



Why Should Different City Characteristics Customize the Rate of Pollution Charge? Evidence of Factors Affecting Willingness-to-pay for Wastewater Management in Thailand

Kwanmanas Meethavorn, Chanathip Pharino*

Department of Environmental Engineering, Faculty of Engineering, Chulalongkorn University,
Bangkok 10330, Thailand

*Corresponding author: chanathip.p@chula.ac.th

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Abstract

A challenge for wastewater management is enhancing the efficiency of resource allocation. Polluter Pays Principle is a wastewater charge collection approach that could help support the financial burden faced by many countries. Tailor-made policy implementation based on city characteristics is critical to the success of implementing a national policy to fit well in different local contexts. This study examined gaps for improving municipal wastewater management systems in Thailand through in-depth interviews and a questionnaire survey to identify the factors influencing households' perception and willingness to pay in three different cities. A contingent variation method technique was used to evaluate the preferences of residents. The study revealed that different cities have different factors that influence willingness-to-pay decisions as well as pay-out levels. A single common factor positively affecting willingness-to-pay preference in all three cities is perception and engagement of wastewater treatment service. Citizens with a positive perception of receiving wastewater service are not only more likely to pay the wastewater charge, but also at a higher amount.

Keywords: City characteristics; Rural city; Tourism city; Urbanized city; Tailored-wastewater management; Willingness to pay (WTP)

Introduction

Water pollution has been a serious problem in Thailand for decades, including poor average water quality; only 45% of public water bodies are of good quality [1]. To solve this problem, the government has mainly focused on wastewater (WW) from industrial and commercial areas by enacting laws and regulations to control

discharge quality. Undeniably, residential areas are also one of the main causes of water pollution which accounted for 9.5 million cubic metre per day [2]. To address this critical situation, the government has invested millions of Baht on more than a hundred wastewater treatment plants (WWTPs) throughout the country. However, the treatment capacity is only 27% in terms of

total WW generated [1]. Technological solutions can effectively address water quality problems to a certain extent. Despite how advanced the approach, huge capital investment will be required if there is the existence of poor operation and maintenance (O&M) manners and financial burden to expand wastewater treatment (WWT) capacity.

Currently, wastewater management (WWM) activities in Thailand rely on government fiscal budget allocation, which is basically insufficient. The financial burden is a great challenge to be resolved. As learned from other countries that are more successful in WWM, economic-based instruments are used to set a particular fund for WWM and aid independence from government budget allocation. Thailand has set a national policy, namely the 7th National Economic and Social development Plan, and local ordinances for municipal wastewater treatment fees in particular areas to levy WW charges. However, WW charge has not been practically collected throughout the country. There are two key factors affecting the success of policy implementation on a national scale. The first is knowledge of causation, while the second is knowledge of context [3]. The policy will possibly be successful if there is sufficient knowledge of causation and high comprehension of context. For knowledge of causation for WWM, WWT could treat WW before discharging and help improve the quality of water bodies. Also, WW charge collection could be used as a financial resource to operate WWM activities without government subsidies. The challenge is gaining knowledge of context since different cities have different circumstances.

Differentiated implementation tactics are needed because one policy succeeding in one area does not mean success in another area. When it comes to charging residents on a national scale, study of WWT willingness to pay (WTP) is significant. WTP is the maximum price that an individual is willing to pay for one unit of products

or services. WTP will reflect the cost and reveal consumer preferences. Bohm [4] also stated the importance of WTP estimation; information about how individual preferences variation among social groups could track the effectiveness of policy distribution since it could vary among communities. The impact of information obtained on public goods provision as well as financial decisions should be better known for expanding the financial capacity of such specific public goods with government budget independence.

Existing WTP research is focused in various areas particularly related to public goods such as water quality improvement. Some use variation of contingent variation method (CVM) technique to investigate the factors influencing WTP and find an average WTP amount. Rodríguez-Tapia, Revollo-Fernández [5] used an open-format questionnaire to identify the factors influencing WTP for clean water in Mexico City. They found that family income was directly proportional to WTP, while lack of trust in the water provider was inversely proportional to WTP. Ezebilo [6] studied willingness to pay for improved residential waste management in a developing country and found that type of dwelling affects WTP. This can be referred that residents who live in different type of house will have different WTP preference. Also, price of service negatively affect WTP meaning that when the price of the service is too high, resident may not pay for the service. Dahal, Grala [7] used a Doubled-Referendum technique to estimate WTP to preserve waterfront open space in coastal cities in Alabama and Mississippi. It was found that age and residence duration had a negative influence, whereas income and respondents' membership in a conservation organization had a positive influence on WTP. Jones, Polyzou [8] used an open-ended technique to find social capital influence for drinking water improvement in Mytilene, the capital of Lesbos Island in Greece. They found that income and trust in the government positively affected WTP

amount. Chatterjee, Triplett [9] used a closed-ended method to find WTP for safe drinking water in Jacksonville, Florida and found that greater WTP was influenced by younger people, including the number of children in a household and higher educational level.

In Thailand, there are numbers of studies. Most of them had done in Bangkok [10-14]. For example, Boontanon [11] used 301 questionnaires to validate WTP pay-out level of Bangkok's residents for WWTPs and found that the average amount of WTP is 89 Baht/month/household. Supphatchai [14] used CVM to study WTP for Mahanag and San Sab canal clean-up project found that the average WTP is 360 Bath/person/year. In other provinces, Suanjai [15] studied WTP for WW in Chomthong community, Chonburi found that the average WTP is 107 Baht/month, and TDRI and HIID [16] studied WTP for WWM in Phuket found that average WTP is 79 Baht/month.

Seeing that different cities have different preference and almost all of the previous studies focused on particular areas with their own specific contexts, ignoring investigation of whether there were key common factors in different cities with the same set of questions.

Different cities are hypothesized to have different key factors affecting WTP and different amounts of WTP preference. Therefore, this study aimed to address the knowledge of context by investigating the key factors influencing 1) WTP decisions and 2) pay-out levels in 3 different cities with unique characteristics in Thailand. The main focus was not only to identify the factors influencing WTP decisions and affecting pay-out levels in each city, but also to examine the common factors in the characteristics of different cities. The information obtained from the study, for both WTP amount and factors, should be helpful for policymakers to set up strategic planning for WWM and apply it in other cities with similar characteristics.

Methodology

In this study, the research methodology was divided into two main sections: data collection and data analysis. Figure 1 summarizes an overview of the analytical research process. Three different cities were selected as case study locations to evaluate the factors influencing WTP preferences in cities with different characteristics.

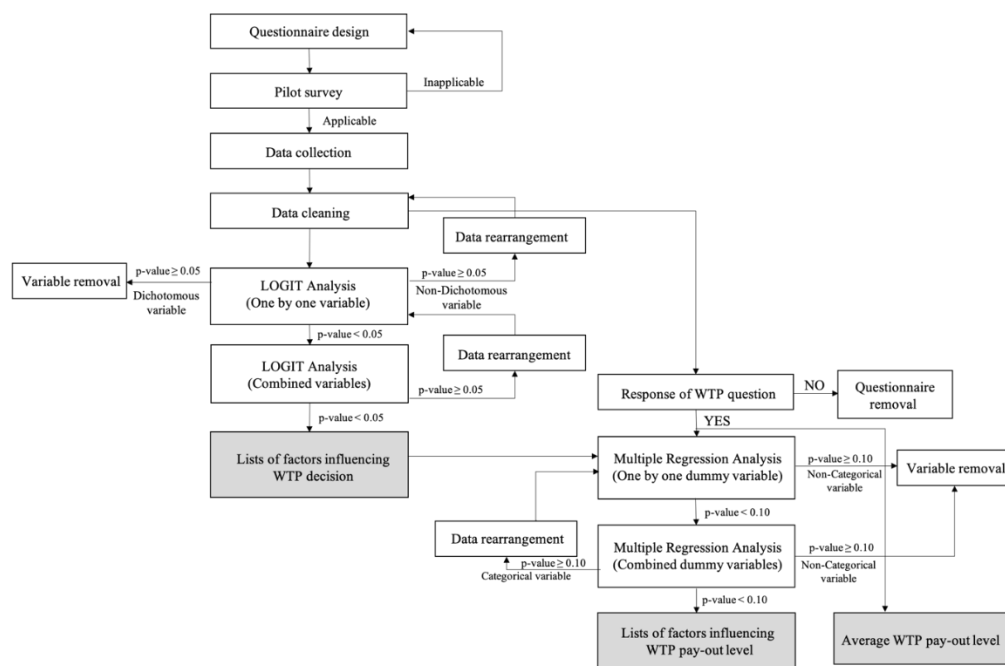


Figure 1 Research analytical process.

1) Case study areas and criteria for selection

There are many cities throughout Thailand. Thus, certain criteria were considered as a filter to select the most suitable cities as case studies. The first considered criterion was WWTPs service coverage. This narrowed the thousands of cities throughout Thailand to 91 municipalities where WWTPs are installed. Then, the characteristics of the city, including population, economic capacity and activities, were taken into consideration. Out of 91 municipalities, 3 cities in Thailand with different and unique characteristics were selected as case studies in this research, namely Bangkok, Pattaya and Tha Rae. The characteristics are summarized in Table 1.

2) Data collection process

2.1) Questionnaire design and development

The questionnaire was designed to examine the factors influencing individual's WTP for water quality improvement in residential areas. To develop the questionnaire, a pilot survey was conducted 3 times with smaller groups of samples than the required sample size in order to ensure that the set of questions could logically reflect the factors influencing WTP. Respondents could complete all questions easily. The questionnaire was divided into two main parts. The first part

mainly focused on the factors potentially influencing WTP. Respondents were generally asked about their sociodemographic information, major environmental concerns, WWM knowledge and perception, pro-environmental behavior and water pollution impacts. The second part was a hypothetical situation of CVM to estimate WTP preferences from residents. A hypothetical situation of water quality was described and compared to the status quo with a diagram. This section began with the introduction of the current situation of poor water quality in Thailand and was followed by a hypothetical management program that used an economic-based instrument (WW charge collection) for better water quality status.

To avoid the influence of initial purport and non-response, the question for estimating WTP is divided into 2 steps. The first step is dichotomous choices, which asks a "Yes" or "No" question. This was designed to let respondents get familiar with the social context and place a simple question to reduce non-response [17]. The question used to evaluate WTP preference is, "If the WW charge collection program enables water quality to be usable and safe for human health without bad odor as well improves city scenery, would you be willing to pay for water quality improvement?"

Table 1 Selection criteria of case study

No	Criteria	Bangkok	Pattaya	Tha Rae
1	Main character or activity	Capital city	Tourist destination	Rural city
2	Total population (NSO, 2019)	5,666,264	119,532	6,944
4	Gross provincial products (NESDC, 2018)	604,421	566,801 (Chonburi)	64,084 (Sakon Nakhon)
5	Main economic activity	Commerce, logistic and communication industry	Tourists related (90%)	Agriculture, Local shops
6	Administration system	Special form considered as metropolis	Special form considered as city municipality	Subdistrict municipality

If the respondents answered “Yes”, the next question would be “What is the maximum WW charge you would be willing to pay monthly?” This question was designed in a direct open-ended format to reduce the influence of initial purport. It allowed respondents to specify their number and reflect individual preferences [17], followed by WW charge payment method choice of preferences. On the other hand, if the respondents disagreed with the program, the next question would address the reasons for rejection.

2.2) Sampling method and sample size

The focus group of the study included residents. Respondents were randomly sampled in residential areas of each city by face-to-face contact. This method allowed respondents to be screened as local residents. They could be clearly advised about the purposes of the survey and were able to ask any questions and could follow the directions correctly. Data collection team members were recruited from a pool of local residents. They were trained and practiced with a real situation until they clearly understood the main objective of the survey as well as the target respondents.

Bangkok residential population were randomly sampled, and questionnaires were collected from 10 different cluster-districts throughout Bangkok. The distribution was aimed to spread through each area suitably varied depending on number of populations of each district. In Tha Rae, Sakon Nakhon, the distribution was made at local government's office where local people mostly come for doing their business daily and at some local shops and restaurants. Additionally, door-to-door data collected was also made because the majority of residents live in detached houses. Questionnaire in Pattaya was also distributed door-to-door by local

residents. They were distributed at local shops, restaurants and residential building throughout Pattaya city both northern and southern part.

In terms of sample size, the level of precision, confidence level and variability level were selected at 0.05, 95% and 0.5, respectively. Referenced by Yamane [18], the equation to calculate the sample size is

$$n = \frac{N}{1+N(e^2)} \quad (\text{Eq. 1})$$

where n = sample size, N = population size, e = level of precision and the total sample size was around 400 samples in all cities, as shown in Table 2. However, questionnaire distribution was planned to add at least 30% of the required sample size in order to compensate for bias among respondents or incompleteness.

3) Analytical process and model used

The aimed results from the analysis process are factors influencing WTP decision, factors influencing WTP pay-out levels of respondents who prefer to pay WW charge and average WTP amount in the 3 cities. The analytical process was divided into 2 main steps. The first step reveals the factors influencing WTP decisions among all respondents by the Logistic regression (Logit) model. In the second step, respondents who refuse to pay WW charge would be removed and the rest could then be used to analyze the factors influencing WTP pay-out level by multiple regression model (MR). With respondents who agree to pay the WW charge, average WTP will be calculated by removing outliers using 3 s.d. measure. The results from the analysis, together with other information in the questionnaire, can then be used to make suggestions for WW charge implementation in each city.

Table 2 Sample size of each city

City	Population size	Sample size requirement	Minimum questionnaire distribution (+30%)	Collected samples
Bangkok	5,666,264	400	520	667
Pattaya	119,532	399	519	565
Tha Rae	6,944	378	492	510

3.1) Logistic regression model

First, the Binary regression model or Logistic regression model (Logit) was selected for WTP preference estimation since the model suits dichotomous dependent answers such as YES or NO, like WTP decision for water quality improvement in this study. The model uses an odds ratio to predict the probability of interested dichotomous responses. Once natural logarithm (ln) was taken into account, this $\ln(\text{Odds})$ is called Logit of $\text{Pr}(\text{success})$ or probability of success. Logit is used to predict multiple independent variables and can be expressed as Eq. 2.

3.2) Multiple regression

Second, multiple regression (MR) was used to analyze the factors influencing average amount of WTP based on data from respondents who are willing to pay the WW charge. MR is used to understand the relationship between one dependent variable and more than one independent variable from the linear relation between dependent and independent variables. The model uses the Least Square (LS) technique for model fit and can be expressed as Eq. 3.

3.3) Remove extreme dataset by 3 standard deviation (3 s.d.) measure

The calculation of average WTP pay-out level is based on 3sd (standard deviation) data. If the maximum or minimum values were out of the range of 3 s.d., the data for those respondents was removed, and the rest would then be used for calculation. This is because 99.7% of data lies within the range of 3 s.d. [19].

Afterward, the factors influencing WTP both decision and pay-out level as well as average pay-out level amount are identified. The information is then grouped and discussed to determine both common factors among these three cities as well as the unique factors for each city. Recommendations for strategic planning of WW charge implemen-

tation are developed accordingly for different local contexts so as to be able to be applied for considerable guidance in other cities throughout Thailand with similar characteristics and perceptions concerning WWTPs.

Results

1) Sociodemographic summary

Regarding the sociodemographic data of samples, the number of female respondents (~60%) was slightly greater than male (~40%) respondents in 3 cities. A majority of respondents (up to 80%) were adults, which can be divided into two groups; early adulthood (20-39 year-old) and adulthood (40-60 year-old). In terms of education level, more than 50% of urban respondents (Bangkok and Pattaya) had up to 12 years of schooling, while a majority of respondents in the rural area (Tha Rae) had not completed secondary school or less than 9 years in an education system. However, only around 20% of respondents in Bangkok and Pattaya had completed at least a bachelor's degree. This was in accordance with national statistics for average education years among Thai workers [20]. Average years of education was 9.5 years or completed secondary school level. Tha Rae respondents had the lowest average income among the 3 cities. Almost all respondents (80%) had a monthly income less than USD 475.84. Only 10% of the previous respondents could earn up to USD 793.06 per month, whereas distribution of income range among major respondents (90%) in Bangkok and Pattaya varied from less than USD 253.78 up to USD 1,586.12 per month. Detached house made up the largest proportion of dwelling type in Tha Rae (up to 90%), while dwelling types in BKK and Pattaya could be divided into 2 major types, namely detached house and shop house.

Note: Currency exchange rate at 1 Baht for 0.032 USD provided by Morningstar for Currency on 25th September 2020.

2) Environmental concern attitude

Water pollution concern was hypothesized to be related positively to WTP. If respondents prioritized water pollution as one of the first three major environmental concerns, it was expected to significantly affect WTP decision and pay-out level. On the other hand, those who prioritized other aspects as the first three major environmental concerns were expected to negatively affect WTP preferences. This is because water pollution has welfare costs and respondents should be willing to pay for better environmental quality in exchange [21]. However, the results showed that the water pollution problem insignificantly affected both WTP decision and pay-out level in all three cities. Water pollution was not a major concern among Bangkok and Pattaya respondents. The first 3 major environmental concerns in Bangkok were traffic congestion, air pollution and waste disposal. Nearly 50% of Bangkok residents prioritized traffic congestion as the 1st problem affecting them, followed by air pollution and waste disposal. Also, Pattaya residents were mostly concerned about traffic congestion. Water pollution, flooding and inundation were not major concerns among Pattaya respondents, unlike in Bangkok. In contrast, traffic congestion accounted for a small portion of concerns in Tha Rae, while water pollution was prioritized as the 1st concern (30%), followed by waste disposal and air pollution.

3) Willingness to pay for WW charge proportion

The results of Bangkok and Pattaya residents' opinions on WTP for water quality improvement are similar. Slightly greater than 50% are not willing to pay for WW charge. On the other hand, 76.8% of residents in Tha Rae municipality are willing to pay the WW charge. However, the rate of pay-out level from Tha Rae is the lowest among these 3 cities. For those who said "No" to the WW charge, the reasons for rejection from the other side of respondents should not be

abandoned. The main reason for respondents who refused to pay the WW charge concerned trust in the government. Some respondents thought that WWM was a government duty and civil tax should cover the WWT cost. Additionally, some did not believe that the money collected would be used effectively to help improve WWM and water quality.

4) Factors influencing WTP decisions

The factors influencing WTP decision analysis not only reveal the list of significant factors, but also show the positive or negative relationships for each factor to WTP decisions. Based on the key factors in Table 3, together with the description of variables in supplementary material, different cities have different factors influencing WTP decisions for water quality improvement. There are 9 significant factors in Bangkok and Pattaya city, and 5 factors in Tha Rae municipality.

Table 3 Significant factors influencing WTP decisions in 3 cities

Variables	B	Sig.	Exp(B)
Bangkok			
Age		0.000	
Age (1)	-1.598	0.013	0.202
Age (2)	-2.148	0.001	0.117
Age (3)	-1.441	0.027	0.237
WWser_Yes		0.006	
WWser (1)	-1.085	0.008	0.338
WWser (2)	-1.121	0.001	0.326
Housesize 6*	0.404	0.088	1.498
Singlehouse	0.556	0.003	1.745
WatBill_250	-0.534	0.005	0.586
Impact 4.0*	0.406	0.069	1.501
WatSav		0.000	
WatSav (1)	-0.800	0.000	0.449
WatSav (2)	-1.201	0.000	0.301
Bachelor	-0.985	0.015	0.373
Inc15000	0.246	0.336	1.278
Bachelor by Inc15000	1.283	0.005	3.608
Constant	3.100	0.000	22.199

Table 3 Significant factors influencing WTP decisions in 3 cities (*continued*)

Variables	B	Sig.	Exp(B)
Pattaya			
Gender	0.412	0.049	1.510
Ownership		0.000	
Ownership (1)	-0.929	0.003	0.395
Ownership (2)	-1.388	0.000	0.250
BillRes	-0.664	0.010	0.515
KNW_4.2	0.578	0.007	1.782
WatBill_400	-0.878	0.000	0.416
Diploma	0.660	0.002	1.934
Wwser_Yes*	0.421	0.086	1.524
Housesize 5		0.000	
Housesize 5 (1)	0.757	0.031	2.131
Housesize 5 (2)	1.176	0.001	3.242
Housesize 5 (3)	1.030	0.001	2.801
Housesize 5 (4)	1.121	0.000	3.069
WatSav		0.004	
WatSav (1)	-0.976	0.002	0.377
WatSav (2)*	-0.526	0.059	0.591
Constant	3.100	0.071	2.207
Tha Rae			
Housesize 8	-1.815	0.001	0.163
KNW 4.0	0.727	0.024	2.069
WWser DK	-0.738	0.028	0.478
Impact_3.2	0.739	0.002	2.094
Edu*		0.063	
Edu (1)	-0.607	0.027	0.545
Edu (2)*	-0.534	0.089	0.586
Constant	0.772	0.026	2.164

Note: *significant at 90 ($p < 0.10$)

4.1) Wastewater management engagement and awareness factors

Among these factors, one common factor for all three cities is wastewater service perception. The factor shows a positive relationship with WTP decision, meaning that residents who perceive that their houses are in a WWT service area are more likely to say “Yes” than those who do not. In Bangkok, residents who perceive a lack of knowledge concerning whether or not they receive WWT service are less likely to pay the WW charge than those who do perceive at around 75% (Table 3). Likewise, Pattaya residents who perceive that their houses are in a

WWT service area are more likely to pay the WW charge by 1.52 times greater than those who do not. In a similar relationship, those who are not certain that their houses are in a WWT service area are less likely to pay the WW charge by around 52.2% than those who are certain that they are in a WWT service area. According to supporting information, Tha Rae had the highest percentage of residents who perceived WWT service in their areas at 78.1%, while Pattaya was 27.8% and Bangkok had the smallest with 9.8%. Thus, acknowledging WW service coverage is one of the crucial factors to increase the success of WW charge policy implementation.

In addition to WWT service perception, other WWM engagement factors are also crucial. Water pollution impact is a common factor influencing WTP decisions on water quality improvement in Bangkok and Tha Rae. More pollution means a higher likelihood of the willingness to pay for the WW charge. Residents who face the negatively high impact of water pollution are more likely to pay the WW charge than those who are less impacted by 1.50 and 2.09 times in Bangkok and Tha Rae, respectively. This result is in accordance with Roomratanapun [13], who argued that more pollution meant more WTP. It could be claimed that pollution has welfare costs and residents would like to pay for better welfare quality in exchange [21]. Besides, knowledge about WWM is a common factor affecting WTP decisions in Pattaya and Tha Rae. The more understanding and awareness about WWM existent, the more residents are likely to pay the WW charge compared to those who have less awareness. Residents with high WWM awareness have high probability to pay the WW charge by 1.78 times than others in Pattaya and 2.07 times in Tha Rae. These results are supported by Jhermpun and Panyasiri [22] and Rammont and Amin [23], whose studies claimed that understanding of WWM significantly affected WTP. Therefore, WWM comprehension is fundamental for local

residents in order to increase the probability of success in WW charge policy.

Water saving awareness is another common factor in Bangkok and Pattaya. People who do not practice water consumption saving when the WW charge is applied are more likely to pay the WW charge than others. The results show that people who said “No” or “Depends on rate levied” to decisions concerning water consumption saving are less likely to pay the WW charge by around 69.9% and 55.1% than those who said “Yes” in Bangkok, respectively. Meanwhile, those who will not save on water consumption are less likely to pay the WW charge by around 62.3% and people who will consider the rate applied beforehand have lower probability to pay the WW charge by around 40.9% than others in Pattaya. From this evidence, it could be implied that WW charge implementation could incentivize water saving behaviors among residents. Still, the rate of the WW charge being levied could affect water saving decisions.

Regarding water bill costs, more water bill costs means a lower likelihood to pay the WW charge. The results show that residents who have a monthly water bill higher than USD 12.69 in Pattaya and higher than USD 7.93 in Bangkok are less likely to pay the WW charge by 41.4% and 58.4%, respectively, compared to those who have cheaper water bills. Besides, responsibility to water bill is another significant factor among Pattaya residents, who in charge of monthly water tariff are 48.4% less likely to pay the WW charge than others. This might be because they have numerous payments and thus prioritize basic needs rather than environmental quality improvement.

4.2) Sociodemographic factors

Education level and income are factors significantly affecting WTP decisions. In Bangkok, residents who possess a bachelor's degree or higher with a monthly income higher than USD 475.84 are 3.61 times more likely to pay the WW

charge compared to others. Similarly, respondents in Pattaya who received at least a diploma level education have a higher probability to pay the WW charge than others. These results are in accordance with studies reporting that respondents are more likely to pay the WW charge when involving higher education level and income groups [22–25]. Meanwhile, Tha Rae contributed an opposite relationship. The longer schooling years, the less probability of WTP for WW charge. Those who have 12 years of schooling or have earned a high school certificate are 45.5% less likely to pay the WW charge; those who have a higher educational level than 12 years of schooling are 41.4% less likely to pay the WW charge than those who had 9 years of schooling or less.

Additionally, household size, types of houses, and house ownership significantly influence WTP decisions. In terms of household size, Tha Rae and Pattaya show that bigger household size means people will be less likely to pay the WW charge, while a higher number of household members mean a higher probability in Bangkok. With 8 members or more, residents in Tha Rae have 83.7% lower probability to pay the WW charge than a smaller household. Also, a smaller number of household members in Pattaya are 2–3 times more likely to pay the WW charge than those houses consisting of 5 members or more. Payment would be prioritized for basic household needs rather than environmental improvement [22, 25]. In Bangkok, bigger household size correlated to a higher probability to pay the WW charge. Houses with at least 6 members are more likely to pay the WW charge than the smaller size by 1.5 times. Moreover, those who live in detached houses, a majority residence type in Bangkok, also have a higher probability to pay the WW charge by 1.74 times than those who live in other types of dwellings. Besides, those who do not live in their own houses are less likely to pay the WW charge in Pattaya. People who rent residences for living or just reside in other people's houses have

75.0% and 60.5% lower probability, respectively, than those who live in their own properties. This might be because most people come to Pattaya for jobs. They do not own their houses, but rather rent instead due to the flexibility of moving once new opportunities arose. Therefore, this group of people is less likely to pay for utilities compared to indigenous residents.

Above all, the factors significantly influencing WTP decisions and their relationships are summarized in Table 4. It is obvious that wastewater service perception is crucial because it is the only common factor among all 3 cities. With this evi-

dence, it could be claimed that informing residents about WWT service coverage areas could enhance acceptance of the WW charge among the population.

5) Average WTP pay-out level

Three different cities provide 3 different pay-out levels. The highest average WTP amount is in Pattaya city at USD 3.38 per month/household, followed by Bangkok at USD 2.06 per month/household and Tha Rae at USD 0.83 per month/household (Table 5).

Table 4 List of significant factors influencing WTP decisions and relationships

No.	Factor (influencing WTP decision)	Bangkok	Pattaya City	Tha Rae Municipality
1	Wastewater service perception (yes)	(+)	(+)	(+)
2	Education (high)	(+)	(+)	(-)
3	Income (high)	(+)		
4	Age (older)	(-)		
5	Household size (large)	(+)	(-)	(-)
6	Water saving awareness (high)	(+)	(+)	
7	Gender (male)		(+)	
8	Water bill (high)	(-)	(-)	
9	Water bill responsibility (yes)		(-)	
10	Types of residence (detached house)	(+)		
11	Residence ownership (owner)		(+)	
12	Water pollution impact (high)	(+)		(+)
13	Knowledge about wastewater management (high)		(+)	(+)

Note: (+) positive relationship
(-) negative relationship

Table 5 WTP pay-out level

	Bangkok	Pattaya City	Tha Rae Municipality
Average WTP amount (USD/month/household)	2.06	3.38	0.83
Min.	0.16	0.63	0.16
Max.	6.34	9.52	4.76
S.D.	1.66	2.46	1.01
WTP pay-out level for WWT	2.06	3.38	0.83
Water tariff bill	7.93	9.20	5.08
On-top percentage (WTP/(WTP+Water tariff))	20.6	26.9	14.0

When comparing WTP for the WW charge with the average monthly water tariff bill, Pattaya gave the highest ratio between the WW charge and monthly water tariff. Pattaya residents are willing to pay 26.9% on top of their water tariff (106 out of 497). Bangkok residents prefer to pay around 20.6% on top (65 out of 315), while the lowest is Tha Rae residents at 14.0% on top (26 out of 186) of their average water tariff per month (Table 5 and Figure 2).

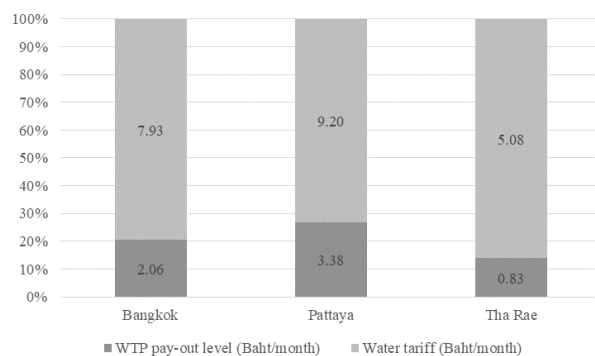


Figure 2 WW charge on-top of average water tariff in 3 cities.

Bangkok was hypothesized to have the highest average pay-out level. This is because Bangkok has the highest population, causing more pollution, followed by Pattaya city and Tha Rae municipality, where the population is the lowest among the 3 case studies. The higher the population, the more pollution and WTP [21]. However, Pattaya residents value water quality as the highest among these 3 cities. This could be because the business activities in Pattaya rely on water quality. It is a tourism destination, and coastal scenery is one of the most important environmental qualities.

6) Factors influencing WTP pay-out level

Factors influencing pay-out level for water quality improvement were further analyzed to better understand the stated amount of WTP among residents. In similar results for factors influencing WTP decisions, three cities also have different factors affecting WTP pay-out level.

Among 13 factors influencing WTP decisions, all 3 cities have different average pay-out levels. This section not only shows the significant factors affecting those amounts respondents stated, but also enable identifying the impact level of each significant factor by using multiple regression (MR). The results of MR analysis for 3 cities are shown in Table 6 together with a description of variables in Supplementary Material.

In MR, the value of unstandardized B; regression coefficient, representing the relation between raw data, are expressed in the equation. This value can be interpreted into the impact level of each factor with relationship direction; in other words, it represents the change of independent value per unit. According to Table 6, the expression of factors influencing pay-out levels to observe the most impactful factors for each city is shown in below.

6.1) Bangkok (Eq. 2)

All significant factors for Bangkok are in a positive direction with WTP pay-out level for water quality improvement. However, the impact level for each factor on WTP is varied. The highest impact level goes to water pollution impact level at 29.523, meaning that those who perceive water pollution effect is larger than the average score are willing to pay 29.523 Baht (USD 0.94) more than those who perceive less. The second is water saving awareness followed by WW service perception, income and water bill cost, respectively.

6.2) Pattaya (Eq. 3)

Among 5 factors, 3 factors have a positive relationship, while 2 factors have a negative relationship with WTP pay-out level for water quality improvement in Pattaya. The greatest impact level for pay-out is water saving awareness. In contrast to Bangkok, residents who have water saving awareness will pay 50.959 Baht (USD 1.62) less than the rest. The second is WW service perception. Those who perceive that their houses

are in the WW service area are willing to pay 36.708 Baht (USD 1.16) more than those who do not. The third, fourth, and fifth are water bill costs, house ownership and house-hold size, respectively.

6.3) Tha Rae (Eq. 4)

There are only 2 factors that significantly influence the pay-out level in Tha Rae. Income is the most impactful to WTP pay-out level. Higher monthly earning means more WTP. Also, lower schooling years means lower WTP.

For all 3 cities, the most impactful factor influencing WTP pay-out level is water pollution impact for Bangkok residents, water saving awareness for Pattaya residents and income for Tha Rae residents. Different cities have different significant factors influencing WTP pay-out level. However, there are some factors that are common between cities, though some are not. All factors can be grouped and are summarized in Table 7.

$$WTP_{Bangkok} = 33.112 + 19.047B_1 + 10.672B_2 + 20.446B_3 + 29.523B_4 + 16.410B_5 \quad (\text{Eq. 2})$$

Where; B_1 = WW service perception, B_2 = Water bill cost greater than 250 Baht per month B_3 = Water saving awareness, B_4 = Water pollution impact level and B_5 = Income more than 25,000 Baht per month

$$WTP_{Pattaya} = 132.550 + 36.708P_1 + 33.650P_2 - 50.959P_3 + 24.419P_4 - 30.734P_5 \quad (\text{Eq. 3})$$

Where; P_1 = WW service perception, P_2 = Water bill cost greater than 400 Baht per month, P_3 = Water saving awareness, P_4 = Household size greater than 5 members and P_5 = House ownership (renter)

$$WTP_{Tha\ Rae} = 28.418 + 24.839R_1 - 13.959R_2 \quad (\text{Eq. 4})$$

Where; R_1 = Income more than 15,000 Baht per month and R_2 = Education level lower than M3 (9 years of schooling)

Table 6 Factors influencing WTP pay-out level by multiple regression

Constant	Unstandardized B	Coefficients Std. W=Error	Standardized Coefficients Beta	t	Sig.
Bangkok					
(Constant)	33.112	5.618		5.894	0.000
WWser_Yes	19.047	8.912	0.119	2.137	0.033
Waterbill_250	10.672	5.810	0.102	1.837	0.067
WatSav_Yes	20.446	5.884	0.196	3.478	0.001
ImpLev4.0	29.523	6.651	0.253	4.439	0.000
Inc25000	16.410	6.186	0.148	2.653	0.008
Pattaya					
(Constant)	132.550	17.195		7.708	0.000
WWser_Yes	36.708	12.132	0.233	3.026	0.003
Waterbill400up	33.650	16.475	0.161	2.043	0.043
WatSav_Yes	-50.959	16.206	-0.248	-3.144	0.002
Famsize_5up	24.419	14.312	0.132	1.706	0.090
House renter	-30.734	13.218	-0.184	-2.325	0.021

Table 6 Factors influencing WTP pay-out level by multiple regression (*continued*)

Constant	Unstandardized B	Coefficients Std. W=Error	Standardized Coefficients Beta	t	Sig.
Tha Rae					
(Constant)	28.418	2.663		10.672	0.000
Inc15000up	24.839	4.380	0.303	5.671	0.000
M3_lower	-13.959	3.409	-0.219	-4.095	0.000

Table 7 List of significant factors influencing WTP pay-out levels and relationships

No.	Factors	BKK	Pattaya	Tha Rae
1	WWT service perception (yes)	(+)	(+)	
2	Water saving awareness (yes)	(+)	(-)	
3	Water bill (high)	(+)	(+)	
4	Household size (large)		(+)	
5	House owner		(+)	
6	Income (high)	(+)		(+)
7	Education (high)			(+)
8	Water pollution (high)	(+)		

Note: (+) positive relationship
 (-) negative relationship

Discussion

Based on the key factors summarized in Table 4 for WTP decision and Table 7 for WTP pay-out level, different cities have different factors influencing WTP for water quality improvement. Table 8 shows the results comparison of both analyses. Some factors are common for both WTP analyses and WTP decision and pay-out level among all characteristic case studies, whereas some are not and are unique factors for each city.

1) Common factors

WWT service perception is the significantly common factor among these cities for both WTP decision and pay-out level. This means that those who perceive that their houses are in WWT service areas are not only more likely to pay the WW charge, but also pay at a higher rate than others. In all three cities, the higher the WWT service perception, the more likelihood of WW charge collection. Additionally, the pay-out level will be significantly greater in Bangkok and Pattaya when people perceive that their houses are in the WWT service areas. Therefore, WTP preference is one of the crucial factors that should be taken

into account when considering WW charge policy implementation.

Looking at the sociodemographic related factors, higher level of education means a higher probability to pay the WW charge in Bangkok and Pattaya. Moreover, those who are willing to pay the WW charge will pay at a higher amount in Tha Rae. Besides, income also significantly influences WTP decisions in Bangkok as well as affects pay-out level in both Bangkok and Tha Rae. The higher the education and income level, the more probability of WTP for the WW charge at a higher amount. The results are in accordance with studies that reported respondents are more likely to pay the WW charge when involving higher education level and income groups [22–25].

Regarding the common factors between Bangkok and Pattaya, there are 2 factors in common significantly affecting WTP preference, namely water saving awareness and water bill costs. People who will reduce water consumption when the WW charge is applied have a higher probability to pay the WW charge than others. Nonetheless, those who are willing to pay the

WW charge in Bangkok will pay at a higher rate, whereas residents in Pattaya will pay at a lower rate than others. For water bill costs, higher water bill costs means the less likely to pay the WW charge. The results show that residents who have a high water bill are less likely to pay the WW charge in addition to a monthly water tariff than those who have cheaper water bills. Nevertheless, those who are willing to pay the WW charge will pay at a higher amount.

Even if the city characteristics of Bangkok and Tha Rae are noticeably different, water pollution impact is a common factor influencing WTP decisions for water quality improvement. Higher pollution means a higher probability for the willingness to pay the WW charge. Moreover, Bangkok residents who perceive high water pollution impact will pay a higher amount for water quality improvement. This result is in accordance with Roomratanapun [13]. Pollution

has welfare costs, and residents would like to pay for better welfare quality in exchange.

In terms of knowledge about WWM, it does not affect WTP pay-out level. However, WTP decisions are significantly affected in Pattaya and Tha Rae. More understanding and awareness about WWM means residents are more likely to pay the WW charge compared to those who have less awareness. The results are supported by several studies [22–23]. Therefore, WWM comprehension is a good foundation for local residents in order to increase the probability of success for WW charge policy.

2) Unique factors of each city

Apart from the common factors, there are unique factors for Bangkok and Pattaya. However, no unique factors influence WTP decisions or pay-out levels in Tha Rae, Sakon Nakhon, as summarized in Table 8.

Table 8 Comparison of significant factors influencing WTP preferences for 3 cities

No.	Factor	Bangkok		Pattaya City		Tha Rae Municipality	
		Decision	Pay-out	Decision	Pay-out	Decision	Pay-out
1	Wastewater service perception (yes)	(+)	(+)	(+)	(+)	(+)	
2	Education (high)	(+)		(+)		(-)	(+)
3	Income (high)	(+)	(+)				(+)
4	Age (older)	(-)					
5	Household size (large)	(+)		(-)	(+)	(-)	
6	Water saving awareness (high)	(+)	(+)	(+)	(-)		
7	Gender (male)			(+)			
8	Water bill (high)	(-)	(+)	(-)	(+)		
9	Water bill responsibility (yes)			(-)			
10	Types of residence (detached house)	(+)					
11	Residence ownership (owner)			(+)	(+)		
12	Water pollution impact (high)	(+)	(+)			(+)	
13	Knowledge about waste-water management (high)			(+)		(+)	

2.1) Bangkok

There are two distinctive factors affecting WTP decisions in Bangkok, an urbanized city. It is apparent that residents who reside in de-tached houses have a higher probability to pay the WW charge rather than those who live in other types of houses (i.e. apartment, town-house, shop house). Besides, older people are less likely to pay the WW charge compared to the younger generation.

2.2) Pattaya

Residence ownership: Residents who live in their own houses are more likely to pay the WW charge than those who rent houses. Those who do not own their houses rent to enable the flexibility to move once new opportunities arise. Moreover, water bill responsibility means residents who are in charge of the monthly water tariff are less likely to pay the WW charge. This might be because they have numerous payments and prioritize basic needs over environmental quality improvement.

From the analytical results, the WW charge should be differentiated for each city by taking into account several significant factors. This could increase acceptance from residents and increase the success rate of policy implementation as a result.

Conclusion

Local context significantly influences residents' WTP preferences for water quality improvement. The proportions of residents who are willing and not willing to pay the WW charge vary between cities. This is affected by several factors that are different among cities. In an urbanized city like Bangkok, type of dwelling is one of the significant factors affecting WTP decisions, while house ownership is significant in Pattaya city. However, some factors related to WWM involvement share commonality among these different cities. WWT service perception, water pollution impact, knowledge about WWM, and water saving

awareness are common factors for both urbanized and rural cities, all of which affect WTP decisions and pay-out levels.

Average WTP pay-out amount is also different among these cities. Pattaya, a coastal city (water quality dependence), has the highest WTP pay-out level, followed by Bangkok, an urbanized city and Tha Rae, a rural city. The highest rate of WTP amount in Pattaya could reflect the significance of water quality in a coastal city, where 90% of economic activity is from seaside-related hospitality business. The most impactful factor influencing WTP pay-out level in Bangkok is water pollution impact level, while water saving awareness and income are the most impactful factors in Pattaya and Tha Rae, respectively. Therefore, once the WW charge is enforced, the WW charge rate as well as strategic planning should be levied differently due to the characteristics and factors of cities influencing residents' WTP preferences.

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