

# DETERMINANT OF HOUSEHOLD FOOD WASTE : A DIRECT MEASUREMENT STUDY IN TANAH SAREAL SUB-DISTRICT OF BOGOR CITY

Liya Putri Rahmaniya<sup>1</sup>, Dodik Briawan<sup>1\*</sup>, Dadang Sukandar<sup>1</sup>, Prita Dhyani Swamilaksita<sup>2</sup>

<sup>1</sup> Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor, Indonesia

<sup>2</sup> Study Program of Nutrition Science, Faculty of Health Science, Universitas Esa Unggul, Jakarta, Indonesia

\*Email: briawandodik@gmail.com

## ABSTRACT

*The percentage of food waste generation has increased in Indonesia for 20 years, with 80% of food waste coming from households. This can cause various significant negative impacts on the environment, economy and social. Various factors affect the production of household food waste. This study aims to analyze household food waste based on its quantity, type, and determinants. This study uses some secondary data from primary research conducted by Swamilaksita (2024) with a cross-sectional design. The study sample of 110 households was selected using a stratified random sampling technique. Food waste data was obtained through direct measurement using the SNI 19-3964-1994 method. The entire data was analyzed descriptively, while multiple linear regression analysis was carried out to determine the determinants of household food waste. This study showed that the average amount of food waste was 318.4 g/HH/day and 76.7 g/cap/day. The cereal group was the most discarded food group, followed by vegetables and fruits group. Only three variables were proven to be statistically significant ( $p$ -value $<0.1$ ) affect the average amount of household food waste, namely the number of household members ( $p=0.000$ ), mother work as civil servant/private employee ( $p=0.049$ ), and purchasing and spending behavior ( $p=0.084$ ). The conclusion was there is an average amount of food waste in units per household and per capita, with the dominant food group is the cereal group, as well as the determinants of household food waste, including number of household members, mother work as a civil servant/private employee, and purchasing and spending behavior.*

**Keywords:** amount, determinants, food waste, household type

## INTRODUCTION

Food waste is one of many critical matters against society because it represents the global condition of health, social, economic, and environmental problems. Food Waste Index Report reports an estimated average global food waste of 121 kg/capita/year with 61% of food waste coming from households weighted 74 kg/capita/year (UNEP, 2021). The percentage of food waste generation in Indonesia has increased over the past 20 years. There has been an increase from 39% in 2000 to 55% in 2019 with an average percentage of 44%. The highest number of food waste generation in 2000 – 2019 occurred at the consumption stage amounting to 25 – 73 kg/capita/year with 80% of food waste coming from households (Bappenas, 2021).

West Java Province is the province with the densest population in Java Island and also

in Indonesia. Tanah Sareal is one of the sub-districts in Bogor City, West Java Province, which has 64,192 households with the second largest population growth rate (2.08%) in Bogor City (BPS Kota Bogor, 2020, 2021). An increase in population size has the potential increasing food waste generation in an area, particularly at the household level.

Food waste is more often thought to occur due to choices such as over-preparation of food or food negligence resulting in rotten, expired food, or excess food which are not eaten (CEC, 2019). Several categories of food waste are edible and inedible food waste, also referred to as avoidable and unavoidable food waste (van der Werf & Gilliland, 2017; Withanage et al., 2021). Food waste is able to cause various significant negative impacts on the environment, economy, and social sectors (Scalvedi & Rossi, 2021; Withanage et

al., 2021). Those impacts affect food security and become a matter of resource efficiency for healthy diets and sustainable food production (Foley et al., 2011; Willett et al., 2019).

The highest percentage of food waste occurs at the consumption stage in middle and high-income countries, especially at the household level with a value of around 6-20% in developing countries and 26-40% in developed countries. Many reasons underlying this thing, include attitude towards food shopping, storage management, personal preferences, beliefs, lifestyle, and awareness about waste and food preparation or consumption methods (Ghaziani et al., 2021), while other factors include demographic factors, psychographic factors, and socio-economic characteristics such as number of household members and household income that shown to be related to household food waste disposal behavior (Elimelech et al., 2018; Oberlin, 2013). In Indonesian context, the main factors of food waste are culture, poor storage, consumer preferences in selecting food, lack of education to the public, and consumer behavior toward consuming excessive portions of food (Kariyasa & Suryana, 2012).

Many studies related to household food waste with its determinants have been conducted in many developed countries such as UK (Grainger et al., 2018) food waste reduction requires an understanding of the socio-economic (contextual and behavioural, Finland (Koivupuro et al., 2012), and Taiwan (Teng et al., 2021). However, only a few studies related to household food waste and its determinants have been carried out in Indonesia, particularly in urban areas. From these considerations, it is necessary to carry out this research which aims to analyze household food waste based on the amount, type, and determinants of households in Tanah Sareal Sub-District of Bogor City. Knowing the amount and type of household food waste is one of important steps in reducing food waste. Meanwhile, exploring the determinants of household food waste is an effort to prevent the production of food waste by households.

## METHODS

This research entirely uses some secondary data from the study “Food Management Behavior

to Reduce Food Waste and Its Implications for Urban Household Food Security” by (Swamilaksita 2024) with a cross-sectional design as the research method. This study was held from December 2023 to February 2024 in Tanah Sareal Sub-District of Bogor City. The total sample in this study was 110 households. The sampling was carried out with stratified random sampling technique based on household income data in accordance with SNI guidelines. The inclusion criteria were housewives in age between 30 – 55 years old, willing to be involved in the research until its completion, in good health condition and able to answer the questions well, carry out conventional household management, have a refrigerator and categorized into medium income (S2) and low income (S3) households based on the UMK Bogor City 2024 towards total household income. The terms S2 and S3 are about waste sampling based on household income as stated in SNI 19-3964-1994.

The variable data of this study consisted of household characteristic (demography, education, occupation, and income), food management behavior (planning, purchasing and spending, storage, processing and consumption), and food waste (amount and type). Data on household characteristic and food management behavior were obtained by interviews using questionnaires, while food waste data was obtained by direct measurement using the collective buckets and digital kitchen scale set with an accuracy of 1 g under a capacity of 5 – 10 kg. The food waste collected is leftover food from household which still suitable for consumption (edible food waste) but thrown away in the trash for various reasons.

Demographic variable consisted of age and the number of household members; age consists of the age of father and mother which is categorized into < 40 years and  $\geq$  40 years while the number of household members consists of father, mother, children, and other members of the family, then categorized into small family ( $\leq$  4 individuals), medium family (5–7 individuals), and large family ( $\geq$  8 individuals). The education variable consisted of the education level of the father and mother seen from the length of completion time of their formal education then categorized into not attending school, not completing elementary school (SD)/equivalent, elementary school (SD)/

equivalent, junior high school (SMP)/equivalent, senior high school (SMA)/equivalent, and higher education level (D1, D2, D3 and S1/equivalent). The occupation variable consisted of the job of father and mother which is categorized into unemployed, laborer, entrepreneur, civil servant/private employee, and others for father occupation; housewife, domestic workers, entrepreneur, civil servant/private employee, and others for mother occupation. The income variable was obtained from the total income of all household members and then categorized based on city minimum wage (UMK) Bogor City 2024 and classified as low household income (<IDR.4,813,988) and medium household income ( $\geq$ IDR.4,813,988). In this study, there were only two categories for household income because it refers to the inclusion criteria used and follows the setting of primary research conducted by Swamilaksita (2024).

The food management behavior variable is shown within a five-dimensional variable (planning, purchasing and spending, storage, processing and consumption). These behavioral dimensions were assessed by a Likert scale. The total score for each food management behavior is categorized according to the data distribution (a good category if the total score is above the average value and a poor category if the total score is below the average value). Food waste amount was obtained from weighing and direct measurement for 8 consecutive days by using SNI 19-3964-1994 guidelines to seek the average amount of the total food waste per capita (g/cap/day) and per household (g/HH/day) with the calculation formula to find the average amount of food waste per capita presented below (BSN, 1994):

$$\frac{Bs}{u} = \frac{\left(\frac{Bs1}{u} + \frac{Bs2}{u} + \dots + \frac{BsK}{u}\right)}{K} \text{ g/cap/day} = \quad (1)$$

Where :

Bs = weight of food waste measured (grams)

u = number of waste producing units (capita)

K = number of households (110 HHs)

Another equation for calculating the average amount of the total food waste per household is:

$$Bs = \frac{(Bs1 + Bs2 + \dots + BsK)}{K} \text{ g/HH/day} = \quad (2)$$

Where :

Bs = weight of food waste measured (grams)

K = number of households (110 HHs)

The type of food waste was obtained from food waste sorting based on the 12 food groups in Household Dietary Diversity Score (HDDS) and then weighed per each food group (Kennedy et al., 2013). After the weighing is complete, the amount of food waste data taken based on food groups will be processed into the calculation of the amount of food waste per food group in accordance with SNI guidelines with the following formula :

$$Kp = \left(\frac{Bklpangan1 + \dots + BklpanganK}{K}\right) \text{ g/HH/day} = \quad (3)$$

Where :

Kp = food group measured

Bklpangan = weight of food waste per food group measured (grams)

K = number of households (110 HHs)

All variables in this study were put into descriptive analysis by employing SPSS software version 25 for Windows to identify household characteristic, food management behavior, and food waste in the household, whereas the determinants of household food waste were analyzed by multiple linear regression analysis. There is a multiple linear regression equation based on 19 independent variables consisting of household characteristic (age of the father and mother, number of household members, education length of the mother and father, total household income, occupational data of the father: unemployed /laborer/entrepreneur/civil servant and or private employee, and mother: housewife/domestic worker/ entrepreneur/civil servant and or private employee) and food management behavior (planning, purchasing and spending, storage, processing and consumption). The multiple linear regression equation for this study is presented as follows:

$$Y = \beta_0 + \beta_1 X_1 + \dots + \beta_{19} X_{19} + \varepsilon \quad (4)$$

Where :

Y = average amount of total food waste for 8 days (g/cap/day)

$\beta_0$  = intercept

$\beta_1$ – $\beta_{19}$  = regression coefficients

$X_1 - X_{19}$  = independent variable  
 $\epsilon$  = error, where the error has a normal distribution with 0 mean value and quadratic sigma variety

Multiple linear regression analysis was applied by SPSS 25 for Windows with the stepwise method. Researcher also carried out classic assumption tests such as the normality, multicollinearity, and homoscedasticity test to fulfill several assumptions in using the multiple linear regression analysis. Although the household food waste data used in the multiple linear regression test was not normally distributed with positive skewness, errors around the mean value are considered normal based on the central limit theorem (CLT).

## RESULTS AND DISCUSSIONS

### Household Characteristic

The household characteristics observed in this study were demographic data (age of the parents and number of household members), education level of the parents, household income, and occupation of the parents.

**Table 1.** Household characteristic in Tanah Sareal Sub-District of Bogor City

Household Characteristic	n (%)
<b>Father Age (years)</b>	
0 year	8 (7.3)
<40 years	43 (39.1)
≥40 years	59 (53.6)
Mean ± SD	38.2 ± 12.9
<b>Mother Age (years)</b>	
<40 years	69 (62.7)
≥ 40 years	41 (37.3)
Mean ± SD	38.2 ± 6.7
<b>Number of Household Members (individuals)</b>	
Small family	63 (57.3)
Medium family	44 (40)
Large family	3 (2.7)
Mean ± SD	4.4 ± 1.2
<b>Household Income (IDR/month)</b>	
< IDR 4.813.988 (<UMK)	66 (60)
IDR 4.813.988 (UMK)	44 (40)
Mean ± SD	3.731.186 ± 1.211.076

Household Characteristic	n (%)
<b>Father Education</b>	
Not attending school	8 (7.3)
Not completing elementary school (SD)/equivalent	1 (0.9)
Elementary school (SD)/equivalent	14 (12.7)
Junior high school (SMP)/equivalent	15 (13.6)
Senior high school (SMA)/equivalent	58 (52.7)
College/university	
D1	1 (0.9)
D2	0 (0)
D3	2 (1.8)
S1/equivalent	11 (10)
Mean ± SD	10.4 ± 4.0
<b>Mother Education</b>	
Not attending school	0 (0)
Not completing elementary school (SD)/equivalent	2 (1.8)
Elementary school (SD)/ equivalent	11 (10)
Junior high school (SMP)/equivalent	28 (25.5)
Senior high school (SMA)/equivalent	51 (46.4)
College/university	
D1	0 (0)
D2	1 (0.9)
D3	6 (5.5)
S1/equivalent	11 (10)
Mean ± SD	10.9 ± 3.2
<b>Father Occupation</b>	
Unemployed	8 (7.3)
Laborer	38 (34.5)
Entrepreneur	13 (11.8)
Civil servant/private employee	34 (30.9)
Others	17 (15.5)
<b>Mother Occupation</b>	
Housewife	87 (79.1)
Domestic worker	4 (3.6)
Entrepreneur	11 (10)
Civil servant/private employee	6 (5.5)
Others	2 (1.8)

Table 1 shows the household sample of this study had an average age of parents between 30–40 years old with most fathers aged ≥40 years (53.6%) and most mothers aged <40 years (62.7%). In this table also shows a 0 year result in the father age (years) which is because there are 8 households that do not have a father or husband so there is no data regarding the father age.

Most of the households fell into category of small family which has less than four family members in one household (57.3%), and the average household income in this study was IDR.3.7 million with majority households fell into category of household income below UMK (60%). The education level of parents was mostly found



at senior high school (SMA)/equivalent level for the fathers (52.7%) and the mothers (46.4%) with an average years of formal education completion of 10 years for both. In parents occupation, most fathers work as laborers (34.5 %) and most mothers work as housewives (79.1%) in this study.

### The Food Management Behavior in the Household

The food management behaviors observed in this study were behavioral data related to planning, purchasing and spending, storage, processing, and consumption behavior. Table 2 shows most of the food management behavior by household falls into the good category behavior as shown in the value of purchasing and spending behavior (55.5%), storage behavior (58.2 %), and processing behavior (54.5%). Only two food management behaviors tend to fall into the poor category behavior as shown in the value of planning behavior (52.7%) and consumption behavior (50.9%).

**Table 2.** The food management behavior in the household of Tanah Sareal Sub-District, Bogor City

Food Management Behavior	n (%)
<b>Planning Behavior</b>	
Poor	58 (52.7)
Good	52 (47.3)
<b>Purchasing and Spending Behavior</b>	
Poor	49 (44.5)
Good	61 (55.5)
<b>Storage Behavior</b>	
Poor	46 (41.8)
Good	64 (58.2)
<b>Processing Behavior</b>	
Poor	50 (45.5)
Good	60 (54.5)
<b>Consumption Behavior</b>	
Poor	56 (50.9)
Good	54 (49.1)

In terms of food planning behavior, most households were only occasionally planning food menus regularly as indicated by the habit of deciding on choosing a food menu when it is time to cook so this is done without planning in prior time. This finding is in line with a study conducted in Turkey that reported half of the households (56.7%) determine the type of food that will be cooked at the moment on the cooking day (Bozdağ

& Çakiroğlu, 2021). Besides that, households also never making a shopping list as one of the planning behaviors. Households that do not make that list mostly were low income households. This is similar with study in Pakistan which show that most households with high income always make shopping list (19%) compared to low income households (12%) (Khalid et al., 2023).

An unplanned meal menu (without prior planning) and not making shopping list can have a negative impact on the production of household food waste. An absence of those behaviors can increase the exposure of excessive and unplanned shopping behavior from consumers (Bravi et al., 2020; Stancu et al., 2016). Purchasing so many varieties of ingredients or too much food will lead to too much cooking which will contribute to food waste (Bravi et al., 2019). Therefore, planning behaviors such as meal menu planning ahead of time and creating a shopping list can limit and decrease food waste (Principato, 2018).

Meanwhile, the consumption behavior classified as deficient is shown by several households that are unaware or do not know their household food portions which cause discrepancies in the food portion implementation within their households. The same finding is found from a study conducted on households in Croatia that stated the main reason for food waste in households was the family members did not eat according to their portions (Ilakovac et al., 2018).

There is a role, a good provider makes the parents especially the mother tend to act as a good mother who shows love for her family by her act in purchasing a variety of foods that are considered as healthy and nutritious food in excessive amounts leads to excessive food preparation, and parents cook more often and serve more food than necessities or appropriate consumption portions for their household members, especially for the children (Porpino et al., 2015). Too large portions served on a plate will make someone unfinished the food on their plate (plate waste). Although the leftover meal is still fit for consumption, eventually it will be thrown away as a result of too much food being cooked, prepared, and served rather than consumed (Katajajuuri et al., 2014; Torode et al., 2023).

### The Amount and Type of Household Food Waste

Food waste is measured by the SNI 19-3964-1994 method. The average amount of total food waste in 110 households was weighed and calculated per household was 318.4 g/HH/day and per capita was 76.7 g/cap/day. The amount of food waste per household in this study is in line with the amount of household food waste in Cibinong sub-district of Bogor Regency (311.8 g/HH/day) (Diana, 2024) dan Norway (310 g/HH/day) (Hanssen et al., 2016). However, the amount of food waste found in this study was higher compared to a recent finding conducted in Canada (207.6 g/HH/day) (Everitt et al., 2022).

In terms of the amount of food waste per capita, the result of this study is similar to the household food waste amount in Southern Finland (around 63 – 77.8 g/cap/day) (Silvennoinen et al., 2022). Meanwhile, the amount of food waste per capita calculated in this study is found lower than the result of a recent food waste study conducted on households in the United Kingdom (191.8 g/cap/day) (Torode et al., 2023).

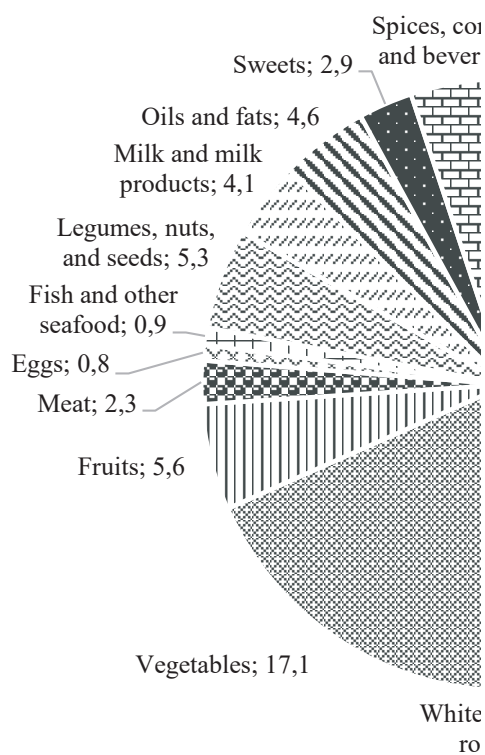
Not only calculating the overall amount of food waste, there is also the amount of food waste calculated based on the 12 food groups. Table 3 shows the cereal group (154.5 g/HH/day) is the type of food group which mostly thrown away by all households, followed by the vegetable (54.4 g/HH/day) and fruit group (17.9 g/HH/day).

**Table 3.** The average amount of food waste based on food group

Food Group	Mean ± SD (g/HH/day)
Cereals	154.5 ± 150.1
White tubers and roots	8.8 ± 18.2
Vegetables	54.4 ± 50.3
Fruits	17.9 ± 46.7
Meat	7.3 ± 11.5
Eggs	2.6 ± 7.9
Fish and other seafood	2.9 ± 5.0
Legumes, nuts, and seeds	17.0 ± 20.3
Milk and milk products	13.0 ± 24.7
Oils and fats	14.8 ± 36.0
Sweets	9.1 ± 17.5
Spices, condiments, and beverages	16.2 ± 47.3
<b>Total</b>	<b>318.4 ± 225.4</b>

These results are in line with a study of food waste in urban households showed that cereals are the food group most often thrown away by households (67.8 kg/HH/year) with the kind of cereals that most wasted is rice (Diana, 2024). Figure 1 shows the proportion of food waste based on food groups. Almost half of the food waste thrown away by households comes from the cereal group (48.5%). This group is the staple food of Indonesians, where it comes mostly from grain commodities and contributes the most to the amount of food waste in Indonesia (44.3%) (Bappenas, 2021). Apart from cereal, other food groups that are mostly thrown away or discarded are vegetables (17.1%) and fruits (5.6%).

A study from China also showed that the largest component of food waste came from cereal products (rice, pasta, and bread). The most wasted food group after cereal products are fruits and vegetables (Zhang et al., 2018). In support of this explanation, similar findings on the household food waste composition were also confirmed by previous research conducted in Israel which showed that vegetables and fruits were the most dominant food being discarded by the households (Elimelech et al., 2018).



**Figure 1.** Proportion of the amount of food waste based on food groups (%)

Cereals, vegetables, and fruits are the food groups most consumed by the Indonesian people, including the people in Tanah Sareal District, Bogor City, West Java Province. This is indicated by the consumption of rice exceeding the recommendation (PPH score 58.9%), while the consumption of vegetables and fruits has reached the ideal composition in West Java Province (PPH score 6.1%) (Bapanas, 2024). Indonesian household consumption which is rich in carbohydrate staple foods (cereals) and the high consumption of vegetables and fruits by the community is in line with the large amount of food waste produced from these food groups (Bappenas, 2021).

### Determinants of Household Food Waste

This research also analyzes determinants or influential factors to the average amount of total household food waste. There were 19 factors or independent variables analyzed in this study. Overall, of the 19 variables, only three variables were proven to have a significant influence on the overall average amount of household food waste as presented in Table 4.

Table 4 shows the R<sup>2</sup> value (coefficient of determination) of the model as stated to be 0.150, which indicates only 15% of the variability in household food waste is explained by the independent variables. The rest (85%) is unexplained. Table 4 also shows the p-value of each variable which is included in the final regression model. Three variables were proven to be statistically significant with p<0.1, listed as the number of household members (p=0.000), the mother occupation as a civil servant/private employee (p=0.049), and purchasing and spending behavior (p=0.084). Whereas the regression equation model based on household characteristic and food management behavior variables included in the final regression model is:

$$Y = 71.905 - 17.988X_3 - 47.322X_{14} + 1.494X_{16}$$

The regression equation shows a constant value of 71.905, meaning if there were no value in variables of the number of household members, mother occupation (civil servant/private employee), and purchasing and spending behavior,

the average amount of total household food waste will be 71.905 g/cap/day. The regression coefficient values for the number of household members (X<sub>3</sub>) is 17.988, the mother occupation (civil servant/private employee) (X<sub>14</sub>) is 47.322 and the purchasing and spending behavior (X<sub>16</sub>) is 1.494 indicating that each additional value, the average amount of total household food waste will increase or decrease according to the coefficient values of these variables within the regression equation. The result of the regression equation showed the number of household members has a negative correlation to the average amount of total household food waste.

**Table 4.** Determinants of household food waste

Variable	B	SE	Sig.
<i>Intercept</i>	71,905	51,109	0.162
Number of household members (X <sub>3</sub> )	-17,988	4,636	0.000**
Mother occupation (civil servant/private employee) (X <sub>14</sub> )	-47,322	23,714	0.049**
Purchasing and spending behavior (X <sub>16</sub> )	1,494	0,856	0.084*
R <sup>2</sup>	0.150		

\* Multiple linear regression test, statistically significant at the 10% level, \*\*statistically significant at the 5% level

The more household members the less average amount of food waste produced by the household. This statement is in line with a study conducted by Giordano et al., which showed that households with one member (single household) throw away more food waste (713.7 g/cap/week) when compared to households consisting of four or more family members (424.5 g/cap/week) (Giordano et al., 2019). In general, the amount of food waste for households with a large number of members is less than a single household or a household of a couple without children while considering the amount per capita (Giordano et al., 2019; Koivupuro et al., 2012).

Mother occupation as a civil servant/private employee also has a negative correlation to the average amount of total household food waste. The more mothers who work as civil servants/private employees, the less the average amount of food waste produced in the household. In line with results of a study conducted on UK households,

namely that 45% of high food wasters, one of whom was unemployed parents (Lyndhurst et al., 2007). Based on direct observations in the field, mothers who work in an office tend to cook less large portions of meals than mothers who do not work since they only have limited time and energy to process food due to excessive workload. Not excessive meal portions are the cause of less leftover food to be wasted as food waste.

Meanwhile, the purchasing and spending behavior variable has a positive correlation with the average amount of total household food waste. The more purchasing and spending behavior as indicated by higher score behavior, the greater the average amount of household food waste produced. Housewives spend much money on food and often buy healthy but perishable foodstuff (including meat and poultry, vegetables and fruits). High household expenditure on food tends to make many households throw away more food (Hermanussen et al., 2022; Visschers et al., 2016). The excessive purchases of food ingredients also the excessive supply of foodstuffs that are not durable and have a short shelf life will increase the risk of food waste because these foodstuffs will easily damage due to improper storage, prepared and served in too large quantities but eventually not consumed, and not been used correctly (Silvennoinen et al., 2014).

## CONCLUSION

The average amount of total food waste from 110 households in unit per household and per capita was found to be 318.4 g/HH/day and 76.7 g/cap/day. The cereal group (154.5 g/HH/day) is the most food group thrown away by households. There are three factors or determinants of household food waste ( $R^2 = 0.150$ ): (a) number of household members, (b) mother occupation as a civil servant/private employee, and (c) purchasing and spending behavior.

It is necessary to execute education such as campaigns and direct assistance to households in improving the household knowledge regarding food waste and ways to reduce it, especially in the type of food groups that are most often thrown away. Apart from that, there is also a need to assist housewives such as assistance or guidance for making shopping lists and checking food supplies

before shopping so they do not pursue excessive purchasing behavior and spending too much on food. This research does not include food waste in the form of liquid such as soup or gravy, so it requires further research to examine these aspects.

## ACKNOWLEDGEMENT

The author gives sincere gratitude to Prita Dhyani Swamilaksana, S.P., M.Si., for her willingness to provide data from the result of dissertation research to be secondary data of this research. This research is part of a thesis entitled “Household Food Waste Estimation Model in Tanah Sareal District, Bogor City”.

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