

**Research Paper**

# Interconnecting Issue of Government's Regional Budget Allocation and Open Burning Behavior: Study from Indonesia

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## Abstract

This research aims to analyze whether people's perception, living area such as rural/urban, and regional budget proportion for the environment at province level influence open burning behavior of a household in Indonesia. Using household-level data in 2017 from the National Socioeconomic Survey of Indonesia and adding control factors such as socio-demographic characteristics, a logit regression method is conducted. The result reveals that burning behavior perception has an important role in open burning trash decisions and people living in rural areas tend to do open burning trash compared to those who are living in urban areas. Furthermore, provinces with higher proportion budgets for environmental facilities tend to have fewer open burning cases done by households compared to provinces with lower proportion budgets for environment. The findings suggest that government should improve waste policies at regional and municipal level to reduce open burning trash behavior of households.

**Keyword:** open burning trash behavior, people's perception, regional budget, urban/rural.

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## 1. Introduction

In developed countries, doing open burning trash on purpose is regulated strictly and has been considered as an old-fashioned technology. However, in developing countries, the application of these technologies is still preferable. Open burning remains to be the cheapest and easiest way to reduce volume and burnable materials disposal (UNIDO, 2008 as cited in Estrellan & Iino, 2010, p. 194). Although environmentally intolerable, practice of doing open burning is still done by most people in developing countries especially those in the groups which arranged waste treatment has not been familiar and people are set aside with their ways for waste dumping; thus, threatening them to the health risks of toxic emissions, for instance, irritation of smoke and unpleasant smell that are related with open burning actions (Estrellan & Iino, 2010). Consequently, a better understanding of internal and external factors' effect on households' open burning behavior would help to map people's preferences. This paper seeks to address open burning trash behavior among households and provide inputs valuable in municipal planning for policymakers.

Waste generation and waste disposal hurt the environment and people's health; therefore, some actions need to be done. Waste handling is coherent with the Sustainable Development Goals (SDGs) target 12.5, that by 2030 each country will significantly reduce the production of waste through prevention, reduction, recycling, and reuse to certify a sustainable way of production and consumption. Municipal solid waste in Indonesia mostly is discarded in landfill locations without any treatment compared to other developing countries (Aye & Widjaya, 2006). The prohibition on open burning is also regulated in Article 29 of Law Number 18 the Year 2008 concerning Waste Management, one of which states that everyone is prohibited from burning waste that is not by the technical requirements of waste management. The regulation also states that the perpetrators of waste burning are threatened with imprisonment or fines. However, the extent of law prosecution varies by region, especially in rural areas where the waste management is still insufficient (Meidiana & Gamse, 2011). From the questionnaire, the results show only 1.2 percent of households doing recycling. The main concern is the number of households that burn garbage reaches 66.8 percent, even though it has been known that burning garbage is a source of pollution that can cause respiratory illnesses (Badan Pusat Statistik, 2018).

The implication is that the Indonesian Government's effort to handle solid waste problems may not be recognized if there is no change at the household level conditions. To improve household solid waste management in the country, knowing the determining factor behind a household's solid waste disposal behavior is necessary (Alhassan et al., 2020). Professionals agreed that solid waste management integration not only about technical and environmental aspects but also they found that a variety of environmental issues are affected by people's behavior and could be relieved by changing the behavior (Steg & Vlek, 2009).

A study that examined the underlying factors of open burning behavior in Indonesia is still few. However, research to break down the drivers of such behavior in the country is limited. Even though open burning is part of waste disposal behavior, the current study mostly models the drivers of households' solid waste sorting and dumping behavior, not specifically observe open burning behavior. Moreover, a paper that uses data obtained from a huge number of respondents on a national scale has not been conducted regarding open burning behavior decisions. Therefore, hypotheses could be taken to prove that internal and external factors matter on open burning behavior. To analyze the hypotheses and to fill the gap from the previous study, logit regression is conducted using 297,276 household data from the National Socioeconomic Survey of Indonesia in 2017. The objective of this study is to identify the influence of people's perception, rural/urban category of living area, and regional budget proportion for the environment at province level on open burning behaviors of household's level in Indonesia.

## 2. Methodology

To investigate the impact of urban/rural category, burning trash perception, and regional budget proportion for the environment on open burning trash behavior of households, this study using binary logistic regression (LOGIT). The following basic specification is used:

$$\text{Logit}(R) = \frac{1}{1 + e^{-z}} ; z = \beta_0 + \beta_1 \text{urb}_{rural_i} + \beta_2 \text{burn}_{percept_i} + \beta_3 \text{reg}_{budget_{prop}_i} + \beta_4 x'_i + \varepsilon_i$$

Where  $z$  is latent measures of household open burning habit,  $\beta$  is the vector of parameters to be estimated,  $\text{urb}_{rural_i}$  is a dummy variable for urban/rural category,  $\text{burn}_{percept_i}$  is a dummy variable for

open burning perception at household,  $reg_{budget,prop_i}$  is variable of regional budget proportion at the province level,  $x'_i$  refers to socio-demographic variables as control variables for household  $i$  and  $\varepsilon$  is the error term. Then, the marginal effect of a change in the explanatory variable on the expected value of the dependent variable is calculated. Logit regression method is conducted since the dependent variable is the binary type, where "1" equals doing burning trash behavior, and "0" equals never burning trash. Moreover, logit is relevant to be utilized in maximizing utility cases to answer the research question.

This study utilized the data from the National Socioeconomic Survey of Indonesia (SUSENAS) year of 2017 that conducted by BPS, with the total number of respondents, were approximately 297,276 households. The data widely used by researchers to examine various topics, particularly health, welfare, demographic issues, and pro-environmental behavior. Especially in Indonesia, the study about open burning trash behavior which uses national scale data is very limited. Therefore, the variables and arguments used by previous studies related to waste disposal behavior can be utilized and applied in this study of open burning behavior. By using the binary logit regression method, household-level data were used in this study to identify the relationship between open burning behavior with internal factors such as people's perception and socio-demographic, as well as external factors. Given the previous studies, this research includes the dependent and independent variables as can be seen in table 1.

The independent variables of this study are socio-demographic factors, people's perception of burning trash perception, the regional budget proportion for the environment, and air quality index factors. Socio-demographic factors consist of age group, gender, family size, marital status, monthly expenses, education level, and poor/non-poor category. According to previous studies regarding waste disposal behavior, socio-demographic variables have a significant outcome on household behavior (Abebaw, 2008; Tadesse et al., 2008; Binyaruka, 2015; Chu et al., 2013; Mamady, 2016). For open burning case, education level variables treated as categorical data because in Indonesia curriculum for chemistry subjects only begin to be taught when students are at the high school level. It is assumed, people can understand the impact of chemical reactions resulting from the open burning and the types of pollutants produced by it after going through high school education. Therefore, the education variable in this study uses categorical rather than ordinal types.

For urban/rural category classification, this study is based on The Head of the Central Bureau of Statistics Regulation Number 37 of 2010 concerning about Classification of Urban and Rural Areas in Indonesia (Badan Pusat Statistik, 2010). Besides, there is an important impact of district area characteristics from the previous study such as ease of the access area (Awah Manga, 2012), inadequate planning on the spatial aspect (Mamady, 2016), or the density of population (Ojewale, 2014). Moreover, many cities in developing countries are struggling to deal with their municipal solid waste. The waste collection rates estimation range is usually still low. For instance in Africa, Sotamenou (2019) found that these low collection rates can be justified by the inadequate service of municipal solid waste collection vehicles, lack of assets and technical skill, continued urbanization, deficient aspect of infrastructure, poor waste management systems, the behavior of household and geo-environmental restrictions which including challenging topography.

For burning trash perception, some people who have the perception to burn garbage might implement them as a real habit or vice versa. The result could be significant or insignificant. The reasoned action theory is based on the hypothesis that people usually act practically; that they take into account information availability and indirectly or consider the consequences of their actions (Ajzen, 1985). In other words, a person's perception could affect whether someone would do (or not to do) a behavior. Therefore, household characteristics, disposal options available as well as people opinions, and social norms are likely to be the main contributing factor to household waste disposal (Sotamenou et al., 2019). Van Liere (1978) found that there is a significant interaction between responsibility acknowledgment, consequences awareness, and burning behavior. To measure the relationship between people's perception and acts, household heads were being asked for their opinion about open burning trash behavior whether they agree that not burning trash will reduce air pollution or not.

Cities authority have the responsibility for waste management, providing an effective and efficient system to the residents. However, they often face problems away from the capability of the municipal authority to handle (Sujauddin et al., 2008) generally due to lack of arrangement, fiscal resources, and systematic variation due to the waste management system. The proportion of the regional budget for the environment is seen as an independent variable in describing the government's efforts to improve the quality of the environment. Environmental protection as one of the national priorities continues to get attention from the government both in terms of budget and implementation. The proportion of budget

allocation at the regional level is used as a policy variable because the government fiscal capacity is closely related to the availability of public goods (Guerrero et al., 2013). Also, compared to other policies, complete data related to the allocation of government budget are only available at the regional level in Indonesia.

Then, the last independent variable, air quality index, is calculated from each province in Indonesia after the annual average concentration of air pollutant parameters in the form of SO and NO is obtained from the results of ambient air quality measurements in districts/cities. Previous studies have largely discussed air pollutant emissions resulting from burning waste in several countries such as Mexico (Gullett et al., 2010), China (Wang et al., 2017), India (Kumari et al., 2017), Thailand (Junpen et al., 2018) and Indonesia (Bastian et al., 2013; Permadi & Kim Oanh, 2013). Improper handling of waste will also have an impact which becomes a global concern, such as greenhouse gases (World Bank, 2018). Measurement of ambient air quality at the regional level is carried out at 4 (four) locations representing industrial, residential, transportation, and office areas using the manual passive sampler method with established requirements and criteria. The formula is used assuming that the measured air quality data are pollutant concentration data (Ministry of Environment and Forestry, 2018). Consequently, it must be converted into air quality concentrations, with a reduction of 100 percent. Therefore, the air quality index results from the calculation are categorized as good results if it gets closer to 100 and vice versa.

Table 1: Variables included in the analysis.

	Code Name	Definition	Type
<b>DEPENDENT VARIABLE</b>	op_burn	0= Never burning trash 1=Doing burning trash	Categorical
	urb_rural	Location Type (Urban=1 Rural=0)	Categorical
	fam_mnbr	Household size with a total family member	Numeric
	marit_stat	Marital Status (1=married; 0=Not married)	Categorical
	gender	Gender (1=male; 0=female)	Categorical
	age	Age of Household's head	Numeric
	educ	Education of Age of Household's head (0=below Senior High School 1=Above Senior High School)	Categorical
	poor	Whether If the household received social security or not (Poor =1 Otherwise=0)	Categorical
	Expend	Total family expenditure (Rp)	Numeric
	dburn_percept	Doesn't burn trash could reduce air pollution (0=not agree 1= agree)	Categorical
	reg_budget_prop	Percentage of Provincial Budget for Environment by Province	Numeric
	air_index	Air quality index, using EU directives. The closer to 100% is better, the further away from 100% is worse.	Numeric

### 3. Results and Discussion

Conducting logistic regression and calculating the marginal effect of each variable could be used to analyze the more reflective relationship between variables and open burning behavior. Three models are established to build up the analysis. In the first model, only the variables of burning perception and urban/rural category are included in the specification to observe the result without controlling sociodemographic and external factors at the province level. It could be seen in Table 2, the relationship between perception, rural/urban category, and burning habit are significant in model 1. Besides, the perception to burn and urban/rural category show a meaningful and negative association on open burning behaviors of households. In other words, the more people agree to not burn trash, they tend to not burn trash, and people who live in rural areas tend to burn trash compared to people who live in urban areas. Since this model could deteriorate from omitted variable bias, it could not directly conclude before including control variables.

This analysis then includes socio-demographic characteristics and external factors such as budget proportion for environment and air quality index at province level in models 2 and 3. From table 2, we can see that socio-demographic factors and external factors could have a relationship with open burning behaviors. This result is in line with previous studies that find that socio-demographic characteristics

matter on open burning behavior (Abebaw, 2008; Tadesse et al., 2008; Binyaruka, 2015; Chu et al., 2013; Mamady,2016). The three models show that marital status, age of household head, poor status, and household size have a positive correlation with open burning behavior. In contrast, the rest characteristics such as gender of household head, education level, and monthly expense of household show a negative correlation with open burning habits.

Table 2: Marginal effects of estimated parameters.

Variables	Model 1	Model 2	Model 3
<b>Open Burning Behavior</b>			
	-0.277***	-0.255***	-0.224***
	(0.00)	(0.00)	(0.00)
<b>Burning perception</b>	-0.198***	-0.190***	-0.180***
	(0.00)	(0.00)	(0.00)
<b>Regional budget proportion</b>		-0.028***	-0.022***
		(0.00)	(0.00)
<b>Air quality index</b>		0.007***	0.007***
		(0.00)	(0.00)
<b>Household size (Family member)</b>			0.013***
			(0.00)
<b>Marital status</b>			0.062***
			(0.00)
<b>Gender</b>			-0.013***
			(0.00)
<b>Age</b>			0.001***
			(0.00)
<b>Education</b>			-0.042***
			(0.00)
<b>Poor</b>			0.013***
			(0.00)
<b>Monthly Expense</b>			-0.000***
			(0.00)

\*significant at the 10%; \*\*significant at the 5% level; \*\*\*significant at the 1% level

After controlling socio-demographic variables, the marginal effect of the urban/rural variable becomes lower from 28% in model 1 to 25% in model 2 and 22% in model 3. The results reveal that people who live in urban areas have a lower probability of burning trash by around 22% compared to those who live in rural areas. It can be concluded that the people who live in rural areas tend to do open burning behaviors more than urban people. This is consistent with the hypothesis that people in rural areas have an incentive to do open burning. Mamady (2016) stated that waste disposal behavior with disrespect for environmental concerns is probably influenced by geographical risk factors (suburban area and residents' distance to municipal legal dumpsite). This finding matches with Awah Manga (2012) which shows that demographic features, geographic topographies, and waste facility aspects seem to affect disposal behavior among farming households in lowland areas of Yaoundé.

For household perception, this study involves the variable of burning perceptions. The marginal effect of the burning perception variable becomes lower from 20% in model 1 to 19% in model 2 and 18% in model 3. The results reveal that people who have good perceptions have a lower probability of burning trash by around 18% compared to those who have bad perceptions. The regression result shows that with higher positive perceptions people tend to not burn trash. This result is matched with the previous study, such as (Van Liere & Dunlap, 1978) who found that there is a significant interaction between responsibility acknowledgment, consequences awareness, and burning behavior. However, Taylor (1995) exposed a comparable vibe with this result were given adequate knowledge, people might be willing to overcome

personal inconvenience to realize the more global benefits of doing appropriate waste disposal. While for some cases they will attempt to not do that when they face a serious obstacle. As a result, household characteristics, disposal options availability, people's opinions, and social norms are likely to be the main contributing factor to household waste disposal (Sotamenou et al., 2019).

In line with the results of the two previous variables, the external factors such as the budget proportion for the environment at province variables shows a negative relationship with open burning behaviors. The marginal effect of the burning perception variable becomes lower from 2.8% in model 2 to 2.2% in model 3. Provinces with a higher budget proportion are more likely to have fewer open burning cases, while provinces with a lower budget proportion are less likely to do so. As can be seen in model 3, increasing the value of budget proportion by 1 level leads to decreasing the probability of doing open burning by 2.2%. In other words, provinces that have more environmental budgets tend to have less open burning behaviors compared to those that have a lower budget. Guerrero (2013) supports this result by explaining that resources are required to have qualified personnel, proper equipment, adequate infrastructure, good maintenance, and operation. The financial support from the government, the interest of the municipal authority in waste handling issues, the participation of the service users, and the accurate funding administration are crucial for a restructured sustainable system.

On the other hand, air quality index factors show a positive relationship with open burning behaviors. The marginal effect of the air quality index variable still has the same level at 0.7% in models 2 and 3. Provinces with higher air quality index are more likely to have higher open burning cases, while provinces with lower air quality index are less likely to do so. As can be seen in model 3, increasing the value of the air quality index by 1 level leads to an increased probability of doing open burning by 0.7%. In conclusion, people who live in provinces with good air quality index, tend to do open burning or the other way around. It could make sense because, in the more developed regional area, the need for transportation and energy increases in line with the increasing population so the causes of low air quality index are not only influenced by open burning (Ministry of Environment and Forestry, 2018). Increased use of transportation and energy consumption will increase air pollution which will have an impact on human health and the environment. Nonetheless, Kumari (2017) discovered that in the case of open burning, 20% of uncollected municipal solid waste, the level of dioxins, furan and its congeners intend to be greater than the limit of its daily intake which can affect in changing various immune and increasing risk for cancer diseases. Therefore, air pollution interventions are required for better air quality and health benefits.

Although it has an intuitive result like the previous study, this study shows that socio-demographic factors, mainly urban/rural category and people perception, as well as a regional budget proportion from the government, have the most significant correlation on open burning behavior using larger observation data in Indonesia. Indonesia is an archipelago country with various regional topology. The decentralization effect makes laws, regulations, and government budget arrangements regulated by each regional authority. This causes the progress of regional development to vary. Included in the case of waste disposal treatment, urban areas tend to have better facilities than rural areas because of the adequate infrastructure and easy access. In Indonesia, farther from the center of government, rule enforcement is usually not well monitored. Because of that, people do the behavior that they think makes it easier for them in the effectiveness of time and lower costs such as open burning. Also, in rural areas, more people have a low educational background and poor economic conditions. This further reinforces the reasons why open burning behavior occurs more in rural areas than in urban areas. Furthermore, assuming that local governments, especially in rural areas, are still lacking in resources to implement ideal waste management, it could be seen from the many cases of open burning behavior mostly in rural areas. The results of this study reinforce these assumptions by showing a significant correlation between urban/rural areas and regional budget by the government on open burning behavior. Therefore, further policy measures could be implemented with the factors examined above to take into account.

As a final point, a connection to possible improvements in waste policies in Indonesia could be generated. From the collected works on household waste disposal practices in Indonesia, three recommendations emerge. Firstly, decision-makers should improve the waste disposal options availability (Aye & Widjaya, 2006; Damanhuri et al., 2009) and invest in infrastructure and improve waste collection services in remote areas (MacRae & Rodic, 2015). It could be done by expanding regional budget allocation for the environment and waste service. Secondly, adjusting waste policies through setting optimal waste retribution tariff and disposal fees, as well as preventing undesirable waste dumping through increasing monitoring and enforcement (Meidiana & Gamse, 2011). Lastly, increasing the engagement of public or private sectors and improved education to encourage households' awareness

(Sekito et al., 2013; Ulhasanah & Goto, 2018) and knowledge of the environmental (Bastian et al., 2013; Permadi & Kim Oanh, 2013) as well as health concerns are also crucial in accelerating changes in the solid waste management system in general.

#### 4. Conclusions

The relationship between people's perception, rural/urban category of living area, and regional budget proportion for the environment at province level on open burning behaviors of household's level in Indonesia are the main focus of this research. It is assumed that perception to burn has an important role in open burning decisions and people living in rural areas tend to do open burning trash compared to those who are living in urban areas. Also, provinces with higher proportion budgets for environmental facilities tend to have fewer open burning cases done by households compared to provinces with lower proportion budgets for the environment. Previous studies reveal that perception and socio-demographic factors as well as government policies affect household waste disposal behavior. Then, to analyze the hypotheses, logit regression is conducted by using Indonesian household-level data.

This study noted that the urban/rural category is the primary driver to encourage households for doing open burning. After controlling socio-demographic characteristics, the result is that the people who live in rural areas tend to do open burning behaviors more than urban people. This result is consistent with the hypothesis that people in rural areas have an incentive to do open burning. Also, the higher positive perceptions people tend to not burn trash. From the external factors, provinces with higher budget proportion are more likely to have fewer open burning cases, while provinces with lower budget proportion are less likely to do so. In other words, provinces that have more environmental budgets tend to have less open burning behaviors compared to those that have lower budgets. However, waste policy implementation in Indonesia, especially in regional areas still needs many improvements. For that reason, the government should convey national benchmarks, rules, or technical support about various waste treatment methods, collection services, and final waste dumping sites and distribute them to the municipal authority.

This research outcome provides a step forward for the national data mapping about household open burning behavior for Indonesia which might be used for the regional government but more specifically for decision-making purposes. However, there are some limitations to this study. Since it is a questionnaire data type, there is a possibility that it could suffer from selection data biases. Consequently, to overcome that problem some field experiments could be possibly done in the future for analyzing open burning behaviors. Moreover, this study has a limitation in describing open burning behavior distribution in smaller areas in Indonesia since solid waste management is a local government responsibility. This study should be improved further including more significant characteristic data like ethnics, social-custom, policy variables, and certain occupations (e.g. farmers) at the district level and updated regularly to reveal the up-to-date changes in the household behavior. Therefore, district level and more microdata characteristics should be included in the future analysis.

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