; for \; y_{ih} = 1 \quad (2)$$

$$IMR_{ih} = \frac{\emptyset(x,\beta)}{\theta(x,\beta)} \; for \; y_{ih} = 0 \quad (3)$$

Where x is the socio-demographic factor, β is the log of commodity prices. y_{ih} is a dummy variable, $y_{ih} = 1$ if the household consumes the commodity and, $y_{ih} = 0$ if the household does not consume the commodity.

Heien and Wessells (1990) used Heckman's two-step estimation by including IMR in the observations. So that the LA-AIDS equation is obtained as follows:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(x/p*) + \beta_i \log ART_j + IMR_j + \mu_i \quad (4)$$

Where w_i is the ith food expenditure share; p_j is the jth commodity price; x is total food expenditure; IMR is the value of Inverse Mills Ratio; α, d, β, γ are estimation parameters, and μ are error terms. p* is the stone price index ($\ln p^* = \Sigma w_i . \ln p_i$). While i, j for 1 (rice), 2 (corn), 3 (cassava), 4 (sweet potato), 5 (wheat flour). The LA-AIDS model to be consistent with the demand theory, the use of the AIDS model in the demand system must go through a demand restriction test consisting of adding up, homogeneity, and symmetry. (Liao dan Chern, 2007).

Adding up : $\sum_i a_i = 1$, $\sum_i a_{ij} = 0$, $\sum_i b_i = 0$,

Homogenitas : $\sum_j c_{ij} = 0$,

Simetri : $c_{ij} = c_{ji}$.

The results of the model estimation with LA-AIDS are used to calculate the elasticity of demand. This analysis uses two approaches in calculating the elasticity of demand, namely the compensated (Hicksian) approach, and the uncompensated (Marshallian) approach. These two approaches are used because they have different effects namely, there is a substitution effect in the compensated analysis, while in the uncompensated analysis, apart from a substitution effect, there is also a real income effect (Nicholson, 1995; Crosetto, 2010).

Compensated elasticity,

Compensated price elasticity value: $\in_{ii}^{H} = -1 + \frac{\gamma_i}{w_i} + w_i$ ..... (5)

Compensated cross-price elasticity value: $\in_{ij}^{H} = \frac{\gamma_{ij}}{w_i} + w_j$ ..... (6)

Uncompensated Elasticity,

Uncompensated price elasticity value: $\in_{ii}^{M} = -1 + \frac{\gamma_i}{w_i} - \beta_i$ ..... (7)

Uncompensated cross elasticity value: $\in_{ij}^{M} = \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_j}{w_i}$ ..... (8)

Expenditure Elasticity: $\eta_i = 1 + \frac{\beta_i}{w_i}$ ..... (9)

Marginal *Expenditure share*

$$m_i = \eta_i . w_i \quad (10)$$

Where $\in_{ii}^{M}$ is uncompensated price elasticity, $\in_{ij}^{M}$ is uncompensated cross elasticity, $\in_{ii}^{H}$ is compensated price elasticity, $\in_{ij}^{H}$ is compensated cross elasticity, η_i is expenditure elasticity, m_i is marginal *Expenditure share*, w_i is budget share, γ_{i-j} is the commodity price parameter, β_{i-j}

is expenditure parameter, *i* for commodity-dependent variable, and *j* for commodity independent variable.

III. RESULT AND DISCUSSION

1.1. Estimation of Food Demand for Carbohydrate Sources

Respondents from Central Java Susenas data in 2016 consisted of 22,838 households. Of the total number of respondents, 51.76% of households live in rural areas and 48.24% of households live in urban areas. According to the Central Statistics Agency (2017a), household consumption of rice in rural areas (1,494 kg/capita) is greater than in urban areas (1,344 kg/capita), which means that households in rural areas are more dependent on demand for rice as the main food ingredient than in urban areas. Several factors influence the size of household consumption in both rural and urban areas, including prices, household expenditures, and the number of household members. The effect of each variable can be seen in Table 1.

Table 1. Estimated Results of Food Demand for Carbohydrate Sources

	Intersep	Lpbr	Lpjg	Lptr	Lpuj	Lpsk	Lpexp	Lpart
				Rural				
Wbr	1.0261	-0.0045	-0.0065	-0.0029	-0.0015	0.0154	-0.0081	0.0184
Wjg	0.8831	-0.0065	0.0303	-0.0074	-0.0007	-0.0156	-0.0012	0.0166
Wtr	0.6824	-0.0029	-0.0074	0.0021	0.0023	0.0059	0.0063	-0.0113
Wuj	0.2009	-0.0015	-0.0007	0.0023	-0.0018	0.0017	0.0051	-0.0004
Wsk	-1.7926	0.0154	-0.0156	0.0059	0.0017	-0.0073	-0.0021	-0.0232
				Urban				
Wbr	1.1345	0.0381	-0.0047	-0.0176	-0.0212	0.0054	-0.0174	0.0276
Wjg	0.0279	-0.0047	-0.0043	0.0037	0.0099	-0.0046	-0.0010	-0.0009
Wtr	0.3138	-0.0176	0.0037	0.0070	0.0108	-0.0040	0.0091	-0.0104
Wuj	-0.2046	-0.0212	0.0099	0.0108	-0.0017	0.0022	0.0072	-0.0027
Wsk	-0.2716	0.0054	-0.0046	-0.0040	0.0022	0.0010	0.0021	-0.0138

Source: Author’s calculations from Susenas

Note: Wbr (*Budget share of rice*), Wjg (*Budget share of corn*), Wtr (*Budget share of wheat*), Wuj (*Budget share of sweet potato*), Wsk (*Budget share of cassava*), lpbr (rice price), lpjg (corn price), lptr (wheat price), lpuj (sweet potato price), lpsk (cassava price), lpexp (expenditure), lpart (size of household member)

All observation variables in Table 1 have a probability value of less than one percent. This means that all independent variables have a significant effect on changes in commodity demand. The significant value of the price and expenditure coefficients can be used to analyze the sensitivity of household consumption to changes in prices and expenditures. The analysis is carried out through an analysis of the elasticity of demand in the form of an analysis of own price elasticity, cross price elasticity, and expenditure elasticity.

Table 1 shows the coefficient for the size of household members, some are positive and some are negative. Positive and negative signs explain the effect of the number of household members on the increase and decrease in demand for commodities. The coefficient on the number of household members has a positive effect on each share of rice expenditure and negatively on the share of wheat, sweet potato, and cassava expenditures. However, the size of household members has a different effect on the share of maize expenditure, which is positive in the rural analysis and negative in the urban analysis.

1.2. The Elasticity of Food Demand for Carbohydrate Sources in Rural Areas

Analysis of elasticity of demand is carried out to determine the level of sensitivity of demand for a commodity to changes in expenditure and changes in commodity prices. Expenditure elasticity describes the behavior of households towards the demand for a commodity due to changes in household spending. Meanwhile, marginal expenditure share is used to determine changes in the share allocation of commodity expenditures in the future due to changes in household expenditures (Andreyeva et al., 2010; Hursh, S. R., & Roma, P. G., 2016; Asare dan Eghan, 2012; Wogbe, 2000). Own price elasticity explains the effect of changes in commodity prices on the demand for these commodities. Meanwhile, cross price elasticity describes the relationship formed between commodities when one of them experiences a price change (Elnovita et al., 2019; Hirshleifer, 1985; Anindita, 2008). The results of the analysis of expenditure elasticity and marginal expenditure share are presented in Table 2. While the results of the analysis of own price elasticity and cross price elasticity are uncompensated and compensated in Table 3.

Table 2. Expenditure Elasticity and Marginal Expenditure share in Rural households

Commodity	Expenditure Elasticity	Marginal expenditure share
Rice	0.9921	1.0180
Corn	0.9986	0.8819
Wheat Flour	1.0092	0.6886
Sweet Potato	1.0254	0.2060
Cassava	1.0012	-1.7946

Source: Author's calculations from Susenas.

The elasticity of the six commodities (rice, corn, wheat, sweet potato, cassava) has a positive between 0.9921 to 1.0254 (Table 2). The positive value of the expenditure elasticity illustrates that an increase in household spending can increase the demand for a commodity (Sa'diyah et al., 2019; Hirshleifer, 1985; Tomek, W. G., & Kaiser, H. M., 2014; Nendissa, D. R., Anindita, R., Khoiriyah, N., & Sa'diyah, A. A., 2021). Rice has a lower elasticity value than other commodities. This means that among other commodities, rice is the main source of carbohydrates because the value of the change in demand is lower than the change in expenditure of 0.9921. This condition is rice consumption has become the main source of carbohydrate food consumption so changes in household spending do not have a major influence on rice consumption for rural households. In addition to rice, the commodity that has an elasticity value of less than one is corn, which is 0.9986. Meanwhile, other commodities have expenditure elasticity values of more than one, namely 1.0092 (wheat), 1.0254 (sweet potato), and 1.0012 (cassava). The results of this analysis support another analysis which states that the elasticity of rice expenditure in rural Indonesia is lower than other carbohydrate sources (Saliem, 2002; Miranti, 2017).

The marginal expenditure share for rice is 1.0180 (greater than one). This large value indicates that in the future only rice will receive a larger increase in expenditure allocation compared to other commodities. Meanwhile, for other commodities, the marginal expenditure share is around 0.2060-0.8819. The interesting thing is the marginal expedited value of cassava is -1.7946. This means that in the long term there will be a decrease in the allocation of expenditure to consume cassava. Even though cassava is one of the local commodities which is an alternative food from the government's efforts to diversify rice (Ariani, 2010; Rahmawati, 2009; Sasongko, L. A., 2009).

Table 3. Own Price Elasticities and Cross Price Elasticities in Rural

Commodity	Rice	Corn	Wheat Flour	Potato Sweet	Cassava
			Uncompensated		
Rice	**-0.9962**	0.0026	0.0010	-0.0027	-0.0185
Corn	0.0357	**-0.9645**	0.0352	0.0345	0.0318
Wheat Flour	-0.0063	-0.0050	**-1.0032**	0.0013	0.0196
Sweet Potato	-0.0348	-0.0312	-0.0261	**-1.0139**	0.0060
Cassava	-0.0021	-0.0020	-0.0017	-0.0012	**-0.9938**
			Compensated		
Rice	**0.0218**	0.8788	0.6781	0.1965	-1.7969
Corn	1.0604	**-0.0826**	0.7167	0.2351	-1.7583
Wheat Flour	1.0292	0.8862	**-0.3145**	0.2040	-1.7894
Sweet Potato	1.0173	0.8743	0.6736	**-0.8079**	-1.8014

Cassava	1.0302	0.8872	0.6865	0.2049	**-2.7885**

Source: Author's calculations from Susenas

The uncompensated or Marshallian price elasticity (Table 3) in rural areas has a negative for each carbohydrate. This result is following the theory of demand, namely the demand for a commodity will decrease when there is an increase in the price of the commodity or it is called downward sloping (Varian, 2010; Febianti, Y. N., 2014; Sudarmanto, E., Syaiful, M., Fazira, N., Hasan, M., Muhammad, A., Faried, A. I., & Purba, B., 2021). The elasticity own price of rice, corn, and cassava are -0.9962; -0.9645; -0.9938, including the category of a commodity that is inelastic to price changes, where the value of the change in demand is not greater than the price change. Meanwhile, the own price elasticity of flour and sweet potato are -1.0032 and -1.0139, including commodity categories that are elastic to price changes, which means that the value of changes in demand is greater than changes in commodity prices. If viewed on a compensated or Hicksian own price elasticity basis (in Table 3), the price elasticity of each commodity in rural areas also has a negative, except for positive rice. Almost all commodities in the compensated analysis have an elasticity of less than one (-0.0218 to -0.8079). This explains that these commodities are included in commodities that are inelastic to price changes. Different conditions occur in cassava which is elastic to price changes because it has more than one elasticity, which is 2.7885.

The results of the uncompensated cross-elasticity analysis show that rice has a substitution relationship with other commodities except for maize which has a complementary relationship. Corn has a substitution relationship with other commodities except for rice. Wheat has a substitution relationship with sweet potato and cassava and has a complementary relationship with rice and corn. Sweet potato has a substitution relationship with rice and cassava, while with corn and wheat it has a complementary relationship. Cassava with other commodities has a complementary relationship except with rice. Although the relationship formed between commodities has differences, the magnitude of the value given from the impact of changes in commodity prices on other commodities overall has a value of less than one or is inelastic to changes in the prices of other commodities. If analyzed on a compensated basis, the cross price elasticity of food demand in rural areas almost all commodities have a complementary relationship with other commodities. In contrast to other commodities, cassava has a substitution relationship with other commodities. Meanwhile, if viewed from the magnitude of the change in value, only changes in the price of rice and cassava provide changes in inelastic demand for other commodities. The results of this study are following the results of BPS research (2009) .

The difference in the results of the uncompensated analysis with the compensated analysis explains that there is an influence given by the income effect on the uncompensated analysis. So that when an analysis is carried out without an income effect (compensated) it can provide different results, both from substitution to complementary relationships and vice versa (Anindita, 2008).

1.3. The Elasticity of Food Demand for Carbohydrate Sources in Urban

The elasticity of demand for food sources of carbohydrates in urban areas is also carried out with three analyzes, namely expenditure elasticity, price elasticity, and cross elasticity. In addition, marginal expenditure share analysis was also carried out. As in rural areas, the elasticity of demand analysis in urban areas is carried out using two approaches, namely the uncompensated or Marshallian approach and the compensated or Hicksian approach. The analysis of expenditure elasticity and marginal expenditure share in urban areas is presented in table 4, while the results of the analysis of price elasticity and cross elasticity are presented in table 5.

Table 4. Expenditure Elasticity and Marginal Expenditure Share of Food Demand in Urban Areas

Commodity	Expenditure Ealastivity	Marginal expenditure share
Rice	0.9846	1.1171
Corn	0.9656	0.0269
Wheat Flour	1.0291	0.3229
Sweet Potato	0.9650	-0.1974
Cassava	0.9923	-0.2695

Source: Author's calculations from Susenas

The expenditure elasticity (Table 4) shows that rice, corn, wheat flour, sweet potato, and cassava are normal goods because they have elacticity less than one. This means that an increase in household spending can increase the demand for these commodities. The elasticity of household expenditure in urban areas is between 0.9650 to 0.9923. Wheat flour is included in a superior (luxurious) commodity with an elasticity of more than one, which is 1.0291. This means that the allocation of urban household expenditures for wheat flour consumption is higher than for other commodities when there is an increase in income (Lantican *et al,* 2013). This condition needs attention from the government. Given that flour is an imported product. The value of the marginal expenditure share of rice commodities in urban areas is the highest compared to the other four commodities (corn, flour, cassava, and cassava). This means that the value of the increase in the allocation of rice expenditure in the future is the highest compared to other commodities, amounting to 1.1171. Meanwhile, other commodities ranged in value from 0.0269 to 0.3229. If rice expenditure allocation increases, sweet potato, and cassava experience a decrease in expenditure allocation for urban households by -0.1974 (sweet potato) and -0.2695 (cassava).

Table 5. Own Price Elasticity and Cross Price Elasticity in Urban

Commodity	Rice	Corn	Wheat Flour	Sweet Poato	Cassava
			Uncompensated (Marshallian)		
Rice	-0.9490	0.0340	0.0384	0.0305	0.0294
Corn	-0.1147	-1.1528	-0.1430	-0.1608	-0.1631
Wheat Flour	-0.0107	0.0215	-0.9868	0.0282	0.0302
Sweet Potato	0.0482	0.0095	0.0195	-0.9986	-0.0010
Cassava	0.0005	-0.0080	-0.0058	-0.0098	-1.0057
			Compensated (Hicksian)		
Rice	0.1681	0.0615	0.3474	-0.1710	-0.2380
Corn	0.9807	-1.1259	0.1600	-0.3584	-0.4254
Wheat Flour	1.1568	0.0502	-0.6639	-0.1823	-0.2493
Sweet Potato	1.1430	0.0364	0.3223	-1.1961	-0.2631
Cassava	1.1309	0.0243	0.3101	-0.2082	-1.2752

Source: Author's calculations from Susenas

Uncompensated own price elasticity in urban areas shows that each commodity has a negative elasticity value according to the theory of demand, an increase in commodity prices can reduce demand for these commodities. In urban areas, commodities that are inelastic to price changes are rice (-0.9490), wheat (-0.9868), and sweet potato (-0.9986). Rice is the most responsive commodity to price changes because it has the lowest inelastic. Meanwhile, commodities that have an elastic elasticity are maize (-1.1528) and cassava (-1.0057). The results of the elastic analysis explain that the value of the change in demand is greater than the value of the in the price change. If analyzed on a compensated basis, the price elasticity in urban areas has the same results as the analysis in rural areas, namely that all commodities have negative values except for rice commodities. Each commodity has a different response to any changes in commodity prices. Rice and wheat are inelastic to price changes, while corn, sweet potato, and cassava are elastic to price changes.

Analysis of uncompensated cross price elasticity in urban areas explains that the relationship between rice and corn and wheat is a substitution, while the relationship with sweet potato and cassava is complementary. Corn has a complementary relationship with all commodities except cassava. Wheat has a substitution relationship with corn and cassava and has a complementary relationship with rice and sweet potato. Sweet potato and cassava have a complementary relationship with rice and wheat. Meanwhile, with other commodities, sweet potato has a substitution relationship. The analysis of compensated cross price elasticity in urban areas explains that the relationship formed between commodities is complementary to rice and other commodities, corn to other commodities, and flour to other commodities. Meanwhile, sweet potato and cassava have a substitution relationship with other commodities. The value of the effect of changes in the price of a commodity with other commodities having a high influence is when a change in the price of rice affects the demand for flour (1.1568), sweet potato (1.1430), and cassava (1.1309). While the change value for other commodities does not reach one or means that the relationship formed is inelastic.

IV. CONCLUSIONS AND RECOMMENDATIONS

The demand for food sources of carbohydrates has differences between rural and urban households which are influenced by several things, including price, income, and number of household members. When viewed from the elasticity of demand, rice and corn are commodities that are inelastic to changes in household expenditure. Wheat is a superior commodity in both rural and urban areas. Meanwhile, sweet potato and cassava are elastic in terms of expenditure for rural households. However, each household allocates higher consumption expenditures for rice compared to other commodities. In line with the expenditure elasticity analysis, rice has the most inelastic price elasticity value compared to other commodities. In addition, the effect of changes in rice consumption on changes in prices of other commodities is lower than the effect of changes in rice prices on the consumption of other commodities. This condition explains that among other commodities, the demand for rice to meet the needs of carbohydrates in the household is the highest. So that effort are needed from the government to maintain the stability of rice commodity prices in the market.

REFERENCES

[1] Akinbode, S. O. (2015). A linear approximation almost ideal demand system of food among households in South-West Nigeria. *International Journal of Social Economics*, *42*(6), 530–542. https://doi.org/10.1108/IJSE-08-2014-0165

[2] Amanto, B. S., Chairul Basrun Umanailo, M., Wulandari, R. S., Taufik, T., & Susiati, S. (2019). Local consumption diversification. *International Journal of Scientific and Technology Research*, *8*(8), 1865–1869.

[3] Andreyeva, T., Long, M. W., & Brownell, K. D. (2010). The impact of food prices on consumption: A systematic review of research on the price elasticity of demand for food. *American Journal of Public Health*, *100*(2), 216–222. https://doi.org/10.2105/AJPH.2008.151415

[4] Barten, A. P., & Turnovsky, S. J. (1966). Some aspects of the aggregation problem for composite demand equations. *International Economic Review*, *7*(3), 231-259.

[5] Bashir, A., & Yuliana, S. (2018). Identifying factors influencing rice production and consumption in Indonesia. *Jurnal Ekonomi Pembangunan*, *19*(2), 172–185.

[6] Bett, H. K., Musyoka, M. P., Peters, K. J., & Bokelmann, W. (2012). Demand for Meat in the Rural and Urban Areas of Kenya: A Focus on the Indigenous Chicken. *Economics Research International*, *2012*, 1–10. https://doi.org/10.1155/2012/401472

[7] Christensen, L. R., Jorgenson, D. W., & Lau, L. J. (1975). Transcendental logarithmic utility functions. *The American Economic Review*, *65*(3), 367-383.

[8] Deaton, A. (1986). Demand analysis. *Handbook of econometrics*, *3*, 1767-1839.

[9] Deaton, A., & Muellbauer, J. (1980). An almost ideal demand system. *The American economic review*, *70*(3), 312-326.

[10] Delavar, A., Yavari, G., & Yazdani, S. (2020). *Testing of Weak Separability and Estimating of Meat Demand System in Iran (Application of Rotterdam Demand System)*. *228*, 215–228.

[11] Delport, M., Louw, M., Davids, T., Vermeulen, H., & Meyer, F. (2017). Evaluating the demand for meat in South Africa: an econometric estimation of short term demand elasticities. *Agrekon*, *56*(1), 13-27.

[12] Elnovita, E., Jamal, A., Seftarita, C., & Saputra, J. (2019). Analysis of demand for food commodities and its impact on the poverty. *Opcion*, *35*(89), 455–474.

[13] Erhabor, P. O. I., & Ojogho, O. (2011). Demand analysis for rice in Nigeria. *Journal of food technology*, *9*(2), 66-74.

[14] Färe, R., Grosskopf, S., Hayes, K. J., & Margaritis, D. (2008). Estimating demand with distance functions: Parameterization in the primal and dual. *Journal of Econometrics*, *147*(2), 266–274. https://doi.org/10.1016/j.jeconom.2008.09.033

[15] Hafizah, D., Budiman Hakim, D., & Nurmalina, R. (2020). Analysing Food Consumption in Indonesia. *International Journal of Progressive Sciences and Technologies (IJPSAT)*, *20*(2), 340–347. http://ijpsat.ijsht-journals.org

[16] Hermanto, Rachmat, D. H. A. M., Ilham, N., Supriyati, Kariyasa, I. K., Setiyanto, A., & Rangga Ditya Yofa Edy Yusuf, S. (2015). Outlook Komoditas Pangan Strategis Tahun 2015-2019. In *Pusat Sosial Ekonomi Dan Kebijakan Pertanian, Badan Penelitian dan Pertanian Indonesia*. http://pse.litbang.pertanian.go.id/ind/pdffiles/anjak_2015_18.pdf

[17] Kassali, R., Kareem, R. O., Oluwasola, O., & Ohaegbulam, O. M. (2010). Analysis of Demand for Rice in Ile Ife, Osun State, Nigeria. *Journal of Sustainable Development in Africa*, *12*(2), 63-78.

[18] Liao, H., & Chern, W. S. (2007). *A dynamic analysis of food demand patterns in urban China* (No. 381-2016-22052).

[19] Lusk, J. L. (2017). Consumer research with big data: Applications from the food demand survey (foods). *American Journal of Agricultural Economics*, *99*(2), 303–320. https://doi.org/10.1093/ajae/aaw110

[20] M.J.A. Van den Tillaart. (2019). *The Price Elasticity of Demand for Fresh Dairy Products*. 1–46.

[21] Maula, L. R., Anindita, R., & Syafrial, N. (2019). Estimasi Permintaan Daging Sapi di Provinsi Jawa Timur dengan Model Sistem Pengeluaran Linier. *Jurnal Agro Ekonomi*, *37*(1), 47. https://doi.org/10.21082/jae.v37n1.2019.47-60

[22] McLaren, K. R., Rossitter, P. D., & Powell, A. A. (2000). Using the cost function to generate Marshallian demand systems. *Empirical Economics*, *25*(2), 209–227. https://doi.org/10.1007/s001819900012

[23] Muyanga, M., T.S. Jayne, G. A.-K., & Ariga, J. (2006). Staple Food Consumption Patterns In Urban Kenya: Trends And Policy Implications By. *Policy*, *20498*(00200).

[24] Nugroho, S., & Suparyono, S. W. (2015). Pola Permintaan

Daging Tingkat Rumah Tangga di Indonesia: Analisa Data Mikro 2013. *Jurnal Ekonomi Dan Pembangunan Indonesia*, *16*(1), 47–58. https://doi.org/10.21002/jepi.v16i1.668

[25] Oyinbo, O., Omolehin, R. A., & Abdulsalam, Z. (2013). Analysis of the demand for rice in Kaduna State, Nigeria. *Agris on-line Papers in Economics and Informatics*, *5*(665-2016-44953), 45-52.

[26] Pangaribowo, E. H., & Tsegai, D. W. (2011). Food demand analysis of Indonesian households with particular attention to the poorest. *ZEF-Discussion Papers on Development Policy*, (151).

[27] Purwaningsih, Y., Hartono, S., Masyhuri, M., & Mulyo, J. H. (2014). Analisis Permintaan Pangan Rumah Tangga Menurut Tingkat Ketahanan Pangan di Propinsi Jawa Tengah (Analisis Data Susenas 2008). *Eko-Regional: Jurnal Pembangunan Ekonomi Wilayah*, *5*(1).

[28] Rahmawati, F. (2009). Pengembangan Industri Kreatif Melalui Pemanfaatan Pangan Lokal Singkong. *Seminar Nasional "Peran Pendidikan Kejuruan Dalam Pengembangan Industri Kreatif" Jurusan PTBB FT UNY, November*, 1–6.

[29] Sa'diyah, A. A., Anindita, R., Hanani, N., & Muhaimin, A. W. (2019). Strategic Patterns of Households' Food Consumption in Indonesia. *Russian Journal of Agricultural and Socio-Economic Sciences*, *87*(3), 79–83. https://doi.org/10.18551/rjoas.2019-03.10

[30] Siami-Namini, S. (2017). Analysis of US Household Final Consumption Expenditure Using LA/AIDS Approach. *International Journal of Current Advanced …*, *6*(9), 6315–6320. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3476878

[31] Sombilla, M. A., Lantican, F. A., & Quilloy, K. P. (2013). Estimating the demand elasticities of rice in the Philippines. *Monograph*.

[32] Stone, R. (1954). Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand. *The Economic Journal*, *64*(255), 511–527.

[33] Sulgham, A. K. (2006). Econometric essays on specification and estimation of demand systems.

[34] Sunaryati, R. (2016). Analisis Permintaan Beras di Provinsi Kalimantan Tengah. *Daun: Jurnal Ilmiah Pertanian dan Kehutanan*, *3*(2), 99-107.

[35] Theil, H. (1965). The analysis of disturbances in regression analysis. *Journal of the American Statistical Association*, *60*(312), 1067-1079.

[36] Zheng, Z., & Henneberry, S. R. (2010). The impact of changes in income distribution on current and future food demand in urban China. *Journal of Agricultural and Resource Economics*, 51-71.

[37] Zheng, Z., & Henneberry, S. R. (2010). An analysis of food grain consumption in urban Jiangsu province of China. *Journal of Agricultural and Applied Economics*, *42*(2), 337-355.