Demand for Agricultural Product and Sustainable Development Issues: Empirical Studies from Household Survey

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Abstract. The agricultural sector is an important sector in the national economy because it has a strategic position in the national economic sector. This sector is a support for the sustainability of other economic sectors. In times of economic crisis, the agricultural sector is relatively resilient in facing turmoil. However, the relative role of this sector in domestic products is getting smaller. This occurs because the demand for this sector is relatively stagnant. Based on this, this paper evaluated the demand for agricultural products in Indonesia using micro household level data. The results showed that the demand for agricultural products was relatively inelastic. The increase in household income has a relatively small effect on the demand for the agricultural sector. Therefore, the development of the agricultural sector is relatively stagnant. In fact, this sector is very important for the economy, so a special strategy is needed to ensure the sustainability of agricultural sector development in the future.

1. Introduction
The agricultural sector is a key sector in the national economy. This sector can act as a buffer for other sectors. During the economic crisis, the growth in the agricultural sector was relatively more stable compared to other sectors. This is evident when the global economy has been hit by the COVID-19 pandemic that has occurred since early 2020 [1]. Almost all economic sectors have experienced a decline in production, except for the agricultural sector, which is still growing. Countries that have a fairly strong agricultural sector are relatively stronger in facing shocks both from internal and from abroad [2].

Although it has a significant role, the growth of the agricultural sector is relatively slow compared to other sectors. Under normal conditions, the share of this sector in national production has gradually decreased. However, the resources working in the agricultural sector are still very large [3]. There are still quite a lot of workers in the agricultural sector. However, available agricultural land is relatively stagnant. Finally, this sector is highly dependent on advances in food production technology. Without the support of food technology, a country's food security will be very vulnerable [4].

The slow development of the agricultural sector is due to changes in people's behaviour in consumption [5]. As income increases, society or households tend to allocate more and more expenses for non-food items. In fact, the lifestyle of modern society tends to prefer imported goods, including foodstuffs. The pattern of consumption of imported goods is formed by the wrong way of looking at imported products. People in developing countries, including Indonesia, prefer to shop for goods from abroad as a symbol of welfare. As a result, many foreign food outlets have developed in Indonesia, such as Korean food, Japanese food, Arabic food, Indian food and so on. This foreign food appears along
with an increase in people's income. On the other hand, local food is still mostly served in a conventional way.

Based on this background, this research was conducted with the following objectives. First, this research evaluated the impact of important variables that affect the level of demand for agricultural goods. Second, this paper analysed the interaction of demand for agricultural products with other goods and estimated the elasticity of household income to demand for agricultural goods.

Research on the demand for agricultural goods has been carried out by experts in several countries [6][7]. In general, the results of this study are not much different from the results of previous studies. The contribution of this research in research on the demand for agricultural goods can be identified as follows. First, this study uses household micro data with a very massive number of household samples. Second, this study disaggregates the types of agricultural goods in more detail, starting with staples, vegetables and spices. Third, this study controls household behaviour at the regional level[8]. To test the robustness of the model, in this study, the measurement of the dependent variable varies from level, percentage to logarithmic form.

2. Data and Analysis Model

This research used survey data published by the latest wave of the Indonesia Family Life Survey (IFLS). IFLS provides data on various aspects of household life in Indonesia in various unit level analyses, from individuals, households, to village units. The IFLS household sample can represent 80 percent of the national population with an initial coverage of around 13 provinces taken based on the 1993 SUSENAS. What's interesting about this IFLS data is that the panel data set has a very high recall rate (above 90 percent). The data was published for the first time in 1993 and data collection was repeated for the next seven years. Except for 1997 which was specifically designed for data collection purposes during the economic crisis, to date IFLS has released publications in five batches. The last release was made in 2014.

2.1. Indonesia Household Data

Although the number of IFLS household samples are relatively smaller than the Survei Sosial Ekonomi Nasional (SUSENAS) sample issued by the Indonesian Central Bureau of Statistics (BPS), the questionnaire features of this data set are relatively richer. Various aspects of household life were successfully investigated, from consumption, health, welfare, assets, farming, employment, decision making to sleep quality. This relatively long data panel feature allows for more flexible data processing techniques.

2.2. Estimation Models

After the data is tabulated, the next step is to construct a demand model for agricultural commodities. The basic demand model used is as follows [9]:

$$CON_i = \alpha + \beta_1INC_i + \beta_2NFD_i + \beta_3SIZ_i + \beta_4OWN_i + \beta_5REG_i + \epsilon_i$$  

Equation (1) above shows the demand model for agricultural commodities. In this case CON is the household consumption of rice, staples, vegetables and spices, respectively. The main explanatory variable is the level of income, INC, which in this study the expenditure variable is used as a proxy. Furthermore, the NFD variable is the expenditure variable for non-food goods. This variable is used to evaluate the relationship between expenditure on commodities with expenditures on other goods, which are substitution or complementary. The variable of household characteristics in this study is represented by two variables, namely the SIZ variable which shows the number of household members and the OWN variable which shows the status of home ownership. Home ownership is a dummy variable with a value of 1 if the household declares the house its own or zero if the house is not owned by itself. In micro data analysis, often environmental factors influence the decisions of economic agents to make decisions. Therefore, in this study the REG variable which represents the area of each household that has been surveyed is added.
The basic model will certainly face challenges from alternative models. In order for the variety of models to be more diverse, two modifications were made in this study. The first modification is to change the form of the variable to logarithms. Not all variables are transformed in logarithmic form, such as the OWN dummy variable and the REG dummy. The SIZ variable is also not transformed into logarithms because the quantitative value is not too wide. The first modification form is as follows:

$$\ln CON_i = \alpha + \beta_1 \ln INC_i + \beta_2 \ln NFD_i + \beta_3 \text{SIZ}_i + \beta_4 \text{OWN}_i + \beta_5 \text{REG}_i + e_i$$  \hspace{1cm} (2)

Equation (2) is a variation of the first model by converting several variables into logarithmic form. The advantage of this model is that the coefficient $$\beta_1$$ and coefficient $$\beta_2$$ can be interpreted as elasticity. The concept of elasticity is very well known in microeconomic analysis so that the resulting analysis can be more in-depth.

The second modification is to change the consumption indicator from a level to a percentage measure. This step was carried out as a way to detect the existence of Engel's function in the case of demand for agricultural commodities in Indonesia [10]. A model with a measurement of consumption as a percentage can be considered in the following equation:

$$\text{SHARE}_i = \alpha + \beta_1 \text{INC}_i + \beta_2 \text{NFD}_i + \beta_3 \text{SIZ}_i + \beta_4 \text{OWN}_i + \beta_5 \text{REG}_i + e_i$$  \hspace{1cm} (3)

Basically equation (3) is the same as equation (1). The only difference is that the dependent variable is replaced by SHARE, which shows the share of expenditure on agricultural commodity consumption to total household expenditure. The results of the three models will be further analysed to obtain robust research conclusions.

3. Results
This research used some important household data for consumption of agricultural goods or products. The data used in this study can be considered in following table. Table 1 briefly describes the data used in this study. In general, there are eight variables used. The first is the monthly expenditure for rice consumption (mrice). There are more than 12,000 households that reported rice consumption during a certain period. The data shows that the average household expenditure on rice reaches more than IDR 124,000 per month with the highest figure being IDR 3,900,000 per month. The amount of expenditure referred to here is the expenditure of one household, not an individual. Second, expenditures for basic needs other than rice (mstaple). Based on available data, the average non-rice staple food expenditure is Rp. 140,000 per month with the largest expenditure being Rp. 3,980,000 per month. Furthermore, the average monthly expenditure on vegetables (mvege) and spices (mspices) is relatively low compared to expenditure on other foodstuffs.

| Variables | Observation | Mean   | Std. Dev | Min  | Max    |
|-----------|-------------|--------|----------|------|--------|
| mrice     | 12843       | 124241.7 | 180647.7 | 0    | 3900000 |
| mstaple   | 12843       | 143349.2 | 190584.1 | 0    | 3986667 |
| mvege     | 12843       | 73163.61 | 95736.81 | 0    | 1824333 |
| mspices   | 12843       | 53911.48 | 69205.34 | 0    | 2632500 |
| hhexp     | 12658       | 1978169  | 1802611  | 70833.33 | 2.72E+07 |
| hhsize    | 13507       | 3.744725 | 1.856064 | 1    | 22     |
| owners    | 12987       | 0.887426 | 0.316084 | 0    | 1      |
| xnonfood  | 12796       | 980910.9 | 1285364 | 15500 | 2.32E+07 |
The average household expenditure on vegetables was IDR 70,000 a month with the highest expenditure value being IDR 1,800,000 per month. Meanwhile, spending on spices is even cheaper, namely IDR 50,000 per month with the highest expenditure of IDR 2,600,000 per month. Furthermore, the total expenditure of IFLS households in the same survey shows that the average household expenditure (hhexp) is IDR 1,978,000 per month. Judging from the deviation of the highest value compared to the highest expenditure value, it is clear that there is an imbalance in household expenditure in Indonesia. The value of the smallest household expenditure is only IDR 70,000, while the highest value is IDR 27,000,000 in one month. When compared with expenditure on non-food items (xnonfood), the pattern of household expenditure will be clearer. On average, household expenditures on non-food items were IDR 980,000 per month with the highest value of IDR 23,000,000 for one month. Survey households on average have less than four household members. The number of household members (hhsiz) varies from just one person per household to a household consisting of 22 people. The survey results also showed that most households stated that the house they occupied was their own.

The estimation result can be presented in three tables according to the number of equation models used in the previous section. The results of the first estimate can be seen in the table as follows.

Table 2. Estimation Result for Equation 1

| VARIABLES | (1) | (2) | (3) | (4) |
|-----------|-----|-----|-----|-----|
| hhexp     | 0.0838*** | 0.104*** | 0.0625*** | 0.0480*** |
|           | (0.00702) | (0.00769) | (0.00305) | (0.00424) |
| xnonfood  | -0.103*** | -0.125*** | -0.0521*** | -0.0534*** |
|           | (0.00874) | (0.00962) | (0.00397) | (0.00535) |
| owners    | 23,592*** | 25,555*** | 8,197*** | 13,479*** |
|           | (4,216) | (4,527) | (2,171) | (1,730) |
| hhsize    | 16,208*** | 17,408*** | -311.1 | 3,052*** |
|           | (1,157) | (1,204) | (483.0) | (549.6) |
| kecid     | -0.00224** | -0.00278** | -0.00207*** | -0.00254*** |
|           | (0.00112) | (0.00114) | (0.000463) | (0.000336) |
| Constant  | -14,913** | -18,344** | 704.5 | -3,586 |
|           | (6,929) | (7,259) | (3,252) | (3,111) |
| Observations | 12,658 | 12,658 | 12,658 | 12,658 |
| R-squared | 0.164 | 0.213 | 0.371 | 0.291 |

Table 2 shows the estimation results from equation (1). There are four columns of estimation results that show each type of commodity analyzed. The first column is the estimated demand for rice commodity. The second column estimates staple goods other than rice. The third column is the estimate for the vegetable agricultural commodity. The fourth column is the estimated demand for commodity spices.

The results of the study generally showed that the income coefficient has a positive effect on the consumption of various agricultural commodities. However, if it is seen from the coefficient obtained, the increase in consumption of agricultural products only increases at a maximum of about 10 percent. It can be seen that the response to an increase in rice consumption was due to an increase in income of 0.08. Meanwhile, the consumption of staples other than rice was 0.10. These results indicated that additional consumption of staples due to additional household income ranges from 0.08 to 0.1. For the consumption of vegetables and spices, the coefficient of income was relatively lower, namely 0.06 for vegetables and 0.04 for spices. This result is certainly not too surprising because the portion for
consumption of foodstuffs as a product of agriculture is not sensitive enough to changes in household income.

Another interesting result was that the regression coefficient for non-food expenditures is negative. Although the coefficient is not very large, it is statistically significant. These results indicate that there is a substitution relationship between consumption of non-food goods to food consumption. Households that increase their expenditure on non-food goods have to save part of their money for foodstuffs. If the increase in income triggers the household to consume luxury goods, the consumption of foodstuffs is threatened to decrease. These findings apply equally well to spending on staple foods, vegetables and spices.

Furthermore, home ownership had a positive correlation with household expenditure on agricultural food. Households that have their own house where they live consume relatively more food. It could be said that established households tend to consume more agricultural products. The next estimation result is the number of household members. In theory, households with more members should eat more food. It can be proven that in the case of staple foods (including rice) and spices, the results of the research are in accordance with the theoretical assumptions. However, for the case of vegetables, the results of the study were not significant enough. In other words, the large number of household members does not cause an increase in vegetable consumption. This result should be noted by policy makers, particularly those related to food policy.

Table 3. Estimation Result for Equation 2

| VARIABLES  | (1) lnrice | (2) lnstaple | (3) lnvege | (4) lnspices |
|------------|-----------|-------------|------------|-------------|
| lnpc       | 0.754***  | 0.900***    | 0.942***   | 0.907***    |
|            | (0.0293)  | (0.0383)    | (0.0288)   | (0.0282)    |
| lnxnonfood | -0.332*** | -0.585***   | -0.112***  | -0.304***   |
|            | (0.0210)  | (0.0282)    | (0.0212)   | (0.0202)    |
| owners     | 0.218***  | 0.0398      | 0.0714**   | 0.131***    |
|            | (0.0261)  | (0.0377)    | (0.0297)   | (0.0296)    |
| hhsize     | 0.280***  | 0.332***    | 0.240***   | 0.276***    |
|            | (0.00907) | (0.0109)    | (0.00831)  | (0.00788)   |
| kecid      | -1.15e-08** | 8.16e-09       | -1.73e-08*** | -4.89e-08*** |
|            | (5.26e-09) | (7.99e-09)    | (5.40e-09) | (4.85e-09)  |
| Constant   | 5.348***  | 6.295***     | -0.876***  | 1.923***    |
|            | (0.200)   | (0.270)      | (0.196)    | (0.192)     |
| Observations | 7,407      | 9,970        | 11,241     | 11,023      |
| R-squared  | 0.272      | 0.100        | 0.321      | 0.254       |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The next estimation uses the equation model (2) which is a modification of equation (1) with a modified form of the dependent variable (consumption of agricultural commodities) and several independent variables, namely household income and expenditure on non-food items. The estimation results from the model can be seen in Table 3.

Table 3 shows the results of the model estimation using equation (2). As in Table 1, there are four yield columns that refer to each type of agricultural product analyzed, namely rice commodity, other staple commodities other than rice, vegetables and spices. The first line used as the independent variable was the logarithm of per capita expenditure. The regression coefficient in the first line is the elasticity of demand due to changes in income. The results showed that the income elasticity coefficient in the case of rice commodity was 0.75. If there is an increase in income by one percent, then there is an increase in rice consumption by 0.75 percent. The same interpretation applies to the case of non-rice
staples of 0.90; the vegetable case was 0.94 and the spices case was 0.9. The calculation results show that the value of the income elasticity coefficient is relatively inelastic. This means that a change in income of one percent is only reacted with a change in consumption of less than one percent. In general, it can be said that in the case of agricultural commodities, the increase in people’s welfare, which is shown by the increase in income, can only increase the demand for this sector in a relatively small portion.

Furthermore, similar to the previous results, consumption expenditure on non-food goods had a negative relationship with consumption of food produced from the agricultural sector. This showed a substitution effect between consumer goods. The more consumption of non-food goods that was carried out by consumers, the less consumption expenditure is made. This substitution relationship certainly has difficult policy implications. Furthermore, the regression coefficients for the variable home ownership and number of household members produce conclusions that are more or less the same as the previous findings (Table 2). Households owning households relatively consume more agricultural commodities (except for the case of insignificant consumption of staples). Furthermore, households with more household members will consume more food commodities.

**Table 4. Estimation Result for Equation 3**

| VARIABLES  | (1) wrice | (2) wstaple | (3) wvege |
|------------|-----------|-------------|-----------|
| hhexp      | -4.47e-07*** | -2.67e-07 | 4.96e-07*** |
|            | (1.51e-07)   | (1.63e-07) | (5.60e-08) |
| xnonfood   | -2.11e-06*** | -2.62e-06*** | -1.22e-06*** |
|            | (2.71e-07)   | (2.99e-07) | (8.31e-08) |
| owners     | 4.088***     | 4.657***    | 1.381***   |
|            | (0.230)      | (0.240)     | (0.104)    |
| hhsize     | 0.899***     | 0.958***    | -0.0270    |
|            | (0.0524)     | (0.0543)    | (0.0198)   |
| kecid      | 1.71e-07***  | 1.80e-07*** | 7.73e-09   |
|            | (5.75e-08)   | (5.89e-08)  | (2.33e-08) |
| Constant   | 6.051***     | 6.864***    | 4.103***   |
|            | (0.317)      | (0.328)     | (0.137)    |
| Observations | 12,658   | 12,658      | 12,658     |
| R-squared  | 0.151       | 0.168       | 0.055      |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 shows the results of the agricultural commodity demand model estimation using equation (3). Unlike the display in the previous table, Table 4 contains only three columns, namely the column for the rice commodity, the column for the commodity of staple foodstuffs and the column for the commodity of vegetables. The dependent variable is not the amount of consumption, but the share of consumption of various agricultural commodities in total household expenditure.

The results showed that the increase in household income was negatively correlated with the portion of consumption for rice, staple foods and vegetables. In other words, an increase in income can lead to a reduced share for consumption of agricultural products. Even though in absolute terms there was an increase in the purchase of agricultural products, there was only a slight increase. The increase in income triggers households to increase their non-food consumption. As a result, the portion for buying food products or agricultural commodities is reduced. This is confirmed by the results of the study in Table 4.
The greater the amount of consumption used to purchase non-food goods, the smaller the portion that is used for purchasing agricultural products or commodities. In other words, the substitution effect between food consumption versus non-food consumption was evident in this study. The home ownership variable is consistently positively related to the food consumption indicator. Households who own houses spend more of their income on buying food. Another interesting result is that the number of household members has a positive correlation with the share of expenditure on rice and staples other than rice. However, the number of household members does not have a significant effect on vegetable consumption. In other words, households with more members consume relatively little vegetables. These findings are consistent with previous findings using the equation model 1 (look again at the research results in Table 2).

4. Implication of Research
The results of this study have broad implications for the development of a sustainable agricultural sector. First, research results consistently showed that the marginal consumption of food commodities due to an increase in household income is relatively small [11]. The estimated result is a maximum of 10 percent. On the other hand, the elasticity of demand for agricultural commodities due to the increase in income is also relatively small and tends to be inelastic[12]. In another model (Table 4) it is found that an increase in household income actually reduces the share of spending on agricultural commodities. These results consistently showed that an increase in household welfare in the form of an increase in income does not have a significant impact on increasing consumption of agricultural commodities. Therefore, in the analysis of the transformation of the economic structure, the role of the agricultural sector has consistently decreased in national domestic products. To overcome this problem, a more comprehensive policy is needed to maintain the role of the agricultural sector in the national economy. As a supplier to other economic sectors, the agricultural sector must innovate smart enough so that the existence of this sector can last a long time [13]. Because after all, the agricultural sector is still needed as an economic buffer, especially in the event of an economic crisis.

Second research indicated that there is a substitution relationship between food consumption expenditure in the form of agricultural products and non-food consumption. An increase in the expenditure allocation for consumption of luxury goods has the potential to reduce consumption expenditure for staple goods. These findings indicated that the consumption of agricultural products can be an inferior activity. Meanwhile, if we look at the trend in the behavior of the middle- and upper-class people who like to eat in luxury dining establishments, this should be an opportunity to develop. If agricultural products are sold in a conventional manner, the process of decreasing the share of this sector will run faster. Several innovations need to be made. Agricultural products must be modified in such a way that they can be absorbed and developed by other sectors creatively. The culinary industry is currently developing very rapidly in line with the increasing economic progress of society. Thus, the service sector, which is starting to target middle- and upper-class households, must be approached by the agricultural sector. One of the fast-growing service developments today is the service between goods or foodstuffs in the form of raw materials or ready-to-consumer goods [14].

Third, there are quite unique findings regarding household consumption habits of several types of agricultural products. Households with a larger number of household members tended to consume more food. However, these findings do not apply to vegetable products. The results showed that households with more members did not consume more vegetables [15]. If the household with more household members is poor, then serious efforts from the government are needed to promote a healthy lifestyle for all layers of Indonesian households, especially poor households.

Finally, this study found evidence that increasing household income actually reduces the share of spending on all types of food from rice to staple foods to vegetables. Viewed from the perspective of microeconomic theory, this phenomenon should not be a cause for concern. The increase in welfare in the form of increasing household income according to Engel’s concept will reduce the portion of food spending. This does not mean that household spending on food has decreased. Total expenditure on agricultural products has continued to rise, but the increase has not been so rapid. Meanwhile, spending on other types of goods has increased relatively rapidly. All expenditures can increase, but the share of
the increase that occurs is different. As a result, the share for agricultural products has decreased relative to other products. Once again, creative government policies are needed to create a climate for the development of agricultural products in a more innovative way [16].

5. Conclusion
After conducting in-depth research, this paper obtained quite important research findings. First, the allocation of expenditures for agricultural goods has been relatively small so far. This is understandable because an increase in income in theory will tend to increase the allocation for non-food goods. Second, an increase in spending on non-food goods has a negative relationship with demand for agricultural goods. This negative relationship shows the nature of the substitution between agricultural goods to non-agricultural goods. Third, the income elasticity of agricultural goods is very inelastic. These results indicate that an increase in welfare has very little impact on an increase in consumption of agricultural goods.

This study yielded several important findings. First, the marginal consumption of agricultural products due to the increase in household income in Indonesia was relatively small. Therefore, the effect of increasing income may not be enjoyed proportionally by the agricultural sector. Second, there was a substitution effect between expenditure on agricultural products and non-food products. Agricultural product innovation is needed to anticipate this problem. Efforts to promote healthy living are still very much needed. Finally, this study found indications of a decrease in the portion of food spending that fell due to an increase in income. Although this phenomenon is commonly found in developing societies, the agricultural sector should still strive to increase product innovation so that the development of this sector remains sustainable.

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