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Externalities of Waste Dis-amenities, the Benefit Transfer Application on the Piyungan and the Putri Cempo Landfill, Indonesia

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ABSTRACT

Waste is a national problem in Indonesia. It is related to the old paradigm of waste management, which is only collected, transported, and disposed to the landfill. The same problem occurs in some big cities in Java. Landfills use open dumps, and that causes an increase in negative externalities in the quality of the environment for people who live nearby. This study aims to analyze the externalities of the Piyungan landfill. The objects of this research are the people who lived around the dump. Cost of illness and replacement cost are analysis tools to calculate the externalities. Benefit transfer is used to analyze the externalities of the Putri Cempo landfill in Surakarta. The benefit transfer method was developed as an alternative way to value externalities using values from studies of similar circumstances, carried out at related sites somewhere else, given the challenges and high costs inherent in assessing the actual price. Accurately, to test the performance of the benefit transfer method, this study focused on estimates of externalities associated with waste dis-amenities. The results indicate that the existence of the Piyungan landfill has a negative influence on the economic and social aspects as well as the environment of the people around it. It also happens in the Putri Cempo Landfill.

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1. Introduction

Waste is a consequence of the human activity. Every human activity must produce waste or garbage. The amount or volume of waste is proportional to the level of human consumption of goods/materials that we use every day. Likewise, with the type of waste, it depends on the kind of content consumed. Therefore, waste management cannot be separated from the 'management' of people's lifestyles.

The increase in population and changes in lifestyle significantly affect the volume of waste generated. The Piyungan landfill is a landfill that serves urban waste in the areas of Sleman Regency, Yogyakarta City, and Bantul Regency. The furthest service area is about 35 km, and the average per day of waste dumped into landfills is 450 tons (Bantul Regency Environmental Agency, 2018). Management that has been carried out is by sorting waste. The amount of waste sorting is still relatively small, which is done by 5% of the incoming waste. Scavengers do waste sorting only for goods that are still sold. These selling items are usually in the form of bottles, plastic, and paper. The amount of garbage entering 150 trucks per day. The existence of the Piyungan landfill provides benefits to the surrounding community but can also be a problem. With the positive and negative impacts of waste management in the Piyungan landfill, an environmental impact assessment is needed. Valuation on environmental impact is using replacement cost method and cost of illness. This calculation is carried out to value the externalities of Piyungan landfills. The results obtained using primary data conducted at the Piyungan landfill location will be calculated benefit transfer at The Putri Cempo landfill.

The Putri Cempo landfill is located in Surakarta. The total land area of the Putri Cempo landfill is 17 hectares and can be used for infrastructure development in waste management with a maximum area of 8 hectares. TPA The Putri Cempo is located in Jatirejo RT 06/11, Kelurahan Mojosongo, Jebres District, Surakarta City. The access road to the Project site is through the Pelangi Mojosongo road in Surakarta. The distance from the way to the Project site is about 919 meters or 1 km. This distance is from TPA The Putri Cempo to the main road, Jalan Mayor Achmadi, via Jalan Pelangi Selatan. Surakarta City, in its daily life, produces garbage that fluctuates between 240 to 300 tons/day, as can be seen in Figure 5. Average waste entering the landfill (final disposal site) The Putri Cempo is 250 tons/day (Surakarta City Environmental Agency, 2018).

Benefit transfer is used because the Piyungan landfill and Putri Cempo landfill have the same characteristics. Krupnick's study (1993) shows that the benefits of the transfer method can be used if the natural resources of the ecosystem have the same ecosystem and market characteristics.

2. Literature Review

Benefit transfer can quantify tourism and existence values (Loomis, 2006), estimates of several million dollars for the increased number of sea otters expected by USFWS in the next decade if the "no otter zone" is eliminated and otters allowed to expand along with the Santa Barbara coast. The benefit estimation of sea otter expansion exceeded the costs to the commercial fishing and benefit transfer approach can contribute to complete economic analysis of endangered species recovery or critical habitat efforts than the current USFWS approach.

Eshet et al. (2006) used the benefit transfer method with four different cities in Israel. This method is used to estimate the value of waste transfer-stations in Israel. The approach used is a policy that will be applied to test the sensitivity of the transfer of functions to the socioeconomic and city characteristics. The specific aspects used are socioeconomic characteristics and type of housing. The benefit of using benefit transfer is that the error rate obtained is smaller in terms of the size and location of the same city.

Plunner's study (2009) carried out benefit transfers on the valuation of ecosystem services. Benefit transfer applies the estimated economic value from one location similar to another site. It was done because according to him to research with primary data requires quite expensive costs. Benefit transfers carried out mostly have a land area or habitat type that is not much different. It has almost the same vulnerabilities and impacts. The benefit of using benefit transfer is that it can provide more insight into the values of ecosystem services.

Nahib (2011) uses the benefit transfer method for mangrove forests in the ALKI II region. The calculation of economic valuation is based on the benefit transfer method based on the valuation value of the primary location as a reference, the quality of the map of mangrove forest resources that will be given benefit transfers, the socioeconomic characteristics of the community. After that, a recalculation is done by estimating the economic valuation value of the primary location (referral location) to the location given benefit transfer. The study results show that the economic valuation value in the study area ranges from the U.S. $ 9,278.14 to the U.S. $ 20,500.99 or reaching 67% to 150% of the value of the primary location.

Barbara (2012) conducted a study of benefit transfers of similarities between research locations and policies. It can be from the quality, area, socioeconomic characteristics, population, income, or environmental changes due to a plan. The advantages obtained by using benefit transfer are cost, time, filtering techniques in assessing the needs that exist at the reference location, and it is easier and faster to apply the estimated values. Weaknesses are the possibility of misunderstandings in the assessment increase, lack of availability, or obtain poor quality results; the estimated value of the unit can be obsolete quickly. In terms of avoiding shortcomings by using the transfer of benefits, there is a need for time and information equality, a meta-analysis, and a calibration function.

3. Research Method

This study uses primary data and secondary data. Primary data was taken based on interviews with several residents living around the Piyungan landfill. Respondents were asked about water and air pollution they felt because of the existence of landfill. The selection of respondents is based on the distance of their closest residence to the landfill.

Data analysis methods used in this study are descriptive statistical analysis, replacement cost, cost of illness, and benefits transfer. Descriptive statistical analysis is used to analyze the impacts that occur at the Piyungan landfill by describing the data collected by the facts on the ground. The replacement cost method is calculated from the amount of cost to obtain clean water due to water pollution in wells and fresh air due to air pollution around the Piyungan landfill. The cost of illness is the cost of treatment due to disease due to contamination. Benefit transfer is used to calculate the externalities value of the Putri Cempo Landfill.

a. Replacement Cost

The replacement cost is used to calculate the negative impact due to pollution from residents' well water, so the community must use another water source. This replacement cost is used to buy water with tanks, gallons, PAM, and other clean water sources. Replacement costs used are costs incurred by paying electricity for fans, more cooling pads, air conditioners, and buy air freshener.

The use of clean water and electricity usage is calculated based on the consumption of each respondent for one month, which is then multiplied by the number of residents of the nearest village. Replacement costs for obtaining water are calculated as follows (Bujagunasti, 2009):

$$TP_{water} = \sum B.A. \quad (1)$$

where: TP_{water} = Total cost of clean water consumption/ year (Rp)
BA = Cost of water consumption/household/year (Rp)

$$TP_{air} = \sum BA \quad \ldots\ldots (2)$$

where: TP_{air} = Total cost of electricity consumption/year (Rp)
BA = Cost of electricity consumption/household/year (Rp)

b. Cost of Illness

The impact of landfills is also calculated using the cost of illness (COI) method. This COI is a medical expense borne by the community to treat the ailments they suffer from air pollution, land, and water originating from the Piyungan landfill. The total costs calculated are the costs incurred to treat the illness suffered, including the loss of hospital care, treatment during healing, and medicine. The formula used to conduct valuations with this method is (Pahlefi, 2014):

$$B.P. = BPRT \times Intensity\ TBP = \sum B.P. \quad \ldots\ldots (3)$$

where: BP = cost of illness/household/year (Rp)
BPRT = cost of illness/household (Rp)
Intensity = Intensity of illness/year
TBP = total cost of illness/year (Rp)

c. Externalities Calculation

The externalities value of The Piyungan landfill is calculated by adding the amount of total cost illness and total consumption cost of water and air

$$\sum EN = TRC_{water+air} + TBP \quad \ldots\ldots (4)$$

Where : $\sum EN$: the number of negative externalities
$TRC_{water+air}$: Total Replacement Cost of water and air
TBP: Total Cost of Illness

d. Benefit Transfer

The benefit transfer method was developed as an alternative way to value externalities using values from studies of similar circumstances, carried out at related sites somewhere else, given the challenges and high costs inherent in assessing the actual price (Eshet et al., 2006). This approach involves transferring an estimated benefit function from a study site to a policy site, is more sophisticated, and is assumed to produce more accurate results than the above approach mainly because it transfers more information.

This method is applied from the externalities calculation of the Piyungan landfill, using replacement costs and costs of illness, to The Putri Cempo landfill. The calculation results show the externalities value of the Putri Cempo landfill.

4. Results and Discussion

a. Replacement Cost

Replacement cost is used to estimate the externalities value of The Piyungan landfills. The existence of the Piyungan landfill has a negative externality, which pollutes the well water of residents and the surrounding air. The way to overcome the availability of clean water is that the community must use other water sources. This fee is applied to buy tank water, gallons, PAM,

and other water sources. The calculation is based on the results of interviews with resource persons in the Putri Cempo landfill area, calculated on average each month. Replacement cost calculation for clean water consumption is shown in table 1.

Table 1. Replacement cost calculation for clean water consumption around The Piyungan landfill area

Water sources	Total Cost (Rp/household/month)	Total Replacement Cost (Rp/year)
PAM	60.000	720.000
Gallon	150.000	1.800.000
Water tank	180.000	2.160.000
Bottled mineral water	165.000	1.980.000
The total cost of clean water consumption		6.660.000
The average cost of clean water consumption		1.665.000
Bawuran Village, 605 household		1.007.325.000
Sitimulyo Village, 19.588 household		32.630.670.000
Replacement Cost		33.637.995.000/year

Source: primary data, 2019

Table 1 shows the replacement cost of clean water consumption in the Piyungan landfill is Rp 33,637,995,000 per year as an external value. Bawuran and Sitimulyo villages are areas that are negatively affected by the existence of the Piyungan landfill because the location of the two communities is very close to the dump. Then the benefit transfer is implemented to calculate the externalities value of The Putri Cempo landfill. The area affected by the Putri Cempo landfill is Mojosongo Village, with a population of around 53,028 people. Table 2 shows the benefit of transfer calculation on replacement cost for clean water on the Putri Cempo landfill area.

Table 2. Benefit transfer for clean water consumption around The Putri Cempo landfill area

Water sources	Total Cost (Rp/household/month)	Total Replacement Cost (Rp/year)
PAM	60.000	720.000
Gallon	150.000	1.800.000
Water tank	180.000	2.160.000
Bottled mineral water	165.000	1.980.000
The total cost of clean water consumption		6.660.000
The average cost of clean water consumption		1.665.000
Mojosongo, 53.028 Household		88.291.620.000
Benefit transfer		88.291.620.000/year

Source: primary data, 2019

The total replacement cost for the consumption of clean water incurred by residents of the Mojosongo Kelurahan due to externalities arising from the Putri Cempo landfill is Rp 88,291,620,000 / year. This amount is quite large compared to The Piyungan Landfill because the number of residents affected by the Putri Cempo Landfill is also higher.

Air pollution is calculated by replacement cost using data in the form of expenses incurred, paying electricity for fans, more cooling pads, air conditioners, and buying air fresheners. The results of the calculation of replacement costs for clean air consumption The Piyungan landfill are shown in table 3.

Table 3. Replacement costs for clean air consumption around The Piyungan landfill area

Air source	Total Cost (Rp/household/month)	Total replacement cost (Rp/year)
Fan	50.000	600.000
Cooling Pack	100.000	1.200.000
Air Conditioner	150.000	1.800.000
Air Freshener	25.000	300.000
Total cost		3.900.000
Average electricity costs incurred for clean air consumption		975.000
Bawuran Village, 605 household		589.875.000
Sitimulyo Village, 19.588 household		19.108.050.000
Replacement Cost		19.697.925.000/year

Source: primary data, 2019

As a result of air pollution around the Piyungan landfill, the local population uses much electricity to eliminate the unpleasant odor that arises due to the piles of garbage in the Piyungan landfill location. The cost of electricity consumption used by residents around the Piyungan landfill to be able to breathe fresh air comfortably costs up to Rp 19,697,925,000/year. Transfer benefit is used to calculate the cost of electricity consumption as a negative externality of the Putri Cempo landfill. The area affected by The Putri Cempo landfill is Mojosongo Village, with a population of around 53,028 people. Table 4 shows the benefit transfer calculation for the cost of electricity consumption in the Putri Cempo landfill area.

Tabel 4. Replacement costs for clean air consumption around The Putri Cempo landfill area

Air source	Total Cost (Rp/household/month)	Total replacement cost (Rp/year)
Fan	50.000	600.000
Cooling Pack	100.000	1.200.000
Air Conditioner	150.000	1.800.000
Air Freshener	25.000	300.000
Total cost		3.900.000
Average electricity costs incurred for clean air consumption		975.000
Total Population of Mojosongo Village (53.028* Rp 975.000)		51.702.300.000
Air Replacement		51.702.300.000/tahun

Source: primary data, 2019

Costs incurred as a substitute for clean air consumption amounted to Rp. 51,702,300,000 / year. The amount issued is more due to the number of residents exposed to the unpleasant odor of The Putri Cempo landfills. Also more.

b. Cost of Illness

The medical expenses used are costs borne by the community. The cost of medical examination for residents affected by the Piyungan landfill is Rp. 5,000. The fee is based on Decree No. 45 and Perbub No. 49 in 2016. The number of patients obtained from the average number of patients during the three years (2015-2017).

Table 5. Medical costs of the population around The Piyungan landfill area

Types of diseases	Number of patients/year	Medical expenses (Rp/year)
Acute nasopharyngitis	3.585	17.925.000
Diarrhea and Gastroenteritis	580	2.900.000
Cough	265	1.325.000
Acute pharyngitis	861	4.305.000
Myalgia	2.913	14.565.000
		41.020.000

Source: primary data, 2019

Medical expenses incurred by residents affected by The Piyungan landfill externalities amount to Rp 41,020,000/year. Diseases that are mostly suffered are illnesses related to breathing. The Putri Cempo landfill also provides externalities that are not much different from The Piyungan landfills, so that benefit transfers can be made using existing data from The Piyungan landfills. At the Putri Cempo landfill, the cost of a health examination for the population was Rp7,500. The fee is based on the regulation of the Mayor of Solo, Central Java Province No. 35 of 2014 concerning health service tariffs. The number of sufferers obtained from the average number of sufferers over the past three years (2015-2017).

Table 6. Medical costs of the population around The Putri Cempo landfill area

Types of diseases	Number of patients/year	Medical expenses (Rp/year)
Acute nasopharyngitis	3.585	26.885.000
Diarrhea and Gastroenteritis	580	4.352.500
Cough	265	1.985.000
Acute pharyngitis	861	6.455.000
Myalgia	2.913	21.845.000
		61.522.500

Source: primary data, 2018

Medical expenses incurred by residents around the Putri Cempo landfill are Rp. 61,522,500 per year. Because it uses the benefit transfer method and the impact of externalities caused by the same as the Piyungan landfill, the disease felt by residents around the Putri Cempo landfill is also the same, which is related to the respiratory tract.

c. Externalities valuation of The Piyungan landfill and The Putri Cempo landfill

The externalities valuation of these two places is the total amount using replacement costs and costs of illness. Table 7 shows the externalities valuation of the Piyungan landfill and the Putri Cempo landfill.

Table 7. Externalities valuation of The Piyungan landfill and The Putri Cempo landfill

Externalities valuation	Amount (Rp)	
	The Piyungan landfill	The Putri Cempo landfill
replacement cost	53.335.920.000	139.993.920.000
cost of illness	41.020.000	61.522.500
Total	53.376.940.000	140.055.442.500

The externalities value of The Putri Cempo landfill is higher than the Piyungan landfill. It indicates the number of people affected by harmful externality exposure.

5. Conclusion

The externalities value of the Piyungan landfill is calculated through two methods, replacement cost and cost of illness. The value is IDR 52,376,940,000. The benefit transfer calculation is implemented in the Putri Cempo landfill because the object has the same existing conditions on the Piyungan landfill. The externalities value of The Putri Cempo landfill is IDR 140,055,442,500, higher 37.4% than the Piyungan landfill. It indicates that the Putri Cempo landfill has a more negative impact than the Piyungan landfill.

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