THE INFLUENCE OF SOCIODEMOGRAPHY AND ECONOMIC FACTORS ON THE BEHAVIOR OF REDUCING ELECTRICITY USE IN INDONESIA

Okfrisda Sakti, Ni Made Sukartini

Universitas Airlangga

Email:
sakti.okfrisda@gmail.com
nimade.sukartini@gmail.com

ABSTRACT

The close relationship between economic and environmental sustainability has led to environmental concerns that have become an interesting topic for research. In an economic view, environmental quality is considered a public good. Savings in electricity usage can reduce household costs and save resources in the electricity production process. This study analyzes the effect of individual characteristics on using electricity. Secondary data from the 2013 Survey Peduli Perilaku Lingkungan Hidup Indonesia (SPPLH) from the Badan Pusat Statistik (BPS) was used in this study. With a total sample of 70406 households covering all regions of Indonesia. The analysis was performed using a binary logistics model. An interesting finding is that an increase in income does not cause individuals to behave in an environmentally conscious manner, in this case reducing electricity usage.

How to Cite:
Sakti, O. (2019). *The Influence of Sociodemography and Economic Factors on the Behavior of Reducing Electricity Use in Indonesia.* Econosains, 17(2), P 1-11

INTRODUCTION

Population growth and high economic growth make environmental problems important to consider. Pressure on the environment becomes more severe with an increasing population (Cropper & Griffiths, 1994). The increase in population will be accompanied by an increase in the need for shelter, food, water, energy, and other natural resources. Coupled with the view that the natural environment is a means of meeting the needs of human life, causing the environment to bear an increasingly heavy burden.

The increasing burden on the environment causes concern for the environment to be considered. The importance of environmental stewardship is in line with the concept of Sustainable Development Goals (SDG). The SDGs concept hopes to strengthen the central role of environmental factors and treat environmental factors as the basis for all development outcomes (BPS, 2014). Economic activities are closely related to the environment. The environment provides raw materials for production inputs and goods consumed directly such as water, air, and natural beauty. Receiving negative effects (recipient waste) from the production and consumption processes is also a function of the environment. The occurrence of air pollution certainly threatens human health. The existence of climate change due to the many emissions that trigger greenhouse gases is also a negative impact on humans. The scarcity of water resources, energy as production inputs is also an impact that can be felt by humans.

Indonesia is a country with a very large population. It currently occupies the fourth most populous country in the world with 261.9 million people (BPS, 2018). 68 percent of Indonesia's population is classified as poor or vulnerable to poverty and on average has a low education. With such a population and conditions of education and income, Indonesia faces environmental problems. The behavior of the poor and poorly educated tends to be present-oriented (trying to meet basic needs first or monetary value) rather than environmental care (environmental value) (Stroup, 2016). Illegal logging, river pollution through waste disposal, forest destruction are clear examples of a lack of concern for the environment.

As the human population grows and poor behavior in water use, clean water is increasingly becoming a scarce and irreplaceable resource. Private individuals and households play an important role in climate change mitigation. Households in the United States, for example, have the potential to reduce CO_2 emissions by 20% in 10 years by changing their consumption patterns (Steinhorst, Klockner, & Matthies, 2015). In 2016, BPS recorded that only 71.4 percent of households had a decent source of drinking water. The condition of river water quality is generally in a heavily polluted status (BPS, 2018). Indonesia is also the largest producer of CO_2 emissions in Southeast Asia with the largest contributor to deforestation and motor vehicle use (Yusuf, 2010). Indonesia is also listed as the second-largest

producer of plastic waste to the sea in the world after China with an average per capita waste reaching 0.52 kg (Jambeck, Andrady, Geyer, Narayan, & Perryman, 2015). For the electricity sector, Indonesia's electricity consumption in 2018 will reach 112.46 TeraWatthour (TWh) or an increase of 4.7 percent (ESDM, 2018).

The findings of the Economic and Environment Program for Southeast Asia study by Joseph and Francisco in 2010 which calculated the vulnerability index for climate change throughout Southeast Asia found that cities in Indonesia (especially Jakarta) were the areas most vulnerable to climate change. In 2014, Indonesia's total GHG emissions reached 1,808 million tons of CO2e. This figure consistently shows an increase in emissions from 2000-2013 of 3.5 percent per year (BPS, 2018). Meanwhile, Indonesia is targeting 2030 to reduce GHG emissions by 29 percent on its efforts or subsequently to 41 percent with international assistance. With these conditions, it can be interpreted that Indonesia is currently facing severe challenges in terms of maintaining environmental quality and maintaining public concern for the environment. So that steps are needed in realizing the target, one of which is through increasing public awareness.

Pro-environment behavior can be characterized as behavior that "has the least possible negative impact on the environment or even benefits the environment" (Thogersen, 2013). Community care is reflected in environmental care behavior that can be done by households or individuals. Some ways that can be done is to reduce the use of electrical energy, water usage and the use of private vehicles. By taking action to care for the environment, a person can feel the immediate impact by reducing expenses to pay electricity and water bills. Reducing the use of clean water has a positive impact, namely maintaining a safe water supply. Reduction in the use of electricity and the use of private motor vehicles have a positive impact on the environment. We know that electricity supply comes from non-renewable coal resources. Vehicle fuel also comes from petroleum resources which are also non-renewable resources. The electricity production process also emits carbon emissions which causes the temperature of the earth to heat up. In the case of the use of private motor vehicles, vehicle exhaust emissions also trigger an increase in earth temperature.

This research focuses on the behavior carried out by individuals in a private space (private sphere) so that it can be done by everyone. The choice of behavior in this group is because this group of behaviors tends to have direct environmental consequences and tends to have a far greater impact on the environment (Stern, 2000). The focus of the community's environmental care behavior in this study is only limited to household electricity usage behavior. Based on the background, the main problem to be examined in this study is whether the socio-economic and demographic factors affect the environmental care behavior of

people in Indonesia, especially in the act of using electricity?.

The purpose of this research is to answer the issue of how the influence of socio-economic and demographic factors, information and normative knowledge in the act of reducing household electricity usage. By researching the influence of socio-economic and demographic factors, information and normative knowledge on people's environmental care behaviors, an overview of which factors have the greatest influence can be used as input for the government in making policies related to the environment.

LITERATURE REVIEW

Environmental problems have become interesting things to be studied by economic agents. Environmental problems such as global warming and threats to biodiversity are the main reasons for studying energy conservation (Abrahamse et al, 2005). Reducing energy use has a positive side to reducing the use of limited coal resources. Reducing energy use can also reduce costs incurred for household energy/electricity consumption. Research by Biesiot and Noorman (1999); Abrahamse et al. (2005) show the influence of socio-demographic variables (income, age, and size of the household) in energy use in the household. Households are an important target group because they are one of the main contributors to greenhouse gas emissions (Abrahamse et al, 2005).

The close relation of the environment to economic activities (as a production input) and as a supporter of sustainability makes the topic of the environment an interesting subject. Developed countries have first examined this topic and then followed by developing countries. The discussion of the environ-

ment does not only cover the economic value of the environment but also discusses how human behavior towards the environment. In addition to psychological and sociological factors, socioeconomic and demographic factors also influence people's environmental care behavior. Chen et al. (2010) conducted a study on urban communities in China about the influence of attitudes and sociodemographic factors on environmental care behavior using logistic regression models, sociodemographic factors used were age, sex, education, marital status, income, employment status, position and the level of urban administration. In his research explained that attitudes and sociodemographic factors can influence environmental care behavior. Xiao and Hong (2010) researched environmental care behavior in Chinese society. The study used free variables age, gender, education, income, employment status, knowledge, and area of residence. The result is that age, sex, education, income, knowledge, and area of residence affect environmental care behavior.

RESEARCH METHODS

The data used are the results of the 2013 Indonesian Environmental Concern Behavior Survey (SPPLH) conducted by the Central Statistics Agency (BPS). SPPLH 2013 was chosen because it is able to present the required data such as (i) individual characteristics of family members or households, (ii) characteristics of housing, (iii) energy utilization, (iv) water source,

(v) transportation utilization, (vi) environmental awareness and (vii) knowledge, awareness and efforts to reduce pollution. SPPLH 2013 has a total sample of 75,000 households spread across 34 provinces and 514 districts/cities in Indonesia with enumerated households totaling 70,406 households.

The dependent variable defined in this study is environmental care behavior in personal activities. Respondents were asked whether they took action in terms of reducing the use of electricity in the past year (1 = yes; 0 = no). The independent variables determined were socioeconomic factors including age (in years), gender (1 = male; 0 = female), marital status (1 = unmarried; 0 = married), education (1 = No elementary school certificate; 2 = elementary school / equivalent; 3 = junior high school / equivalent; 4 = high school / equivalent; 5 = D1 / D2 / D3; 6 = D4 / S1; 7 = S2 / S3), income (1 = <500 thousand rupiah; 2 = 500 thousand - 1 million rupiah; 3 = 1.1 -2.5 million rupiah; 4 = 2.6 - 5 million rupiah; 5 = 5.1 - 10 million rupiah; 6 => 10 million rupiah), employment status (1 = working; 0 = not working), residential area (1 = city; 0 = village). Information source factors include information received directly (1 = yes; 0 = no) and information received through the media (1 = yes; 0 = no).

For environmental knowledge, we adopt research (Xiao & Hong, 2010). This variable is formed from 11 statements (table 1) about the environment, the right answer gets one value and the other answers don't get value. The highest value is 11 and the lowest is 0. For statement number 2,3,9 it is a negative statement so the wrong

answer gets a value 1. Example of a positive statement "Sunlight can be used as an alternative source of electrical energy", the normative answer is "right". Example negative statement " doing vehicle maintenance has no relation with protecting the environment", the normative answer is "wrong".

Table 1. Normative Knowledge of Respondent Regarding Environmental Issues

No	Statement	Normative/Expected Answer	Percentage of Respondent's Answer		
			True	False	Do not Know
1	Burning garbage pollutes the air	True	78,86	10,3	10,84
2	Plastic waste, food waste, paper waste, and other garbage do not need to be sorted before dispose	False	37,25	41,79	20,96
3	Waste containing chemicals (such as used mosquito repellent cans, battery light bulbs, insecticide bottles, etc.) should be buried	False	72,25	9,77	17,98
4	Vehicle exhausted causes warmer the earth's temperature	True	65,22	6,29	28,49
5	Water flows without utilization is wasting resources	True	89,23	4,26	6,51
6	Households need to provide a water catchment area	True	59,93	7,28	32,79
7	Save electricity means saving energy	True	81,01	5,41	13,58
8	Riding with public transport when traveling means saving fuel	True	66,31	14,36	19,33
9	Perform maintenance on motor vehicles has nothing to do with conserving the environment	False	34,95	32,3	32,75
10	Sunlight can be used as alternative energy for electric	True	77,1	3,12	19,78
11	Covering the pan properly when cooking can save fuel	True	75,9	6,07	18,03

Sources: Author's Calculation

This research is quantitative. The analysis used binary logistic regression analysis. In binary logistic regression analysis, the dependent variable is a dummy variable consisting of two categories (yes or no). Binary logistic regression is used to see the chance of an event that is affected by the characteristics of certain independent variables. Meanwhile, to find out the probability of the occurrence of the dependent variable (in this case the reduction in electricity usage) influenced by the characteristics of the independent variable, the odds ratio is used. The models in this study are as follows:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 Age + \beta_2 D_1 Sex + \beta_3 Mar + \beta_4 Educ_{[i]} +$$

$$\beta_5 Income_{[i]} + \beta_6 D_3 Kerja +$$

$$\beta_7 D_4 Media + \beta_8 D_5 Personal + \beta_9 D_6 Resident + \beta_{10} Know + \varepsilon$$

.................................(1)

Where:
ln(P/(1-P))   : the probability to take action to reduce electricity usage
B0   : Constanta
Bi   : coefficient
Age   : age of the respondent
Sex   : sex of respondent
Mar   : Marriage Status
Educ   : Educ level
Income   : Income household
Work   : work status
Resident   : Resident area
Media   : get information through media
Personal   : get information through a person

Know   : environmental knowledge and
E   : *error*

FINDING DN DISCUSSION

This section discusses a statistical summary of the variables used and the results of the model estimation. Table 2 shows the total information of the observation sample in this study was 70,406 individuals representing household information. The dependent variable cares for the use of electrical energy. Showing the binary variable, the value of one indicates that the household reduced electricity usage in the past year. In the case of independent variables, almost all data is measured on a non-ratio measurement scale, except for the respondent's age. The level of education and income is presented on an ordinal scale, and the coding follows BPS standards. The average level of education of respondents was 1.734 with a standard deviation of 1.398. This figure implies that the average length of school respondents is between 6 years (elementary school) to 9 years (secondary school). On the other hand, the average income level is 2.71 with a standard deviation of 1.11. This figure shows that the average respondent earns under Rp 1,000,000 per month.

Table 2. Summary statistics of pro-environmental behaviors, environmental knowledge and sociodemographic conditions of respondents.

No	Variable Description	No of Obsv.	Mean and SD	Minimum Value	Maximum Value
Dependent Variables					
1	Electricity. Value 1=subjective report that individual engages in reducing daily use of electricity; 0 otherwise	70,406	0.362 (0.480)	0	1
Individual Characteristics					
4	Age (years)	70,406	43.693 (14.238)	12	98
5	Sex (1=male)	70,406	0.459 (0.498)	0	1
6	Marital Status (1=married)	70,406	0.2003 (0.4002)	0	1
7	Educational Level	70,406	1.724 (1.398)	0	6
8	Income Level	70,406	2.714 (1.111)	1	6
9	Employment Status	70,406	0.643 (0.478)	0	1
10	Dummy location (urban=1)	70,406	0.4221 (0.4939)	0	1
11	Source of Inf. (Self-Knowledge)	70,406	0.6988 (0.4587)	0	1
12	Source of Inf. (Media)	70,406	0.7175 (0.4502)	0	1
13	Normative Knowledge about Environmental Issues	70,406	6.774 (2.444)	0	11

Sources: Author's Calculation

From the knowledge variable (table 1), it is known that 81 percent of respondents already know that saving electricity means saving fuel. The respondents' knowledge about sunlight that can be used as an alternative energy source by 77 percent is quite encouraging. The good percentage of respondents' knowledge must certainly be supported by government efforts to create policies that are more concerned about the environment. Socializing homes with good lighting and promoting the use of solar-based devices (solar cells) are actions that can be taken. By maximizing sunlight during the day it can reduce the use of electrical energy.

Based on data processing (table 3), it is known that all independent variables show a significant effect. Table 3 column 4 shows the value of the odds ratio which is the probability value of the characteristics of the independent variable to take action to reduce the use of electricity. The first thing to note is that individual awareness about the environment is positively related to age and education level. As individuals become more mature, and better educated, their awareness of the environment becomes better.

Table 3. Estimation Model

Independent Variabels	Symbol	β	Odds Ratio
(1)	(2)	(3)	(4)
Intersep	β_0	-1,974*	0,1469
Sex (male=1)	Male	-0,1651	0,8477
	Female		
Age (year)	Respondent's age	0,0815	1,0081
Marital Status (singe =1)	Single	-0,0512	0,9501
	Married		
Educ. Level	Educ level of repondent	0,9130	1,0956
Income Level (Rp)	Respondent's income	-0,0291	0,9712
Dummy Region (urban=1)	Urban	0,1544	1,1669
	Rural		
Media (yes=1)	Get information from media	0,4558	1,5774
	No		
Personal (yes=1)	Get information from personal	0,1913	1,2108
	No		
Knowledge	Normative Knowledge environmental	0,7592	1,0788
Work status (work=1)	Work	-0,9415	0,9101
	Unemployment		
Observations=70406			
Wald Chi Sq (10)= 2,446.30			
Prob>Chi Sq= 0.0000			
Pseudo R-Square = 26,2 persen			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In terms of gender, men have a 0.8877 chance lower than women in terms of reducing the use of electrical energy. In other words, men tend not to do activities to reduce the use of electricity. That happens because usually men spend a lot of time outside the home to work and women spend time at home to take care of the household. Turning off the lights during the day and turning off electronic equipment that is not used is something that can be done. Chen et al, (2011) also found the same thing that women in China tend to be more involved in environmental care activities in the private sector (in the household) compared to men guys.

Increasing age also increases awareness of environmental care behavior. With the increasing age of the respondent will increase the opportunity to reduce the use of electrical energy by 0.9501. The level of maturity and ability to process information related to the reduction in electricity usage provides awareness in behaving in an environmentally conscious manner. This finding is by research findings (Chen et al, 2011; Xiao & Hong; 2010) conducted in China.

The effect of education on activities to reduce electricity usage is positive. The results of the data obtained by the presence of better education tend to increase opportunities to conduct electricity care behaviors by 1.0956 points. Education plays an important role because it might not only facilitate people's understanding of environmental problems but also enhance normative knowledge of the community's environment. Kollmuss & Agyeman (2010) revealed the initial scheme of education and actions by which education will trigger an increase in one's knowledge, then that knowledge will lead to actions according to their knowledge.

This research found that when there is an increase in income, a person tends not to behave in an environmentally conscious manner. An increase in income decreases the opportunity to reduce the use of electricity by 0.9817. An explanation of this is in research (Huebner, Shipworth, Hamilton, Chalabi, & Oreszczyn, 2016) which says that an increase in household income will increase purchases of other electronic goods so they tend not to care about the environment. Although the goods purchased are more energy saving and environmentally friendly, and are in the high electricity user group this household tends not to reduce electricity consumption. These households are more amenable to rising electricity prices or using more environmentally friendly goods (more expensive) than reducing their satisfaction.

Someone who lives in an urban area tends to behave in an environmentally friendly manner towards activities that reduce the use of household electricity. Someone who lives in the city has the opportunity to reduce electricity usage by 1.1169 compared to someone who lives in the countryside. Easy access to information and services in cities can be the reason why respondents who live in cities behave more in an environmentally conscious manner. The relatively high cost of living also makes urban communities more concerned about their electricity usage. Limited water sources also cause urban household

to save more water than rural households.

The source of information that comes from the media and directly has a positive effect on reducing electricity usage. The role of the media in promoting low-energy devices also plays a role in getting people to be more concerned about reducing electricity usage. For example, LED lights and LED televisions can reduce household electricity consumption. These energy-friendly items do have relatively higher prices but have the advantage of long-lasting (efficient) use and positive effects of reducing (electric) household electricity bills. Information about global warming, one of which is caused by excessive electricity consumption also makes people more concerned about electricity usage.

Working status has a negative influence on activities to reduce household electricity usage. Respondents who work have a lower chance of doing activities to reduce the use of electricity by 0.9101 compared to respondents who do not work. An additional income from work causes someone to buy electronic equipment that is used to fulfill their satisfaction. They are willing to pay higher electricity bills as long as they do not reduce satisfaction.

CONCLUSION

This study investigates the determinants of individual characteristics in the use of electrical energy. This study found that individual awareness is in line with the level and age of education. Educated and mature individuals are more aware to consume economic resources (electricity) more efficiently. Urban respondents also consume electricity more wisely than rural respondents. In their daily activities, urban respondents report that they use electricity as efficiently as possible.

Possible policy implications for the findings of this study are as follows. First, it is necessary to spread knowledge and awareness about environmental problems and practice efficient consumption and production. The findings of this study indicate that respondent awareness is positively related to the level of education and information received. Second, the behavioral response of urban consumers responds with higher wattage of electricity. In Indonesia, the higher the wattage of electricity, the more expensive the tariff. Urban areas on average use higher wattage of electricity. This implies pricing strategies can be implemented to efficiently enforce economic resources consumed by consumers. Progressive pricing for electricity must be applied to consumers who consume quantities above the conventional per capita amount. Consumers who consume conventional per capita amounts above mean enjoying premium quality. A progressive pricing strategy for electricity, while increasing efficient consumption also allows for cross-subsidies.

The government must mobilize information for the public both through the media and directly. Because there is a close relationship between information received by the public regarding environmental care behavior with knowledge so that it has implications for the

community's environmental care behavior. The emergence of environmentally friendly schools (adiwiyata) is also able to have a positive influence on people's behavior in the future.

This research has weaknesses and limitations both in terms of data and variables used. In terms of data, the data presented are only cross-section data (one-time point) so that no other data can be used as a comparison. Suggestions for further research, it is advisable to add other variables that have not been included in this study such as the number of household members, and how many household members work so that it can be seen how the influence of household structure can also influence the behavior of household electricity usage. The addition of variable changes in the basic electricity tariff is also interesting to analyze. Looking at household electricity consumption patterns with cluster analysis can also be done in the next analysis.

REFERENCE

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of environmental psychology*, 25(3), 273-291.

Biesiot, W., & Noorman, K. J. (1999). Energy requirements of household consumption: A case study of the Netherlands. *Ecological Economics*, 28, 367–383

BPS. (2014). *Kajian Indikator Sustainable Development Goals*. Jakarta: Badan Pusat Statistik.

BPS. (2018). *Statistik Indonesia 2018*. Jakarta: Badan Pusat Statistik.

BPS. (2018). *Statistik Lingkungan Hidup Indonesia 2017*. Jakarta: Badan Pusat Statistik.

Chen, X., Hong, D., Liu, J., Peterson, M. N., Hull, V., & Lu, C. (2011). Effects of attitudinal and sociodemographic factors on pro-environmental behavior in urban China. *Environmental Conservation*, 38(1), 45–52.

ESDM. (2018). *Statistik Ketenagalistrikan Indonesia 2017*. Jakarta. Direktorat Jendral Ketenagalistrikan.

Huebner, G., Shipworth, D., Hamilton, I., Chalabi, Z., & Oreszczyn, T. (2016). Understanding electricity consumption: A comparative contribution of building factors, sociodemographics, appliances, behaviors, and attitudes. *Applied Energy*, 177, 692–702.

Kollmuss, A., & Agyeman, J. (2010). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260.

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, 56(3), 407–424.

Steinhorst, J., Klockner, C., & Matthies, E. (2015). Saving electricity - for the money or the environment? Risks of limiting pro-environmental spillover when using monetary framing. *Journal of Environmental Psychology*, 43, 125-135.

Chen, X., Hong, D., Liu, J., Peterson, M. N., Hull, V., & Lu, C. (2011). Effects of attitudinal and sociodemographic factors on pro-environmental behavior in urban China. *Environmental Conservation, 38*(1), 45–52.

ESDM. (2018). *Statistik Ketenagalistrikan Indonesia 2017*. Jakarta. Direktorat Jendral Ketenagalistrikan.

Huebner, G., Shipworth, D., Hamilton, I., Chalabi, Z., & Oreszczyn, T. (2016). Understanding electricity consumption: A comparative contribution of building factors, sociodemographics, appliances, behaviors, and attitudes. *Applied Energy, 177*, 692–702.

Kollmuss, A., & Agyeman, J. (2010). Mind the Gap : Why do people act environmentally and what are the barriers to proenvironmental behavior ? *Environmental Education Research, 8*(3), 239–260.

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues, 56*(3), 407–424.

Steinhorst, J., Klockner, C., & Matthies, E. (2015). Saving electricity - for the money or the environment? Risks of limiting pro-environmental spillover when using monetary framing. *Journal of Environmental Psychology, 43*, 125-135.

Stroup, R. L. (2016). *Economics: What Everyone Should Know About Economics and the Environment*. Washington DC. Cato Institute.

Thogersen, J. (2013). Psychology: inducing green behavior. *Nature Climate Change, 3*(2), 100-110.

Xiao, C., & Hong, D. (2010). Gender differences in environmental behaviors in China. *Population Environment, 32*, 88–104.

Yusuf, Arief Anshory & Herminia Francisco, Hotspots! Mapping Climate Change Vulnerability in Southeast Asia, 2010, *Economy and Environment Program for Southeast Asia*, Singapore. ISBN: 978-981-08-6293-0.