HOUSEHOLDS' ECONOMIC LOSSES DUE TO FOOD WASTE: A CASE STUDY IN THE HOUSEHOLDS AT BOGOR REGENCY, WEST JAVA, INDONESIA

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ABSTRACT

Food waste is one of the global agricultural problems that occur in various regions of both developed and developing countries. Food waste affects the fulfillment of food and nutrition needs of the community. This study sought (1) to describe the condition of household food consumption, (2) to compute the amount of food waste, and (3) to estimate the economic loses due to food waste at the household level. The determination of household samples and collection of food waste was carried out using the method specified in SNI number 19-3964-1994, while determination of the value of economic losses is based on the cost of wasted food method. The results showed that high-income households tended to allocate more income for non-food expenditures, whereas middle- and low-income households prioritized their income for food. Rice, vegetabless, and poultry are the most frequently consumed food groups, while red meat is the food group that is rarely consumed by middle- and low-income households. The highest food waste occurs in the middle-income household group, while the lowest food waste occurs in the hohg-income household group. The value of economic losses incurred due to food waste was the highest for middle-income households and the lowest is for low-income households.

Key words: household consumption, food expenditure, food waste, economic loss

INTRODUCTION

The problem of food loss and waste has an important role in the efforts of reducing hunger and increasing income and food security, especially in developing countries. Food loss and waste (FLW) is becoming an increasingly important topic in development programs. In fact, the UN has included the FLW issue in its Sustainable Development Goals target 12.3, which aims to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" by 2030 (FAO2019). FAOIFAD, UNICEF, WFP and WHO (2017) stated that food is lost or wasted along the food supply chain (FSC), from the agricultural production stage to household consumption. Food loss and waste (FLW) is defined as a decrease in the quantity or quality of edible food that is intended for human consumption (FAO 2011 and 2019). Food loss and food waste are two different terms. Food loss is caused mainly by the malfunctioning of the food production and supply system or its institutional and policy framework, which could be due to managerial and technical limitations (FAO 2011 and 2019). Food waste refers to the removal from the food supply chain of food which is still fit for human consumption. Food waste typically but not exclusively happens at the retail and consumer levels whereas food loss takes place at the earlier stages of the food supply chain – during production, post-harvest and processing stages.

In middle- and high-income countries, most food is wasted at the consumption stage; although significant food losses also occur early in the food supply chain. In low-income countries most of the food is lost in the early and middle stages of the food supply chain; while the food wasted at the consumer level is slightly lower (FAO 2011). Approximately one-third of the food produced for human consumption is lost or wasted globally, which amounts to 1.3 billion tons per year (FAO 2011). The amount of resources used in agricultural production is wasted and causes greenhouse gas emissions. The amount of FLW represents a tremendous quantity of wasted land resources i.e., 1.4 billion hectares of agricultural land (FAO 2015) or equivalent to 30 percent of the world's agricultural land area (FAO 2013). The market value associated with FLW was estimated at USD 936 billion in 2012, which is slightly larger than the GDP of Indonesia or the Netherlands for the same year (FAO 2015).

Fulfilling food needs is the main basic need for every human being. Unfortunately, not all residents can meet their food needs. The problem of fulfilling this food need will be even more severe with the increasing FLW. Galanakis (2015) states that based on global estimates from The State of Food Insecurity in the world, approximately 805 million people were chronically malnourished between 2012 and 2014. More recent data revealed by FAO, IFAD, UNICEF, WFP and WHO (2017) which stated that in 2016 around 815 million people in the world were still in a state of hunger.

The need for food in Indonesia increases continuously. The government makes efforts to meet food needs by increasing production, but these efforts have encountered several obstacles. The difficulty in increasing agricultural production to meet the food and nutrition needs of the community is actually exacerbated by the waste of food in the community. The World Resources Institute states that food waste at the consumer level occupies the highest position in food waste, which is 35 percent of the total food waste at each level of the food supply chain (WRI 2013). The Economist Intelligence Unit and the Barilla Center for Food and Nutrition Foundation (2016) stated that - based on the Food Sustainable Index (FSI) - Indonesia is a developing country that produces as much as 300 kg of food waste per person per year. This shows that Indonesia is a country with the second largest food waste in the world after Saudi Arabia. Based on this figure, Indonesia is considered incapable of dealing with the problem of food waste. In 2016 FSI Indonesia is ranked 21st out of 25 countries with a score of 32.53. FSI measures the sustainability of food systems across three categories: food loss and waste, sustainable agriculture and nutritional challenges.

Data from the National Waste Management Information System (*Sistem Informasi Pengelolaan Sampah Nasional* or SIPSN) of the Ministry of Environment and Forestry (Kementerian Lingkungan Hidup dan Kehutanan 2017) indicated that households are the largest waste producer, amounting to 48 percent of the total waste generation. As much as 60 percent of total household waste is food scraps. Households as the largest producer of organic waste in the form of food scraps directly affect the level of food waste which has an impact on the fulfillment of food and nutrition problems, resulting in levels of hunger, malnutrition and economic losses. If food waste can be reduced by 25 percent, rice consumption in Indonesia can be increased by 4.1 kg per capita so that food security can be guaranteed (Kariyasa and Suryana 2012).

In addition to the macro indicator as stated by the above two reports, food waste can be viewed at lower level i.e., locations where food waste occurs, such as household, schools, office, restaurant, commercial and industrial area, and others. However, food waste reports at lower level in Indonesia are relatively limited. A survey of food waste at household level in Sidoarjo regency, East Java Province, showed that rice waste reached 108.47 gr/capita/month (equivalent to 650.82 gram/household/month) which implied an average IDR 7,809 (equivalent to USD 0.56; assuming USD 1.00 = IDR 14,000) financial loss per household per month (Nafiroh and Fuad 2019). Research food waste (particularly rice) at 32 ethnic restaurants and tend stalls (including Sunda, Padang and Java) revealed that Sundanese restaurants had the highest rice loss i.e., 2.02 kg of rice per week (Anriany and Martianto 2013).

Reports on food waste in Indonesia are still relatively limited and show ambiguity, as presented above, where the macro indicator shows a relatively high level of food waste, while based on micro indicators it shows relatively low food waste that occurs. Therefore, this study tried to look more deeply at the level of food waste in the households. This is very important considering that Indonesia has more than 50 million households. The specific objectives of this study are (1) to describe the condition of household food consumption, (2) to compute the amount of food waste at the household level, and (3) to estimate the economic loses due to food waste at the household level.

METHODOLOGY

Location and time. The research was carried out in housing around the Darmaga Campus of IPB (Bogor Agricultural University), which include Darmaga and Ciampea districts, Bogor Regency. The research location was determined deliberately based on the consideration that these two districts have relatively large number of population, most of the students and administrative staffs of IPB stay in these areas, and households around the IPB Darmaga Campus are relatively diverse. Heterogenous characteristics of the households are important to be considered since different income and lifestyle will produce different food consumption patterns, and may imply different food waste. Based on these heterogeneity conditions, the households are divided into three groups, namely: high-, middle-, and low-income households. Sampling of the respondents for the three household groups was carried out in three separate locations, namely Darmaga Cantik Housing (*Perumahan DC*) for high-income households, *Taman Darmaga Permai* Housing (*Perumahan TDP*) for middle-income households, and Babakan Village for low-income households. *Perumahan* DC and Desa Babakan are in Darmaga district, while *Perumahan* TDP is in Ciampea district. The research was conducted from November 2019 to January 2020.

Sampling method. The sampling method used in this study is guided by the Indonesian National Standard (*Standar Nasional Indonesia* or SNI) number 19-3964-1994 (*Badan Standarisasi Nasional* or National Standardization Agency 2019) regarding the sampling methods for collection and measurement of municipal (urban) waste which has been adjusted to the location of the study. Based on this national standard, the number of household samples are determined by using the following formulas:

$$K = \frac{S}{N} \quad and \quad S = C_d\sqrt{P_s} \qquad (1)$$

where K = number of household respondents, S = size of samples (in persons), N = number of household size (5 persons), Cd = coefficient for region (large city = 1.0, mid city =0.5), and Ps = number of population (in persons).

With a total district population of 112,437 people and with a moderate urban housing coefficient of 0.5 (mid city), and assuming that a household consists of 5 persons, the number of household sample is:

$$S = 0.5\sqrt{112,437} = 167.66 \approx 168 \; persons$$

$$and \quad K = {168}/{5} = 33.6 \approx 34 \; households$$

Based on this calculation, the total number of household samples to be taken is 34 households. The number of each household respondents for the high-, middle-, and low-income houses are 11, 12, and 11, respectively, with the assumption that there are more middle-income households than the other two household groups. The selection of respondents for high-, middle-, and low-income households is purposively determined by taking into account several factors, namely the area of the house, the physical

condition of the house, the housing environment, the appliances owned by the respondents, and the income level.

The data needed is the residual food generated in the sample households. The residual food is grouped into five categories, namely: rice, vegetabless, red meat, poultry, and fish. The food waste data from each sample household were collected for 8 consecutive days. These food waste data are then transformed into daily, weekly and then monthly data (assuming 30 days in a month). The number of household is relatively limited due to intensity of research in those days. The food waste from each sample household was measured using the following four steps: 1) distributing marked bags to each sample household; 2) collecting bags that have been filled with food waste; 3) sorting out the existing food waste based on the five food categories; 4) weighing and recording the weight of leftover food from each food group. Equipment used in weighing food waste included bags for the food waste, scales, boxes with a size of 14 cm × 14 cm × 20 cm, gloves, and shovels.

Types of data. The data used in this study are primary data which is related to the characteristics of the respondent, the conditions of household food consumption, and food waste generation. Primary data was obtained from the direct interviews with 34 respondents using a questionnaire.

Data analysis

Household consumption conditions. Analysis of household food consumption condition used descriptive analysis method which explains the general description of household food consumption. The things identified are food expenditure, frequency of cooking food, and quantity of food cooked, as well as conditions of household consumption.

Estimated weight of food waste. Estimates of the amount of food waste in households were analyzed using the approach of Djekic et al. (2019). The food waste gathered from the sampled household was first separated into five food groups (rice, vegetabless, red meat, poultry and fish) and then weighted. The weight of food waste is in the form of wet (cooked) weight. The wet weight is then transformed into the raw weight. According to the Ministry of Health (*Kementerian Kesehatan RI, 2014*), raw weight is obtained by multiplying the cooked weight by the conversion factor. The conversion factor used for rice was 0.4 (Ministry of Health RI, 2014), vegetabless was 0.8 (FAO 2011), red meat and poultry were 1.23, while fish was 1.25 (Bowman et al. 2011). The calculation of the raw weight was estimated using equation (2):

$$QW_j = \sum_{i=1}^{5} F_{ij} \ W_{ij} \tag{2}$$

where QW_j = total weight of food waste from each household in j category (gram/week), F_{ij} = frequency of wasting food for each food and household groups (times/week), W_{ij} = weight of food waste for each category of food and household, i = category of food (rice, vegetabless, red meat, poultry and fish), and j = type of household (high-, middle-, and low-income households).

Estimated economic value of food waste. The economic value of losses from food waste in households was analyzed using the cost of wasted food method. The calculation of this loss value uses food prices at the household level. The determination of the value of the losses is based on three household groups, namely high-, middle-, and low-income households. The economic value of the losses from food waste in each household group is obtained from the following formula (adapted from Nahman et al. 2012):

$$TEL_j = \sum_{i=1}^{5} WAP_i \ W_{ij} \tag{3}$$

where TEL$_j$ = total economic losses due to food waste to household in the category j (rupiah or IDR per month), WAP$_i$ = weighted average price i.e., average price of food in the category i at consumer level (IDR per kg), i = category of food (rice, vegetabless, red meat, poultry and fish), j = category of household (high-, middle-, and low-income households).

The price for the rice group uses the average price at the consumer level according to the West Java Food Price Information Portal (*Priangan*) in the FKPI (2019), which is IDR 10,483 per kg or IDR 10.48 per gram, while the price used to assess economic losses for group of vegetabless, red meat, poultry, and fish using the WAP of the food group that is often consumed by the public. The types of vegetabless and fish taken were based on the five types of vegetabless and fish which had the highest percentage of consumption by households. Based on BPS (2019), the five types of vegetabless that have the highest percentage of consumption are kangkung, eggplant, spinach, long beans, and cabbage; whereas for the types of fish that are mostly consumed by households are tuna, tilapia, catfish, mackerel and milkfish. The WAP calculation for each food group is presented in Table 1. Based on the WAP calculation, the price used to estimate the loss value for the vegetables group is IDR 7.30 per gram, red meat group is IDR 113.40 per gram, the poultry group is IDR 40.08 per gram, and the fish group of IDR 25.15 per gram.

Table 1. Determination of food price by category of food

No	Food category	Percentage of consumption (%)	Price (Rp)	WAP (IDR/kg)	WAP (IDR/gram)
1	Vegetables				
	Kangkung	0.25	6,372*	1,593	
	Eggplant	0.23	7,289*	1,699	
	Spinach	0.21	7,243*	1,542	
	Long beans	0.18	8,869*	1,618	
	Cabbage	0.12	7,010*	853	
	Total			7,304	7.30
2	Red meat				
	Beef	0.80	114,655	91,724	
	Lamb	0.20	108,403*	21,681	
	Total			113,405	113.40
3	Poultry				
	Broiler meat	0.79	35,068	27,911	
	Chicken meat	0.20	59,648	12,173	
	Total			40,084	40.08
4	Fish				
	Tuna	0.34	22,168	7,569	
	Tilapia	0.18	27,164	4,969	
	Catfish	0.16	20,483	3,372	
	Mackerel	0.15	39,400	5,766	
	Milkfish	0.16	21,113	3,476	
	Total (IDR)			25,152	25.15
	Total (USD)			1.80	0.002

Note: *projected data
Source: BPS (2019), FKPI Jawa Barat (2019), and Kementerian Pertanian RI (2019)

RESULTS AND DISCUSSION

Conditions of household food consumption. The condition of food consumption by households illustrates how the pattern of food consumption by households. Based on the analysis, there are

differences in the conditions of food consumption in each household group. Several things analyzed are related to the condition of household food consumption, including household expenditure, and frequency and quantity of food cooking.

   1) Household food consumption. The amount of household expenditure reflects the level of household economic welfare. The survey results indicated that the highest percentage of monthly food expenditure is low-income households (61.20%), followed by middle-income households (58.13%) and high-income households (35.50%) – relative to the total household expenditure (Table 2). Statistical test indicated that food consumption expenditures between high-income and low-income households are significantly different. However, food expenditures between high-income and middle-income households, and between middle-income and low-income households are not significantly different.

   Side dishes (including fish and meat) are the food groups that have the highest percentage of food expenditure among the three household groups. The high expenditure of the side dishes is in line with the results of the National Socio-Economic Survey (Susenas) in March 2019 (BPS 2019), which shows that the percentage of household expenditure on side dishes is in the third place out of thirteen per capita household expenditure groups, with the first rank namely food and beverage. Based on the Food Security Agency (*Badan Ketahanan Pangan*, 2019), in the 2015 to 2019 period, communities' consumption of side dishes experienced an increasing trend.

   The proportion of non-food expenditures for high-, middle-, and low-income households are 64.5%, 58.13%, and 38.80%, respectively (Table 2). Statistically, non-food consumption expenditures between middle-income and low-income households, and between high-income and low-income households are significantly different. However, non-food expenditures between high-income and middle-income households are insignificantly different. Electricity, water and fuel are the non-food group with the highest percentage of expenditure in the three household groups. These products are one of important components of households' daily activities. In addition, electricity, water and fuel expenditures were quite high due to inflation in West Java in December 2019 which reached 3.21 percent[1]. The results of the March 2019 Susenas in BPS (2019) also show that most of the percentage of non-food household expenditure is dominated by 50.11 percent for consumption of housing needs and household facilities, which includes expenditures on water and household energy needs.

   The percentage of food and non-food expenditures are in accordance with Engel's Law which states that the proportion of total expenditure devoted to food decreases when households' income increases (Nicholson 1995). Demand for food will increase more slowly than non-food demand as household income increases. The same thing was also conveyed by BPS (2016) which stated that as a person's income increases, there will be changes in spending patterns, where the percentage of income spent on food will decrease and the percentage of non-food expenditure will increase.

   2)   Frequency and quantity of household food cooking. The survey results show that there are differences in cooking frequency and quantity in each household group (Table 3). The rice group has the highest cooking frequency and quantity compared to other types of food in the three household groups. This is due to the fact that rice is the staple food consumed by the community every day, so that households are sure to cook rice every day. The quantity of rice cooked by high-income households is less than the middle- and low-income households, due to the awareness and knowledge of high-income households regarding the diversification of basic food sources, where the source of carbohydrates is not only from rice but also obtained from other foodstuffs (corn, wheat flour, potatoes, and cassava). The reason for the high quantity of cooked rice in the middle- and low-income household groups is due to a

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[1] Pemerintah Provinsi Jawa Barat, "Inflasi Jawa Barat 2019 Capai 3,21 Persen" (http://jabarprov.go.id/index.php/news/35899/2020/0103//Inflasi-Jawa-Barat-2019-capai-321-persen accessed at February 22, 2020)

culture or community habit in these two household groups that regard not eating rice during a meal as not eating at all, thus the quantity of cooked rice increases.

Table 2. Average and percentage of household expenditure based on commodity group and household status (IDR/household/month)

Commodity group	High income		Middle income		Low income	
	Average Expenses (IDR)	%	Average Expenses (IDR)	%	Average Expenses (IDR)	%
Food						
1. Rice	95,568	8.37	47,323	5.07	69,682	13.45
2. Vegetables	48,773	4.27	106,167	11.38	43,204	8.34
3. Side-dish	175,727	15.40	113,333	12.15	128,830	24.87
4. Seasoning	26,341	2.31	26,229	2.81	35,636	6.88
5. Prepared food	37,727	3.30	86,771	9.30	25,273	4.88
6. Gas	21,159	1.85	10,771	1.15	14,409	2.78
Total food expenditure	**405,295**	**35.50**	**390,594**	**41.87**	**317,034**	**61.20**
Non Food						
7. Household appliances	36,477	3.19	66,583	7.14	36,091	6.97
8. Electricity, water and petrol	231,818	20.30	147,458	15.81	87,273	16.85
9. Health	95,454	8.36	8,437	0.90	2,773	0.54
10. Education	196,590	17.22	126,250	13.53	47,727	9.21
11. Cloth	63,636	5.57	28,354	3.04	20,341	3.93
12. Credit payment	112,500	9.85	165,208	17.71	6,818	1.32
Total non-food expenditure	**736,477**	**64.50**	**542,292**	**58.13**	**201,023**	**38.80**
Total (IDR)	1,141,773	100	932,885	100	518,057	100
Total (USD)	81.56		66.63		37.00	

Vegetabless have the second highest cooking frequency and quantity after rice. The average frequency and quantity of cooked vegetabless is highest in the middle-income household group. The high frequency and quantity of cooking vegetables in households is affected by several factors, including total food expenditure which significantly and positively affects household vegetables consumption (Hanifah et al. 2014; Aswatini et al. 2008; Jorissen et al. 2015). This is consistent with the results of this study, where the middle-income household has a higher percentage of expenditures on vegetabless than the low-income household group, so that the frequency and quantity of vegetables consumption is 11.38 percent higher. Red meat has the lowest average frequency and quantity compared to other food groups in the three household groups. The low consumption of red meat in low- and middle-income households is because red meat is considered to be a luxury food group due to its relatively expensive price, so people do not cook red meat too often. The frequency and quantity of poultry and fish were higher than red meat in all household groups as the prices of poultry and fish are relatively more affordable.

Table 3. Average frequency and quantity of cooking food according to food and household goups (per month)

Food group	High income		Middle income		Low income	
	Frequency	Quantity (kg)	Frequency	Quantity (kg)	Frequency	Quantity (kg)
Rice	30.00	10.77	32.83	22.14	25.09	22.25
Vegetables	26.18	5.69	28.42	15.79	23.82	8.52
Red meat	9.54	6.12	1.08	0.69	0.18	0.04
Poultry	15.64	9.36	8.83	4.42	5.27	1.64
Fish	11.18	5.72	10.33	4.62	3.36	1.42
Total	92.54	37.67	81.49	47.66	57.72	33.87

Economic value of household food waste. The survey results show that the total food waste in households, from the highest to the lowest, is middle-income household (6.64%), low-income household (5.73%), and high-income household (3.30%). Statistically, only high-income and middle-income households show significantly different food waste (Table 4).

Table 2 . The amount of food waste per household in each food group and household group.

Food group	Food cooked (kg/month)	QW_{ij}	F_{ij}	QFW_{ij} $(QW_{ij} \times F_{ij})$	QFW'_{ij}	Percentage (%)
		High-income households				
Rice	10.77	27.55	5.00	137.73	590.26	5.48
Vegetables	5.69	19.04	3.82	72.68	311.50	5.47
Red meat	6.12	12.79	1.27	16.28	69.76	1.14
Poultry	9.36	20.88	2.27	47.46	203.40	2.17
Fish	5.72	11.16	1.45	16.24	69.60	1.22
Total	37.67	91.42		290.39	1,244.52	3.30
		Middle-income households				
Rice	22.14	65.54	5.92	381.87	1,636.59	7.39
Vegetables	15.79	70.11	4.50	315.49	1,352.09	8.56
Red meat	0.69	5.47	0.83	4.56	19.54	2.84
Poultry	4.42	6.84	1.08	7.41	31.76	0.72
Fish	4.62	20.17	1.42	28.57	122.46	2.65
Total	47.66	168.13		737.90	3,162.44	6.64
		Low-income households				
Rice	22.25	62.95	5.45	343.34	1,471.45	6.61
Vegetables	8.52	40.36	2.45	99.07	424.60	4.98
Red meat	0.04	1.23	0.45	0.56	2.40	5.27
Poultry	1.64	8.93	0.72	6.50	27.84	1.70
Fish	1.42	4.56	0.82	3.73	15.99	1.13
Total	33.87	118.03		453.20	1,942.28	5.73

Note: QW = weight of food waste per day (gram); F = frequency of food waste per week (times)
QFW = weight of food waste per week (gram); QFW' = weight of food waste per month (gram)
i = food category (group); j = household category (group)

Each family member has a different behavior regarding food waste. Based on the results of this survey, about 85.29 percent of respondent households still have children who often waste food. Oftentimes children have unpredictable eating behavior. Children will refuse foreign food that has not been consumed 8 to 15 times before actually receiving it (Daniel 2016). Ilakovac et al. (2020) also argues that the number of children in the household has a positive relationship to food waste. Households with children tend to waste more food. The higher the number of children in the household, the higher the level of food waste (Tucker and Farrelly 2016; Schanes et al. 2018). The results of this study also show this kind of pattern. Since the percentage of the presence of children in middle-income households is the highest, it has a high potential for food waste.

About 76.47 percent of respondent households had a habit of not leaving food on the table since they were young and the rest have a habit of 'sometimes' or 'often' leaving food on the table (Fig. 1). Religion was the reason for not leaving food which accounts for 80.77 percent of households that are accustomed to not leaving food since childhood. People tend not to waste food because of their religious beliefs to value food (to avoid *mubazir*, an Islamic term which means wasting food). Religion can reduce the level of food waste because religion increases household sensitivity to food (Abdelradi 2017). Therefore, religious education needs to be instilled from an early age, so that consumers do not waste food.

Household income and education were social characteristics that could affect the level of food waste. This research shows that the food waste of middle-income household is higher than low-income household. The average income of the middle-income households is IDR 5,458,333 (USD 389.88) per month, while that of the low-income households is IDR 2,759,090 (USD 197.08) per month. This is consistent with the findings of Abeliotis et al. (2016) and Lusk and Ellison (2017) that showed households with higher incomes tend to waste food than households with lower incomes.

The average income in luxury households is higher than that of medium-income households, amounting to IDR 7,272,727 (USD 519.48) per month. However, the percentage of food waste in luxury households is lower than that of medium and simple households due to the level of education in luxury households which is higher than in simple households. The higher the level of education of an individual, the more responsive in preventing food waste (Abeliotis et al. 2016). Individuals who have taken tertiary education waste less food than individuals who have otherwise not done so.

Several reasons for food waste in the households, include: there is a part of the food that cannot be consumed, no one can consume food anymore so that the food is discarded, the food is stale, the taste of the food does not suit your taste, and others (Fig. 2). These results are similar to those of Tucker and Farrelly (2016) in which leftover and uneaten vegetables were usually the main reason for food waste. To reduce food waste in the household, improvements in three categories are needed: food technology and planning, packaging and storing, and information and awareness campaigns (Hebrok and Boks 2017)

Economic value of food waste. The results showed that the middle-income household experienced the highest economic loss compared to the high- and low-income households, namely IDR 33,602 per month. This is in line with the highest amount of food waste from middle-income households. Table 5 shows that the value of economic losses incurred by high-income households due to food waste is higher than low-income households (IDR 26,278 compared to IDR 20,316 per month), although the weight of food waste in high-income households is lower than that of low-income households. This is because the food waste in high-income households is more varied than that in low-income households, including waste of red meat and poultry. Red meat (beef and lamb) is very expensive, so this contributes to the high value of losses incurred by high-income households. This similar result was also reported by Amirudin et al. (2019), who determined that access to food related to food prices affects the level of food waste in households.
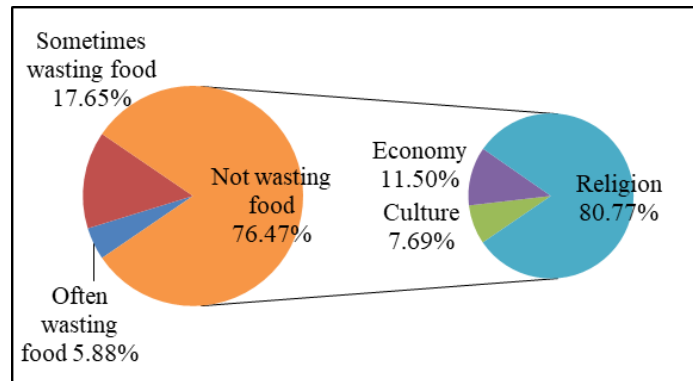
Fig. 1. Eating habits of the respondents
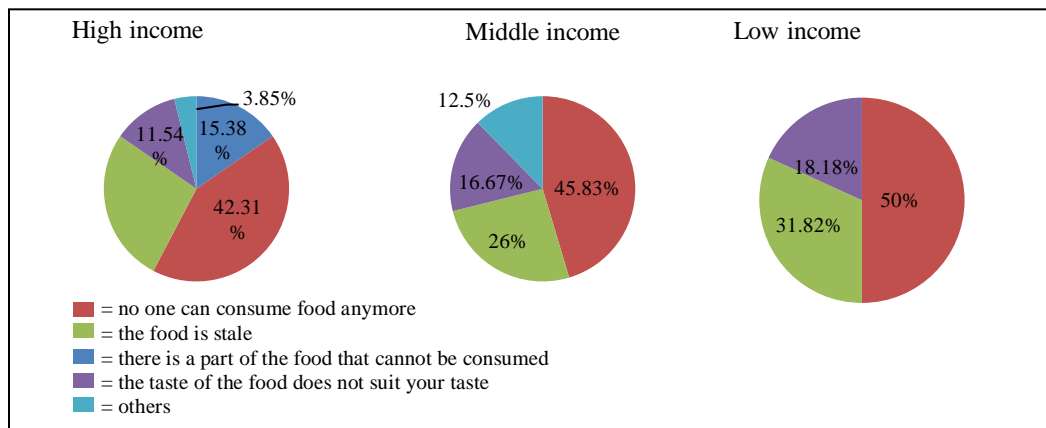

Fig. 2. Reasons for leaving food on the table according to household status (percent)

Table 3. Economic value of the monthly food waste per household according to the food group and household status (IDR/month)

Food Group	WAP_i (IDR/gram)	High income		Middle income		Low income	
		QW1	TEL1	QW2	TEL2	QW3	TEL3
Rice	10.48	590.26	6,188	1,636.59	17,156	1,471.45	15,425
Vegetables	7.30	311.50	2,275	1,352.09	9,876	424.60	3,101
Red meat	113.4	69.76	7,911	19.54	2,216	2.40	272
Poultry	40.08	203.40	8,153	31.76	1,273	27.84	1,116
Fish	25.15	69.60	1,750	122.46	3,080	15.99	402
Total		1,244.52	26,278	3,162.44	33,602	1,942.28	20,316
Total (USD)			1.88		2.40		1.45

Note: QW_j = weight of food waste at household group j (gram/month)

WAP_i = weighted average of price for foo group i (IDR/gram)

TEL_j = total economic loss of the household at group j due to food waste (IDR/month)

CONCLUSION AND RECOMMENDATION

Household food consumption conditions vary depending on the type of household. The allocation of household expenditures to meet food needs is still in accordance with Engel's Law, where high-income (luxury) households tend to allocate more of their income for non-food expenditures, while middle-income and low-income households allocate more of their income for food expenditure. Rice, vegetables, and poultry were the food groups most frequently consumed by the three household groups, while red meat was rarely consumed by middle- and low-income households. Based on the weight and percentage of food waste, the highest food waste occured in middle-income households; while the lowest food waste occured in high-income households. Rice is the food group with the highest percentage of waste in high- and low-income households, while vegetabless are the food group with the highest waste in middle-income households. The value of economic losses that occur due to food waste is borne highest by middle-income households followed by luxury and simple households.

Our findings indicated that the households are generally concerned and feel guilty about wasting food. The factors that influence the high food waste are minimal knowledge related to food waste, eating habits, and household food supply. Therefore, it is necessary to provide education/knowledge to housewives regarding food expenditure planning, adjustments between the frequency and quantity of food cooked with the number of household members. Most food wastage incidents were carried out by children. Therefore, the application of the value of respecting food and the habit of eating food needs to be practiced by children from an early age, especially through the media of religious education. Further research is expected to be able to analyze more deeply factors that cause food wasteful behavior, especially at the household level. In addition, an analysis of the impact of food waste on food security at a local or national scale needs to be carried out.

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