

HOUSEHOLDS' AWARENESS AND WILLINGNESS TO PAY FOR DOMESTIC WASTEWATER SERVICES: A CASE OF BATAM CITY, INDONESIA

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Abstract

Most developing countries lack access to a reliable domestic wastewater service. The perception that government should deliver public goods, along with high investment and limited public budget capacity, create barriers for investing in and providing this service. Literatures on the implementation of Polluter-Pays Principles bring the possibility for charging households for wastewater service to recover operational cost and capital cost. This study aims to see the relationship between public awareness and the probability to pay higher for domestic wastewater services using the case of Batam City, Indonesia. Logit regression analysis method is utilized to 663 observations and result shows that households - who realize that domestic wastewater is a source of pollution and the polluter must pay - have a positive relationship with the probability of paying higher for domestic wastewater services. This finding could be an opportunity for charging the externality of water user and increasing economic feasibility for investing in wastewater service.

Keywords: domestic wastewater, environmental awareness, Polluter-Pays Principle, willingness to pay

Introduction

The use of clean water will result in 65%-85% of domestic wastewater discharge (Elysia, 2018; Metcalf & Eddy, 1991), whereas untreated domestic wastewater is a form of negative externality as they pollute the environment and create a negative impact on health. Global estimation shows that more than 80% of wastewater discharge into the environment without being treated safely (United Nations, 2017). The World Health Organization (2019) states that at least 2 billion people use drinking water contaminated with feces, posing a risk to disease, particularly diarrhea, which can cause death. Globally, it estimates an economic loss of about USD 260 billion each year due to limited access to water and sanitation (Hutton, 2012).

Domestic wastewater management in developed countries is relatively better

than in developing countries, most still lacking access to clean water and sanitation (Jhansi & Mishra, 2013). Developing countries have limitations in funding the construction of centralized domestic wastewater treatment facilities, which are relatively expensive (Massoud et al., 2009). According to the Asian Development Bank (2011), several countries in Asia do not yet have an effective domestic wastewater treatment system, which results in a shallow rate of domestic wastewater that safely treats as shown in the Philippines (10%), India (9%), and Vietnam (4%). Meanwhile, several big cities in Asia have served with a sewerage treatment system that uses modern technology, including Singapore, Hong Kong and Osaka (100%), Seoul (98%), and Kuala Lumpur (80%) (Asian Development Bank, 2004).

In Indonesia, only 1% of domestic wastewater and 4% of sewage treat safely

(The World Bank dan AusAID, 2013). The Water and Sanitation Program study estimated that Indonesia had lost IDR 56 trillion (USD 6.3 billion) or around 2.3% of GDP in 2007 due to poor sanitation and hygiene conditions (The World Bank and AusAID, 2013). The majority of cities in Indonesia received financial assistance in the construction of a centralized domestic wastewater management system, such as Medan and Yogyakarta from ADB, Surakarta, and Banjarmasin from the World Bank, Palembang from AusAID, Denpasar and Jakarta from JICA, and Batam from EDCF South Korea (The World Bank and AusAID, 2013).

Domestic wastewater service fees are charged to service users to fulfill the full cost recovery in the facility's operation. In Indonesia, wastewater tariffs determine at the municipality level, with different policies in each region. Bandung charges the domestic wastewater service fee of 30% from the water user bill; Jakarta uses the building size as the benchmark for the tariff, while Yogyakarta sets the tariff based on the number of rooms and the number of residents. The study by USAID (2006) shows that wastewater tariffs in Bandung and Jakarta can cover the investment, operation and maintenance (O&M), and depreciation costs of the centralized domestic wastewater treatment facility services. It is plausible because areas such as Jakarta mainly serve the commercial entities that have a good revenue stream. In Banjarmasin, the condition is different; the tariff is 25% of the clean water usage bill, which is only sufficient to cover O&M costs. The situation in other cities is even worse; the tariff is so low that it leads to financial losses (The World Bank and AusAID, 2013). In general, it can conclude that wastewater management's performance in Indonesia is still low, and most centralized domestic wastewater services have not yet achieved cost recovery due to low system utilization and willingness to pay

connection fees or user fees (The World Bank dan AusAID, 2013).

Implementation of Polluter-Pays Principle (PPP): A Review

Externalities generated from water use are often overlooked and not considered in determining water user fees; thus, clean water tends to be undervalued and overused (White, 2015). The cost of providing clean water should incorporate not only investment and O&M costs but also the environmental and societal impact cost as the additional cost bear by the user as the responsible party (Djono, 2017). The Polluter-Pays Principle (PPP) is a concept used to overcome market failures by internalizing external costs or environmental costs into production costs which put the polluter as the payer for the cost incurred (OECD, 1992). The cost of domestic wastewater treatment in many countries calculates using the benchmark of clean water usage (Palanca-Tan, 2015). The cost of wastewater services based on Willingness To Pay (WTP) use as a cost-recovery price approach (Le & Aramaki, 2019). User contributions to O&M costs and (partially) investment costs by paying user fees/tariffs expect to achieve the sustainability of domestic wastewater services and attract private sector investment through the Public-Private Partnership scheme so that more people serve.

Knowing the public's willingness to pay becomes relevant to see whether the polluter could bear the burden of O&M cost or even capital cost. Awareness of polluters to bear the burden is important because it can encourage their motivation to pay the cost of wastewater services. Yulianti & Ansusanto (2002) stated that a person's environmental awareness could drive by his concern for the impact of pollution, which base on the Polluter-Pays Principle. In addition, consumers' willingness to pay reflects an effort or behavioral intention strongly influenced by

awareness and perception (Ajzen & Driver, 1992).

Increasing people's awareness of environmental and water conservation can change their behavior to help improve the environment by being willing to pay for increased sewerage services (Munusami, Othman, Ismail, & Siwar, 2016). Consumers who have low environmental awareness attitudes are likely to have a low willingness to pay for environmental products (Husted, Russo, Meza, & Tilleman, 2014). Meanwhile, the Palanca-Tan study (2015), which aims to monetize the benefits of wastewater treatment facilities in Metropolitan Manila City, found that household perceptions of domestic wastewater being the source of water pollution influence WTP for domestic wastewater management. Meanwhile, perceptions that households must contribute money to clean water bodies do not influence the WTP of domestic wastewater management.

This study uses quite specific questions regarding household perception, which other studies have not raised. From the authors' observation so far, the study regarding willingness to pay for wastewater services is quite rare, particularly those using specific perception questions used in this study. Hence, this study aims to see the relationship between households' perception—who realize that domestic wastewater is a source of pollution and as a polluter must pay according to the PPP concept—with the probability of having a higher willingness to pay for domestic wastewater services. This study does not use a specific economic valuation method in estimating the WTP, and the result is present in the form of a higher probability of willingness to pay obtained from the logit regression estimation results.

Clean Water and Proper Sanitation Facilities in Batam City

This study uses Batam City as the case to represent most cities in developing

countries. Batam City is one of the Free Trade Areas and Free Ports in the Riau Islands Province, Indonesia (Batam City Statistics Agency, 2021). With a population of 1.2 million people in 2020, Batam City has a very strategic regional position directly adjacent to Singapore and Malaysia and is in the international shipping lanes of the Singapore Strait and the Malacca Strait. As a destination for foreign investment that must have competitiveness in the Asia Pacific, Batam City is required to provide access to clean water and proper sanitation to support the industrial, trade, maritime, tourism, and other sectors to achieve sustainable development goals.

In 2020, households in Batam City had access to safe drinking water sources that cover 97.62% and access to proper sanitation covering 95.99% of the population (Batam City Statistics Agency, 2021). However, the source of fresh water for the people of Batam City is very dependent on rain-fed reservoirs/dams. At the same time, the results of the Surveyor Indonesia's 2020 research show that the levels of water pollution in five reservoirs in Batam City are moderate (Batam Indonesia Free Zone Authority, 2020b). It happens due to the overflow of surface runoff and drainage channels that carry organic substances/waste from upstream to the reservoir (Batam Indonesia Free Zone Authority, 2020b) and the bauxite soil structure in Batam City, which makes domestic wastewater in drainage unable to be decomposed and absorbed by the soil (Joko & Fikri, 2012).

Currently, Batam City is carrying out the construction of centralized domestic wastewater facilities that plan to cover 11,000 house connections. Hence, a fee for domestic wastewater services included in the clean water bill will charge to clean water customers of Batam City. To determine whether households in the area are willing to pay the cost of domestic wastewater management services, a survey takes place to look at the potential of

charging households for wastewater services and whether it can cover the O&M cost.

Methodology

Testing the Models

Based on the survey data, two variables of interest tested in this study: (1) Opinion1 is a dummy variable with '1' refers to the perception of households who agree that domestic wastewater is the largest source of waste and '0' refers to disagree; and, (2) Opinion2 is a dummy

variable with '1' refers to the perception of households who agree that polluters must pay according to the PPP concept and '0' refers to disagree. In addition to those two variables, this study also uses several dummy control variables—i.e., monthly income, monthly water consumption, household size, and work status. Table 1 explains the category of each variable used. The sub-district dummy variable was included in the model equation to control, eliminate, or reduce the heterogeneity bias of the sample characteristics.

Table 1: Operational Definition of Variables

Variable Name	Variable Description	Category
Dependent Variable		
WTP	Willingness to pay domestic wastewater service charges	1: Willing to pay higher than IDR 2,000 per m ³ 0: Unwilling to pay higher than IDR 2,000 per m ³
Variables of Interest		
Opinion 1	Respondents' perception of "household wastewater as the largest source of waste"	1: Agree 0: Disagree
Opinion 2	Respondents' perception of "polluters must pay according to the Polluter-Pays Principle"	1: Agree 0: Disagree
Control Variables		
Income 1	Household monthly income level 1	1: > IDR 2 mio up to IDR 4 mio 0: otherwise
Income 2	Household monthly income level 2	1: > IDR 4 mio up to IDR 6 mio 0: otherwise
Income 3	Household monthly income level 3	1: > IDR 6 mio up to IDR 8 mio 0: otherwise
Income 4	Household monthly income level 4	1: > IDR 8 mio 0: otherwise
Water Consume 1	The volume of monthly water consumption level 1	1: 11 - 20 m ³ 0: otherwise
Water Consume 2	The volume of monthly water consumption level 2	1: 21 - 30 m ³ 0: otherwise
Water Consume 3	The volume of monthly water consumption level 3	1: 31 - 40 m ³ 0: otherwise
Water Consume 4	The volume of monthly water consumption level 4	1: > 40 m ³ 0: otherwise
HH Size 1	Number of household members level 1	1: 2-4 person 0: otherwise
HH Size 2	Number of household members level 2	1: 5-8 person 0: otherwise
Work	Working status	1: Working 0: Not working

Source: Batam Indonesia Free Zone Authority (2020).

This study aims to examine the relationship between households' perceptions of "wastewater disposed of by households is the largest source of waste" (*Opinion1*) and "polluters must pay according to the PPP concept" (*Opinion2*) with the probability of households having higher willingness to pay for water services. The binary logistic estimation is used and formulated as follows:

$$P_i (highWTP = 1) = \frac{1}{1 + \exp^{-Z_i}}$$

$$highWTP_i = \ln \left[\frac{p_i}{1-p_i} \right] = Z_i = \beta_0 + \beta_1 Opinion1_i + \beta_2 Opinion2_i + \sum_{n=1}^{k=5} \beta_n X_{ni} +$$

ε_i

Where *highWTP_i* is a dummy variable with '1' for WTP for wastewater service more than IDR 2,000 per m³ and '0' for WTP IDR 2,000 per m³ or less. The construction of the questionnaire does not allow us to use the Contingent Valuation Method (CVM) because the questionnaire did not design to estimate the WTP with elicitation methods that applied for CVM, such as open-ended or dichotomous choice.

Several procedures conduct before estimating the logit model, including the multicollinearity test, the goodness of fit

test, and the Wald test. A correlation coefficient of 0.8 is sufficient to indicate the existence of a multicollinearity problem (Gujarati & Porter, 2009). Pseudo-R square use to measure the goodness of fit model, but the results of the Pseudo-R square are pretty weak and doubtful to be analyzed, so it is necessary to test the goodness of fit with Pearson chi-square to measure the accuracy of the model (Hosmer & Lemeshow, 2000). The chi-square value uses to test the significance of the model, and a partial test with the Wald test statistic is also needed to see the effect of each value (β) individually in the model.

The Use of Batam Survey Data

This study used a secondary data from the survey conducted by the Batam Indonesia Free Zone Authority (BIFZA) in 9 sub-districts in Batam Island, namely Batam Kota, Sagulung, Sekupang, Batu Aji, Sungai Beduk, Lubuk Baja, Nongsa, Bengkong, and Batu Ampar at November 2020. From a population of 279,431 clean water customers as of October 2020, the sample size is 663 as calculated from Isaac and Michael's formula (Sugiyono, 2013), with a margin of error of 1%. The sample was divided proportionally according to the composition of the number of customers in each sub-district (Table 2).

Table 2: Distribution of Samples

Sub-District		Population	Sample	%
1	Batam Kota	66,543	158	24%
2	Sagulung	50,422	120	18%
3	Sekupang	43,508	103	16%
4	Batu Aji	37,326	89	13%
5	Sungai Beduk	21,214	50	8%
6	Lubuk Baja	19,160	45	7%
7	Nongsa	18,475	44	7%
8	Bengkong	13,671	32	5%
9	Batu Ampar	9,112	22	3%

Sub-District	Population	Sample	%
Batam City	279,431	663	100%

Source: Batam Indonesia Free Zone Authority (2020).

The questionnaire consists of 3 question blocks—*First*, the general information of the respondents, such as the name, location, and contact number. *Second*, the socio-economic conditions include household's monthly income and expenditure, monthly water usage and bill, willingness to pay for domestic wastewater service charge, household size, and work status. *Third*, questions about respondents' perceptions of the existence and management of wastewater comprehensively and sustainably, with 15 questions including: "Do you agree that the wastewater released by households is the largest source of waste?", "Do you agree that the polluters must pay according to the Polluter-Pays Principle?", "Do you agree that the condition of a septic tank that has not been empty for more than two years indicates a good septic tank condition?" and "Do you agree that there is a need for a cost-sharing policy on wastewater management between the community and the government?".

The question regarding willingness to pay for domestic wastewater services is constructed as follows: "How much is the willingness to pay for domestic wastewater per m³?". The answer is present in five categories, namely below IDR 2,000, between IDR 2,100–IDR 4,000, between IDR 4,100–IDR 5,000, between IDR

5,100–IDR 6,000, and above IDR 6,000, which later in the regression estimation, the category is constructed into binary dummy variable as explained before. This question does not follow any specific method in valuation, particularly elicitation types in the Contingent Valuation Method; thus, this study does not intend to estimate the WTP in terms of value. However, a rough estimation of the WTP and comparing the value to the Ability to Pay (ATP) were conducted as a complementary analysis.

Results and Discussions

Respondent Characteristics, Water Consumption, and Perception on Wastewater

As shown in Table 3, respondents dominate by households with income ranging from IDR 4 million up to IDR 6 million per month (39.06%), having expenses of about 66%–80% of income (27.45%), having 2–4 household members (75.57%), living in a house with type below 72 m² (86.88%), and has working status (68.63%). In terms of water use, most respondents consume water as much as 11–20 m³ per month (36.80%), and the household budget for monthly water payments is in the range between IDR 51,000 and IDR 100,000 (37.86%).

Table 3: WTP with Perceptions and Socio-Economic Characteristics of Households

Variables		WTP			
		Willing to pay higher than IDR 2,000 per m ³		Unwilling to pay higher than IDR 2,000 per m ³	
Respondents' Characteristic					
Household monthly income	up to IDR 2 mio	9	(1.36%)	43	(6.49%)
	> IDR 2 mio up to IDR 4 mio	35	(5.28%)	121	(18.25%)
	> IDR 4 mio up to IDR 6 mio	76	(11.46%)	183	(27.60%)
	> IDR 6 mio up to IDR 8 mio	74	(11.16%)	78	(11.76%)
	> IDR 8 mio	27	(4.07%)	17	(2.56%)
Percentage of	≤ 50%	7	(1.06%)	69	(10.41%)

Variables		WTP			
		Willing to pay higher than IDR 2,000 per m ³		Unwilling to pay higher than IDR 2,000 per m ³	
monthly expenses on income	51 – 65%	73	(11.01%)	96	(14.48%)
	66 – 80%	74	(11.16%)	108	(16.29%)
	81 – 94%	47	(7.09%)	92	(13.88%)
	≥ 95%	20	(3.02%)	77	(11.61%)
Number of household members	1 person	12	(1.81%)	64	(9.65%)
	2-4 person	169	(25.49%)	332	(50.08%)
	5-8 person	40	(6.03%)	46	(6.94%)
House size	< 72 m ²	201	(30.32%)	375	(56.56%)
	≥ 72 m ²	20	(3.02%)	67	(10.11%)
Working status	Working	155	(23.38%)	300	(45.25%)
	Not working	66	(9.95%)	142	(21.42%)
Respondents' Water Usage					
Volume of monthly water consumption	0 - 10 m ³	33	(4.98%)	169	(25.49%)
	11 - 20 m ³	99	(14.93%)	145	(21.87%)
	21 - 30 m ³	55	(8.30%)	66	(9.95%)
	31 - 40 m ³	20	(3.02%)	34	(5.13%)
	> 40 m ³	14	(2.11%)	28	(4.22%)
Household budget for monthly water payments	≤ IDR 50,000	31	(4.68%)	156	(23.53%)
	IDR 51,000 - 100,000	107	(16.14%)	144	(21.72%)
	IDR 101,000 - 150,000	38	(5.73%)	76	(11.46%)
	IDR 151,000 - 200,000	25	(3.77%)	37	(5.58%)
	≥ IDR 201,000	20	(3.02%)	29	(4.37%)
Respondents' Perception					
Opinion 1	Agree	196	(29.56%)	294	(44.34%)
	Disagree	25	(3.77%)	148	(22.32%)
Opinion 2	Agree	206	(31.07%)	325	(49.02%)
	Disagree	15	(2.26%)	117	(17.65%)

Source: Batam Indonesia Free Zone Authority (2020), processed data.

The cross-tab between household size and water consumption in Table 4 shows that about 67% of households consume water below 20 m³ per month, and most of them have 2 to 4 household members. The proportion of respondent who has 5 to 8 family members accounts for 13% of the overall samples, and most

of them use more than 20 m³ of water per month. However, respondents who have more household members tend to lower the volume of water consumption per capita (Figure 1), and, as seen in Figure 2, people with higher income tend to consume more clean water.

Table 4: Water Consumption and Household Size

Monthly Water Consumption	Household Size						
	1 person		2-4 person		5-8 person		Total
0 - 10 m ³	53	(8%)	145	(22%)	4	(1%)	202 (30%)
11 - 20 m ³	19	(3%)	189	(29%)	36	(5%)	244 (37%)
21 - 30 m ³	2	(0%)	91	(14%)	28	(4%)	121 (18%)
31 - 40 m ³	0	(0%)	46	(7%)	8	(1%)	54 (8%)
> 40 m ³	2	(0%)	30	(5%)	10	(2%)	42 (6%)
Total	76	(11%)	501	(76%)	86	(13%)	663 (100%)

Source: Batam Indonesia Free Zone Authority (2020), processed data.

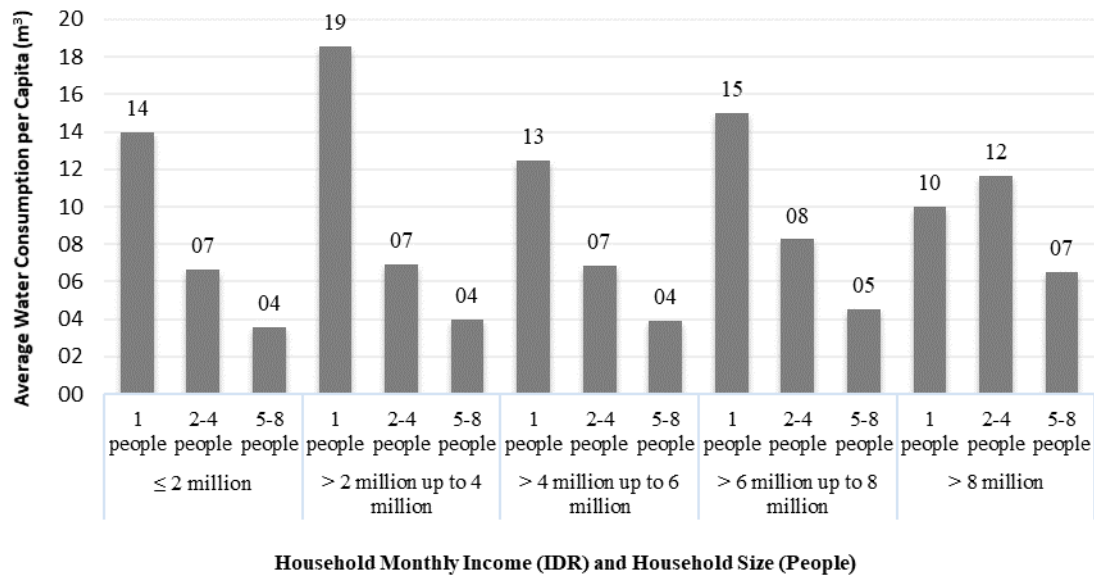


Figure 1. Average Water Consumption per Capita by Households' Size and Income (Batam Indonesia Free Zone Authority, 2020, processed data)

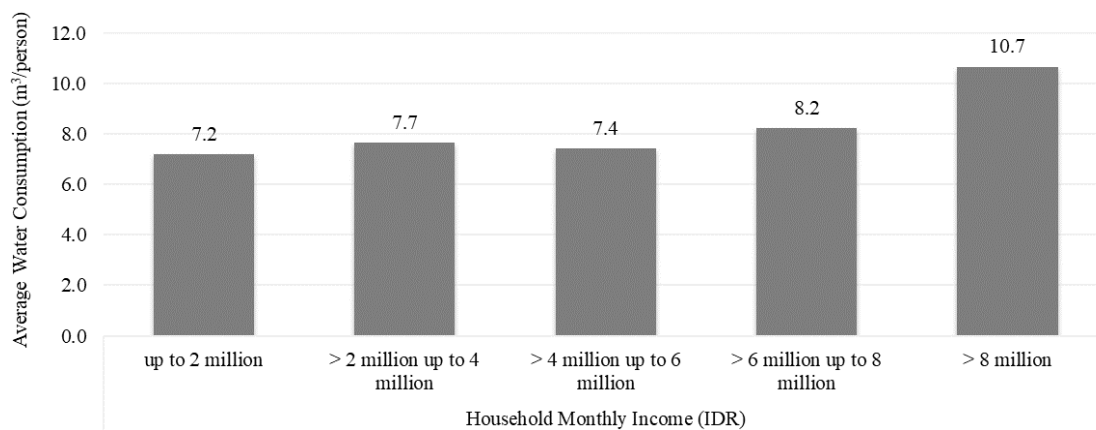


Figure 2. Average Water Consumption per Capita by Households' Income (Batam Indonesia Free Zone Authority, 2020, processed data)

Concerning perceptions, the majority of respondents (73.90%) agreed that "*Wastewater released by households is the largest source of waste*" (*Opinion1*), and most respondents (80.09%) also agreed that "*Polluters have to pay according to PPP*" (*Opinion2*). Nonetheless, most respondents (66.7%) indicated a willingness to pay for domestic wastewater services at a cost lower than IDR 2,000 per m³.

As indicated in Table 5, most respondents (64.86%) approve domestic wastewater as the largest source of waste

and agree that polluters must pay the cost of tackling and preventing pollution. However, 26.09% of respondents do not understand and do not agree that domestic wastewater is the largest source of waste, and some of those respondents do not agree that as polluters, they must pay. Although the proportion is not large, this condition needs to address so that the entire Batam City community can understand the negative externalities of using clean water in daily household activities.

Table 5: Respondents' Perceptions of Pollution and PPP

Respondents' Perception		The polluters should pay according to the "Polluter-Pays Principle"					
		Agree		Disagree		Total	
The wastewater released by households is the largest source of waste	Agree	430	(64.86%)	60	(9.05%)	490	(73.91%)
	Disagree	101	(15.23%)	72	(10.86%)	173	(26.09%)
Total		531	(80.09%)	132	(19.91%)	663	(100.00%)
The condition of a septic tank that has not been empty for more than two years indicates a good septic tank condition	Agree	214	(32.28%)	14	(2.11%)	228	(34.39%)
	Disagree	317	(47.81%)	118	(17.80%)	435	(65.61%)
Total		531	(80.09%)	132	(19.91%)	663	(100.00%)
There is a need for a cost-sharing policy on wastewater management between the community and the government	Agree	482	(72.70%)	43	(6.49%)	525	(79.19%)
	Disagree	49	(7.39%)	89	(13.42%)	138	(20.81%)
Total		531	(80.09%)	132	(19.91%)	663	(100.00%)

Source: Batam Indonesia Free Zone Authority (2020), processed data.

The community needs to understand that as the users of clean water, they have also become the perpetrator of pollution, and when externality occurs, they must bear the external costs. People need to understand and realize this to motivate them to pay the costs arising from the pollution. It is important because users' contribution to the cost of domestic wastewater treatment facilities determines the sustainability of domestic wastewater services and the realization of proper and safe sanitation.

The data from the respondent perception survey also showed that 65.61% of respondents disagreed with the statement that the condition of the septic tank that was not empty for more than two years showed good septic tank condition. It indicates a good understanding by respondents that septic tanks need to be empty periodically to avoid them becoming a source of water and soil pollution. Some respondents (47.81%) who understand it also agree that polluters must pay according to the PPP concept. However, 34.39% of respondents do not understand that septic tanks should be empty periodically, although most respondents perceive that polluter should

pay. This result shows many people who do not know and realize the need to empty septic tanks regularly.

In addition, Table 5 also showed that 72.70% of respondents who agreed with the Polluters-Pay Principle stated the need for a policy of cost-sharing wastewater management between the community and the government. While 20.81% of respondents stated that there is no need for a cost-sharing policy, only 7.39% agreed with the principle of polluters having to pay, and the remaining 13.42% disagreed with the principle of polluters paying. This result shows that the community agrees with the principle that as polluters, they must pay. However, most of the community still expects a cost-sharing policy between the community and the government regarding wastewater management.

Considering the above explanation, in order to make the public understand the benefits of domestic wastewater management facilities and formed motivation to be willing to contribute to the cost of service of the facility, we must perform education to the public related to pollution stemming from the use of clean water to the provision of technical and

financial information from domestic

wastewater management facilities.

Estimation Results and Analysis

The multicollinearity test shows no explanatory variable that is strongly correlated ($\text{Corr} < 0.8$). Nine models of the logit regression estimation are present in Table 6. The consistency of the significance of the interest variables (*Opinion1* and *Opinion2*) across models shows evidence of robustness from the model. Model 1 and Model 2 include only the interest variables, while other models

(Model 3 and Model 4) add the interaction of interest variables. Model 5 only puts the control variables without incorporating interest variables. Model 6 until 9 incorporate both interest variables, interaction variables, and control variables. The goodness of fit tests for all models shows the significance value ($\text{Prob chi-square} > 0.05$) for Model 4, Model 5, Model 7, and Model 9.

Table 6: Logit Model Estimation for Domestic Wastewater Service WTPs

Variable	WTP								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Opinion 1	3.947*** (0.9278)			3.012*** (0.7314)		3.622*** (0.9486)			2.801*** (0.7575)
Opinion 2		4.944*** (1.4256)		3.648*** (1.0826)			5.615*** (1.8185)		4.578*** (1.5467)
Opinion 1 # Opinion 2									
0.Opinion1#1.Opinion2			10.32*** (7.7958)					10.21*** (7.9190)	
1.Opinion1#0.Opinion2			9.681*** (7.5764)					7.095** (5.8153)	
1.Opinion1#1.Opinion2			25.93*** (18.7674)					24.69*** (18.3253)	
Income									
> IDR 2 mio up to IDR 4 mio					1.598 (0.7209)	1.766 (0.8158)	1.654 (0.7607)	1.749 (0.8216)	1.822 (0.8549)
> IDR 4 mio up to IDR 6 mio					1.821 (0.7739)	2.012 (0.8790)	1.926 (0.8379)	2.052 (0.9134)	2.049 (0.9126)
> IDR 6 mio up to IDR 8 mio					3.362*** (1.5083)	3.558*** (1.6418)	4.185*** (1.9554)	4.185*** (1.9936)	4.260*** (2.0290)
> IDR 8 mio					5.285*** (2.8732)	5.351*** (2.9989)	4.863*** (2.7238)	4.898*** (2.7893)	5.039*** (2.8741)
Water Consumption									
11 - 20 m ³					5.515*** (1.5987)	5.237*** (1.5313)	5.859*** (1.7508)	5.505*** (1.6430)	5.526*** (1.6522)
21 - 30 m ³					4.319*** (1.4578)	4.353*** (1.5046)	4.307*** (1.5104)	4.307*** (1.5238)	4.351*** (1.5438)
31 - 40 m ³					3.363*** (1.4016)	3.016*** (1.2730)	3.927*** (1.7060)	3.495*** (1.5240)	3.629*** (1.5835)
> 40 m ³					2.965** (1.4698)	2.627** (1.3232)	3.493** (1.8029)	3.084** (1.5976)	3.223** (1.6756)
HH size									
2-4 person					1.606 (0.6213)	1.678 (0.6637)	1.570 (0.6249)	1.634 (0.6563)	1.600 (0.6433)
5-8 person					3.018** (1.3991)	3.186** (1.5061)	2.737** (1.3041)	2.898** (1.3912)	2.852** (1.3710)
Work					1.099 (0.2385)	1.090 (0.2426)	1.082 (0.2444)	1.076 (0.2467)	1.082 (0.2483)
District					Yes	Yes	Yes	Yes	Yes
_cons	0.169*** (0.0365)	0.128*** (0.0352)	0.028*** (0.0204)	0.069*** (0.0222)	0.042*** (0.0261)	0.147*** (0.0100)	0.008*** (0.0060)	0.002*** (0.0022)	0.004*** (0.0033)
N	663	663	663	663	663	663	663	663	663
pseudo R-sq	0.0492	0.0490	0.0807	0.0768	0.1944	0.2267	0.2362	0.2569	0.2548
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Variable	WTP								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Pearson Chi-Square	.	.	.	0.0861	0.0541	0.0253	0.1157	0.0173	0.0585
GOF Test									

Exponentiated coefficients; Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Source: Batam Indonesia Free Zone Authority (2020), processed data.

Model 9 represents the complete model that will be referring in the narrative analysis. Model 9 is empirically proven to be significant with a chi-square value of 0.0000 and significant ($p < 0.05$), meaning that all independent variables together statistically significantly affect dependent variables in the model. The pseudo-R square value of 0.2548 indicates the model can predict the probability that the public has a higher willingness to pay 25.48%. Partial testing with the Wald test statistic was also carried out and showed statistically significant results ($p < 0.05$) on each interest variable and several control variables. All interest variables and control variables have odds ratio values above '1', which means they have a positive coefficient, so it can interpret that each group of variables has a higher probability of paying higher than the base group.

Logit regression results show that *Opinion1* (wastewater discharged by households is the largest source of waste) positively correlates with a probability of higher willingness to pay for domestic wastewater services. This finding is in line with Palanca-Tan (2015), which found that the perception of a household that wastewater is the leading cause of water pollution tends to pay for managing domestic wastewater in Metropolitan Manila. Therefore, understanding the impact of domestic wastewater on the environment is associated with understanding the benefits of domestic wastewater treatment facilities. The importance of wastewater services perceived by households could bring the potential to charging the user fees that include the clean water service and the cost for treating the domestic wastewater

service, which later can sustain the availability of the clean water itself.

The result also shows that *Opinion2* (polluters must pay according to the Polluter-Pays Principle) positively correlates with a probability of higher willingness to pay for domestic wastewater services. This finding is different from the research results by Palanca-Tan (2015), which found that respondents' opinions about "all households should contribute money to clean water bodies" did not significantly affect willingness to pay for domestic wastewater management fees in Metropolitan Manila. It could be because they do not understand who the responsible party for such a negative externality is. In this study, most respondents agree that domestic wastewater is the largest source of waste (*Opinion1*), and as polluters, they agree that they must pay according to the PPP concept (*Opinion2*). It implies that most of the communities who use clean water already know and realize that they are the cause of pollution, so by understanding the PPP concept, they tend to be willing to pay the cost of domestic wastewater services as a form of responsibility for pollution prevention and control.

Meanwhile, empirical testing for control variables indicates that the household's monthly income, the volume of clean water consumption, and the number of household members have an odds ratio above 1, showing a positive association with the probability of the household having a higher willingness to pay for domestic wastewater services. Higher household income positively correlated with the probability of willingness to pay higher for domestic wastewater services, following the results

of several studies which show that the higher the income, the higher the financial ability and individual opportunity to be able and willing to pay the costs of environmental improvements (Annisa et al., 2015; Emalia & Huntari, 2016; Hagos et al., 2013; Herdiani, 2009; Irawan, 2009; Ladiyance & Yuliana, 2014; Le & Aramaki, 2019; Muhammad et al., 2014; Palanca-Tan, 2015; Saptutyningsih, 2007; Sizya, 2015).

Lower usage of clean water positively correlated with the probability of paying higher for domestic wastewater services. When the water use is relatively low, the water bill amount also tends to be low and might reflect a smaller portion of the water bill from the overall household's expenditure and the importance of water use for primary consumption. Irawan (2009) and Munusami et al. (2016) found similar results showing that less water consumption positively correlates with willingness to pay for clean water services in Surakarta City and sewerage services improvement in Selangor, Malaysia. Based on these findings, we need to promote efficient behavior in water use according to the minimum needs so that the community is willing to pay higher for domestic wastewater services.

Household size positively correlated with the probability of paying higher for domestic wastewater services. In this study, respondents with bigger household sizes tend to lower the water consumption per capita or more efficient use of water, which could also correlate with the smaller household expenditure allocation for water use. As mentioned

previously, it could positively correlate with the probability of paying higher for domestic wastewater services. Byambadorj & Lee (2019) found a corresponding result that the greater the household size, the greater the chance of respondents' willingness to pay O&M costs for the water supply and wastewater treatment improvement system in the Ger area Ulaanbaatar City, Mongolia. In addition, Kaliba, Norman, & Chang (2003) also found that the greater the number of household members, the greater the chance of respondents' willingness to pay for the cost of improving domestic water cleanliness in Tanzania.

Policy Implications of Internalizing Domestic Wastewater Costs

This study examines factors affecting household's intention for paying higher for domestic wastewater services, considering two essential factors: the understanding of households that domestic wastewater is the source of pollution and whether they agree the polluter should pay for the externality they made. The significant result of this study lies in the empirical evidence that the two factors are well-acknowledged as the driver of higher willingness to pay. The result also found the potential of charging domestic wastewater service along with the clean water bills.

As a complementary analysis, this study tries to compare the ATP and WTP values, which are based on the formula adopted from Holloway & Tharp (1990) as follows:

$$ATP = \frac{\text{Income} \times \% \text{ of Expenditure of Income} \times \% \text{ of Wastewater Cost}}{\text{Wastewater Volume}}$$

$$WTP = \frac{\sum_{i=1}^n \text{WTP of Respondent}-i}{\text{Number of Respondents}}$$

As shown in Table 7, the respondents with income below IDR 4 million and above IDR 8 million tend to have a higher WTP than ATP. The World Bank dan AusAID (2013) stated that low-income communities have relatively limited access to sanitation. Therefore, they tend to have a higher willingness to pay for sanitation improvements. Meanwhile, people with income above IDR 8 million show a higher WTP value than ATP due to the relatively lower proportion of expenditure to income and the relatively larger domestic wastewater volume, thus affecting the ATP value.

As indicated in Table 7, respondents with monthly income between IDR 4 million and IDR 8 million show that

ATP is higher than WTP. It means that the WTP of the middle-income community is relatively lower, not due to the low-income ability of the community, but possibly because they do not have high utility for services, considering that the community has not yet experienced the benefits of domestic wastewater treatment facilities which are currently still under construction. The government must provide reliable and professional services to increase public utility for domestic wastewater services so that the community is willing to trust and support the government domestic wastewater service program. It may reduce negative issues that potentially could hinder the sustainability of the program in the future.

Table 7: Domestic Wastewater ATP and WTP by Household Income Level

Household Income Level	Average Percentage of Expenses to Income	Average Domestic Wastewater Volume (m ³ /month)	Domestic Wastewater Tariff of 30% by cubication (IDR/m ³)	Average Domestic Wastewater ATP (IDR/m ³)	Average Domestic Wastewater WTP (IDR/m ³)
Up to IDR 2 mio	68%	14.14	759	1,019	1,404
> IDR 2 mio up to IDR 4 mio	69%	15.12	759	1,546	1,606
> IDR 4 mio up to IDR 6 mio	70%	14.16	759	2,660	1,730
> IDR 6 mio up to IDR 8 mio	73%	17.75	759	3,197	2,286
> IDR 8 mio	69%	26.18	1,695	2,328	3,239
Average by Income Level				2,150	2,053

Source: Batam Indonesia Free Zone Authority (2020), processed data.

However, most of the respondents (66.7%) indicated a willingness to pay for domestic wastewater services below IDR 2,000 per m³, and some of these respondents possibly did not have the willingness to pay for domestic wastewater services. Therefore, the community needs to educate to understand and realize that domestic wastewater is a source of pollution. Thus, the community as the cause of pollution expects to be motivated to pay for domestic wastewater services to prevent and control the pollution.

In addition, if the community consumes less water and the income level of the community increases, then the domestic wastewater tariff can be

considered to be gradually increased up to the limit of the ATP or WTP value. The increase in wastewater rates accompanied by the principle of efficiency in O&M costs expect to increase the excess revenue used to finance investment in providing additional domestic wastewater treatment facilities.

The concept of internalizing the cost of domestic wastewater into clean water bills can also prevent the possibility of arrears in payments for domestic wastewater services. Determining the cost of domestic wastewater services in proportion to the cost of clean water following a progressive tariff pattern according to the consumption block

(increasing block tariff) is also entirely appropriate because this can encourage water and environmental conservation efforts, protect low-income communities in meeting basic water needs at a relatively low price, and meet cost recovery from clean water and domestic wastewater management services (Ma et al., 2018). People with higher income tend to consume more clean water, so the increasing block tariff will result in higher water bills when people use large amounts of water. If people object to more expensive bills and exceed the allocation of income for water consumption, the community will try to reduce the use of clean water. As a result, domestic wastewater discharges can also reduce.

Suppose there is no determination of water tariff in Indonesia, which states it must not exceed 4% of the minimum wage; there is the potential to determine higher tariffs to cover O&M costs and investments. The Batam Indonesia Free Zone Authority (BIFZA), as a domestic wastewater management unit in Batam, estimates that domestic wastewater tariffs will charge at 20% to 30% of the cost of water bills to all customers, not just to customers who have connected to a centralized domestic wastewater pipeline. If implemented, it estimates that O&M costs will be covered, and investment costs will cover within 18 years on average (Batam Indonesia Free Zone Authority, 2020a). However, the problem is that only 11,000 customers receive services through a centralized domestic wastewater pipeline, while all about 280,000 customers as of December 2020 (Batam City Statistics Agency, 2021) pay domestic wastewater service fees. This provision predicts not to sustain because the one who pays the wastewater charge is naturally the one who receives the wastewater service.

Suppose the management wants to expand a centralized domestic wastewater system with coverage to all water customers. In that case, it can be sure that the rate of 20%-30% of the water use bill

will not cover the cost of investment and O&M. Therefore, it is necessary to have particular strategies and incentives for installation construction and cover O&M deficiencies. Tariff evaluation on the use of clean water and wastewater per m³ also needs to be done to ensure that O&M cost is covered, although affordability needs to consider as well. In addition, creating the proper progressive tariff structure can be the solution.

Conclusions

Besides examining the relationship between public perceptions that domestic wastewater is a source of pollution and the probability for the public of having higher willingness to pay for domestic wastewater services in Batam City. This study also attempts to find out the relationship between the public who realize that as polluters, they must pay according to the PPP concept with the probability of having a higher willingness to pay for domestic wastewater services in Batam City.

This empirical study uses the binary logistic regression method on 663 clean water customer households. This result states a positive relationship between public perception—domestic wastewater is a source of pollution—with the probability of the public having a higher willingness to pay for domestic wastewater services in Batam City. Furthermore, there is a positive relationship between the public's perception—who realize that as a polluter must pay according to the PPP concept—with the probability of having a higher willingness to pay for domestic wastewater services in Batam City.

Taking into account the findings on the probability of willingness to pay for the domestic wastewater management service, a number of recommendations can be proposed as policies for the local government, which are among others: (1) The need to internalize the cost of domestic wastewater services into clean water bills because clean water users are polluters who must be responsible for

paying externality costs from the use of clean water; (2) The need to increase public knowledge and awareness that domestic wastewater is a source of pollution and that the public as polluters must be responsible for paying the cost of domestic wastewater services; (3) The need for some efforts to promote water-saving behaviour to the community; (4) The need for effective communication by opening public discussion spaces, information campaigns, socialization, and education, as well as increasing public media support for sanitation; (5) The need for communicators with high credibility, as well as the involvement of community leaders, scholars, and the most influential people in order to change the mindset, attitudes, and behaviour of the community to support the program.

For further research, considering that this study uses data from the BIFZA survey with limited variables, the questionnaire form can adopt the Contingent Valuation Method or other methods using open-ended formats or other formats to determine the amount of WTP value.

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