# Household Food Insecurity in DKI Jakarta Province at The Beginning of The Covid-19 Pandemic

**L H Sutikno, Budiasih**

STIS Polytechnic of Statistics, Jakarta, Indonesia

*Corresponding author's e-mail: 211709794@stis.ac.id, budiasih@stis.ac.id

**Abstract.** Food insecurity is a global issue that's concern not only in poor and developing countries, but also in developed countries. Its conditions have worsened since the beginning of the Covid-19 pandemic where social restrictions and economic contraction caused many people to lose their jobs, incomes, and increased poverty. DKI Jakarta was one of the most economically affected provinces at the beginning of the Covid-19 pandemic where economic growth in the first quarter of 2020 recorded grow 5.06 percent year on year (the lowest in the last ten years) and slowed down by 0.56 percent overall quarter to quarter, and an increase of poverty 1.11 percent, the highest in Indonesia. This study examines the effect of household characteristics in DKI Jakarta on their food insecurity status at the beginning of the Covid-19 pandemic. The data used is the March 2020 Susenas which was analyzed descriptively and inferentially using firth logistic regression. The results showed that there were 4.47 percent of households in DKI Jakarta had food insecurity status at the beginning of the Covid-19 pandemic. In general, households with food insecurity status are poor, don't have social security, the head of the household doesn't work and less than high school education.

## 1. Introduction

Food insecurity is a global issue that is of concern not only in poor and developing countries, but also in developed countries (Conceicao et al., 2016). The alleviation of food insecurity was stated in several points of the Sustainable Development Goals (SDGs): no hunger and no poverty. These SDGs target was also ratified by the Government of Indonesia in the 2015-2019 national medium-term development plan (RPJMN) through economic independence, one of which is by increasing food welfare, also in the 2020-2024 RPJMN through the mission of inclusive economic development for fair and equitable, one of which is with food supply.

Food insecurity is a condition of inability to access sufficient and nutritious food for normal and healthy growth for development of the body due to unavailability of food and/or lack of resources to obtain food (FAO, 1998). Specifically, the United States Department of Agriculture (USDA) states that food insecurity refers to the lack of financial resources available to access food at the household level. This is supported by the results of a national survey in the US, namely the Survey of Income and Program Participation (SIPP) and the Current Population Survey of Food Security (CPS-FSS) which document that most households with food insecurity status have incomes below the poverty line (Gundersen et al., 2011).

Food insecurity conditions have worsened since the beginning of the Covid-19 pandemic where social restrictions and economic contraction caused many people to lose their jobs and incomes as well as increasing poverty due to the inability to meet basic needs such as food and shelter (Wolfson and

Leung, 2020). Indications of increasing food insecurity since the beginning of the Covid-19 pandemic have also occurred in Indonesia. Since the discovery of the first case on March 2, 2020, the number of positive cases of Covid-19 has continued to increase which has led to the designation of Covid-19 as a "Public Health Emergency" on March 31, 2020 to "National Disaster Emergency" on April 13, 2020. Indonesia was ranked 37th as the country with the highest number of positive Covid-19 cases in the world as of March 31, 2020 or at the end of the first quarter of 2020 where DKI Jakarta was recorded as the province with the highest number of positive cases of Covid-19 in Indonesia (49.8 percent of the national case rate). The number of positive cases of Covid-19 in Indonesia continued to increase in the second quarter of 2020. Indonesia was ranked 28th as the country with the highest number of positive cases of Covid-19 in the world as of June 30, 2020 or at the end of the second quarter of 2020 where the province of DKI Jakarta was recorded as the province with the second highest number of positive Covid-19 cases in Indonesia (20.26 percent of the national case rate). DKI Jakarta was one of the most economically affected provinces at the beginning of the Covid-19 pandemic where economic growth in the first quarter of 2020 was recorded grow 5.06 percent year on year (the lowest in the last ten years) and slowed down by 0.56 percent overall quarter to quarter, and an increase of poverty 1.11 percent, the highest in Indonesia (BPS, 2020).

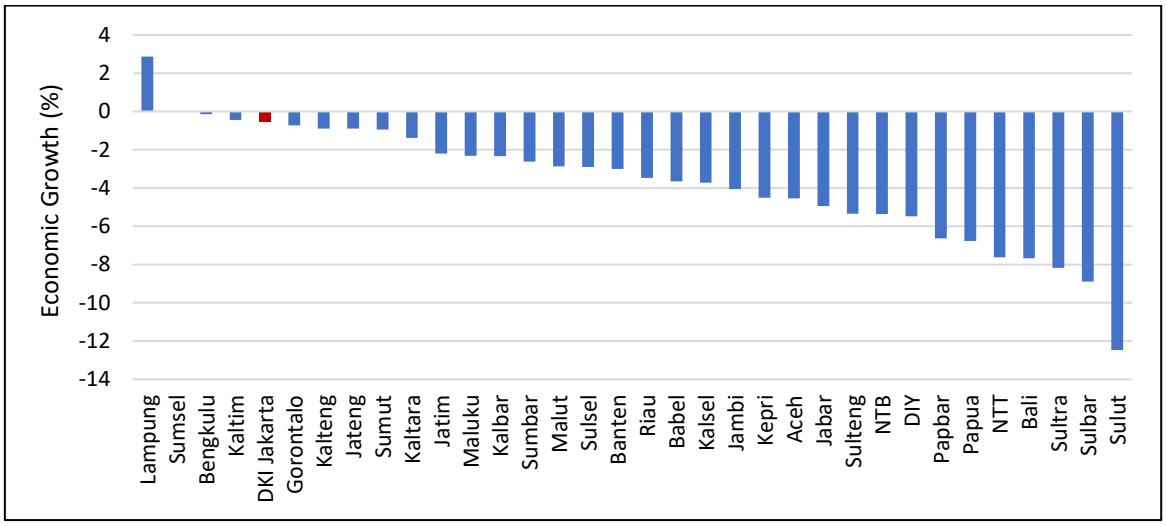


**Figure 1.** q-to-q economic growth in Q1/2020 to Q4/2019 by province

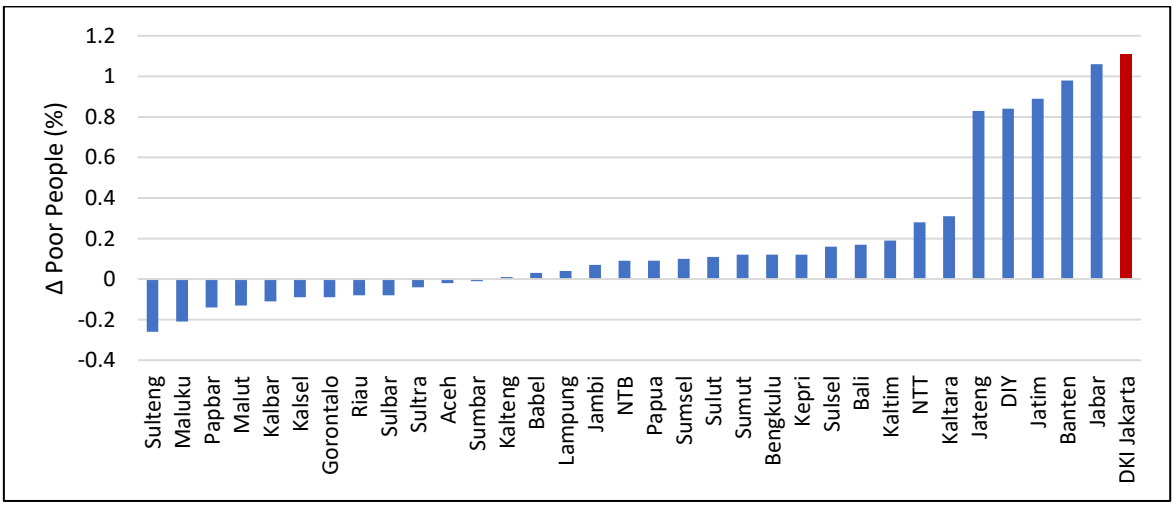


**Figure 2.** The increase in the percentage of poverty by province March 2020 to September 2019

The overview of poverty and slowing economic growth raises questions about the condition of household food insecurity in DKI Jakarta Province at the beginning of the Covid-19 pandemic. The heterogeneous characteristics of DKI Jakarta Province households indicate that there are different conditions and factors driving food insecurity. This study examines the effect of household characteristics in DKI Jakarta Province on their food insecurity status at the beginning of the Covid-19 pandemic.

## 2. Method

### *2.1 Literature Review*

*2.1.1 Food Insecurity*. Food insecurity is a condition of inability to access sufficient and nutritious food for normal and healthy growth for development of the body due to unavailability of food and/or lack of resources to obtain food (FAO, 1998). Specifically, the United States Department of Agriculture (USDA) states that food insecurity refers to the lack of financial resources available to access food at the household level. The measurement of household food insecurity status is based on conditions that occurred during the 12 months prior to the interview where household food insecurity status is dichotomous to "food insecure versus not food insecure" (Cook, 2006). Lee and Frongillo (2001) in the National Health and Nutrition Examination Survey (NHANES) data study used food insufficiency questions to determine food insecurity status. Food insufficiency is defined as "insufficient amount of food intake due to lack of resources" with details of the question "do you have enough food to eat, sometimes do not eat enough, or often do not eat enough?". A person is classified as food insecure if he or she states "sometimes or often doesn't get enough food to eat".

*2.1.2 Household Poverty Status*. BPS (2018) defines poverty as an economic inability to meet basic food and non-food needs as measured from the expenditure side. Therefore, the measurement of poverty carried out by BPS uses the concept of the basic needs approach. So that the population is categorized as "poor" if the average monthly per capita expenditure is below the poverty line. Based on the concept and measurement of poverty, the poverty status of households in this study is divided into "poor" and "non-poor" households. Household poverty is very influential on the status of food insecurity. Households experiencing food insufficiency have a strong correlation with poverty (Feeding America, 2021). Lee and Frongillo (2001) in the NHANES data study stated that poverty is related to the prevalence of food insecurity where people with incomes less than 50 percent poverty index ratio have the highest prevalence of food insecurity in the United States.

*2.1.3 Head of Household Job Status*. BPS (2021) defines work as an economic activity carried out by a person with the intention of obtaining or helping to earn income or profit, for at least 1 hour (uninterrupted) in the past week. These activities include the pattern of activities of unpaid workers who help in a business/economic activity. In fulfilling household needs, the employment status of the head of household has a very important role. Etana and Tolossa (2017) state that the prevalence of food insecurity is higher in households headed by the unemployed. Unemployed household headed will increase the tendency of household food insecurity. This refers to the results of his research that 55.9 percent of households in urban areas of Ethiopia have unemployed household headed of which 87.6 percent are food insecure households.

*2.1.4 Head of Household Education Level*. As someone who is most responsible for meeting the daily needs of the household, the characteristics of the head of the household, especially education, will greatly affect the lifestyle and household income. This is supported by Alves (2012) who concludes that the level of education has a positive impact on increasing household income. Better education will increase the chances of households getting a better income so that it will reduce the level of food insecurity (Nwokolo, 2015).

*2.1.5 Gender of the Head of the Household*. The gender of the head of household has an effect on household food insecurity. Kennedy and Peters (1992) in Hasanah (2018) state that female household headed are more able to meet household food needs than male household headed, because when female household headed have income, they tend to spend on food needs first compared to other needs. On the other hand, Abdullah et al. (2017) in Hasanah (2018) states that male household headed are more able to meet household food needs with the ability to work which on average has a higher income than women.

*2.1.6 Number of Household Members*. Household members are all people who usually live in a household (head of household, husband/wife, children, in-laws, grandchildren, parents/in-laws, other relatives, housemaids or other household members), both those who are at home respondent's ladder and temporarily did not exist at the time of enumeration (BPS, 2018). The number of household members describes the level of consumption needed by the household and shows the burden of meeting the food needs of household members (Mango et al., 2015). Households with a larger number of members have greater food needs and tend to be food insecure than households with fewer members (Babatunde et al., 2007).

*2.1.7 Social Security Ownership*. Social security is a form of risk reduction through the provision of income support and/or cost coverage when sick, birth, accident at work, old age and death (BPS, 2021). Social security uses the principle of social insurance with contributions paying premiums. The reference for the implementation of social security has been regulated based on Law (Undang-Undang) Number 40 of 2004 concerning the National Social Security System with the aim of meeting the basic needs of public health that should be given to everyone who has paid dues or whose contributions have been paid by the Government. Social security as part of a social safety net helps vulnerable households to be protected from the impact of loss of livelihood, maintain adequate levels of food consumption and reduce the risk of food insecurity (FAO, 2011). Furthermore, FAO (2011) also mentions that there is evidence that households protected by social safety nets tend to experience less hunger which leads to reduced levels of food insecurity. Social safety nets also have a broader economic impact through increased productive activities by households.

*2.1.8 Logistics Regression Analysis on Rare Events Data*. Binary rare event data is a condition where the proportion of successful events with code 1 is much smaller (about 5% and below) than non-success events with code 0 (King and Zeng, 2001). Rare event data is a problem faced in performing statistical analysis. According to King and Zeng (2001), data on rare events is commonly found in political science research, social science, and the prevalence of international conflicts such as the incidence of war and rare disease infections. Rare events have proven difficult to explain and predict. Analysis of rare events using popular statistical procedures, such as logistic regression, will lead to a tendency to overlook the probability of rare events. King and Zeng (2001) explained that estimating logistic regression parameters using the Maximum Likelihood Estimation (MLE) method on rare events data would underestimate the probability value of $Pr(Y=1)$ and overestimate the probability of failure $Pr(Y=0)$.
Logistic regression analysis on rare events can be done by using parameter estimation method that corrects the bias of parameter estimators such as the method proposed by King and Zeng (2001). Then, another method that can also be used to perform logistic regression analysis on rare events is the Firth method. The Firth method performs parameter estimating using a penalized maximum likelihood estimation (PMLE) to reduce bias in the parameter estimation of MLE results (Puhr et al., 2017). The Firth method can also overcome the problem of data separation caused by several highly predictive and unbalanced risk factors (Heinze and Schemper, 2002). Data separation problems can cause MLE to fail to obtain a convergent maximum likelihood value, so it is necessary to apply the Firth method as a solution in dealing with data separation problems (Allison, 2008).

*2.2 Research Scope*
This study was conducted to examine the effect of household characteristics in DKI Jakarta Province on their food insecurity status at the beginning of the Covid-19 pandemic. The unit of analysis used in this

study was an ordinary household in DKI Jakarta Province which was the sample for the March 2020 National Social and Economic Survey (Susenas). The number of units of analysis used in this study was 5,456 household samples in DKI Jakarta province at the beginning of the Covid-19 pandemic.

This study uses secondary data sourced from raw data from the March 2020 Susenas. The dependent variable used is household food insecurity status (1 = food insecurity, 0 = not food insecurity). While the independent variables used were household poverty status, household headed work status, household headed education level, gender of household headed, number of household members, and household social security ownership.

*2.3 Analysis Method*

The analytical method used in this research is descriptive analysis and inferential analysis. Descriptive analysis is used to describe the condition of food insecurity and a general description of the household characteristics of DKI Jakarta Province at the beginning of the Covid-19 pandemic which is presented in the form of graphs and tables. While the inferential analysis used is the firth logistic regression method.

*2.3.1 Firth logistic regression model*. This model is used to determine the variables that affect household food insecurity status along with the tendency of a household in DKI Jakarta province at the beginning of the Covid-19 pandemic to have food insecurity status. The use of firth logistic regression is due to the disparity in the number of observations between food insecurity categories where households with food insecurity status are a rare event in the study (Firth, 1993).

Firth method is a logistic regression analysis method proposed by Firth (1993) which performs parameter estimation using penalized maximum likelihood estimation (PMLE). This method serves to correct the bias generated by parameter estimation using the MLE method due to small samples, rare events, and separation (Karabon, 2020). The principle of the Firth method is to develop the log likelihood function of the MLE function and the elements of the score vector in the form of penalization (Leitgöb, 2013). The penalized likelihood function of the Firth method (1993) is shown in Equation (1).

$$L_{PML}(\boldsymbol{\beta}) = L_{ML}(\boldsymbol{\beta})|\boldsymbol{i}(\boldsymbol{\beta})|^{\frac{1}{2}} \quad (1)$$

While the log likelihood function is shown in Equation (2).

$$logL_{PML}(\boldsymbol{\beta}) = logL_{ML}(\boldsymbol{\beta}) + \frac{1}{2}log|\boldsymbol{i}(\boldsymbol{\beta})| \quad (2)$$

$L_{PML}(\boldsymbol{\beta})$: The penalized likelihood function of the Firth method.
$L_{ML}(\boldsymbol{\beta})$: Likelihood function of the MLE method.
$|\boldsymbol{i}(\boldsymbol{\beta})|^{\frac{1}{2}}$ : *Jeffreys invariant prior*

The basis of the Firth method is to reduce the bias in parameter estimators by including a small bias in the score function (Firth, 1993). Modifications to the score function are shown in Figure (4).

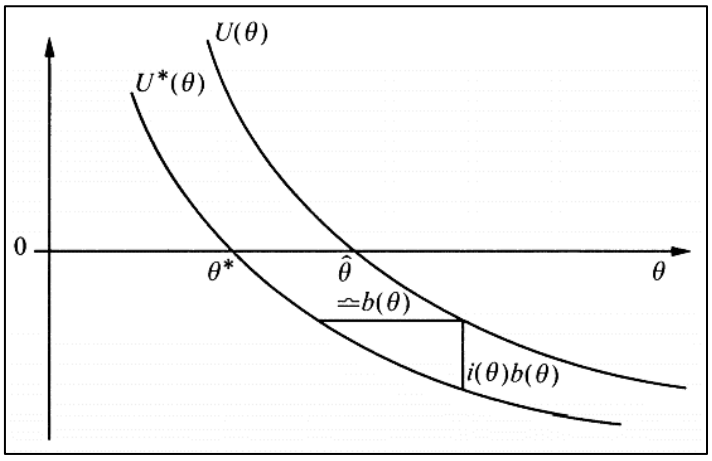


**Figure 4.** Modification of the unbiased score function

If the parameter estimator has a positive bias, then *score function* $U(\beta)$ will shift down at each parameter point by $i(\beta)b(\beta)$ where $-i(\beta) = U'(\beta)$ is the local gradient and $b(\beta)$ is the bias of the MLE parameter estimator (Firth, 1993). Equation (3) shows the modified score function equation.

$$U^*(\boldsymbol{\beta}) = U(\boldsymbol{\beta}) - \boldsymbol{i}(\boldsymbol{\beta})\boldsymbol{b}(\boldsymbol{\beta}) \tag{3}$$

The effect of Jeffrey's invariant prior in Equation (9) can be neglected asymptotically. Using the modification as in the equation, $O(n^{-1})$ bias of parameter estimator $\hat{\beta}$ (MLE results) can be omitted. Heinze and Schemper (2002) stated that the parameter estimator $\hat{\beta}$ with the Firth method can be obtained using Equation (4).

$$\beta^{(s+1)} = \beta^{(s)} + I^{-1}(\beta^{(s)})U(\beta^{(s)})^* \tag{4}$$

with (s) representing the s-th repetition.

Actually, the binary logistic regression model used in binary logistic regression analysis with Firth bias correction is the same as the model used in ordinary binary logistic regression analysis. The difference is the process of estimating the model parameters, $\beta_0$ and $\beta$. The details are as follows:

| **Ordinary binary logistic regression** | **Binary logistic regression with Firth bias correction** |
|---|---|
| Logistic regression model:<br>$\pi(x) = \frac{e^{\beta_0+\beta_1 x_1+\cdots+\beta_p x_p}}{1+\ e^{\beta_0+\beta_1 x_1+\cdots+\beta_p x_p}}$ | Logistic regression model:<br>$\pi(x) = \frac{e^{\beta_0+\beta_1 x_1+\cdots+\beta_p x_p}}{1+\ e^{\beta_0+\beta_1 x_1+\cdots+\beta_p x_p}}$ |
| Logit transformation result:<br>$g(x) = \beta_0 + \beta_1 x_1 + \cdots + \beta_p x_p$ | Logit transformation result:<br>$g(x) = \beta_0 + \beta_1 x_1 + \cdots + \beta_p x_p$ |
| $\beta_0$ dan $\beta$ parameters estimated using the MLE method | $\beta_0$ dan $\beta$ parameters estimated using the Penalized-MLE method |
| L*ikelihood function:*<br>$l(\boldsymbol{\beta}) = \prod_{i=1}^{n}[\pi(x_i)]^{y_i}\,[1-\pi(x_i)]^{1-y_i}$ | L*ikelihood function:*<br>$l_{PML}(\boldsymbol{\beta}) = l_{ML}(\boldsymbol{\beta})\lvert\boldsymbol{i}(\boldsymbol{\beta})\rvert^{\frac{1}{2}}$<br>where $\lvert\boldsymbol{i}(\boldsymbol{\beta})\rvert^{\frac{1}{2}}$ is *Jeffrey's invariant prior*<br>$\lvert\boldsymbol{i}(\boldsymbol{\beta})\rvert^{\frac{1}{2}}$ function is to eliminate the first order bias $O(n^{-1})$ from $\hat{\beta}$ parameter estimation (MLE results) through first-order Taylor series expansion beheading, because this bias has a severe impact on small sample or rare case data. |
| *log-likelihood function:*<br>$L(\boldsymbol{\beta}) = \ln[l(\boldsymbol{\beta})]$<br>$L(\boldsymbol{\beta}) = \sum_{i=1}^{n} ln[\pi(x_i)^{y_i}] + \sum_{i=1}^{n} ln[1-\pi(x_i)]^{(1-y_i)}$ | *log-likelihood function:*<br>$L_{PML}(\boldsymbol{\beta}) = ln[l_{PML}(\boldsymbol{\beta})]$<br>$L_{PML}(\boldsymbol{\beta}) = ln[l_{ML}(\boldsymbol{\beta})] + \frac{1}{2} ln[\lvert\boldsymbol{i}(\boldsymbol{\beta})\rvert]$ |
| First derivative of $L(\boldsymbol{\beta})$ to $\beta_0$<br>$\frac{\partial L(\boldsymbol{\beta})}{\partial(\beta_0)} = 0$<br>$\sum_{i=1}^{n}[y_i - \pi(x_i)] = 0$ | First derivative of $L_{PML}(\boldsymbol{\beta})$ to $\beta_0$<br>$\frac{\partial L(\boldsymbol{\beta})}{\partial(\beta_0)} + \frac{1}{2} trace[\boldsymbol{i}(\boldsymbol{\beta})^{-1}\left(\frac{\partial i(\boldsymbol{\beta})}{\partial(\beta_0)}\right) = 0$ |

| Ordinary binary logistic regression | Binary logistic regression with Firth bias correction |
|---|---|
| First derivative of $L(\boldsymbol{\beta})$ to $\beta$<br>$\frac{\partial L(\boldsymbol{\beta})}{\partial(\beta)} = 0$<br>$\sum_{i=1}^{n} x_i[y_i - \pi(x_i)] = 0$ | First derivative of $L_{PML}(\boldsymbol{\beta})$ to $\beta$<br>$\frac{\partial L(\boldsymbol{\beta})}{\partial(\beta)} + \frac{1}{2} trace[\boldsymbol{i}(\boldsymbol{\beta})^{-1}\left(\frac{\partial i(\boldsymbol{\beta})}{\partial(\beta)}\right) = 0$ |
| *Score function* (gradient/first derivative of the log-likelihood function with respect to parameter $\beta$)<br>$U(\boldsymbol{\beta}) = \frac{\partial L(\boldsymbol{\beta})}{\partial(\beta)} = \sum_{i=1}^{n} x_i[y_i - \pi(x_i)] = 0$ | *Score function* (gradient/first derivative of the log-likelihood function with respect to parameter $\beta$)<br>$U^*(\boldsymbol{\beta}) = U(\boldsymbol{\beta}) - \boldsymbol{i}(\boldsymbol{\beta})\boldsymbol{b}(\boldsymbol{\beta})$ |
| Using the Newton Raphson method (using software) to solve the likelihood equation to obtain an estimator $\beta_0$ and $\beta$. In the iteration process to find an estimator, the estimated value is then formulated as follows:<br>$\boldsymbol{\beta}^{(s+1)} = \boldsymbol{\beta}^{(s)} + (\boldsymbol{H}^{(s)})^{-1}\boldsymbol{U}(\boldsymbol{\beta}^{(s)})$<br>where $\boldsymbol{H}$ is the *Hessian matrix.* | Using the Fisher Scoring method (using software) to solve the likelihood equation to obtain an estimator $\beta_0$ and $\beta$. In the iteration process to find an estimator, the estimated value is then formulated as follows:<br>$\boldsymbol{\beta}^{(s+1)} = \boldsymbol{\beta}^{(s)} + (\boldsymbol{i}(\boldsymbol{\beta})^{(s)})^{-1}\boldsymbol{U}(\boldsymbol{\beta}^{(s)})^*$<br>where $\boldsymbol{i}(\boldsymbol{\beta})$ is the *Fisher information matrix.* |

*2.3.2 Goodness of Fit Test*. Goodness of Fit test is a test conducted to determine whether the model formed is effective in explaining the dependent variable (Hosmer and Lemeshow, 2000). One way to do this test is with the Hosmer-Lemeshow test as follows:
*Statistical Hypothesis*

$H_0$ : The model formed is appropriate in explaining the dependent variable.

$H_1$ : The model formed is not appropriate in explaining the dependent variable.

*Test Statistics*

$$\hat{C} = \sum_{k=1}^{g} \frac{(o_k - n'_k\bar{\pi}_k)^2}{n'_k\bar{\pi}_k(1-\bar{\pi}_k)} \sim \chi^2_{(g-2)} \tag{5}$$

$o_k$ : Total value of dependent variable, $o_k = \sum_{j=1}^{c_k} y_j$.

$c_k$ : The number of combinations of independent variables in the k-th group.

$\bar{\pi}_k$ : Average estimated probability, $\bar{\pi}_k = \sum_{j=1}^{c_k} \frac{m_j\hat{\pi}_j}{n'_k}$.

$n'_k$ : number of subjects in the k-th group.

$g$ : number of groups.

*Decision*

The hypothesis is rejected if $\hat{C} > \chi^2_{\alpha(g-2)}$ or *p-value* < $\alpha$

*Conclusion*

If it rejects $H_0$, it means that with a significance level of $\alpha$, the model formed is not suitable in explaining the dependent variable.

*2.3.3 Simultaneous Test.* Simultaneous test is a parameter test conducted to determine the effect of all independent variables simultaneously on the dependent variable. This test was carried out using the likelihood ratio test statistic (Hosmer and Lemeshow, 2000). Simultaneous test stages as follows:
*Statistical Hypothesis*

$H_0$ : $\beta_1 = ... = \beta_p = 0$ (there is no significant effect between all independent variables simultaneously on the dependent variable).

$H_1$ : there is at least one $\beta_j \neq 0, j = 1, 2, ... p$ (there is at least one independent variable that significantly affects the dependent variable).

*Determine the significance level (α) of 5%.*

*Test Statistics*

$$G = -2ln\left[\frac{L_0}{L_1}\right] \sim \chi^2_{(p)}$$

$$= -2ln\left[\frac{\left(\frac{n_1}{n}\right)^{n_1}\left(\frac{n_0}{n}\right)^{n_0}}{\prod_{i=1}^{n}\hat{\pi}_i^{y_i}(1-\hat{\pi}_i)^{(1-y_i)}}\right] \sim \chi^2_{(p)} \quad (6)$$

$L_0$ : maximum likelihood value of the model without independent variables.

$L_1$ : maximum likelihood value of the model with all independent variables.

$p$ : number of independent variables.

*Determine the critical region, namely the region to reject H₀. The hypothesis is rejected if* $G > \chi^2_{\alpha(p)}$ *or p-value* $< \alpha$.

*Conclusion*

If it rejects $H_0$, it means that with a significance level of $\alpha$, there is at least one independent variable that has a significant effect on the dependent variable.

*2.3.4 Partial Test.* Partial test is a parameter test conducted to determine which independent variables have a significant effect on the dependent variable. This test was carried out after the simultaneous test obtained a decision to reject H₀. This test was carried out using the Wald test statistic (Hosmer and Lemeshow, 2000). The stages of partial test as follows:
*Statistical Hypothesis*

$H_0$ : $\beta_i = 0$ (there is no significant effect between the i-th predictor variable on the response variable).

$H_1$ : $\beta_i \neq 0 \; with \; i = 1,2,3, ... ,6$ (there is a significant effect between the i-th predictor variable on the response variable).

*Determine the significance level (α) of 5%.*

*Test Statistics*

$$W = \left[\frac{\widehat{\beta_i}}{SE(\widehat{\beta_i})}\right]^2 \sim Z_{\alpha/2} \quad (7)$$

$\widehat{\beta}_i$ : the i-th parameter estimator.

$SE(\widehat{\beta}_i)$ : i-th parameter estimator standard error.

$i$ : 1, 2, …, $p$ where p is the number of predictor variables.

*Determine the critical region, namely the region to reject $H_0$. The hypothesis is rejected if $W > Z_{\alpha/2}$ or p-value < $\alpha/2$.*

*Conclusion*

If it rejects $H_0$, it means that with a significance level of $\alpha$, there is a significant effect between the i-th independent variable on the dependent variable.

## 3. Results and Discussion

*3.1 Overview of Food Insecurity and Household Characteristics of DKI Jakarta Province at the Beginning of the Covid-19 Pandemic*

Food insecurity is a condition of inability to access sufficient and nutritious food for normal and healthy growth and development of the body due to unavailability of food and/or lack of resources to obtain food (FAO, 1998). Food insecurity conditions have worsened since the beginning of the Covid-19 pandemic where social restrictions and economic contraction caused many people to lose their jobs and incomes as well as increasing poverty due to the inability to meet basic needs such as food and shelter (Wolfson and Leung, 2020). Whereas economic growth and poverty reduction are sustainable solutions in efforts to alleviate food insecurity (FAO, 1999).

Based on the March 2020 Susenas, as many as 4.47 percent of households in DKI Jakarta Province are food insecure.

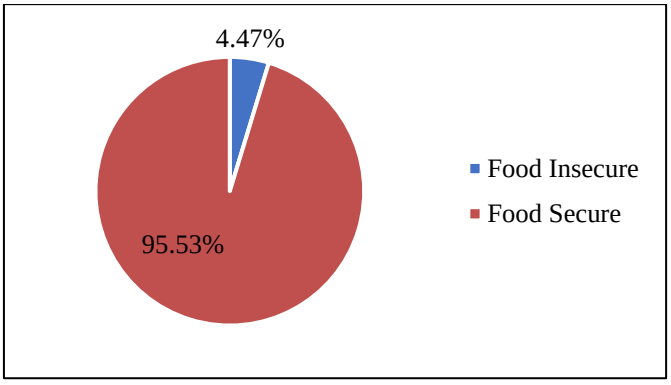


**Figure 5.** Percentage of food insecurity status in DKI Jakarta at the beginning of the Covid-19 pandemic

Table 1 shows an overview of the household characteristics of DKI Jakarta province at the beginning of the Covid-19 pandemic. Based on the table of research results, DKI Jakarta province households at the beginning of the Covid-19 pandemic were dominated by non-poor households, which were 96.79 percent, while poor households were 3.21 percent. The majority of households in DKI Jakarta have no more than four members, namely 77.34 percent of households.

Households in the DKI Jakarta province are still dominated by male household headed with a percentage of 83 percent, working household headed with a percentage of 84.73 percent, and household headed with a high school education and above with a percentage of 62.67 percent. However, household

participation in social security ownership is still low, it is recorded that more than 85 percent of households do not have social security.

**Table 1.** General description of household characteristics of DKI Jakarta province at the beginning of the Covid-19 pandemic

| No. | Variable | Category | Percentage |
|---|---|---|---|
| 1 | Poverty status of the household | Poor | 3.21% |
| | | Not poor* | 96.79% |
| 2 | Employment status of the head of household | Not working | 15.27% |
| | | Working * | 84.73% |
| 3 | Education level of head of household | < high school | 37.33% |
| | | ≥ high school * | 62.67% |
| 4 | Gender of head of household | Female | 17% |
| | | Male * | 83% |
| 5 | Number of household members | > 4 people | 22.66% |
| | | ≤ 4 people | 77.34% |
| 6 | Social security ownership | Don't have | 85.70% |
| | | Have * | 14.30% |

* reference category

Table 2 shows the percentage of household food insecurity in DKI Jakarta province based on household characteristics at the beginning of the Covid-19 pandemic. Based on table 2, it can be seen that the status of poverty greatly affects the condition of household food insecurity. A total of 20.70 percent of poor households are food insecure. Meanwhile, the percentage of food insecurity in non-poor households is only 4.35 percent.

When viewed from the gender of the head of household, employment status, and education level, the condition of food insecurity is more experienced by households with female head of household, not working, and with high school education and below. Based on the gender of head of household, 5.56 percent of households with female head of household experience food insecurity. Based on the employment status of the head of household, 6.62 percent of the households with the head of household do not work experience food insecurity conditions. Based on the education level of the head of household, 7.63 percent of households with a household headed with a high school education and below experience food insecurity conditions.

When viewed from the number of household member and social security ownership status, the condition of food insecurity is more experienced by households with more than 4 members and do not have social security. Based on the number of household member, 5.21 percent of households with more than 4 members experienced food insecurity conditions. Based on social security ownership status, 4.98 percent of households that do not have social security experience food insecurity conditions.

**Table 2.** Percentage of households in DKI Jakarta province with food insecure status based on their characteristics at the beginning of the Covid-19 pandemic

| No. | Variable | Category | Food Insecurity | | Total |
|---|---|---|---|---|---|
| | | | Food Insecure | Food Secure | |
| 1 | Poverty status of the household | Poor | 20.70% | 79.30% | 100% |
| | | Not poor* | 3.94% | 96.06% | 100% |
| 2 | Employment status of the head of household | Not working | 6.62% | 93.38% | 100% |
| | | Working * | 4.09% | 95.91% | 100% |
| 3 | Education level of head of household | < high school | 7.63% | 92.37% | 100% |
| | | ≥ high school * | 2.59% | 97.41% | 100% |
| 4 | | Female | 5.56% | 94.44% | 100% |

| | | | | | |
|---|---|---|---|---|---|
| | Gender of head of household | Male * | 4.25% | 95.75% | 100% |
| 5 | Number of household members | > 4 people | 5.21% | 94.79% | 100% |
| | | ≤ 4 people | 4.26% | 95.74% | 100% |
| 6 | Social security ownership | Don't have | 4.98% | 95.02% | 100% |
| | | Have * | 1.47% | 98.53% | 100% |

* reference category

*3.2 Variables Affecting Household Food Insecurity in DKI Jakarta Province at the Beginning of the Covid-19 Pandemic*

Firth logistic regression analysis was used to determine the variables that affect household food insecurity status and the tendency of a household to have food insecurity status by using each explanatory variable. There are three stages of testing carried out, namely the model suitability test, simultaneous test and partial test. The three tests used a significance level of 5%.

In the goodness of fit test, the test was carried out with the Hosmer-Lemeshow test to see whether the model formed was appropriate to explain the food insecurity status of the DKI Jakarta Province household at the beginning of the Covid-19 pandemic. Test statistic value $\chi^2_{count}$ obtained is 7.0244. The results then compared with the value of $\chi^2_{(0,05:8)}$= 15.51, which results in the decision to fail to reject $H_0$, because the value of $\chi^2_{count}$ less than the chi-square table value. So it can be concluded that with a significance level of 5 percent, the model formed is appropriate in explaining the food insecurity status of the DKI Jakarta province household at the beginning of the Covid-19 pandemic.

**Table 3.** *Goodness of fit* test

| | $\chi^2_{count}$ | df | $\chi^2_{table}$ | *p-value* |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| Model | 7.0244 | 8 | 15.51 | 0.534 |

In the simultaneous test, statistical testing on the model is carried out with the likelihood ratio test to determine the effect of the independent variables on the dependent variable simultaneously. The statistical value of the deviance test (G) obtained is 197.1. The results are then compared with the value of $\chi^2_{(0,05:6)}$= 12.59, which results in a decision to reject H0, because the deviance value is greater than the chi-square value. So it can be concluded that with a significance level of 5 percent, there is at least one independent variable that affects the food insecurity status of the DKI Jakarta province household at the beginning of the Covid-19 pandemic.

**Table 4.** Simultaneous test

| | Deviance (G) value | df | $\chi^2_{table}$ |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Model | 197,1 | 6 | 12,59 |

Subsequently, a partial test was conducted to determine the effect of each independent variable on the dependent variable.

**Table 5.** Partial test

| Variable | $\hat{\beta}$ | *p-value* | $\exp(\hat{\beta})$ |
|---|---|---|---|
| *Intercept* | -4.4766 | $2.25 \times 10^{-7}$ ** | 0.0114 |
| Poverty status of the household | | | |
| Not poor * | | | |
| Poor | 1.5564 | $2.25 \times 10^{-7}$ ** | 4.7419 |

| Variable | $\hat{\beta}$ | *p-value* | $\exp(\hat{\beta})$ |
|---|---|---|---|
| Employment status of the head of household | | | |
| Working * | | | |
| Not working | 0.3223 | 0.0348 ** | 1.3803 |
| Education level of head of household | | | |
| ≥ high school * | | | |
| < high school | 1.0262 | $1.66 \times 10^{-6}$ ** | 2.7905 |
| Gender of head of household | | | |
| Male * | | | |
| Female | 0.1579 | 0.2977 | 1.1711 |
| Number of household members | 0.0029 | 0.9379 | 1.0029 |
| Social security ownership | | | |
| Have * | | | |
| Don't have | 0.9452 | 0.0006 ** | 2.5733 |

* reference category

** Significant at α = 5%

Based on the partial test of the six independent variables in table 4, it can be shown that four variables significantly affect the household food insecurity of DKI Jakarta province at the beginning of the Covid-19 pandemic. The significant variables are household poverty status, household headed employment status, household headed education level, and household social security ownership. The model formed is as follows.

$$\hat{g}(x) = -4.4766 + 1.5564X_1 + 0.3223X_2 + 1.0262X_3 + 0.1579X_4 + 0.0029X_5 + 0.9452X_6 \quad (5)$$

The positive or negative sign on the coefficient of each model parameter indicates the direction of the relationship between the independent variable and the dependent variable, $\exp(\hat{\beta})$ value (odds ratio) of each independent variable provides information on the magnitude of the tendency of the independent variable to the dependent variable in the model. Based on the direction of the relationship on the parameter coefficients and the odds ratio of each independent variable, it can be shown that:

- In the household poverty status variable, the parameter coefficients are positive and the $\exp(\hat{\beta})$ is 4.7419. This shows that households with poor status have a tendency to be food insecure by 4.7419 times greater than non-poor households assuming other variables are constant. The results of this study are in line with previous studies which stated a high tendency for poor households to have food insecurity status (Lee and Frongillo, 2001; Onime and Tamuno, 2021).
- In the variable of household headed work status, the parameter coefficient is positive and the $\exp(\hat{\beta})$ is 1.3803. This shows that households with non-working head of household have a tendency to be food insecure by 1.3803 times greater than households with working head of household assuming other variables are constant. The results of this study are in line with previous studies which state that employment status has a strong correlation with food insecurity status (Tolossa, 2010; Etana and Tolossa, 2017).
- In the variable of the education level of the head of the household, the parameter coefficient is positive and the $\exp(\hat{\beta})$ is 2.7905. This shows that households with household headed with high school education and below have a tendency to be food insecure by 2.7905 times greater than households with household headed with high school education and above assuming other variables are constant. The results of this study are in line with previous studies which state that better education will increase the chances of households getting a better income so that it will reduce the level of food insecurity (Nwokolo, 2015; Alves, 2012).
- In the gender of the head of household variable, the parameter coefficient is positive and the $\exp(\hat{\beta})$ is 1.1711. This shows that households with female head of household have a tendency

to be food insecure by 1.1711 times greater than households with male head of household assuming other variables are constant. The results of this study are in line with previous studies which stated that the gender of the household headed had an effect on household food insecurity. Abdullah et al. (2017) in Hasanah (2018) states that male household headed are more able to meet household food needs with the ability to work which on average has a higher income than women.

- In the variable number of household members, it can be shown that the number of members has a positive relationship to household food insecurity. The parameter coefficients in table 4 show that the higher the number of members, the greater the opportunity for households to be food insecure. When the number of members increases by one person, the household will tend to be food insecure by 1.0029 times compared to not being food insecure. The results of this study are in line with previous studies which stated that households with a larger number of members have greater food needs and tend to be food insecure than households with fewer members (Babatunde et al., 2007; Mango et al., 2015; Mubyarto, 2003).
- In the social security ownership variable, the parameter coefficient is positive and the $\exp(\hat{\beta})$ is 2.5733. This shows that households that do not have social security have a tendency to be food insecure by 2.5733 times greater than households that have social security assuming other variables are constant. The results of this study are in line with previous research which states that households protected by social safety nets tend to experience a reduction in food insecurity (FAO, 2011; Schmidt, Sheppard & Watson, 2016).

## 4. Conclusion

Based on the results and discussion, there are several conclusions obtained:

1. There are still 4.47 percent of households in DKI Jakarta Province with food insecure status at the beginning of the Covid-19 pandemic.
2. In general, households with food insecurity status are poor households, do not have social security, the head of the household doesn't work, and the head of the household has less than high school education.

There are several suggestions given based on the research:

1. The need of the Government's efforts together with the community to develop job opportunities through labor-intensive industries that are able to absorb a lot of workers.
2. Improving the quality of human resources through skills training, free courses, and fostering an entrepreneurial spirit so that after participating in the skills training, they can develop their potential to create jobs.
3. Steps are needed to increase community participation in the ownership of social safety net as an effort to reduce household food insecurity.

## References

[1] Agresti, A. (2000). *Categorical Data Analysis* (2nd *ed*). New York: John Wiley & Sons.
[2] Astuti, E.T. & Yanagawa, T. (2000). Testing nonlinear trend in proportions under binomial and extra-binomial variabilities. *Bulletin of Informatics & Cybernetics,* 32(2), 157-168.
[3] Babatunde, R.O., Omotesho & Sholotan. (2007). Socio-Economics Characteristics and Food Security of Farming Household on Kware State, North-Central Nigeria. *Pakistan Journal of Nutrition*, 6(1), 49-58
[4] Bain, L.J. & Engelhardt, M. (2000) Introduction to Probability and Mathematical Statistics (2nd ed). Boston: PWS-KENT.
[5] Bappenas. (2016). Pelaksanaan Pengentasan Kelaparan serta Konsumsi & Produksi Berkelanjutan dalam Tujuan Pembangunan Berkelanjutan (SDGs) di Indonesia.
[6] BPS. (2020). Berita Resmi Statistik : Pertumbuhan Ekonomi Indonesia Triwulan IV-2019. Jakarta: Badan Pusat Statistik. Diambil kembali dari
[7] https://www.bps.go.id/pressrelease/2020/02/05/1755/ekonomi-indonesia-2019-tumbuh-5-02-persen.html

[8] BPS. (2020). Berita Resmi Statistik : Pertumbuhan Ekonomi Indonesia Triwulan I-2020. Jakarta: Badan Pusat Statistik. https://www.bps.go.id/pressrelease/2020/05/05/1736/ekonomi-indonesia-triwulan-i2020-tumbuh-2-97-persen.html
[9] BPS. (2020). Berita Resmi Statistik : Pertumbuhan Ekonomi Indonesia Triwulan II-2020. Jakarta: Badan Pusat Statistik. https://www.bps.go.id/pressrelease/2020/08/05/1737/-ekonomi-indonesia-triwulan-ii-2020-turun-5-32-persen.html
[10] BPS. (2020). Berita Resmi Statistik : Pertumbuhan Ekonomi DKI Jakarta Triwulan I-2020. Jakarta: Badan Pusat Statistik Provinsi DKI Jakarta. https://jakarta.bps.go.id/pressrelease/2020/05/05/489/perekonomian-jakarta-triwulan-1-2020-terendah-selama-sepuluh-tahun-terakhir.html
[11] Chinnakali, P., et al. (2014). Prevalence of Household-level Food Insecurity and Its Determinants in an Urban Resettlement Colony in North India. Journal of Health Popular Nutrition, 32(2), 227-236.
[12] Daniel Maxwell, Carol Levin, Margaret Armar-Klemesu, Marie Ruel, Saul Morris, & Clement Ahiadeke. (2000). Urban Livelihoods and Food Nutrition Security in Greater Accra, Ghana. IFPRI Research Report No. 112.
[13] David W. Hosmer, Jr., Stanley Lemeshow, & Rodney X. Sturdivant. Applied Logistic Regression (3rd ed). New Jersey: Wiley. ISBN 978-0-470-58247-3.
[14] Etana, D. & Tolossa, D. (2017). Unemployment and Food Insecurity in Urban Ethiopia. *African Development Review,* 29(1), 56-68.
[15] FAO. (2006). Food Insecurity: Policy Brief. June 2006. Issue 2.
[16] Firth, D. (1993). Bias Reduction of Maximum Likelihood Estimates. *Biometrika*, 80(1), 27-38.
[17] Frongillo, E.A. (1999). Validation of Measures of Food Insecurity and Hunger. *American Society for Nutritional Sciences*, 506s-509s.
[18] Gundersen, C. & Ziliak, J.P. (2015). Food Security and Health Outcomes. *Health Affairs*, 34(11), 1830-1839.
[19] Hanani, N., Sujarwo, & Asmara, R. (2015). Indikator dan Penilaian Tingkat Kerawanan Pangan Kelurahan untuk Daerah Perkotaan. *AGRISE*, 15(2), 101-109.
[20] Hasanah, B.I. (2018). *Penerapan Regresi Logistik Biner: Determinan Status Ketahanan Pangan di Indonesia tahun 2016* [Skripsi]. Jakarta: Politeknik Statistika STIS.
[21] International Food Policy Research Institute (INFRI). (2016). 2016 Global hunger index: Getting to zero hunger.
[22] John Neter, William Wasserman, & Michael H. Kutner. (1989). Applied Linear regression models (2nd ed). Irwin: Homewood, III.
[23] Kennedy, Eileen & Peters, Pauline. (1992). Household food security and child nutrition: the interaction of income and gender of household headed.
[24] King, G. & Zeng, L. (2001). Logistic Regression in Rare Events Data. *Political Analysis*, 9, 137-163.
[25] Lee, J.S. & Frongillo, E.A. (2001). Factors Associated with Food Insecurity among U.S. Elderly Persons: Importance of Functional Impairments. *Journal of Gerontology: Social Science*, 56B(2), 94-99.
[26] Maharjan, A., et al. (2020). Migration and Household Adaptation in Climate-Sensitive Hotspots in South Asia. *Current Climate Change Reports*, (6), 1-16.
[27] Million, M. & Muche, M. (2020). Factors Determing the Food Insecurity Status of Rural Household in Manna Woreda of Jimma Zone, Ethiopia. *Sustainability, Agri, Food and Environmental Research*, 8(X), 1-15.
[28] Nelson Mango, Byron Zamasiya, Clifton Makate, Kefasi Nyikahadzoi & Shephard Siziba. (2014). Factors influencing household food security among smallholder farmers in the Mudzi district of Zimbabwe. Development Southern Africa, 2014 Vol. 31, No. 4, 625–640.

[29] Nwokolo, E.E.. (2015). The Influence of Educational Level on Sources of Income and Household Food Security in Alice, Eastern Cape, South Africa. Journal of Human Ecology, 52:3, 208-217.
[30] Onime, B.E. & Tamuno, S. (2021). Poverty, Unemployment, and Food Insecurity: Empirical Evidence from Nigeria. *Asian Journal of Economics, Business and Accounting*, 21(6), 107-123.
[31] Pelto, Gretel H. & Armar-Klemesu, Margaret. (2016). Identifying Interventions to Help Rural Kenyan Mothers Cope With Food Insecurity: Results Of a Focused Ethnographic Study. Maternal & Child Nutrition (2015), 11 (Suppl. 3), pp. 21–38.
[32] Republik Indonesia. (1945). Undang-Undang Dasar 1945. Sekretariat Negara, Jakarta.
[33] Republik Indonesia. (2012). Undang-Undang Republik Indonesia Nomor 18 Tahun 2012 tentang Pangan. Sekretariat Negara, Jakarta
[34] Schimdt, L. Sheppard L.S. & Watson, T. (2016). The Effect of Safety-Net Programs on Food Insecurity. *The Journal of Human Resources*, 51(3), 589-614.
[35] Sutikno, S.R. (2018). *Determinan Status Kepemilikan Rumah Layak Milik Sendiri di Provinsi DKI Jakarta tahun 2017* [Skripsi]. Jakarta: Politeknik Statistika STIS.
[36] The Economist Intelligence Unit (EIU). (2016). Global Food Security Index 2016.
[37] The World Bank, The Food and Agricultura Organization, & The International Fund for Agricultural Development. (2008). Gender in agriculture sourcebook.
[38] Victor Owusu, Awudu Abdulai, & Seini Abdul-Rahman. (2011). Non-farm work and food security among farm households in Northern Ghana. Food Policy 36 (2011) 108– 118.
[39] Walpole, Ronald E. & Myers, Raymond H. (1995). Ilmu Peluang dan Statistika Untuk Insinyur dan Ilmuwan Edisi ke-4. Terjemahan RK Sembiring. Bandung: Penerbit ITB
[40] Yunastiti Purwaningsih, Slamet Hartono, Masyhuri, Jangkung Handoyo Mulyo. (2015). Pola Pengeluaran Pangan Rumah Tangga Menurut Tingkat Ketahanan Pangan di Propinsi Jawa Tengah. Jurnal Ekonomi Pembangunan.