ORIGINAL ARTICLE

Determinants of Waste-sorting Practice of Rural Households

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ABSTRACT

Introduction: Household waste across the globe is increasing, including in rural areas. Rural households in Indonesia prefer open dumping and open burning than start recycling their waste. This study investigates the determinants of waste-sorting practice as a vital part of recycling practice among rural households. **Materials and methods:** We surveyed 2,459 households living in Bojonegoro district where the largest rural areas of East Java. We used data on education, income, healthy lifestyle, the 3R campaign outreach, the availability of final disposal site and the waste circular system as the predictors of waste-sorting practice. We used multiple linear regression analysis to model the predictors of this behavior. **Results:** 3R practices around Bojonegoro Regency amounted to 3.9%. Second model shows that the presence of a Temporary trash disposal sites influences waste sorting behavior with $p<0.1$, the magnitude of R2 for the presence of a Temporary trash disposal sites (R2=0.039). The third model shows that the availability of waste management influences waste sorting behavior with a p value <0.01, the magnitude of R2 is the availability of waste management (R2 = 0.184). The fourth model shows that the 3R practice influences waste sorting behavior (R2 = 0.333). The fifth model with $p<0.01$ shows that the availability of waste management and the 3R practice influence waste sorting behavior. **Conclusion:** Amid the waste-sorting practice among rural households is pathetic, there is still possibility to change this behavior. Providing a proper infrastructure of waste circular system and familiarizing 3R practice could help improving the waste-sort behavior among rural households.
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INTRODUCTION

Household waste in the world is increasing, including in rural areas. It is recorded that more than 2 billion tons of household waste are thrown away every year globally (1). Household waste generated in the world is more than 60 tons per second in 2020. Therefore, it is necessary to sort household waste so that it can be recycled. However, not everyone is able to do this. Sorting household waste does not work well because most people think that the waste will get mixed up in rubbish trucks and carts. Limited facilities at Reduce-Reuse-Recycle (Temporary trash disposal sites-3R) waste processing sites and waste banks are also an obstacle. Apart from that, waste management in various regions is not handled by professionals and experts in the waste field (2). Most people still do not realize that waste management is the responsibility of the entire community. Based on research, this behavior can influence the health of the community's environment, where this behavior is part of Clean and Healthy Living Behavior (3).

Whether people live in affluent areas or not can also be an important factor in enabling access to waste management services, given that the provision of such services can vary in different regions of a country or even within cities (4). The challenges and waste management problems faced by several developing countries are related to the low level of technological development, scavengers and unofficial waste collectors in various developing countries in Africa, Asia and Latin America (5). One of the developing countries that has the habit of burning waste without sorting it first is India. Some Indian people, especially the younger generation, are

aware that recycling is a positive activity, but there are no facilities to support this activity (6).

Rural households in Indonesia prefer open waste disposal and open burning rather than starting to recycle their waste. As many as 53% of households in Indonesia prefer to burn the waste, they produce rather than recycle it (7). Open dumping systems are often found in final disposal sites where the waste is simply thrown away without any prior processing. Meanwhile, open burning systems are often found in rural households who burn their waste openly on empty land. Even though the accumulation of waste can increase non-carcinogenic risks to health (8).

People in rural areas tend to dispose of their waste by burning it. Factors that influence behavioral patterns in sorting waste include lack of land for building temporary shelters, poor facilities and infrastructure, and the low level of public awareness (9). Smoke from burning waste is accumulatively released into the atmosphere, mainly in the form of carbon dioxide (CO2). The presence of carbon dioxide can cause shortness of breath or Upper Respiratory Tract Infections (10). In addition, the toxicity of pollutants can cause damage to the respiratory system in at-risk age categories such as the elderly and people suffering from respiratory diseases (11).

On the other hand, burning waste also has a negative impact on the environment, one of which is causing air pollution. Open burning can produce dangerous compounds including CO, CO2, CH4, NOX, SO2, volatile organic compounds (VOC), Particulate Matter 2.5 (PM2.5), PM10 (12). PM2.5 emissions can be the main source of air pollution due to burning waste, causing poor air quality (13).Based on several problems that occur, this research aims to identify the determinants of waste sorting practices as an important part of recycling practices in rural households. In the future, this research can be used to find out what kind of approach is needed to make people aware of waste sorting practices.

MATERIALS AND METHODS

Research Design

This type of research is observational research with a cross-sectional design. The respondent's behavior is observed simultaneously over a certain period. The approval and ethic clearance from the Faculty of Nursing Universitas Airlangga was attained upon commencement of the study [Reference No: 1769-KEPK].

Population and Sample

The research was conducted in Bojonegoro Regency, East Java, Indonesia, which is the largest rural area in East Java. The population of this study is all households living in Bojonegoro Regency, East Java, Indonesia. The data taken came from 2,459 households in Bojonegoro Regency, East Java, Indonesia.

Statistical Analysis

The variables used in this research include education, income, clean and healthy living behavior, the existence of the 3R practice (reduce, reuse, recycle), the availability of temporary disposal sites near the residence and the waste management system in the home environment as predictors of waste sorting practices. Clean and healthy living behaviors analyzed include smoking habits, exercising for more than 10 minutes every day, washing hands with soap, and brushing teeth at least twice every day. Data analysis was carried out using the multiple linear regression method to model predictors of respondent behavior.

RESULTS

Descriptive analysis of the sample shows that most households do not sort waste. Table I presents a summary of the results of the sample's sociodemographic characteristics, PHBS behavior, availability of TPS, availability of a waste management system and the presence of 3R practices around the residence.

Table I: Cross Tabulation of Respondent Sub Variables and Waste Sorting Behavior

Variable	Total	Yes	Mean (%)	SD
Carry out waste sorting	2239	220	9.8%	0.29
Level of education (% of total)	2250			
No School		32	1.4%	
Elementary School		689	30.6%	
Junior High School		614	27.3%	
Senior High School		747	33.2%	
Diploma's degree		48	2.1%	
Bachelor's degree		116	5.2%	
Master's degree		4	0.2%	
Fixed income	2269	538	23.7%	0.425
Clean and Healthy Living Behavior				
Smoke	2308	1752	75.9%	0.427
Exercise more than 10 minutes every day	2308	1743	75.5%	0.43
Wash hands with soap	2308	1710	74.1%	0.438
Brush teeth at least at 2 times every day	2308	2170	94.0%	0.237
Clean and Healthy Living Behavior Score	2308		2.67	0.78
There is a temporary trash disposal sites near the residence	2237	246	11.0%	0.312
A waste management system is available in the home environment	2238	296	13.2%	0.338
There is 3R practice around the residence	2239	87	3.9%	0.193

The education level of most of the respondents was high school, 33.2% and 30.6% of the total respondents had elementary school education. Most variable households do not have a fixed income, namely 76.3%. Most of the respondents' middle and low education can be attributed to the household's fixed income. The Clean and Healthy Living Behavior variable consists of smoking behavior, exercising more than 10 minutes every day, washing hands with soap, and brushing teeth at least twice every day. Table 1 shows that most of the respondent's smoke 75.9%, most respondents exercise more than 10 minutes every day 75.5%. Most respondents wash their hands with soap and brush their teeth at least twice a day, 74.1% and 94.0% respectively. The variable availability of Temporary trash disposal sites around the residence is very low, namely 11.0%. The availability of a waste management system in the home environment is very low, namely 13.2%. And the low 3R practice around the residence was 3.9%.

To identify predictors of waste sorting, testing was carried out using multiple linear regression as listed in Table II.

Table II:. Multiple Linear Regression Analysis of Waste Sorting Predictors

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Elementary School	-0.078	-0.077	-0.077	-0.087	-0.085
	(0.058)	(0.058)	(0.058)	(0.057)	(0.057)
Junior High School	-0.052	-0.051	-0.048	-0.062	-0.058
	(0.058)	(0.058)	(0.058)	(0.057)	(0.057)
Senior High School	-0.068	-0.069	-0.073	-0.084	-0.087
	(0.058)	(0.058)	(0.058)	(0.057)	(0.057)
Diploma's degree	0.007	0.005	-0.004	-0.029	-0.034
	(0.074)	(0.074)	(0.073)	(0.073)	(0.072)
Bachelor's degree	0.007	0.005	-0.011	-0.031	-0.042
	(0.064)	(0.064)	(0.063)	(0.062)	(0.062)
Master's degree	0.178	0.183	0.202	0.178	0.198
	(0.177)	(0.177)	(0.173)	(0.173)	(0.170)
Fixed income	-0.006	-0.006	-0.004	-0.007	-0.005
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Clean and Healthy Living Behavior	0.007	0.007	0.003	0.006	0.003
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Temporary trash disposal sites		0.039*			-0.000
		(0.021)			(0.021)
Waste management			0.184***		0.157***
			(0.019)		(0.019)
3R (Reduce, Reuse, Recycle)				OR 0.333***	0.289***
				(0.033)	(0.033)
Constant	0.135**	0.132**	0.123**	0.138**	0.128**
	(0.062)	(0.062)	(0.061)	(0.060)	(0.060)
Observations	1.971	1.967	1.969	1.969	1.963
R-squared	0.008	0.009	0.053	0.057	0.090

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The basic model offered is education level, fixed income, clean and healthy living behavior, availability of temporary trash disposal sites, waste management and the 3R practice. This second model shows that the presence of a temporary trash disposal sites influences waste sorting behavior with p<0.1, the magnitude of R2 for the presence of a temporary trash disposal sites (R2=0.039). The third model shows that the availability of waste management influences waste sorting behavior with a p value <0.01, the magnitude of R2 is the availability of waste management (R2 = 0.184). The fourth model shows that the 3R practice influences waste sorting behavior (R2 = 0.333). The fifth model with p<0.01 shows that the availability of waste management and the 3R practice influence waste sorting behavior.

DISCUSSION

Based on research, it was found that the factors that influence household waste sorting behavior in rural areas are the existence of temporary trash disposal sites, the availability of waste management sites and the 3R

practice.The results of the regression test in this research showed that the presence of temporary trash disposal sites influenced waste sorting behavior. In line with research by Sahil *et al.* (2016) in the Dufa-Dufa Village settlement which stated that the household waste produced was sorted and contained using plastic bags/ sacks/cardboards and then disposed of at the temporary trash disposal sites (14). The waste is sorted by the community itself and then it is transported by cleaning staff. However, there are some people who do not sort their waste and throw it directly into the temporary trash disposal sites.

People tend to pile up rubbish on empty land because there are no temporary shelters in residential areas. In the end, they will burn the waste without sorting it first. This can happen due to the unavailability of empty land and the lack of transportation to take the waste to the landfill (9).

Most people, especially housewives, do not sort their waste. Even though the mother's role is very important in terms of waste management because she takes care of the household every day (15). They tend to throw rubbish directly into their yards and burn the rubbish because there is no land available to use as a temporary trash disposal site. Apart from being influenced by the availability of temporary trash disposal sites, the low level of waste sorting behavior in rural areas can also be influenced by the level of individual knowledge and awareness (16). Increasing the level of knowledge will improve attitudes and practices in sorting waste (17).

Furthermore, the results of the regression test show that there is an influence between the availability of waste management and waste sorting behavior. People who do not implement waste sorting behavior are due to the lack of a waste management system in their home environment. Households that have a good waste management system tend to care about the environment and have waste sorting behavior (18).

Another research conducted by Sari et al. (2017) stated that waste sorting behavior is influenced by knowledge. Good knowledge about waste management is also the basis for a good attitude in waste management. Knowledge of thinking plays an important role in shaping individual attitudes and behavior (19). However, good knowledge must also be supported by the availability of facilities such as waste management to create waste sorting behavior (6).

Another reason why people don't sort their waste is because they are too lazy. Even though they have knowledge about waste management, they are reluctant to sort waste. This is due to the absence of driving factors such as the availability of a good waste management system in the residential environment (7). The community will show a positive attitude in sorting waste if there is a waste management system such as a separate container near where they live. Apart from that, clear guidelines from the authorities also play an important role so that the public participates in sorting household waste (20).

Other regression test results show that there is an influence between the 3R practice (Reduce, Reuse, Recycle) and waste sorting behavior. The low level of 3R practice in the home environment is caused by a lack of individual awareness of the environment. Lack of socialization regarding the 3R practice is also one of the factors causing the low level of public knowledge regarding waste sorting. In fact, good use of technology and recycling of household waste can reduce the impact on the environment and also obtain economic benefits (21).

Most people still throw rubbish in their yards without separating organic and inorganic waste. The rubbish will be left piled up in one place and will then be transported by cleaning staff. If there are no officers to transport the rubbish, the rubbish will be burned in the open field. This attitude is motivated by a lack of public knowledge regarding waste sorting. Apart from that, the number of people living in one household also influences waste sorting behavior. The higher the number of people in a household, the smaller the opportunity for them to sort waste (22). Efforts that can be made to increase the positive attitude of the community require regulations regarding household waste in the sorting process (23).

Other research conducted by Trisnawati and Khasanah (2020) stated that people's attitudes towards implementing the 3R practice tended to improve after counseling and training on waste processing. The community is also starting to realize and get used to sorting organic and inorganic waste as the initial key to implementing the 3R practice (24). Counseling can encourage someone to get involved in recycling the waste they produce. However, this must also be supported by available facilities (6).

Apart from providing outreach and training to the community, implementing regulations and policies regarding waste management also has an important role in improving waste sorting behavior. There is the term good environmental governance which means various activities carried out by the government but still paying attention to environmental sustainability. One of the efforts made by the government to increase the 3R practice is by implementing waste banks in various regions (25). The 3R practice; Reduce, Reuse, and Recycle in household waste management is one of the long running programs. Although these three practices

stand simultaneously, the results obtained indicate that there are differences in respondents' perceptions of each practice (26).

CONCLUSION

The waste management system of rural residents in Bojonegoro is still not good. This can be seen from most residents who do not sort their waste before throwing it away and immediately burn it in the open. This behavior is influenced by the absence of supporting facilities and infrastructure such as polling stations in the living environment. Apart from that, the absence of a waste management system in residential areas is also one of the factors preventing people from sorting waste. Another thing that supports people throwing away waste without sorting it first is a lack of knowledge about the 3R practice. In rural areas, the 3R practice campaign is still very rare so that residents' understanding of the importance of sorting waste is still very lacking. In the end, they will throw away the rubbish without sorting it first and burn it around residential areas because of a lack of awareness of the importance of environmental health.

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