International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

http://ijpsat.ijsht-journals.org
Vol. 15 No. 1 June 2019, pp. 157-169

Why Rice is Still Considered as an Important Food Ingredient in Indonesia? : Overview of the Pattern of Household Food Demand

Rita Yuliana[1], Harianto[2], Sri Hartoyo[3], Muhammad Firdaus[4]

[1]Polytechnics Statistics STIS, Jl. Otto Iskandardinata
No. 64C, Jakarta, Indonesia 13330

[2]Faculty of Economics and Management, Bogor Agricultural University,
Jl. Raya Dramaga Bogor Jawa Barat, Indonesia

[3]Faculty of Economics and Management, Bogor Agricultural University,
Jl. Raya Dramaga Bogor Jawa Barat, Indonesia

[4] Faculty of Economics and Management, Bogor Agricultural University, J
l. Raya Dramaga Bogor Jawa Barat, Indonesia,

Abstract - One of the problems of food in Indonesia is the increasing of food prices. Therefore, information on food demand elasticities is important for policymakers. Demand elasticity was derived from the estimated function of demand for food. This research aims to analyse household food demand in Indonesia using Linear Approximation/Almost Ideal Demand System for 12 food groups from The National Socioeconomic Survey of March 2016. The results revealed that factors influencing demand on food are food prices, real expenditures, and socio-demographic variables. All commodities have negative own-price elasticity indicating that as the price of a food group increases the quantity consumed decreases, while the absolute value of own-price elasticity for some food groups in rural areas, poor household, and agricultural household are more than one, which is referring to the high sensitivity of food demand. The role of rice in household consumption remains high or quite dominant.

Keywords - Aids Model, Expenditure Elasticity; Food Groups; Household Groups; Price Elasticity.

I. INTRODUCTION

One of the issues of food in Indonesia is the increased number of people that require the provision of food in a very large number specifically for rice as a staple food. However, the capacity to supply food actually faces a number of challenges such as global climate change, competition in the use of land and water resources for agricultural and non-agricultural activities, and environmental degradation which reduces national food production capacity. Indonesia also still faces issues of vulnerability to food insecurity.

An issue that is related to the level of welfare is increasing food prices. Based on data of BPS-Statistics Indonesia, the Consumer Price Index (CPI) of food groups increased from 124.73 in March 2015 to 129.83 in September 2015 and 136.07 in March 2016. Consumers will change their behaviour when their incomes or prices of commodities are changed (Pindyck and Rubinfeld 2013). The effect of changes in consumer behaviour has important implications for food policies, thus policy analysts need to know it.

Corresponding Author: Rita Yuliana

The impact of economic changes such as increases in food prices and policies made by the government are determined by the response or sensitivity level of households. In a matter with the sensitivity level of these households, it is necessary to see the differences in each household group. The household group can be divided according to the area of residence, namely urban and rural, according to the conditions of poverty, namely poor and non-poor households, and according to the main source of household income, namely agricultural and non-agricultural households. This is to make policies that are right on target because each household group has different behaviours in food consumption.

The type of household residence area which is urban and rural will affect its behaviour in food consumption. This is because the characteristics of the two types of regions are different. Suharno (2010), Pangaribowo and Tsegai (2011) show that there are differences in food consumption patterns between households in urban and rural. Likewise, the behaviour of poor and non-poor households will be different because there are differences in purchasing power. Pangaribowo and Tsegai (2011), Berges and Casellas (2002) show differences in patterns of food demand between poor and non-poor households.

The main source of household income is one indicator of welfare level which is expected to reflect the socio-economic conditions of a household. Households with the main source of income in the agricultural sector are generally households with low-income, even the profile of the poor is often attached to those who work in the agricultural sector, such as small farmers, fishermen, farm labourers, and plantations. Although farmers are generally producers and consumers at the same time, rising food prices do not necessarily increase their income. This was indicated by the low farmer exchange rate of food crops (Nilai Tukar Petani=NTP), which were 99.33 in March 2014, 98.14 in September 2014, 100.80 in March 2015, 101.46 in September 2015 and 100.69 in March 2016 (BPS-Statistics Indonesia). NTP is a comparison between the price index received by farmers and the price index paid by farmers which are expressed as a percentage. NTP that is less than 100 means that the price index received by farmers is lower than the price index paid by farmers which indicates a low level of welfare and vice versa if more than 100. Some policies are prepared by the Government for agricultural household interests including food consumption needs. Therefore, information is needed about the behaviour of agricultural households, namely the level of their sensitivity to rising food prices.

The level of sensitivity of consumers or households can be seen from the value of elasticity of food demand, both income elasticity, and price elasticity. Information on the value of elasticity of food demand can be used to evaluate changes in the level of household welfare and the rate of growth of food demand which is very useful for various food policies. These values can be obtained from estimates of food demand functions. Empirical research on the function of food demand is very much included in Indonesia. Some researchers analyse food demand for the entire Indonesian scope such as Harianto (1994) and Moeis (2003), without distinguishing household groups. Researchers who differentiate the analysis of food demand for poor and non-poor households and urban and rural areas for the whole of Indonesia are Pangaribowo and Tsegai (2011). From these researchers, no one has yet analysed the complete food demand that distinguishes between urban and rural areas, poor and non-poor households, and agricultural and non-agricultural households for the whole of Indonesia. Therefore, complete research is needed on this issue.

This study is aimed to (1) estimate the food demand function of households in Indonesia; (2) analyse the expenditure and price elasticity of food demand for households in Indonesia; and (3) analyse the differences in the expenditure and price elasticity on various household groups (urban/rural, poor/non-poor or agriculture/non-agriculture).

II. METHODOLOGY

1.1. Data Sources and Study Scope

This study used data from the National Socioeconomic Survey (Indonesia: Susenas) of March 2016 compiled by BPS-Statistics Indonesia. Susenas data is cross-section data with households as its sample units. The data in Susenas consists of basic data and information on household members and their consumption expenditures. Food consumption data is divided into 112 groups and each group consists of data on the quantity and the value of expenditures. The data analysed in this study include household consumption data for different types of food commodities and household characteristic.

March 2016's Susenas covers 300 000 sample households spreading across geographic regions of Indonesia. However, the data processed in this study are around 288 631 households since there are some non-response households and incomplete data. The scope of this study is all provinces in Indonesia. This study assumes that the total income received by the household is equal to their

total expenditures, and thus, the total expenditures will be used to estimate the income elasticity of the households. The analyses on demand will be limited only to food commodities.

1.2. Model Specification and Estimation

This study used econometric method to estimate food demand functions using Linear Approximation/Almost Ideal Demand System (LA/AIDS) model developed by Deaton and Muellbauer (1980). Researchers who use the AIDS model are numerous, for example Nigel and Bogahawatte (1990), Huffman and Johnson (2000), Ackah and Appleton (2007), Sheng et al. (2008), Haq et al. (2008), Le (2008), Tash et al. (2012). Researchers who use the AIDS model for Indonesia are Teklu and Johnson (1987), Deaton (1990), Harianto (1994), Moeis (2003), Suharno (2010).

In addition to the AIDS model, which is quite widely used in the study is the Quadratic Almost Ideal Demand System (QUAIDS) model built by Banks et al. (1997). Some researchers who use the QUAIDS model are Fashogbon and Oni (2013), Attanasio et al. (2013), Dybczak et al. (2014), and Kane et al. (2015). Researchers who use the QUAIDS model for Indonesia are Pangaribowo and Tsegai (2011), Widarjono (2012), Widarjono and Rucbha (2016).

Since the reference time of the survey is during the past week, there are some types of food which has a value of zero. The zero value means households do not consume these foods. To reduce the zero value in every type of food, there is an aggregation or a combining of different types of food commodities into a group. Nicholson and Snyder (2008) state that a composite commodity is a group of items which have a similar movement in their prices and thus, could be treated as a single commodity.

In this study, the food groups were formed based on several considerations which refer to the food groups in the calculation of the consumer price index (CPI), policy targeting (rice) and the content of nutrients (carbohydrates, fats, animal and vegetable protein). The food group is composed of 12 groups, namely: (1) rice/group$_1$; (2) grains other than rice and tubers/group$_2$; (3) fresh fish/group$_3$; (4) meat, eggs and milk/group$_4$; (5) vegetables/group$_5$; (6) legumes/group$_6$; (7) fruits/group$_7$; (8) oil and coconut/group$_8$; (9) beverages stuffs/group$_9$; (10) spices/group$_{10}$; (11) other foods (fish preserves and other consumption)/group$_{11}$; and (12) prepared food & beverage, and cigarettes/group$_{12}$.

The empirical model of demand using LA/AIDS this study is formulated as follows:

$$w\_group_{ih} = \alpha_{0i} + \sum_{j=1}^{12} \gamma_{ij}\, lnp\_group_{jh} + \beta_i lnpexp\_defl_h + \sum_{k=1}^{9} \alpha_{ik} S_{kh} + \alpha_{i10} imr\_group_{ih} + \varepsilon_{ih} \quad (1)$$

i, j	=	1,2, .., 12 (food group i/group j)
h	=	1,2, ..., h (households)
w_group$_i$	=	the proportion of food expenditure of ith group (group i) to total household food expenditure
lnp_group$_j$	=	the estimated of the natural logarithm (ln) of the price of food group j
lnexp_defl	=	ln of monthly total household food expenditure deflated by Stone price index (P) that is ln(P) = Σ w_group$_i$ lnp_group$_i$
S_k	=	socio-demographic variables with k = 1, ..., 9 namely: S_1: the number of household members, S_2: the floor area per capita, S_3: the age of the household head, S_4: the year schooling of the household head, S_5: dummy for sex of the household head (0=female, 1=male), S_6: dummy marital status of the household head (0= not married/divorced , 1= married), S_7: dummy for type of area of household residence (0 = rural, 1= urban), S_8: dummy for poverty status of households (0 = not poor, 1= poor), S_9: dummy for the main source of household income (0 = non-farm/others, 1= on farm agriculture)
imr_group$_i$	=	*inverse mills ratio*, a correction variable of the estimated price of the ith food groups (group$_i$)

ε = *error term*

α, γ, β = the estimated parameters

According to the theory of demand, some restrictions are applied to the equation (1). There are three characters that restrict the parameter values on demand systems such as the restriction of adding-up, symmetry ($\gamma_{ij}=\gamma_{ji}$) and homogeneity ($\Sigma_j\gamma_{ij}= 0$, for all i). The adding-up restriction is done by reducing the estimated regression equation for food groups (also to avoid the variance-covariance matrix being singular), from 12 equations to 11 equations and estimations of unregressed demand equations obtained from 11 estimated equations so that they meet the requirements adding-up as follows:

$$\Sigma_i\alpha_{0I}= 1;\Sigma_i\gamma_{ij}= 0;\Sigma_i\beta_i= 0;\Sigma_i\alpha_{ik}= 0, \text{ for } k = 1, ..., 9;\Sigma_i\ \alpha_{i10}= 0 \quad (2)$$

The reduced regression equation is the regression equation for the 11th food group which is categorized as another food group.

The proportion of expenditure for the i[th] food group (w_group_i) of every household could be written as:

$$w\_group_i = \frac{\Sigma_{j=1}^{J_i} e_j}{\Sigma_{i=1}^{I} e_i} \quad (3)$$

Where e_j and e_i are the expenditure value of j[th] commodity and i[th] food group.

The proxy for food price variable in this study is obtained by dividing total food expenditure with its quantities or the unit value of these foods. Moeis (2003), in his research, mentions that the use of the unit value will create an endogeneity problem in demand system because the unit value is influenced by the quality and quantity purchased. A predicted model with an endogeneity problem will produce a biased estimator if it is used with an ordinary regression (Ordinary Least Square).

Based on the model specifications, the estimation of the LA/AIDS model in this study used the Seemingly Unrelated Regression (SUR) method with the three-stage least squares (3-SLS) procedure with iterations and restrictions. Researchers who used 3-SLS in estimating the LA/AIDS model and using cross-section data were Nigel and Bogahawatte (1990).

Some studies use Seemingly Unrelated Regression (SUR) or SUR with iteration to overcome these problems, for examples Suharno (2010) and Tash et al. (2012). However, if heteroskedasticity exists, SUR method will produce an inefficient estimator (Moeis 2003). Three-stage least squares (3-SLS) method with iteration is a method which is able to produce efficient estimator although there is heteroscedasticity. Therefore, this study uses LA/AIDS model and the estimation method using 3-SLS with iterations and restrictions.

Referring to the equation (1), w_group_i used is the average of w_group_i. The food expenditure elasticity (η_i), the own-price elasticity (ε_{ii}), cross-price elasticity (ε_{ij}) of Marshallian (uncompensated) could be written as adopted by Ackah and Appleton (2007):

$$\eta_i = 1 + \beta_i / w\_group_i \quad (4)$$

$$\varepsilon_{ii} = - (1 + \beta_i) + \gamma_{ii} / w\_group_i \quad (5)$$

$$\varepsilon_{ij} = \gamma_{ij} / w\_group_i - \beta_i (w\_group_j / w\_group_i) \quad (6)$$

The elasticity of demand for certain food group (y_food) to total household expenditure (y_total) or expenditure elasticity (η_{iI}) is formulated as follows (Teklu and Johnson 1987):

$$\eta_{iI} = \eta_i \,.\, el_p \quad (7)$$

Where, by using the model of ln y_food = a + b ln y_total + ε, el_p could be written as follows:

$$el_P = \frac{dln\ y\_food}{dln\ y\_total} = b \quad (8)$$

The expenditure elasticity and price elasticity are analysed generally (total), according to the region (urban/rural), the poverty status (poor/non-poor), and the main source of household income (farm/non-farm agricultural activities).

III. RESULT AND DISCUSSIONS

1.3. Demand Function Estimation

Table 1 shows that most independent variables significantly influence ($p<0.01$) the expenditure proportion (dependent variable) of all food groups. The own-price (written in bold) of all commodities have a positive sign, except for $Group_2$ (non-rice and tubers) and $Group_8$ (oil and coconut) that have a negative sign. A positive sign means that the increasing price will be followed by the increasing proportion of expenditure. On the other hand, the negative sign indicates that if the price rises, the proportion of expenditure will decrease. These influences of prices to the proportion of expenditure are possible since the proportion of expenditure is the total amount of money spent on a certain food group divided by the total money spent for the entire group of foods. Hence, the expenditure proportion could be used to describe expenditure distribution among food groups consumed. Similar results were also shown by other researchers such as Harianto (1994), Moeis (2003), Pangaribowo and Tsegai (2011).

Similarly, for the influence of cross prices, there are positive and negative signs. For example, if the price of rice rises, the proportion of expenditure for all food groups will decrease (negative sign) except for $Grup_2$ (non-rice and tubers) and $Group_8$ (oil and coconut) the proportion will rise (positive sign) and on the contrary, the proportion of rice will decrease (negative sign) if there is an increase in the price of food groups other than $Grup_2$ (non-rice and tubers), $Group_8$ (oil and coconut) and $Group_{11}$ (other foods). The negative sign means that the increase in the price of rice will decrease the expenditure proportion of other commodities. On the contrary, the price of rice could also give positive impact when the rise of the rice price could increase the expenditure proportion of non-rice and tubers commodities ($Group_2$) as well as oil and coconut ($Group_8$). Meanwhile, negative sign could also be seen when the rising price of other commodities, except for non-rice and tubers, oil and coconut and other foods, could decrease the expenditure proportion of rice.

The effect of price, either own-price or cross-price, to food groups could not be interpreted directly by seeing the parameter estimation of the demand function. It could be interpreted through the elasticity of demand for food which will be discussed in the next section. This relates to the sensitivity of households in response to changes in prices and total expenditure.

A monthly food expenditure is deflated by the price index of Stone (lnexp_defl) and is well known as the real food expenditure. The real food expenditure is significant ($p<0.01$) and influences positively the proportion of expenditure of $Group_4$ (meat, eggs, milk), $Group_7$ (fruits) and Group12 (prepared food & beverages, and cigarettes), while on the other food groups, the real food expenditures have a negative influence. This implies that if the real food expenditure rising (as a proxy for income) then the household will allocate their spending for these food groups. These three food groups could be categorized as a luxury good, while other food groups as necessity good.

The number of household members has a different effect on the expenditure proportion of food groups. The number of household members is significant ($p<0.01$) and influences positively the proportion of expenditure for $Group_1$ (rice), $Group_3$ (fresh fish), $Group_4$ (meat, eggs, milk), $Group_5$ (vegetables), $Group_7$ (fruits), and $Group_8$ (oil and coconut). In other words, the larger the number of household members, the higher the proportion of food expenditure, especially for rice since it has the highest coefficient. The impact of the number of household members to the expenditure proportion of other food groups is negative.

The floor area per capita is significant ($p<0.01$) and influences positively the expenditure proportion of all food groups except $Group_2$ (non-rice and tubers) and $Group_{12}$ (prepared food & beverage, and cigarette) which has a negative impact. The positive impact indicates the larger the floor area per capita, the higher the expenditure proportion of food groups except for two food groups which have opposite conditions.

Table 1 Estimated parameters of the demand function LA/AIDS

The independent variables	Dependent variables										
	w_ Group$_1$	w_ Group$_2$	w_ Group$_3$	w_ Group$_4$	w_ Group$_5$	w_ Group$_6$	w_ Group$_7$	w_ Group$_8$	w_ Group$_9$	w_ Group$_{10}$	w_ Group$_{12}$
lnp_group$_1$	**0.0614**[a]	0.0030[a]	-0.0146[a]	-0.0082[a]	-0.0111[a]	-0.0050[a]	-0.0059[a]	0.0013[a]	-0.0013[a]	-0.0048[a]	-0.0158[a]
lnp_group$_2$	0.0030[a]	**-0.0039**[a]	0.0126[a]	0.0027[a]	-0.0044[a]	0.0009[a]	-0.0032[a]	0.0023[a]	0.0016[a]	-0.0013[a]	-0.0017[a]
lnp_group$_3$	-0.0146[a]	0.0126[a]	**0.0030**[a]	-0.0037[a]	0.0057[a]	0.0042[a]	-0.0028[a]	0.0013[a]	-0.0028[a]	-0.0005[a]	-0.0013[a]
lnp_group$_4$	-0.0082[a]	0.0027[a]	-0.0037[a]	**0.0254**[a]	-0.0031[a]	-0.0011[a]	0.0008[a]	-0.0011[a]	-0.0011[a]	-0.0005[a]	-0.0070[a]
lnp_group$_5$	-0.0111[a]	-0.0044[a]	0.0057[a]	-0.0031[a]	**0.0232**[a]	-0.0049[a]	-0.0016[a]	0.0010[a]	-0.0011[a]	0.0002[a]	-0.0060[a]
lnp_group$_6$	-0.0050[a]	0.0009[a]	0.0042[a]	-0.0011[a]	-0.0049[a]	**0.0025**[a]	0.0015[a]	0.0009[a]	0.0019[a]	0.0013[a]	-0.0008[a]
lnp_group$_7$	-0.0059[a]	-0.0032[a]	-0.0028[a]	0.0008[a]	-0.0016[a]	0.0015[a]	**0.0106**[a]	-0.0009[a]	-0.0004[a]	0.0007[a]	0.0044[a]
lnp_group$_8$	0.0013[a]	0.0023[a]	0.0013[a]	-0.0011[a]	0.0010[a]	0.0009[a]	-0.0009[a]	**-0.0056**[a]	0.0012[a]	0.0002[a]	-0.0015[a]
lnp_group$_9$	-0.0013[a]	0.0016[a]	-0.0028[a]	-0.0011[a]	-0.0011[a]	0.0019[a]	-0.0004[a]	0.0012[a]	**0.0068**[a]	0.0006[a]	-0.0040[a]
lnp_group$_{10}$	-0.0048[a]	-0.0013[a]	-0.0005[a]	-0.0005[a]	0.0002[a]	0.0013[a]	0.0007[a]	0.0002[a]	0.0006[a]	**0.0034**[a]	-0.0004[a]
lnp_group$_{11}$	0.0011[a]	-0.0085[a]	-0.0008[a]	-0.0029[a]	0.0022[a]	-0.0012[a]	-0.0030[a]	0.0010[a]	-0.0015[a]	0.0012[a]	-0.0012[a]
lnp_group$_{12}$	-0.0158[a]	-0.0017[a]	-0.0013[a]	-0.0070[a]	-0.0060[a]	-0.0008[a]	0.0044[a]	-0.0015[a]	-0.0040[a]	-0.0004[a]	**0.0354**[a]
lnexp_defl	-0.1037[a]	-0.0164[a]	-0.0132[a]	0.0269[a]	-0.0335[a]	-0.0084[a]	0.0140[a]	-0.0147[a]	-0.0142[a]	-0.0062[a]	0.1647[a]
ln_S$_1$	0.0933[a]	-0.0085[a]	0.0067[a]	0.0055[a]	0.0086[a]	-0.0002	-0.0092[a]	0.0052[a]	0.0016[a]	-0.0012[a]	-0.1167[a]
ln_S$_2$	0.0023[a]	-0.0129[a]	0.0035[a]	0.0144[a]	0.0029[a]	0.0027[a]	0.0072[a]	0.0027[a]	0.0011[a]	0.0010[a]	-0.0266[a]
ln_S$_3$	0.0301[a]	-0.0100[a]	0.0104[a]	-0.0064[a]	0.0132[a]	0.0042[a]	0.0051[a]	0.0046[a]	0.0096[a]	0.0003[a]	-0.0633[a]
S$_4$	-0.0002[a]	-0.0003[a]	0.0013[a]	0.0025[a]	0.0002[a]	-0.0003[a]	0.0012[a]	0.0000	-0.0003[a]	-0.0002[a]	-0.0036[a]
S$_5$	-0.0105[a]	0.0047[a]	-0.0105[a]	-0.0262[a]	-0.0201[a]	-0.0027[a]	-0.0126[a]	-0.0072[a]	0.0030[a]	-0.0052[a]	0.1038[a]
S$_6$	0.0049[a]	-0.0053[a]	0.0024[a]	0.0225[a]	0.0199[a]	0.0042[a]	0.0106[a]	0.0073[a]	0.0028[a]	0.0051[a]	-0.0892[a]
S$_7$	-0.0393[a]	-0.0077[a]	-0.0087[a]	0.0092[a]	-0.0090[a]	0.0004[a]	0.0019[a]	-0.0061[a]	-0.0052[a]	-0.0033[a]	0.0687[a]
S$_8$	0.0167[a]	0.0039[a]	-0.0095[a]	-0.0084[a]	-0.0053[a]	0.0013[a]	-0.0019[a]	0.0001	-0.0013[a]	-0.0012[a]	0.0144[a]
S$_9$	0.0157[a]	0.0117[a]	0.0030[a]	-0.0099[a]	0.0066[a]	-0.0012[a]	0.0001	0.0030[a]	0.0047[a]	0.0005[a]	-0.0388[a]
imr_group	0.0226[a]	-0.0397[a]	-0.0320[a]	-0.0059[a]	-0.0002	-0.0138[a]	0.0058[a]	-0.0021[a]	-0.0006	-0.0091[a]	0.0132[a]
constants	0.5080[a]	0.1989[a]	0.0950[a]	-0.1275[a]	0.1880[a]	0.0533[a]	-0.0738[a]	0.0860[a]	0.0855[a]	0.0681[a]	-0.0389[a]
R-square	0.4521	0.1259	0.0601	0.2909	0.2226	0.1226	0.1008	0.2141	0.1773	0.1823	0.3132

[a]showed statistically significant estimate at the level of 1%

The age of the household head is significant ($p<0.01$) and influences positively the expenditure proportion of all food groups except for $Group_2$ (non-rice and tubers), $Group_4$ (meat, eggs, milk) and $Group_{12}$ (prepared food & beverage and cigarette). This means that the older the head of household, the higher the proportion of spending on majority of food groups except for those three food groups. Therefore, there is an indication that the head of the household who are older than others will reduce their expenditure proportion on those three food groups. This is thought to be related to the level of his health.

The year schooling of the household head does not significantly influence ($p>0.10$) the proportion of expenditure of $Group_8$ (oil and coconut), but significantly influences ($p<0.01$) the expenditure proportion of other food groups. The variable has a positive impact on $Group_3$ (fresh fish), $Group_4$ (meat, eggs, milk), $Group_5$ (vegetables) and $Group_7$ (fruits). This means that the higher the education level of the household head, the higher the proportion of spending on those food groups. There is an indication that the higher the education level of household head, the higher the awareness of household head to the importance of nutrients contained in those food groups.

The inverse Mill's ratio does not significantly influence ($p>0.10$) the proportion of expenditure for $Group_5$ (vegetables) and $Group_9$ (beverages stuffs). The variable significantly affects ($p<0.01$) the proportion of expenditure for other food groups. These variables are included in the LA/AIDS demand function to overcome the problem of selectivity bias (bias associated with the selection). The results show that there was indeed a problem selectivity bias (bias associated with the selection). The variable inverse Mill's ratio does not significantly influence the expenditure proportion for $Group_5$ (vegetables) and $Group_9$ (beverages stuffs) since the majority of households (>94%) consume those food groups.

The values of R-squares are varied from 6.01% ($Group_3$, fresh fish) to 45.21% ($Group_1$, rice). These coefficients of determination are low, similar to the results of the research by Moeis (2003) and Ackah and Appleton (2007), because the data used is a cross-section data that have very high diversity. This suggests that the variation in the proportion of expenditure for food groups could be explained partly by the model, while the remaining could be explained by other factors.

1.4. Expenditure Elasticity

Table 2 shows that all food groups have positive expenditure elasticity. The positive value of expenditure elasticity indicates that all food groups are normal goods. For normal goods, the rising household expenditures (a proxy for income) will increase the quantity of food consumed. The food groups which have the elasticity of expenditure more than one could be categorized as luxury goods. These food groups are $Group_4$ (meat, eggs, milk), $Group_7$ (fruits), and $Group_{12}$ (prepared food & beverage, and cigarettes). For other food groups are categorized as normal goods to the value of expenditure elasticity less than one, including rice.

The value of the rice expenditure elasticity of 0.3389 means that the increase in the household expenditure (a proxy for income) by 1%, it will increase the demand for rice by 0.3389%. The elasticity value less than one implies the less responsiveness of household in rice consumption to changes in total expenditure (income).

Some researchers have shown different values of rice expenditure elasticity. Teklu and Johnson (1987) using data from Surgasar 1980 showed an elasticity of expenditure for rice of 0.33, the value of which was almost the same as this study. Moeis (2003) using data from Susenas 1996 and 1999 showed expenditure elasticity for rice of 0.500 in 1996 and 0.581 in 1999.

Sheng et al. (2008) showed expenditure elasticity for rice in Malaysia in 2004/2005 of 1.334, a value of more than 1 which means categorizing as luxury goods. Haq et al. (2008) also showed a value of more than 1 for rice expenditure elasticity in Pakistan in the same year which was equal to 1.162, while Le (2008) showed a value that was less than 1 in Vietnam in 2004, which was equal to 0.761.

Table 2 Elasticity expenditure by food groups and household groups

Food groups	Household groups						
	General	Urban	Rural	Poor	Not poor	Farm	Non-farm
$Group_1$	0.3389	0.2681	0.3934	0.6241	0.3045	0.4449	0.2778
$Group_2$	0.3034	0.5391	0.2916	*-0.6042*	0.3365	0.2645	0.4750
$Group_3$	0.6811	0.6411	0.7496	0.7171	0.6784	0.8246	0.6321
$Group_4$	1.0812	0.9577	1.2667	0.9548	1.0767	1.3134	1.0184

$Group_5$	0.5169	0.4665	0.5926	0.7388	0.5092	0.6323	0.4881
$Group_6$	0.5126	0.3899	0.6836	1.3082	0.4963	0.7436	0.4560
$Group_7$	1.1192	1.0336	1.2410	1.1508	1.1134	1.2598	1.0859
$Group_8$	0.4701	0.4192	0.5314	0.6268	0.4634	0.5597	0.4433
$Group_9$	0.5463	0.5146	0.6001	0.7394	0.5370	0.6311	0.5236
$Group_{10}$	0.6021	0.5227	0.7018	0.9847	0.5913	0.7528	0.5603
$Group_{11}$	0.9366	0.7922	1.0550	1.2740	0.9193	1.0992	0.8612
$Group_{12}$	1.2057	1.0953	1.3752	2.0080	1.1801	1.4458	1.1476

The lowest expenditure elasticity is on $Group_2$ (non-rice and tubers), which is almost similar to the expenditure elasticity of rice, 0.3034. On the other hand, the highest expenditure elasticity is on $Group_{12}$ (prepared food & beverage, and cigarette), 1.2057. The sensitivity of households to changes in total expenditure (income) in consuming $Group_{12}$ (prepared food & beverage, and cigarette) is quite high. This implies the changes in lifestyle when the households are richer. They would prefer to consume prepared foods and beverages that are generally more expensive than foods and beverages made by the households.

Generally, commodities with high-income elasticity have a high nutritional value such as meat, eggs, milk, fruits. However, there are some commodities with relatively high nutritional value that have low-income elasticities such as fresh fish and legumes (tofu, tempeh, peanuts). For commodities like this, if the Government wants to increase its consumption it can be through a subsidy program or through education/socialization (Norton et al. 2010).

According to the household groups, there are sensitivity differences between household groups for all food groups. The expenditure elasticity for rice is higher in the rural areas than in urban areas. Meanwhile, households with poverty status, the expenditure elasticity of rice is higher in poor households compared to non-poor households which have a quite similar result to Moeis (2003). The expenditure elasticity of farm household for rice is higher than those of non-farm households. In other words, the expenditure elasticity of rice will be higher for people with low income compared to those with high income which is similar to Harianto (1994) and Pangaribowo and Tsegai (2011). This is because the level of food sufficiency is still low in people with low income so that if there is an increase in income it will be allocated to the food.

In poor households, it is seen that the expenditure elasticity of all food groups is quite high, which is more than 0.5, except for $Group_2$ (non-rice and tubers) which is negative. Based on needs, the poor have no choice, they will spend a large part of their income on food and when income increases they will increase spending on a higher proportion of food. Unlike the case in high-income communities where the proportion of food expenditure will be lower than non-food. This is in accordance with Engel's Law, when income increases, the proportion of expenditure on food will be smaller.

The expenditure elasticity of $Groups_2$ (non-rice and tubers) for poor households is negative, indicating that the food group is inferior goods if income increases demand will decrease. Harianto's research (1994) resulted in a negative value for tubers (inferior goods) income elasticity in Indonesia in 1984.

The expenditure elasticity of $Group_7$ (fruits) and $Group_{12}$ (prepared food & beverage, and cigarette) have a value of more than 1 which shows the category of luxury goods for all household groups, even for poor households the value of $Group_{12}$ (prepared food & beverage, and cigarette) expenditure elasticity reaches 2.008. This means that if their income increases by 1%, the demand for $Group_{12}$ (prepared food & beverage, and cigarette) will increase 2,008%. This is a dilemma for poor household conditions, when income increases, spending on prepared food & beverage, and the cigarette will increase, even though cigarettes are not good for health.

In poor households, in addition to $Group_7$ (fruits) and $Group_{12}$ (prepared food & beverage, and cigarette), which have a value of the expenditure elasticity of more than 1 or a category of luxury goods are $Group_6$ (legumes) and $Group_{11}$ (other foods). In agricultural households and rural households, in addition to $Group_7$ (fruits) and $Group_{12}$ (prepared food & beverage, and cigarette), which have an expenditure elasticity value of more than 1 or luxury goods category are $Group_4$ (meat, eggs, milk) and $Group_{11}$ (other food). These food groups have high nutritional values, namely as a source of animal and vegetable protein so that if the Government wants to increase the consumption of these food groups for rural households, poor households, and agricultural households, the Government can provide social

safety nets that can increase their income because if income increase by 1%, the demand for these food groups will increase by more than 1%.

1.5. Price Elasticity

Marshallian (uncompensated) own-price and cross-price elasticity for 12 food groups could be seen in Table 3. Table 4 presents the value of own-price elasticity for whole household groups. Table 3 shows that the own-price elasticity (written in bold) of all food groups has negative values. This is consistent with the economic theory which illustrates the inverse relationship between price and quantity. In other words, the rising price will decrease the demand for the commodity and vice versa.

According to its absolute value, the value of own price elasticity greater than one indicates that the commodity is price-elastic. Price-elastic commodities have their demand falling by more than 1% for every 1% increase in the price of the commodities. These commodities are $Group_2$ (non-rice and tubers), $Group_8$ (oil and coconut), and $Group_{12}$ (prepared food & beverage, and cigarettes). Meanwhile, the remaining food groups have its price elasticity value less than 1.

The results of Teklu and Johnson's research (1987) obtained their own-price elasticity for rice in 1980 of -0.58, the value is almost the same as this study. Moeis (2003) showed its own- price elasticity for rice at -0.3036 in 1996 and -0.1999 in 1999.

Teklu and Johnson (1987) and Moeis (2003) showed the elasticity of expenditure of positive and low for rice and the elasticity of own-price which is inelastic. These mean that the sensitivity of households to changes in their income and rice price is low because it is a staple food. These results support the results of this study, which show that the role of rice is still high in the consumption of the Indonesian people.

The cross-price elasticity has either negative value (the complementary goods) or a positive value (the substitution goods). As could be seen in Table 3, the increase in the price of rice could increase the demand for those four food groups ($Group_2$, $Group_8$, $Group_9$, and $Group_{11}$). On the other hand, the increase in the price of rice could decrease the demand for another seven food groups. The increasing price of five food groups ($Group_3$, $Group_5$, $Group_6$, $Group_7$, and $Group_{10}$) could decrease the demand for rice. The increase in rice price has led to a decline in other food demand, meaning that consumers reduce their consumption rather than seek a replacement (diversification), while most of the increase in other food prices causes a decrease in demand for rice. Those facts indicate the important role of rice in demand for food. According to the National Socioeconomic Survey (Susenas) of March 2016, the share of rice in food consumption reaches 14.86% or the second highest ranked after groups of prepared food and beverage (BPS-Statistics Indonesia).

Sheng et al. (2008) showed the own-price elasticity for rice in Malaysia in 2004/2005 was -1.9268, in absolute terms the value was more than 1 which means elastic. Haq et al. (2008) also showed its elastic own-price elasticity for rice in Pakistan in the same year which was -1.469, while Le (2008) showed an inelastic value in Vietnam in 2004, which was -0.334.

In absolute value, the lowest value of the own-price elasticity is in rice and the highest value is in $Group_8$ (oil and coconut). This implies that households are very insensitive to the changes in the price of rice but very sensitive to the price changes in oil and coconut.

Table 4 shows the differences in the sensitivity of households to changes of the own-price for all food groups among household groups. The absolute value of the own-price elasticity of rice is slightly higher in the rural areas than in the urban areas. According to the poverty status of households, the absolute value of the own-price elasticity for rice is higher in poor households than in non-poor households. The absolute value of the own-price elasticity for rice in the farm household is higher than in non-farm households. Therefore, it would be said that households in rural areas, poor households, and farm households are very sensitive to the changes of the price of rice than households in the urban areas, non-poor households, and non-farm households. Pangaribowo and Tsegai (2011) showed that in absolute terms the own-price elasticity value for staple foods is higher in rural areas than in urban areas and higher in poor households than in non-poor households in 1997, 2000 and 2007.

Table 4 Own-price elasticity Marshallian (uncompensated) by food groups and household groups

Food groups	Household groups					
	Urban	Rural	Poor	Not poor	Farm	Non-farm
$Group_1$	-0.5083	-0.5647	-0.6031	-0.5517	-0.6041	-0.4943

$Group_2$	-0.6223	-1.2392	-1.5071	-0.9626	-1.3052	-0.5928
$Group_3$	-0.7700	-1.0246	-1.4408	-0.8846	-1.0959	-0.7984
$Group_4$	-0.7354	-0.7097	-0.7437	-0.7258	-0.7158	-0.7266
$Group_5$	-0.7164	-0.7143	-0.7668	-0.7033	-0.7132	-0.7152
$Group_6$	-0.8394	-0.9442	-1.2764	-0.8254	-0.9743	-0.8479
$Group_7$	-0.6440	-0.8170	-1.8435	-0.6726	-1.0112	-0.6170
$Group_8$	-1.1002	-1.1566	-1.1130	-1.1523	-1.1579	-1.1275
$Group_9$	-0.8190	-0.8301	-0.8894	-0.8192	-0.8356	-0.8192
$Group_{10}$	-0.8502	-0.8464	-0.8624	-0.8458	-0.8471	-0.8471
$Group_{11}$	-0.5923	-0.5886	-0.8582	-0.5527	-0.5874	-0.5983
$Group_{12}$	-1.0363	-1.0897	-1.2045	-1.0537	-1.1176	-1.0396

The absolute value of the own-price elasticity for $Group_2$ (non-rice and tubers), $Group_3$ (fresh fish), $Group_6$ (legumes), $Group_7$ (fruits), $Group_8$ (oil and coconut) and $Group_{12}$ (prepared food & beverage, and cigarettes) is higher than one or elastic for households in the rural areas, poor households and farm households. These indicate the high sensitivity of the households to the changes in the prices of those food groups. In other words, the increasing price of those food groups would reduce the consumption significantly and subsequently reduce the nutrient intake needed and the level of their health. Therefore, there is an indication of food and nutrition security caused by the increasing price of those food groups. The Government should develop policies aimed at those household groups that are affected by the increasing prices of those commodities. The required policy is to increase the purchasing power and to maintain the prices of food to be lower and stable as well as to control the inflation.

$Group_{12}$ (prepared food & beverage, and cigarettes) has its own-price elasticity value which is more than 1 in absolute terms so that it is elastic, equal to expenditure elasticity whose value is also more than 1 in all household groups. The policy that can be arranged to reduce the consumption of these food groups, especially cigarettes, is to increase the price because if the price rises 1%, the demand will decrease by more than 1%.

In poor households, $Group_2$ (non-rice and tubers) are inferior goods but have their own-price elasticity which has an absolute value of more than 1 or elastic. This means that if the income of poor households and the price of the food group increase, the demand will decrease.

IV. CONCLUSION

The estimation of the demand function for 12 food groups illustrates that the prices and the social-demographic variables significantly affect ($p<0.01$) the demand function. The total real expenditure of food has a positive effect on demand of a groups of meat, eggs, milk, groups of fruits, groups of prepared food & beverages and cigarettes.

The household sensitivity to changes in total expenditure and food prices could be seen in the elasticity of expenditure and the price elasticity. This study shows that the total monthly expenditure has a positive effect on all food groups, while the prices of the commodities have a negative effect. Several food groups have the expenditure elasticity more than 1 which indicates the luxury goods. These food groups are groups of meat, eggs, and milk, groups of fruits, and groups of prepared food & beverage and cigarettes.

Rice has an expenditure elasticity value of less than one indicating that the rice is necessity goods. The own-price elasticity of rice is also less than one or inelastic. This implies that household sensitivity to changes in total expenditure and rice price in consumption is quite low. The elasticity value of some food groups shows that households are very sensitive to income changes, but less sensitive to price changes for example in groups of meat, eggs, milk, and groups of fruits.

The role of rice in household consumption remains high or quite dominant. The dominant role of rice in food consumption could be an indication of the unsuccessful program of diversification because households are still concerned with rice in their food consumption.

Table 3 Price elasticity Marshallian (uncompensated) for 12 food groups

Food groups	on prices											
	$Group_1$	$Group_2$	$Group_3$	$Group_4$	$Group_5$	$Group_6$	$Group_7$	$Group_8$	$Group_9$	$Group_{10}$	$Group_{11}$	$Group_{12}$
$Group_1$	**-0.5489**	0.0324	-0.0374	0.0032	-0.0097	-0.0153	-0.0109	0.0274	0.0177	-0.0134	0.0251	0.1168
$Group_2$	0.2281	**-1.1340**	0.5324	0.1561	-0.1122	0.0480	-0.1003	0.1093	0.0890	-0.0353	-0.3071	0.1564
$Group_3$	-0.1590	0.1669	**-0.9476**	-0.0337	0.0887	0.0580	-0.0299	0.0222	-0.0294	-0.0031	-0.0052	0.0425
$Group_4$	-0.1530	0.0231	-0.0684	**-0.7278**	-0.0652	-0.0203	-0.0032	-0.0238	-0.0261	-0.0135	-0.0446	-0.1943
$Group_5$	-0.0572	-0.0389	0.0912	-0.0027	**-0.7099**	-0.0460	-0.0033	0.0236	0.0037	0.0106	0.0358	0.0635
$Group_6$	-0.1592	0.0494	0.2174	-0.0185	-0.1866	**-0.8800**	0.0813	0.0535	0.1021	0.0650	-0.0439	0.0952
$Group_7$	-0.2181	-0.0936	-0.1015	-0.0110	-0.0742	0.0307	**-0.7387**	-0.0365	-0.0261	0.0098	-0.0907	-0.0134
$Group_8$	0.1126	0.0773	0.0698	0.0044	0.0672	0.0358	-0.0104	**-1.1479**	0.0542	0.0155	0.0420	0.1070
$Group_9$	0.0292	0.0468	-0.0409	0.0031	0.0046	0.0526	0.0032	0.0407	**-0.8267**	0.0215	-0.0241	0.0245
$Group_{10}$	-0.1590	-0.0492	-0.0031	-0.0000	0.0323	0.0602	0.0405	0.0175	0.0367	**-0.8460**	0.0625	0.0743
$Group_{11}$	0.0078	-0.2653	-0.0364	-0.1016	0.0534	-0.0415	-0.0985	0.0249	-0.0517	0.0350	**-0.5821**	-0.0849
$Group_{12}$	-0.1278	-0.0170	-0.0401	-0.0598	-0.0596	-0.0128	-0.0055	-0.0204	-0.0311	-0.0121	-0.0185	**-1.0641**

There are differences in elasticity values (expenditure elasticity and price elasticity) between household groups, those are between urban and rural households, poor and non-poor households, farm and non-farm households. The sensitivity of poor households to changes in total expenditure (income) on demand of all food groups is very high. The sensitivity of rural households, poor households and farm households to price changes in most food groups is also very high. Thus, there is an indication of the occurrence of food insecurity and nutrition in the household group.

REFERENCES

[1] Ackah C, Appleton S. (2007), *Food price changes and consumer welfare in Ghana in the 1990s*. CREDIT Research Paper No. 07/03, University of Nottingham.

[2] Attanasio O, Di Maro V, Lechene V, Phillips D. (2013), *Welfare consequences of food prices increases: Evidence from rural Mexico*. Journal of Development Economics, 104:136-151.

[3] Banks J, Blundell R, Lewbel A. (1997), *Quadratic Engel curve and consumer demand*. Review of Economics and Statistics, 79(4):527-539.

[4] Berges ME, Casellas KS. (2002), *A demand system analysis of food for poor and nonpoor households. The case of Argentina.* The Xth EAAE Congress Exploring Diversity in The European Agri-Food System Zaragoza, Spain, 28-31 August 2002.

[5] Deaton A. (1990), *Price elasticities from survey data are: extensions and Indonesian results*. Journal of Econometrics, 44: 281-309.

[6] Deaton A, Muellbauer J. (1980), *An almost ideal demand system*. American Economic Review, 70(3): 312-326.

[7] Dybczak K, Toth P, Vonka D. (2014), *Effects of price shocks on consumer demand: Estimating the QUAIDS demand system on Czech Household Budget Survey Data*. Czech Journal of Economics and Finance, 64(6):476-500.

[8] Fashogbon AE, Oni OA. (2013), *Heterogeneity in rural household food demand and its determinants in Ondo State, Nigeria: An application of quadratic almost ideal demand system*. Journal of Agricultural Science, 5(2):169-177.

[9] Haq ZU, Nazli H, Meilke K. (2008), *Implications of high food prices for poverty in Pakistan*. Agricultural Economics, 39:477-484.

[10] Harianto. (1994), An empirical analysis of food demand in Indonesia: a cross-sectional study (dissertation). La Trobe Univ, Victoria (US).

[11] Huffman SK, Johnson SR. (2000), *Re-evaluation of welfare changes during the transition in Poland*. Working Paper 00-WP 255, Iowa State University.

[12] Kane GQ, Tene GLM, Ambagna JJ, Piot-lepekit I, Sikod F. (2015), *The impact of food price volatility on consumer welfare in Cameroon*. WIDER Working Paper 013.

[13] Le CQ. (2008), *An empirical study of food demand in Vietnam*. ASEAN Economic Bulletin, 25(3):283-292.

[14] Moeis, JP. (2003), Indonesian food demand system: An analysis of the impacts of the economic crisis on household consumption and nutritional intake (dissertation). The George Washington University, Washington DC (US).

[15] Nicholson W, Snyder C. (2008), Microeconomic Theory: Basic Principles and Extensions. 10th Ed. South-Western, Thomson, Ohio (US).

[16] Nigel J, Bogahawatte C. (1990), *Demand system of food using cross-section data: Evidence from Badulla District, Sri Lanka*. Tropical Agricultural Research, 2:183-196.

[17] Norton GW, Alwang J, Masters WA. (2010), Economics of Agricultural Development. World Food System and Resource Use. 2nd Ed. Routledge, London (GB) and New York (US).

[18] Pangaribowo EH, Tsegai D. (2011), *Food demand analysis of Indonesian households with particular attention to the poorest*. ZEF-Discussion Papers on Development Policy No. 151, Zentrum für Entwicklungstorschung, Center for Development Research, Bonn (DE): University of Bonn.

[19] Pindyck RS, Rubinfeld DL. (2013), Microeconomics. 8th Ed. Pearson Education, New Jersey (US).

[20] Sheng TY, Shamsudin MN, Mohamed Z, Abdullah AM, Radam A. 2008. *Complete demand system of food in Malaysia*. Agri.Econ.-CZECH, 54(10):467-475.

[21] Suharno. (2010), An almost ideal demand system for food based on cross-section data: rural and urban East Java, Indonesia (dissertation). Georg-August-Universität Göttingen, Göttingen (DE).

[22] Tash MNS, Shahraki J, Jangi SN. (2012), *Estimating the almost ideal demand system model for rural households in Iran*. International Journal of Academic Research in Business and Social Sciences, 2(8):281-292.

[23] Teklu T, Johnson SR. (1987), *Demand systems from a cross-section of data: An experiment for Indonesia*. CARD Working Papers, Iowa State University.

[24] Widarjono A. (2012), Food and nutrient demand in Indonesia (dissertation). Oklahoma State University, Oklahoma (US).

[25] Widarjono A, Rucbha SM. (2016), *Household food demand in Indonesia: A two-stage budgeting approach*. Journal of Indonesia Economy and Bussiness, 31(2):163-177.