I J A B E R, Vol. 14, No. 11, (2016): 7775-7790

IS DEMAND FOR STAPLE FOOD SENSITIVE TO PRICE CHANGE? EVIDENCE FROM INDONESIA

Agus Widarjono[1]

Abstract: *One important indicator of society welfares is sufficient levels of nutrition consumed by human being. The sufficient levels of nutrition can be fulfilled by consuming sufficient amount of food primarily from staple food. Food price crisis recently have been affecting consumption on staple food across the world, mostly developing countries such as Indonesia. This study analyzed demand for the staple foods in Indonesia using the national social and economic survey of households (SUSENAS) in 2011. The quadratic almost ideal demand system was applied to estimate price and expenditure elasticities. These estimates were applied for policy simulation. Empirical study finds that rice consumption, rice as a main staple food in Indonesia, is not sensitive to price change of other staple foods such as cassava, maize, wheat, and roots. Urban households suffer more than rural households as price of rice increases. Stabilizing price of rice is favorable for urban households than rural households.*

Keywords: *Quadratic almost ideal demand system, Staple food, price and expenditure elasticities, Indonesia.*

1. INTRODUCTION

Since the global food price crisis in 2008, world food prices are still relatively high. The food prices index in 2013 and 2014 was still above the 200 with value of 209.8 and 201.8 respectively. World food prices decreased drastically in which the food price index was 164 in 2015. More interestingly, the food price index of staple food is also relatively high . In 2013 and 2014, the price index of cereals was 219.3 and 191.1. Food prices index of staple foods then decreased to 162.4 in 2015 (FAO, 2016). The food prices in Indonesia have been increasing recently similar to the world food prices. The inflation rate of food groups was relatively high recently. Inflation rate of food stuffs was 5.61%, 11.35% and 10.57% while the inflation rate of prepared food and beverage and tobacco products was 6.11%, 7.45%, and 8.11% during 2012-2014 (Indonesian Central Bureau of Statistics, 2015).

[1] Department of Economics, Faculty of Economics, Islamic University of Indonesia, Yogyakarta, Indonesia. *E-mail: widarjonoagus@yahoo.com*

In addition to rising food prices, population is one of the major issues faced by Indonesia. With approximately 240 million people in 2013, Indonesia is the fourth biggest populous country in the world (Indonesian Central Bureau of Statistic, 2014). With these huge population and high food prices, Indonesia is facing problems of food security issues. Therefore, Indonesia also is facing nutritional deficiency issue since staple foods such as rice are the largest contributor to nutrient intakes in Indonesia. Average daily per capita consumption of calorie (kcal) and protein (grams) from all foods was 1,859 kcal and 53.91 grams in 2014 while per capita consumption of calorie and protein from staple foods was 962.59 kcal and 21.57 grams or 49.3% and 38.3% to total consumption of calorie and nutrient (Indonesian Central Bureau of Statistic, 2014).

An increase in the staple food prices recently definitely influences food security as well as nutritional deficiency because households certainly substitute from high quality to low quality foods and for some extent also reduce food consumption. The goal of this study is to estimate demand for staple food in Indonesia consisting of rice, cassava, maize, wheat, and roots. From estimated demand elasticity, then this study try analyze the impact of an increase in staple food price on rice consumption. However, this study differs with previous food demand studies in Indonesia. First, most previous food demand studies used almost ideal demand system (AIDS) with linear price index as known as a linearized almost ideal demand system (LA/AIDS). However, LA/AIDS results in inaccurate demand elasticities (Alston, Foster and Green, 1994). This study used a quadratic almost ideal demand system (QUAIDS) model developed by Banks *et. al.* (1997).

The rest of this paper is organized as follows: Section 2 discusses staple foods consumption patterns. Section 3 presents literature Reviews and model specification and data are discussed in section 4. The next section discusses the results and interpretation. Section 6 proceeds simulation policy to addresses an increase in staple food price recently. The final section provides some conclusions of this study.

2. STAPLE FOOD AND NUTRIENT CONSUMPTION IN INDONESIA

Because of the high economic growth over 1970-1994 periods, the Indonesian economy has moved from the low income category to the middle income category. GDP per capita was S517 in 1980 and increased to $1,124 in 1996. GDP per capita decreased drastically to only $ 459 in 1998 because the economic crisis hit Indonesian economy in 1997. After the economic recovery since 2001, the Indonesian economy has moved toward the middle income category. GDP per capita was $3,495 in 2011.

Economic growth has contributed to not only an increase in income but also a change in the demand composition for foods in Indonesia. Food expenditure in Indonesia has been fluctuating. Monthly average food expenditures were 55.3 percent of total expenditure in 1996 and rose sharply to 62.9 percent in 1999 due to the impact of the economic crisis in 1997. Food expenditures decreased to 50.62 percent in 2009, but increased slightly to 51.43 percent in 2010 and decreased slightly to 49.45 percent in 2011. Staple foods are an important component of food expenditure in Indonesian households. Percentage of monthly average staple food expenditures to food expenditures was 16.16 percent in 2011. Rural households (20.6%) had higher monthly average staple food expenditure than urban households (12.72%).Rural household spend more staple foods than urban households. Percentage of monthly average staple food expenditure of rural households was 19.12% while it was 12.05% in urban households in 2011.

Staple foods in Indonesia can be disaggregated into 5 staple food groups encompassing rice, cassava, maize, wheat and roots. Rice consists of rice, sticky rice, rice flour and other rice; Cassava encompasses cassava, dried cassava, cassava flour, tapioca; Maize consists of fresh corn, dried corn/dry shelled corn, maize flour; Wheat is wheat flour; and Roots are sweet potato, potato, taro, sago and other roots. Table 1 reports average consumption and budget share of staple foods SUSENAS in 2011. On average, consumption of rice as a main staple food was 0.259 kg per day per person in 2011. Rice consumption in rural areas (0.273 kg) was higher than urban areas (0.229 kg). However, budget share of rice in urban areas (0.929 kg) was higher than in rural areas (0.883). It implied that urban households were more dependent in consuming rice than rural households. Roots were the second-staple food, followed by cassava, maize, and wheat. Rural households consumed more cassava, maize than urban households but rural families consumed less wheat than urban families.

Total per capita calories consumption has been remarkable. Average daily per capita consumption of calorie also has increased from 1,849.36 kcal per person in 1999 to 1952.01 kcal per person in 2011. The contribution of cereals and tubers to total calorie consumption per person was dominant, accounting for 60.95 percent in 1999. However, it was only 49.31 percent in 2011. On the other hand, the contribution of high-value foods to total calorie consumption such as fish, meats, eggs and milks, vegetables, fruit, oil and fats and processed foods and beverages was 28.24 and 39.02 percent respectively in 1999 and 2011 (Indonesia Central Bureau of Statistics, 2011).

Daily average nutrient consumption consisting of calories, protein, fats and carbohydrate per person in 2011 is shown in Table 1. Staple foods contributed mostly for calories intakes, followed by carbohydrate, protein and fats.

Consumption of calories were 1001.16 kcal per person and were mostly from rice consumption (912.45 kcal), followed by roots (39.17 kcal), cassava (27.80 kcal), wheat (12.42 kcal) and maize (9.32 kcal). Other nutrients showed same patterns. Rice was the largest contributor to protein, fats and carbohydrate intakes. Urban families consume less all nutrients under study than rural families.

Table 1
Daily Consumption per capita and Budget Share, Staple Foods, Indonesia

		Consumption (kg)	*Budget Share*	*Calorie (kcal)*	*Protein (grams)*	*Carbohydrate (grams)*
All	Rice	0.259	0.902	912.45	149.31	195.38
	Cassava	0.020	0.024	27.80	1.18	6.65
	Maize	0.006	0.012	9.32	2.38	2.71
	Wheat	0.004	0.015	12.42	2.35	2.88
	Roots	0.026	0.047	39.17	4.45	9.10
	Total		1001.16	159.66	216.72	
Urban	Rice	0.229	0.929	827.90	19.36	177.28
	Cassava	0.010	0.015	14.12	0.09	3.38
	Maize	0.002	0.006	2.76	0.10	0.78
	Wheat	0.004	0.016	12.82	0.35	2.97
	Roots	0.011	0.035	12.33	0.26	2.79
	Total		869.93	20.14	187.20	
Rural	Rice	0.273	0.883	988.88	23.12	211.74
	Cassava	0.026	0.031	36.98	0.22	8.85
	Maize	0.008	0.016	14.03	0.51	4.08
	Wheat	0.009	0.014	12.39	0.33	2.87
	Roots	0.036	0.056	54.61	0.87	12.74
	Total		1106.90	25.06	240.29	

Source: calculated from the 2011 SUSENAS household survey data

3. LITERATURE REVIEWS

Previous empirical works have been conducted to estimate demand for staple foods in Indonesia. Timmer and Alderman (1979) using the national social and economic survey of households (SUSENAS) in 1976 found that demand for rice was elastic (–1.105) while demand for cassava was inelastic (–0.804). Tell and Johnson (1987) using SUSENAS 1980 found that the demand for rice were inelastic (–0.58) and a normal good (0.43). With time-series data from 1969 to 1985, study of Tabor, Klaus and Adinugroho (1989) showed that demand for rice (–0.169), Corn (-0.173) and Cassava (–0.421) were inelastic. Study of Jensen and Manrique (1998) using SUSENAS 1981, 1984 and 1987 indicated that demand for rice was elastic for low income category and inelastic for high income category, but rice was normal good for all income categories.

The critical issue in estimating demand for food is modeling of demand. AIDS is widely used to estimate demand for foods. Many previous empirical works used AIDS either using linear price index or non linear price index. The former is easy to estimate and known as linearized almost ideal demand system (LA/AIDS). However, LA/AIDS using linear price index such stone's price index leads a bias in price and expenditure elasticities (Alston, Foster and Green, 1994). AIDS assumes that the Engle curve is linear in income.

Empirical Engel curve studies indicate that some commodities have quadratic terms in income. This quadratic logarithmic in income in demand model allows goods to be luxuries at some income levels and necessities at other income levels. To capture non linear Engel Curve, a quadratic almost ideal demand system (QUAIDS) model developed by Banks *et. al.* (1997) is more appropriate model. Basically, AIDS model is nested with the QUAID model because the QUAIDS model allows for a non-liner relationship in the estimation of the Engel curve.

4. MODEL SPECIFICATION AND DATA

4.1 Model Specification and Estimation Procedures

The goal of this study was to estimate demand for staple foods in Indonesia. This study applied a three stages budgeting in analyzing Indonesian staple food demand. Weak separability is important for the multiple stages of budgeting in the demand system analysis. We assume that foods are weakly separable from non-foods, then the consumer's utility maximization decision can be decomposed into several stages budget procedures (Deaton and Muellbauer, 1980). In the first-stage budgeting, total expenditures are allocated among foods and non-food commodity. Food expenditures are then allocated among the food groups in the second-stage budgeting. In the final stage budgeting, staple food expenditures are allocated among 5 staple food groups encompassing rice, cassava, maize, wheat, and roots.

This study used QUAIDS model to estimate demand for staple foods in Indonesia. The QUAIDS has the same degree of price flexibility as AIDS model proposed by Deaton and Muelbauer, 1980) and translog model proposed by Christensen, Jorgenson and Lau (1975). Moreover, AIDS is nested within QUAIDS since QUADS has nonlinear relationship in Engle curve. The QUAIDS model of demand for staple foods can be written as:

$$= + = 1 + ( ) + \lambda ( )2+ \qquad (1)$$

and are staple foods consisting of 5 major staple food groups, is the share of total expenditures allocated to the th staple foods for each household, is the price of the staple foods, is the household expenditures on staple foods in the system, is the price index, is the Cobb-Douglas price aggregator, and λ are parameters to be estimated, and is error term. The price index ( ) is defined as:

$$\ln = 0 + = 1 + 0.5 = 1 = 1 \quad (2)$$

The Cobb-Douglas price aggregator for household is defined as:

$$= 1 \quad (3)$$

The household characteristics such as demographic variables also affect the demand for staple foods. Those demographic variables can be augmented in equation (1) as:

$$= 0 + = 1 \quad (4)$$

where is the th demographic variables. Demographic variables in this studies are urban, household size, educational level of household head (years of schooling), age of household head, gender of household head, five region dummy variables (Sumatra versus non-Sumatra for region 1, Java versus non-Java for region 2, Kalimantan versus non-Kalimantan for region 4, Sulawesi versus non-Sulawesi for region 5, Papua versus non-Papua for region 6) and two seasonal dummy variables (Quarter 2 and quarter 3).

The properties of demand theory can be imposed on the equation (1) by restricting its parameters (Banks *et. al.*, 1997). These restrictions are known as adding-up, homogeneity and Slutsky symmetry. The adding-up restriction is imposed as:

$$= 1\ 0 = 1; = 1 = 0; = 1 = 0; = 1 = 0 \text{ and } = 1\lambda = 0. \quad (5)$$

Homogeneity is given by:

$$= 1 = 0 \text{ for any} \quad (6)$$

Slutsky symmetry is imposed as;

$$=, \neq. \quad (7)$$

Expenditure variables in equation (1) might be endogenous variables leading to biased model parameter estimates. To correct for the endogeneity, this study follows procedure proposed by Blundell and Robin (1999). The first step is to estimate a reduced-form expenditure equation as follow:

(8)

Where is total staple food expenditures, is the set of explanatory variables consisting of total household expenditures, prices of the studied staple foods, and demographic variables that are used in equation (4), are parameter to be estimated and is error term. Although, SUSENAS recorded household's income, but these income data had a lot missing income data. If income data are available, the data are unreliable. SUSENAS 2011 contains 20.30% missing income data. Therefore, this study used total household expenditures as a proxy for income (Deaton, 1996).

The computed residuals from equation (8) and by assuming, = 0 are augmented into equation (1) as follow:

$$= + \tag{9}$$

Survey about food consumption to Indonesian households reported by SUSENAS is conducted during one week before survey. It likely happens that some households have zero expenditures during the survey period. The zero expenditures might be caused no preference for given commodity during survey period, infrequency of purchase and survey error. Because expenditure share in the demand system cannot be negative in value and we have zero expenditures, this would imply that the dependent variables are the limited dependent variables or censored model. Therefore, estimation techniques failing to consider this limited dependent variables cause to biased estimation (Heien and Wessels, 1990). This study employed the consistent two- step estimation procedure for a system of equations with limited dependent variables as proposed by Shonkwiler and Yen (1999) in order to account for zero expenditure shares. The first step is to estimate a probit regression to determine the probability of buying a given type of staple foods. The first-step estimation results in the estimated cumulative distribution function (CDF) and probability distribution function (PDF). The probit regression can be written as follow:

$$= 1 = \Phi(') \tag{10}$$

$$= 0 = 1 - \Phi' \tag{11}$$

where is a vector of explanatory variables in probit estimation and is the vector of associated parameters for the commodities in probit estimation. The explanatory variables in the first step include the logarithms of prices of the 5 staple food groups, the logarithms of total household expenditures and demographic variables as equation (4).

The second-step estimation includes estimated CDF and PDF from the first-step estimation in the QUAIDS model. Therefore, the QUAIDS model used in this study is:

$$= \{ + = 1 + + \lambda(\ )2+\}\Phi. + (\cdot) + \tag{12}$$

where and are cumulative distribution function (CDF) and probability distribution function (PDF) respectively.

Unlike conventional model without censoring, the right-hand side of system equation (12) in censoring model does not add up to unity across all equations of the demand system. As a result, the error terms do not add up to zero. Thus, the adding-up condition does not hold in the system of equations (12) (Yen *et. al.*, 2002). Therefore, second-step estimation of system equation (12) should be estimated on entire equations in the demand system (Yen *et. al.*, 2002). However, the consistent two- step estimation procedure leads heteroskedasticty problem in equation (12) (Shonkwiler and Yen (1999). This heteroskedasticity in the second-step estimation of demand system leads to inefficient but consistent parameter estimates (Shonkwiler and Yen, 1999).

The Marshallian price elasticities (uncompensated elasticity) of QUAIDS model are calculated as follows:

$$= 1 - (+ 2\lambda) + = 1 - \lambda(\ )2\Phi - \delta \quad (13)$$

where δ is the Kronecker delta (1 if = and 0 otherwise).

The expenditure elasticity can be calculated as:

$$= 1 + 1[+2\lambda]\Phi \quad (14)$$

All price and expenditure elasticities were evaluated on the basis of parameter estimated and sample means of independent variables using equation (13) and (14). Standard errors of both price and expenditure elasticities were calculated using the delta method.

Because this study used three stages budgeting, elasticities of demand for individual staple food groups in the third-state budgeting are conditional on total staple food expenditures in the second-stage budgeting. Following Carpentier and Guyomard (2001), unconditional expenditure elasticity for the th commodity within the staple food group are defined as:

$$= (\ )\ (\ ) \quad (15)$$

where ( ) is the conditional expenditure elasticity for th commodity within staple food group and is the expenditure elasticity of staple food group.

The unconditional Marshalian price elasticity within the staple food group is given by

$$= + (\ )\ 1\ (\ ) + (\ )\ (\ )\ (\ ) + (-1) \quad (16)$$

where is the unconditional Marshallian cross-price elasticity between the commodity with the price of the commodity, is the conditional Marshallian cross price elasticity, ( ) is the conditional expenditure elasticity for the commodity, ( ) is the Marshallian own price elasticity of staple food group, is the expenditure share of th commodity in staple food group, and is share of total expenditures allocated to staple food group.

4.2 Data

The data set for this study was collected from the national social and economic survey of households in Indonesian (SUSENAS). The Indonesia government through Central Bureau of Statistics (CBS) conducts these surveys every year to collect data related to expenditure foods and non-foods and socioeconomic characteristics of Indonesian Households. The survey interviews households about food consumption during one week before survey and non-food consumption during one month before survey. However, expenditure questions are collected only every three years. The SUSENAS consists of 225 commodities that can be classified into 14 group foods encompassing cereals, tubers, fish, meat, eggs and milk, vegetables, pulses, fruits, oil and fats, beverage, condiment, miscellaneous foods, prepared food and cigarette and tobacco. Cereals and tubers are staple foods in Indonesia. Cereals consist of 8 commodities encompassing rice, sticky rice, rice flour, fresh corn, dried corn/dry shelled corn, maize flour, wheat, other rice. On the other hand, tubers consist of 9 commodities encompassing cassava, dried cassava, cassava flour, tapioca, sweet potato, potato, sago, taro, and other roots. In addition, the SUSENAS also provides information about nutritional content for each food that households consume.

CBS uses a nutrient conversion table from the Ministry of Health and Nutrition Research Institute to calculate nutrient available to a household by multiplying the nutritional content of food items per unit of quantity to total quantity of that food items available (Indonesian Central Bureau of Statistics, 2000). The SUSENAS records only four major macronutrients encompassing calories (kcal), protein (grams), fats (grams) and carbohydrate (grams). For the purpose of this study, we need to regroup staple foods into five groups consisting of rice, cassava, maize, wheat and roots. Rice, sticky rice, rice flour and other rice are classified as rice; Cassava, dried cassava, cassava flour, tapioca are grouped in cassava; Fresh corn, dried corn/dry shelled corn, maize flour are classified as maize; Wheat flour is grouped in wheat ; and sweet potato, potato, taro, sago and other roots are grouped in roots

This study used the latest SUSENAS in 2011. However, this study did not include the fourth quarter survey because the government has not published it as this study started. The sample of household in the SUSENAS 2011 consists of 213,505 households from all 33 provinces. The total number of households living in urban and rural areas is 88,049 and 125,456 households respectively. The SUSENAS provides information about prices for individual staple foods. To calculate aggregate price for each staple food groups, this study followed procedure proposed by Moschine (1995) by weighted average of price within groups using budget share as a weight. However, it is common for cross sectional data to contain outlier data. Therefore, this study deleted outlier data associated with price. This study followed the previous studies in the demand analysis using cross sectional data such as Cox and Wohlgnant (1986) and Yen, Lin and Smallwood (2003) by deleting data that exceeds five standard deviations above the mean in the national level. After dropping households that contain zero expenditures for all 5 staple food groups and deleting outlier data, available data set are 207,452 households consisting of 84,075 urban and 123,377 rural households respectively. If missing or unreported aggregate price exists, this price was calculated by regressing observed prices on five regional dummies (Sumatra, Java, Kalimantan, Sulawesi and Papua), seasonal dummies (second quarters and third quarter), and total household expenditure (Heien and Wessells, 1988).

5. RESULTS

We estimated demand for staple foods based on all, urban and rural areas. In the first-stage budgeting, this study estimated demand for food and non-foods. Monthly food and non-food expenditures data were used in estimating food and non-foods in the first-stage budgeting. The SUSENAS did not provide information prices for non-food expenditures. Following study of Jensen and Manrique (1998), this study used the consumer price indexes for non-food items to represent non-food prices. The AIDS model was applied to estimate food and non-food demand elasticity using the using Full Information Maximum Likelihood (FIML) .The first-step demand system resulted in unconditional price and expenditure elasticities of food and non-food commodity. All own-price elasticities are negative and statistically significant at 1% level. Demand for food is inelastic for all cases. The own-price elasticities in all, urban, and rural areas are -0.911, -0.916, and -0.895 respectively. All food expenditure elasticities are positive and statistically significant at 1% level. Food expenditure elasticities in all, urban, rural areas are 0.763, 0.736 and 0.781 respectively. The results indicate that demand for food is inelastic and normal goods. The information on food price and expenditure elasticities in the first-stage demand system was used to calculate unconditional price and expenditure elasticities in the second-stage demand system.[2]

Next step was to estimate demand for 10 food groups encompassing cereals, fish, meat, eggs and milk, vegetables, fruits, oil and fats, prepared food and drink, other foods and tobacco. Cereal groups consist of cereals and tuber and were grouped as staple foods. Because the data set used contains some zero observations, the consistent two-step estimation procedure is employed to deal with these zero observation. Probit model were applied to estimate 10 food groups separately using maximum likelihood estimation. Then, in the second-step estimation, demand for 10 food groups were estimated using QUAIDS model using FIML estimation with homogeneity and symmetry condition were imposed. Demand elasticities in the second-step demand system are conditional elasticities on the first-step demand system. The unconditional demand elasticities indicate that own-price elasticities of staple foods in all, urban and rural areas are -0.536, -0.614 and -0.602 while its expenditure elasticities are 0.449, 0.795 and 0.521 respectively.[3] Demand for staple food group is inelastic and normal good in the second-step demand system.

Like the second-step demand system, in the third-stage demand system the two-step consistent estimation was applied to estimate demand for staple foods because of some zero observation in the SUSENAS data. In the first-step estimation, probit model was estimated separately by using maximum likelihood for all 5 staple food groups encompassing rice, cassava, maize, wheat and roots. The QUAIDS demand system then was estimated for all the 5 staple food groups in the second-step estimation using FIML estimation with imposition of homogeneity and symmetry because the adding-up condition does not hold. Parameter estimates of the demand system for 5 staple foods in all areas show that 102 of 105 independent variables are statistically significance at 10% or lower levels. The all estimated values of non-linear Engle curve are statistically significance at 10% or lower levels. These results indicate that the QUAIDS model is appropriate model in estimating demand for staple foods in Indonesia. Among 100 independent variables, 96 variables in urban areas are statistically significance while in rural areas 97 variables are statistically significant at 10% or lower levels. The QUAIDS model is also superior to AIDS model in both urban and rural areas because all the estimated values of non-linear Engle curve are statistically significant at 10% or lower levels. More importantly, all parameter estimates for standard normal PDF in the second-stage demand are significant in all equations in all, urban and rural areas. These findings prove evidence that we have to account for zero observations in estimating demand for staple foods in Indonesia. [4]

Table 2 reports the full matrix of the conditional Marshallian (uncompensated) price and expenditure elasticities for the 5 staple food groups. All, urban and rural areas are shown in the top, middle and bottom parts. The diagonal elements in table 3 reveal own-price elasticities. All own-price elasticities are negative and statistically significant at 1% level. These results are consistent with economic theory. The estimated conditional Marshallian cross-price elasticities are indicated by the non-diagonal elements in table 3. Among 60 cross-price elasticities, 58 cross-price elasticities are statistically significant at 10% or lower levels and their signs are mixed between gross substitute and complement. Expenditure elasticities are shown in the bottom of each part. All conditional expenditure elasticities are positive and statistically significant at 1% level.

Table 2
Conditional Price and Expenditure Elasticities, Staple Foods, Indonesia

		Rice	*Cassava*	*Maize*	*Wheat*	*Roots*
All	Rice	–0.892***	–0.082***	–0.040***	0.050***	–0.068***
	Cassava	–1.381***	–1.289***	0.935***	0.060***	1.307***
	Maize	–0.089***	0.107***	–1.067***	–0.011***	0.094***
	Wheat	0.319***	0.057***	–0.011***	–0.995***	–0.253***
	Roots	–0.218***	0.202***	0.129***	–0.112***	–0.936***
	Expenditure	0.915***	2.043***	1.079***	0.867***	2.358***
Urban	Rice	–0.940***	–0.117***	0.049***	–0.120***	–0.108***
	Cassava	–1.252***	–0.319***	0.632***	–0.140***	–0.416***
	Maize	0.120***	0.127***	–1.179***	0.138***	0.005**
	Wheat	–0.554***	–0.034***	0.280***	–0.685***	–0.006
	Roots	–0.108***	–0.026***	–0.056***	0.002	–0.726***
	Expenditure	1.168***	1.350***	0.840***	0.999***	0.773***
Rural	Rice	–0.890***	–0.055***	–0.046***	0.041***	–0.080***
	Cassava	–0.828***	–1.939***	0.717***	0.285***	1.278***
	Maize	–0.123***	0.104***	–1.068***	–0.026***	0.223***
	Wheat	0.221***	0.275***	–0.011**	1.031***	–0.227***
	Roots	–0.240***	0.221***	0.265***	0.102***	–0.986***
	Expenditure	0.910***	1.660***	1.100***	1.016***	2.168***

Note: Single, double and triple asterisk denote statistical significance at the 10%, 5% and 1% level respectively.
Source: Estimated using the 2011 SUSENAS household survey data

The unconditional Marshallian price and expenditure elasticities of staple foods are shown in Table 3. Unconditional demand elasticity is calculated using equation (15) and (16). All own-price elasticities are negative and range from –0.478 to –1.289 in all areas. Rice is the least responsive and cassava is most responsive to own-price change. Not surprisingly, because rice is a main staple foods and cassava is a low-quality staple foods in Indonesia. Expenditure elasticities range from 0.389 for wheat to 1.059 for roots. As expected for staple foods, all expenditure elasticities are inelastic, except roots. The middle part of table 4 represents unconditional elasticities for urban areas.

All own-price elasticities are also negative. Unlike all areas, cassava is the least responsive while maize is most responsive to own-price change. But rice is still less responsive to own-price change than the other staple foods. Expenditure elasticities range from 0.614 for roots to 1.073 for cassava and roots having lowest values (0.079). For rural areas, rice is the least responsive and cassava is the most responsive. Expenditure elasticities range from 0.474 for rice to 1.130 for roots. In general, urban households are less responsive to both own-price change and income change than rural households.

Table 3
Price and Expenditure Elasticities, Staple Foods, Indonesia

		Rice	*Cassava*	*Maize*	*Wheat*	*Roots*
All	Rice	–0.478	–0.054	–0.033	0.057	–0.005
	Cassava	–1.474	–1.289	0.934	0.058	1.309
	Maize	0.252	0.130	–1.062	–0.006	0.148
	Wheat	0.755	0.086	–0.004	–0.989	–0.188
	Roots	–0.453	0.195	0.126	–0.116	–0.951
	Expenditure	0.411	0.917	0.484	0.389	1.059
Urban	Rice	–0.609	–0.110	0.050	–0.116	–0.102
	Cassava	–1.039	–0.314	0.633	–0.137	–0.413
	Maize	0.662	0.137	–1.176	0.146	0.017
	Wheat –0.114	–0.026	0.282	–0.678	0.004	
	Roots	0.478	–0.016	–0.054	0.010	–0.713
	Expenditure	0.928	1.073	0.668	0.794	0.614
Rural	Rice	–0.536	–0.030	–0.038	0.048	–0.018
	Cassava	–0.845	–1.935	0.718	0.285	1.292
	Maize	0.137	0.124	–1.061	–0.021	0.274
	Wheat	0.523	0.297	–0.004	–1.026	–0.171
	Roots	–0.509	0.211	0.260	–0.107	–1.004
	Expenditure	0.474	0.865	0.573	0.529	1.130

Source: Estimated using the 2011 SUSENAS household survey data

6. POLICY SIMULATION

The estimated price and income and elasticities then were used to analyze the impact of changes in prices and income on rice consumption as a main staple food in Indonesia Three scenarios were considered for simulating effect of price and income changes on rice consumption in responding to the world cereals price crisis recently. We used per capita consumption of rice data to assess how the total rice consumption change. The Scenario 1 considered an increase rice as the main staple foods by 10% holding income and other staple food prices constant. The scenario 2 considered that all staple food prices increased by 10% assuming income unchanged. The last scenario involved simultaneously both increasing the prices of all staple foods and decreasing income by 10%. The results of these simulation are presented in Table 4.

The simulation policies find a decline in rice consumption between 4.78% (0.012 kg) – 9.25% (0.024 kg) for all households. The simulation policies for urban and rural households show the same pattern. Rice consumption drops from 6.09% (0.014 kg) to 18.15% (0.041 kg) and from 5.36% (0.015 kg) to 10.48% (0.029 kg) for urban and rural households respectively. The simulation policies find that there is no significant difference between scenarios 1, namely the increase in the price of rice by 10% while holding other price and income as constant, and scenario 2, namely the rise in prices of all staple foods by 10% while holding income as constant. These results indicate that the decline in rice consumption is mostly influenced by the increase in rice prices, while increasing prices of other staple foods do not have much effect on rice consumption.

Urban households reduced more on rice consumption than rural households as price of all staple food increased. The decline in rice consumption significantly happen if the increase in staple food prices is accompanied by a decrease in household income (scenario 3). Households reduced consumption of rice nearly twofold. For example, for all households decreases rice consumption from 5.14% (0.013 kg) to 9.25% (0.024 kg). The third scenario is worse effect on urban households than households in rural areas.

Table 4
Effect of Change in price and income on Rice Consumption, Indonesia

		Scenario 1		*Scenario 2*		*Scenario 3*	
	Mean Rice Consumption	*%*	*Quantity (kg)*	*%*	*Quantity (kg)*	*%*	*Quantity (kg)*
All	0.259	–4.78	–0.012	–5.14	–0.013	–9.25	–0.024
Urban	0.229	–6.09	–0.014	–8.87	–0.020	–18.15	–0.041
Rural	0.273	–5.36	–0.015	–5.74	–0.016	–10.48	–0.029

Source: Estimated using the 2011 SUSENAS household survey data

6. CONCLUDING REMARK

This study estimated the demand for staple foods in Indonesia using the quadratic almost ideal demand system (QUAIDS). The national social and economic survey of household in Indonesian (SUSENAS) in 2011 was used to accomplish those goals. Staple foods demand were estimated for separately urban and rural area. Demand for rice, wheat and roots are inelastic while demand for cassava and maize are elastic. Rice is the least responsive and cassava is the most responsive to price change. As a basic food with exception roots, all staple foods are normal. Both price elasticities and expenditure elasticities in rural areas are more elastic than in urban areas.

This study show that rice is not sensitive to price change of staple foods such as cassava, maize, wheat, and roots. This condition happens because rice is a main of staple food in Indonesia since government introduced rice self-sufficiency in 1980 and succeeded in 1984. Rice consumption in Indonesia on average was 163 kg per capita per year 2012-1204. This rice consumption in Indonesia was still high compared to countries in Southeast Asia such as Thailand (142.5 kg) and Philippines (121.9 kg) (OECD, 2016). Urban households suffer more compared to rural households as price of rice increases. Because urban households are more dependent in consuming rice than rural households, price stability policy of rice is very favorable for urban households than rural households.

References

Alston, J. M, K. A. Foster and R. C. Green. (1994), "Estimating Elasticities with the Linear Approximate Almost Ideal Demand System: Some Monte Carlo Results." *Review of Economics and Statistics* 76: 351-56.

Banks, J., R. Blundell, and A. Lewbel. (1997), "Quadratic Engle Curves and Consumer Demand."*The Review of Economics and Statistics* 79: 527-39.

Blundell, R., and J.M. Robin. (1999), "Estimation in Large and Disaggregated Demand System: An Estimator for Conditionally Linear System." *Journal of Applied Econometrics* 14: 209-32.

Carpentier, A., and H. Guyomard. (2001), "Unconditional Elasticities in Two-Stage Demand System : An Approximate Solution," *American Journal of Agricultural Economics* 83: 222-29.

Cox, T. L., and M.K. Wohlgnant. (1986), "Price and Quality Effects in Cross-Section Demand Analysis." *American Journal of Agricultural Economics* 68: 908-918

Christensen, L. R., D.W. Jorgenson, and L. J. Lau. (1975), "Transcendental Logarithmic Utility Function." *American Economic Review* 65: 367-83.

Deaton, Angus and J. Muellbauer. (1980), "An Almost Ideal Demand System."*American Economic Review* 70: 312-26.

Deaton, Angus. (1996), *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. Baltimore: John Hopkins University Press.

FAO. http://www.fao.org/worldfoodsituation/foodpricesindex/en. Accessed August 2016.

Hein, D. and C. R. Wessels. (1988), "Demand for Dairy Products: Structure, Prediction, and Decomposition." *American Journal of Agricultural Economics* 70: 219-28.

Hein, D. and C. R. Wessels. (1990), "Demand System Estimation with Microdata: A Censored Regression Approach." *Journal of Bussiness and Economic Statistics*, 8: 365-71.

Indonesian Central Bureau of Statistics (CBS). www.bps.go.id. Accessed September 2015.

Jensen, Helen H., and Justo Manrique. (1998), "Demand for Food Commodities by Income Groups in Indonesia." *Applied Economics* 30: 491-501.

Moschini, G. (1995), "Unit of Measurement and the Stone Index in Demand System Estimation." *American Journal of Agricultural Economics* 77: 63-68.

OECD. http://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2015/rice-projections-consumption-per-capita_agr_outlook-2015. Accessed Sept 2016.

Shonkwiler, J.S., and S.T. Yen. (1999), "Two-Step Estimation of a Censored System of Equations."*American Journal of Agricultural Economics* 81: 972-82.

Tabor, Steven R, Klaus A., and Bambang Adinugroho. (1989), "Food Crop Demand in Indonesia: A System Approach." *Bulletin of Indonesian Economic Studies* 25: 31-51.

TelI, T., and S.R. Johnson. (1987), "Demand System from Cross Section Data: An Experiment for Indonesia." *Canadian Journal of Agricultural Economics* 36: 83-101.

Timmer, C. P., and H. Alderman. (1979), "Estimating Consumption Parameters for Food Policy Analysis."*American Journal of Agricultural Economics* 61: 982-87.

Yen, S. T., K. Kan and Shew-Jiuan Su. (2002), "Household Demand for Fats and Oils: Two Step Estimation of a Censored Demand System." *Applied Economics* 14: 1799-1806.

Yen, S.T., B. Lin., and D.M. Smallwood. (2003), "Quasi-and Simulated-Likelihood Approaches to Censored Demand Systems: Food Consumption by Food Stamp Recipients in the United States." *American Journal of Agricultural Economics* 85: 458-78.

Notes

[2] The complete estimations and results in the first-stage demand system are available upon request.

[3] The complete estimations and results in the second-stage demand system are available upon request.

[4] The complete estimations and results in the third-stage demand system are available upon request.