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Research Article

Understanding Household Cooked Rice Waste: A Comparative Study between Rural and Urban Areas in Pasuruan, Indonesia

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ABSTRACT

Household food consumption patterns exhibit variability, with households serving as prominent contributors to food waste generation, thereby leading to adverse economic ramifications. This study aims to calculate the amount of household cooked rice waste, calculate the economic value loss from household cooked rice waste, and analyze the factors that influence household cooked rice waste in rural and urban areas. The investigation was carried out in two distinct locales: Purwo, Sekarmojo, Purwosari, Pasuruan (representing rural areas) and Sebani, Gadingrejo, Pasuruan (representing urban areas). The weight of household cooked rice waste is computed utilizing the fDMM (Faktor Dalam Masak Mentah or Factor in Raw Food Cooking) methodology. Economic loss incurred due to household cooked rice waste is estimated by multiplying the prevailing rice price by the converted volume of rice waste. Multiple regression analysis is employed to discern the contributing factors to household cooked rice waste. Findings indicate a higher incidence of household cooked rice waste in rural settings compared to urban counterparts, consequently resulting in greater economic repercussions. In Sekarmojo, household cooked rice waste is affected by several factors, including the quantity of rice cooked, household income, family size, and frequency of rice consumption. Likewise, in Sebani, household cooked rice waste is affected by variables such as the quantity of rice cooked, household size, frequency of rice consumption, and the utilization of mobile phones for food procurement.

INTRODUCTION

Population growth exerts multifaceted impacts encompassing food security and the proliferation of food waste (Mokrane et al., 2023; Vittuari et al., 2019). Globally, food waste has emerged as a paramount concern within the international community's purview (Çosan & Aymankuy, 2023; Trivedi et al., 2023; Wani et al., 2023). The swift expansion of the global economy has precipitated a surge in food waste generation, attributable to population growth and escalated consumption (FAO, 2013). According to the Food and Agriculture Organization (FAO), approximately one-third of the total food produced for consumption, equating to 1.3 billion tons annually, is loss or wasted. Jimmyanto et al. (2017) contend that population upsurges contribute to

escalated waste accumulation within nations, with solid waste accounting for 55-80% of urban waste, comprising both organic and inorganic components. Indonesia, ranking second globally in food waste contribution after Saudi Arabia, confronts a formidable challenge. As per data from the Ministry of Environment and Forestry (2020) cited in Saputra et al. (2017), national waste production has soared to 67.8 million tons. Indonesia's annual food waste production stands at 1.3 million tons, translating to an average per capita waste generation of 300 kilograms. This cumulative food waste amounts to IDR 27 trillion, a figure capable of sustaining 28 million individuals annually (Saputra et al., 2017). Alarmingly, despite this surplus, 19.6 million Indonesians still grapple with malnutrition. The economic value of this wasted food could substantially bolster efforts to alleviate food insecurity and malnutrition, starkly underscoring the impediment posed by food waste to Indonesia's progress towards achieving the Sustainable Development Goals (SDGs) in terms of food security and nutritional outcomes.

Households emerge as the primary agents driving food waste generation (Wulandari et al., 2020). According to Alfiati (2018), variables such as family size, maternal age, and maternal education level significantly shape household food consumption patterns. Neff et al. (2015) assert that inadequate awareness, knowledge, motivation, and behavioral patterns among communities are pivotal in exacerbating food waste. Kowalska (2017) contends that income levels serve as determinants of food waste, with affluent nations exhibiting distinct patterns from those with lower incomes. Moreover, Nafiroh et al. (2019) highlight the critical role of family size in influencing household food waste volumes. Anriany and Martianto (2013) observe a gender-based disparity in food waste generation, with women being identified as the primary contributors. Extant literature consistently underscores the impact of family size and familial behaviors in shaping the magnitude of household food waste.

Household food consumption patterns exhibit variability influenced by factors such as food availability, socio-cultural norms, nutritional awareness, economic circumstances, and environmental considerations. Urban consumption behaviors, shaped by factors like readily accessible information and food sources, as well as diverse dining practices both within and outside the home, can contribute significantly to food waste generation (Fami et al., 2019). This phenomenon is often driven by consumer perceptions of food quality and variety. In contrast, rural communities, characterized by distinct home dining practices, limited food options, and ingredient availability, experience differing levels of food waste compared to their urban counterparts. The resulting food waste poses considerable economic burdens on households and contributes to environmental degradation. Consequently, this study aims to examine the behavior of rural and urban communities in generating rice waste in their households. This study aims to calculate the amount of household cooked rice waste in rural and urban areas, calculate the economic value loss due to the formation of household cooked rice waste, and analyze the factors affecting the formation of household cooked rice waste in rural and urban areas.

METHOD

This study was conducted in two distinct locations: Purwo, Sekarmojo, Purwosari, Pasuruan, representing rural households, and Sebani, Gadingrejo, Pasuruan, representing urban households. These locations were purposefully chosen to investigate household cooked rice waste generation behaviors in rural and urban settings. Participants comprised households residing in the designated research sites. Random sampling techniques were employed in both locations to select participants. The sample size was deliberately set as follows: 45 households were chosen from Purwo, Sekarmojo, Purwosari, which represents a population of 78 households, and 45 households were selected from Sebani, Gadingrejo, Purwosari, representing a population of 62 households.

The data utilized in this study is classified as primary data. Primary data collection involved administering surveys, conducting interviews, and distributing questionnaires. The questionnaire encompassed respondent attributes such as family size, gender, age, education, occupation, and income. Measurement of household cooked rice waste involved direct weighing using digital scales with a capacity of 10 kg and an accuracy of 1 g. Data collection spanned one month to streamline the process and expedite the retrieval of economic value. Each participant recorded daily remaining rice quantities on a provided table throughout the month. The implementation team closely monitored each sample weekly using a combination of online and direct data gathering methods conducted by researchers.

a. Analytical method to calculate the amount of household food waste

The specific data required for collection pertains to the weight of leftover rice post-cooking within households. To determine the reduced rice weight from leftovers, the cooking weight is multiplied by the fDMM (Factor in Raw Food Cooking). Daily residual rice quantities from each household were gathered using plastic bags and measured against the cooking weight. The fDMM formula was applied to assess the volume of food waste resulting from raw rice consumption at the household level. Additionally, to calculate food loss, it is essential to convert cooked food weight to its raw weight using the fDMM (Factor In Raw Food Cooking). The FDMM for standard cooked rice stands at 0.347, while for coconut milk cooked rice, it is 0.376, calculated through the predetermined methodology.

$$\text{Raw Food Weight} = \text{Cooked Food Weight (grams)} \times \text{fDMM}$$

b. Analytical method to calculate the loss of economic value due to the formation of household cooked rice waste

The economic value of household cooked rice waste is calculated by multiplying the current market price of rice by the quantity of waste generated. This involves applying a conversion factor of 0.347 to the quantity of rice waste produced by households. Hence, the resulting economic value represents the monetary equivalent of rice waste generated. The formula utilized is expressed as follows:

$$NE = BSMSK \text{ (grams)} \times H \text{ (IDR/gram)}$$

where:
NE = Economic Value (IDR);
BSMSK = Weight of Leftover Food After Conversion (grams) ;
H = Market Price of rice per gram (IDR/gram)

c. Analyzing the factors affecting the formation of household cooked rice waste

To determine the factors affecting the formation of household cooked rice waste, multiple regression analysis was used. The following is the multiple linear regression model:

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + b7X7 + e$$

where:
Y = household cooked rice waste (expressed in kilograms per capita per month);
X1 = the quantity or amount of cooked rice consumed daily (measured in kilograms per day);
X2 = household income (measured in Indonesian Rupiah per month);
X3 = the number of family members (measured in individuals);
X4 = the mother's education level (measured in years);
X5 = the frequency of rice consumption per day;
X6 = a dummy variable indicating active use of mobile phones for food purchases; and
X7 = a dummy variable representing the habit of eating out. The error term is denoted by 'e', while 'a' signifies the constant, and 'b1', 'b2', 'b3', 'b4', 'b5', 'b6', and 'b7' represent the regression coefficients associated with each respective variable.

RESULTS AND DISCUSSION

Amount of household cooked rice waste

Utilizing distributed questionnaires among respondents residing in rural (Sekarmojo) and urban (Sebani) areas, the monthly quantity of food waste, specifically cooked rice, was estimated. The comprehensive estimation calculations are outlined in Table 1.

Table 1. Amount of Household Cooked rice Waste

Location	Number of Respondents	Household Cooked Rice Waste		
		Cooking Food Weight (Kg/month)	fDMM	Raw Food Weight (Kg/month)
Sekarmojo	45	227.49	0.347	78.93903
Sebani	45	145.38	0.347	50.447
	Total			**129.38589**

Source: processed data 2022

This study investigates household cooked rice waste, referring to the quantity of rice produced by households but left unconsumed and subsequently discarded. Table 1 presents the total weight of leftover rice at each research site. In Purwo, Sekarmojo, a monthly total of 227.49 kilograms of cooked rice waste was identified, equivalent to 78.93903 kilograms of raw rice. In Sebani, 145.38 kilograms of cooked rice waste was discovered monthly, translating to 50.447 kilograms of raw rice. The findings indicate that each household in Purwo, Sekarmojo, generates 1.1727 kg/month or 0.0584 kg/day (equivalent to 58.47 grams/day/household) of raw rice leftovers, while in Sebani, each household produces 1.21 kg/month or 0.0321 kg/day (equivalent to 32.1 grams/day/household) of raw rice leftovers. This signifies a higher quantity in Purwo, Sekarmojo, compared to Sebani. Sugiyarto (2021) highlighted the scarcity of research on food waste in rural areas, specifically citing the case of cooked rice waste in Yogyakarta neighborhoods, amounting to 0.051 grams per day of raw rice. Additionally, noted an average of 37.6 grams per day per household of cooked rice waste in Indonesia.

Figures 1 and 2 depict the distribution of household cooked rice waste across the two research sites. As shown in Figure 1, households in Purwo, Sekarmojo, generated a maximum of 14.38 kg of cooked rice waste per month and a minimum of 0.17 kg per month. The total quantity of cooked rice waste produced by households in this area amounted to 227.49 kg per month, averaging 5 kg per family per month. In contrast, Figure 2 illustrates that households in Sebani produced a maximum of 5.95 kg of cooked rice waste per month and a minimum of 0.95 kg per month. Consequently, the total monthly waste generated in this region was 145.38 kg, averaging 3 kg per household per month.

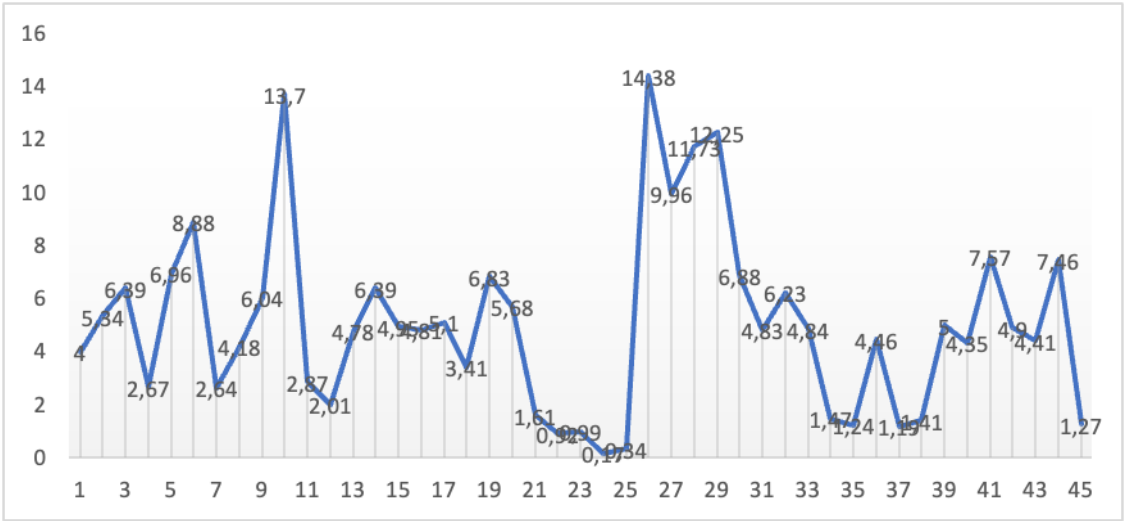

Figure 1. Graph of Household Cooked Rice Waste in Purwo, Sekarmojo, Purwosari, Pasuruan

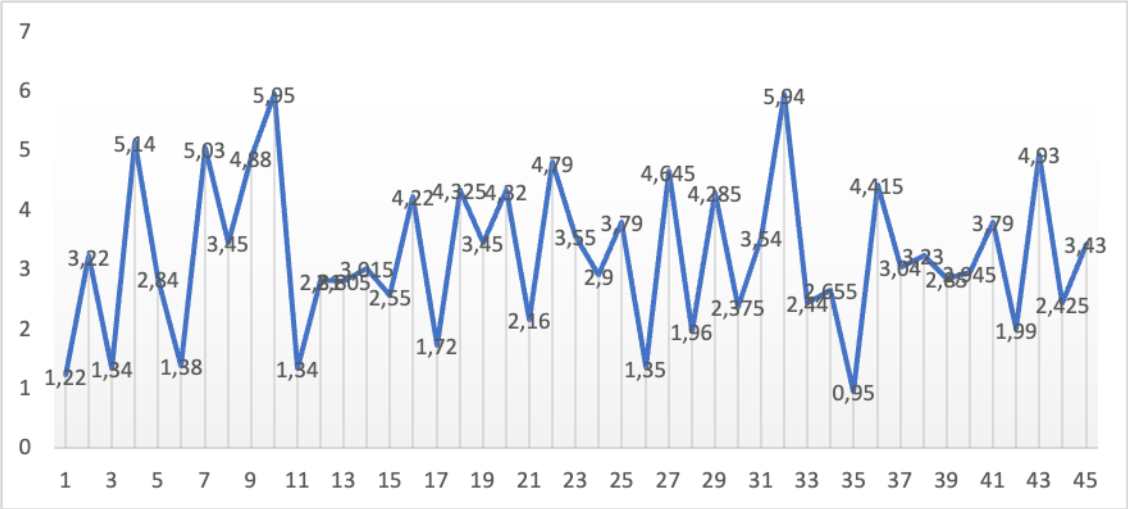

Figure 2. Graph of Household Cooked Rice Waste in Sebani, Gadingrejo, Pasuruan

The economic value loss caused by the generation of household cooked rice waste

Table 2. Economic Value Loss from Food Waste

Location	Number of Respondents (persons)	Price of Rice (IDR)	Raw Rice Waste (KG/Month)	Economic Value Per Month (IDR)	Average Of Economic Value Per Month (IDR/Household/Month)
Purwo, Sekarmojo	45	9,500	78.93903	750,395.78	16,675
Sebani	45	10,500	50.447	529,693.5	11,770

Source: processed data 2022

The disposal of cooked rice waste in households can lead to economic losses (Annunziata et al., 2021; Sunday et al., 2022). These losses can be quantified by multiplying the quantity of cooked rice waste converted to raw rice waste by the prevailing price of rice. The rice price utilized is the mean price reported by respondents during interviews. In Purwo, Sekarmojo, Purwosari, Pasuruan, respondents reported a rice price of IDR 9,500, while in Sebani, Gadingrejo, Pasuruan, it was IDR 10,500. Table 2 presents the projected economic losses resulting from rice wastage at the individual household level. In the Purwo region of Sekarmojo, the conversion of raw rice waste leads to an economic loss of IDR 750,395.78 per month, equivalent to IDR 16,675 per household per month. In Sebani, the economic loss is smaller at IDR 529,693.5 or IDR 11,770 per household per month. This variable is subject to fluctuations based on the rice price at the research site. Excessive rice cooking and family members purchasing food from external sources were identified as contributing factors based on interview findings.

a. Factors affecting household cooked rice waste

This study examined the influence of various factors on the production of cooked rice waste in households. Variations in the quantity of cooked rice waste per household are illustrated in Figures 1 and 2. A disparity in cooked rice waste quantities exists between rural and urban settings, with rural areas showing higher levels compared to urban areas. The variables investigated in this study to ascertain the determinants of household cooked rice waste include the quantity of rice cooked, household income, family size, maternal education level, frequency of rice consumption, mobile phone usage for food ordering, and dining habits outside the home. Household factors contributing to cooked rice wastage, as noted by Matharu et al. (2022) and Nunkoo et al. (2021), encompass feelings of guilt, lack of awareness, space constraints, inadequate policies, and time constraints. These factors have been identified in previous research exploring attitudes toward food waste in households. The impact of these factors on cooked rice waste generation is presented in Tables 3 and 4.

Table 3. Results of the analysis of factors affecting household cooked rice waste in Serkarmojo

Variable	Coefficient of the Parameter	T_{count}	Probability
Constant	1,287	1,583	0,032
Quantity of rice cooked per day (kg/day)	2,671	4,178	0,000
Household income (IDR/month)	0,001	1,957	0,058
Number of family members (people)	-1,179	-1,722	0,094
Education level of the housewife (years)	-0,194	-1,051	0,330
Frequency of eating rice	-0,112	-2,654	0,007
Active use of mobile phone for food purchasing	0,566	0,604	0,550
Eating habits outside the home	2,194	2,207	0,129

Source: results of data analysis 2022

Table 4. Results of the analysis of factors affecting household cooked rice waste in Sebani

Variable	Coefficient of the Parameter	T_{count}	Probability
Constant	0,016	1,227	0,099
Quantity of rice cooked per day (kg/day)	0,319	2,832	0,013
Household income (IDR/month)	0,365	0,200	1,821
Number of family members (people)	0,365	2,227	0,077
Education level of the housewife (years)	-0,019	0,030	-0,639
Frequency of eating rice	0,132	0,805	0,161
Active use of mobile phone for food purchasing	0,927	2.102	0,083
Eating habits outside the home	0,016	0,027	0,599

Source: results of data analysis 2022

Table 3 depicts the outcomes of the analysis concerning factors influencing the generation of cooked rice waste within households in Sekarmojo. These variables encompass the quantity of rice cooked, household income, number of family members, and frequency of rice consumption. A notable positive correlation is observed between the quantity of cooked rice and the produced waste, indicating that an increase in cooked rice volume corresponds to a higher amount of waste. Respondents from Sekarmojo typically prepare around 1 kilogram of rice daily, adjusted to household size and composition. The primary occupation of household heads, often engaged in rice cultivation, ensures a steady rice supply, contradicting Li et al. (2021), who contend that rural residents consume more due to limited access. Household income exhibits a significant positive effect, suggesting that higher incomes lead to increased waste. The mean income in Sekarmojo, IDR 4,170,000, falls below the 2022 Pasuruan Regional Minimum Wage of IDR 4,365,000, with residents employed in farming, labor, manufacturing, and trade. Greater financial means enable larger food purchases, contributing to more waste, as noted by Saputro et al. (2021). Conversely, family size shows a significant negative correlation with waste generation, indicating that larger families produce less waste. Household food consumption is directly influenced by family size, necessitating accurate rice portion estimation to minimize waste. Respondents report an average family size of 5 individuals. Additionally, increased rice consumption frequency among family members correlates with reduced waste. Interviews reveal a twice-daily rice consumption habit, often with breakfast skipped or taken outside due to morning fieldwork. The Sekarmojo community practices waste reduction by repurposing cooked rice as animal feed, fertilizer through fermentation, or drying for alternative food products. Such practices contribute to waste minimization within households.

Table 4 illustrates the variables influencing rice waste production in households of Sebani, encompassing the quantity of rice cooked, family size, rice consumption frequency, and mobile phone use for food purchases. An increase in cooked rice quantity positively impacts waste production, akin to findings in Sekarmojo. Accurate rice preparation knowledge is crucial for housewives to minimize waste, as higher cooking quantities correspond to increased waste. Sebani's average rice consumption is 0.75 kg/day lower than Sekarmojo's, correlating with a family size average of 4 individuals. Family size significantly increases cooked rice waste production; as family members rise, so does waste. Additionally, frequent rice consumption correlates with increased waste, as indicated by Hidayat et al. (2020), attributing this trend to overeating due to food availability. Mobile phone use for food ordering significantly impacts waste production, prevalent in urban areas for its convenience and menu diversity accessible only via mobile. Fami et al. (2019) emphasize the role of information technology in waste production, a key rural-urban distinction. Sekarmojo's investigation indicates insignificant mobile phone effects on waste, attributed to low active usage and limited online food app access.

CONCLUSION

In Purwo, Sekarmojo, cooked rice waste weighed 227.49 kilograms monthly, equivalent to 78.93903 kilograms of raw rice. Sebani yielded 145.38 kilograms of cooked rice waste monthly, or 50.447 kilograms of raw rice. Economic losses from wasted cooked rice in Purwo, Sekarmojo, total IDR 750,395.78 monthly, equating to IDR 16,675 per household. Sebani's loss is smaller at IDR 529,693.5 or IDR 11,770 per household monthly. Key determinants of cooked rice waste in Sekarmojo include rice volume, household income, family size, and consumption frequency. In Sebani, waste determinants encompass rice quantity, household size, consumption frequency, and mobile phone use for food orders.

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