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Introducing centralised wastewater treatment in Bangkok: a study of factors determining its acceptability

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Abstract

Water pollution is a problem all over the world and also in Thailand and particularly in Bangkok. The Government of Thailand and the Bangkok Metropolitan Administration have realised the seriousness of the problem and have started the construction of centralised wastewater treatment systems. The idea of centralised wastewater treatment is new for Bangkok where wastewater is normally treated on-site in septic tanks. The start-up and operational costs of a wastewater treatment system are high. The success and the sustainability of the system require the support of the Bangkok population. In order to gain this support, a better knowledge and understanding of the environmental concerns of the Bangkok population, their willingness to pay for environmental improvements and the acceptability of a wastewater treatment project is needed. The study applied the theory of diffusion and adoption to examine the acceptance of the project by the residents of Bangkok, the contingent valuation method to analyse the willingness to pay of Bangkok residents and the theory of environmental psychology to investigate the factors influencing acceptance of the wastewater treatment project by Bangkok residents. Personal questionnaire interview surveys and the willingness-to-pay were used to provide information on these issues. The Bangkok residents were found to prefer a centralised system, but they had no clear preference for a cost recovery system. The majority preferred the convenience and easy comprehension of a volumetric flat rate system. Two-thirds of the respondents preferred a separate collection system and expressed a preference for the Bangkok Metropolitan Administration as the fee-collecting agency. Most were willing to pay Baht 86.87 per month or Baht 3.28 per m^3 (Baht 25 = US$1), while the rate proposed by the BMA is Baht 3.50 per m^3. Distance to a *klong* (canal) and the direct experience of polluted surface water did not have any influence on the preferences. Monthly household income, level of education and environmental awareness were the principal factors that influenced acceptability of various aspects of the wastewater treatment system. However, acceptability declined when direct costs and changes in life style were involved. The conclusions of the study support the claim that the process of acceptance of wastewater treatment in Bangkok is closely related to the concept of adoption. The study found that complex stimuli, such as cost-effectiveness and the convenience of the technology, tend to influence the acceptability of the wastewater treatment project by Bangkok residents. In order to be able to

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introduce measures that require sacrifices from the population, the BMA should undertake campaigns of public hearings, public education and public surveys to know public opinion and the public's willingness to pay.

Keywords: Wastewater in Bangkok; Acceptability of wastewater; Willingness to pay

1. Introduction

Water is needed in all aspects of life (UNCED, 1992, 166), but an adequate supply of fresh water and the disposal of wastewater is becoming a serious problem all over the world (ESCAP, 1993, pp. 5–20), including in Bangkok, Thailand (Arpapirome & Chattharatana, 1995, pp. 63–65). Every year, the Government of Thailand tries to persuade rice farmers in the Central Region not to plant a second paddy crop and to save water for other users. In the dry season, a second crop requires 9 billion m^3 of irrigated water. In 1992, industrial and urban water consumption in the Bangkok Metropolitan Region stood at 3 billion m^3 and this is expected to double in the next 10 years. Some 2.5 billion m^3 is needed to maintain enough flow in the Chao Phraya River to flush out waste and saline water in the lower end of the basin. Annual rainfall in the Chao Phraya basin averages only 1–1.4 billion m^3 per year. Agriculture, industry and households, therefore, depend almost entirely on water from two dams with a capacity of 22.9 billion m^3, but 6.6 billion m^3 is required to power the turbines for electricity production. At the same time, growing water consumption upstream, destruction of watersheds through deforestation and drops in annual rainfall reduce the yearly inflow into the dams (Christensen & Boon-Long, 1994, pp. 5, 6).

The water in the lower part of the Chao Phraya River has been contaminated by large quantities of wastewater from the *klong* (canals) of Bangkok (Arpapirome & Chattharatana, 1995, pp. 63, 64). One of the main causes of the water pollution is the lack of adequate sanitation facilities and a sewerage system in the city where the most common wastewater treatment device is the septic tank (Kulchai, 1991, pp. 47–58). Building regulations require a septic tank for each house. If a septic tank is correctly designed, built according to design, properly operated and regularly emptied, it is an effective device to treat wastewater. After treatment, the effluent is discharged in the drainage system and the *klong* which take it to the river. In practice, local authorities only review the building plans for approval, but rarely inspect the actual construction or operations. As a result, tanks may not be built or not built according to specifications. If built according to specifications, they are rarely or never emptied. If the tank is too small or filled with sewage, the effluent will not have been sufficiently treated before it is discharged in the drains and it will pollute the river.

The volume of wastewater in the *klongs* may total more than 1 million m^3 per day. It contains a high level of coliform, of BOD and heavy metal. The quality of the water in the 1145 *klongs* of Bangkok and the lower part of the Chao Phraya River is such that the river's ecosystem can no longer absorb the waste (Levy & Potter, 1995, p. 10). Water pollution does not only affect the quality of the surface water, but it can also affect the quality of life of the population of Bangkok and cause health problems. People living near a *klong* daily face the *klong*'s unsanitary condition and bad smell due to floating garbage (Ratanathusnee, Puntong, Kypredarborisuthi, & Panswad, 1990, p. 100). A Japanese International Cooperation Agency study (1989, p. B-30) reported that

19.7% of the respondents nevertheless used *klong* water for washing and bathing, 9.9% for swimming or fishing, 8.2% for agriculture, and 7.1% for drinking.

To combat water pollution in the city and the Chao Phraya River, the Bangkok Metropolitan Administration has developed plans for six wastewater treatment plants in Bangkok (DPC, 1993, p. 36). Their construction requires massive investments and the costs will have to be paid by the public through taxes, fees or otherwise. The payment of taxes or fees for the development and operations of the infrastructure will, however, not be enough to make environmental improvements. These also require changes in attitude and life style and a greater concern about water consumption and wastewater disposal. This study used the wastewater treatment projects as a case study to determine the environmental knowledge and concerns of Bangkok residents, to measure the acceptability of the wastewater treatment projects and to assess the willingness of the residents to contribute financially to the projects. The objective of the study was to identify the factors that contribute to a positive attitude among an urban population to urban environmental improvement.

Fieldwork for the study was conducted in 1996 in Phayathai district of the Bangkok Metropolitan Area, a part of the Phase I Wastewater Treatment Project. Two *klongs* cross the area where households are the main sources of wastewater. The study interviewed a random sample of 367 respondents from Phayathai district, 157 living near (i.e. less than 100 m from) a *klong* and 210 living away (i.e. more than 100 m) from a *klong*. In addition, officials of the Bangkok Metropolitan Administration were interviewed. The main research approaches were the questionnaire survey and the willingness-to-pay method. The study also used hypothetical-direct-question, bidding-game and scenario-building techniques. The study hypothesised that the acceptability of a wastewater treatment system would depend on personal attributes (income, education, etc.), direct experience of polluted surface water (distance from the house to a *klong*), environmental concern and knowledge (about the impact of wastewater and about local and global environmental problems). Note that at the time of the fieldwork US$1.00 was equal to Baht 25.

2. Environmental knowledge and concern

An initial hypothesis of the study was that residents living near to a polluted *klong* would be more inclined to support the development of a wastewater treatment system than those living away from a *klong*, because of their first-hand experience with pollution. The study found that respondents living near a *klong* reported a higher average number of months with polluted water in the *klong* than those living away from a *klong*. They also were more concerned about the impact of polluted water. However, it was also found that respondents living away from a *klong* had a significantly higher monthly household income (Baht 32,495 vs. Baht 17,778) and a significantly higher level of education (11.6 yr vs. 9.1 yr) than those living near a *klong*. There was also a significant correlation between level of monthly household income and level of education. The settlements near the *klong* were mainly informal settlements with a low-income population. Whereas first-hand experience of water pollution was expected to have a positive correlation with the acceptability of a wastewater treatment system, income and education level were also expected to have a positive correlation with acceptability, but income and education were negatively correlated with the first-hand experience of water pollution.

Table 1
Correct knowledge about conditions of surface water

First-hand knowledge	%	General knowledge	%
a. Safe use of *klong* water	79.7	f. Natural recovery of water quality	58.4
b. Condition of fish population in the river	72.8	g. Main producers of wastewater	36.9
c. Water quality in *klongs* of Phyathai district	60.3	h. Causes of water price increases	31.7
d. Water quality in the Chao Phraya River	44.9	i. Volume of domestic wastewater	18.7
e. Legality of wastewater discharge in *klongs*	81.3	j. Quantity of global fresh water supply	5.3
Total (average of a–e)	67.8	Total (average of f–j)	30.2

Table 2
Concerns about environmental issues

Immediate	%	Secondary	%	Societal	%
Traffic congestion	69.5	Deforestation	63.5	Global warming	19.9
Water pollution	65.4	Loss of agric. and	13.1	Biodiversity	13.4
Air pollution	58.9	Hazardous waste	16.6	Ozone layer	11.7
Solid waste disposal	43.3	Chemical waste	16.3	Acid rain	7.9
Floods	13.9	Desertification	6.5	Nuclear power	6.3
Noise pollution	13.6	Marine pollution	10.6		

The study, therefore, focused on hypotheses relating acceptability of a wastewater treatment system to environmental concerns and knowledge. The study tested the knowledge of the respondents about the conditions of surface water in Bangkok. The study classified the issues into two groups: one group of issues related to direct experience or first-hand knowledge and one group of general-knowledge issues (Table 1). The study found that all income groups had a considerably better first-hand knowledge than general knowledge about conditions of water quality. First-hand knowledge and general knowledge increased, however, with increases in monthly household income and in education.

The study also examined the environmental issues that were of the greatest concern for the respondents (Table 2). The issues can be divided into three groups: issues closely related to their daily life (traffic congestion, water pollution, air pollution, solid waste disposal, floods and noise pollution), issues of secondary concern (hazardous waste, chemical waste, marine pollution, deforestation, desertification, loss of agricultural land) and issues that concern society as a whole (depletion of the ozone layer, acid rain, nuclear power, global warming, loss of bio-diversity).

Given Bangkok's notorious traffic jams, it is not surprising that the respondents mentioned traffic congestion as a first environmental concern, with air pollution resulting primarily from the traffic and the traffic congestion as the fourth highest concern. Water pollution is the second most important concern in Bangkok. Respondents further mentioned deforestation and solid waste disposal (Table 3).

Table 3
Concern about problems caused by polluted water

Problems caused by polluted water	Distance to *klong* (m)	*f*[a]	Degree of concern	*t*-test for equality of means		
				t	df	Sig.
Health impact	≤ 100	155	9.1	3.512	363	0.001[b]
	> 100	210	8.4			
Reduction in freshwater sources	≤ 100	155	8.2	4.999	363	0.000[b]
	> 100	210	6.9			
Lower water utility and safety	≤ 100	155	8.6	3.458	363	0.001[b]
	> 100	210	7.9			
Reduction in food supply (fish)	≤ 100	155	8.9	3.921	363	0.000[b]
	> 100	210	8.1			
Bad odour	≤ 100	155	8.7	5.497	363	0.000[b]
	> 100	210	7.5			

[a]Number of respondents.
[b]The difference is significant at the 0.01 level (2-tailed).

Initially, it is hard to image why respondents of this study (Bangkok residents) are more concerned about deforestation than air pollution or solid waste disposal. However, deforestation is a major environmental problem in Thailand. Forest reserves have dwindled due to legal and illegal logging and the clearance of land for agriculture. For more than three decades now, the government and non-government organisations have been campaigning for the preservation of forests in Thailand. So, the concern of the respondents may reflect the concern of Bangkok residents and may also reflect the influence of information and communication. On the other hand, floods and noise pollution, which are definitely problems in Bangkok, score relatively low.

Differences in immediate environmental concerns (traffic congestion, water pollution, deforestation and air pollution) between respondents in different income groups and with different levels of education were small. When it comes to secondary and societal concerns, higher-income groups displayed a significantly greater concern for issues like global warming, the state of the ozone layer and acid rain than lower-income groups. This is presumedly the result of better access to information and education for the higher-income groups.

Polluted water can affect the quality of life of the population. To assess the concern of the respondents towards the environment, the study examined the attitude of the respondents with regard to the specific issues that the respondents see as a problem caused by polluted water. Among 12 items of specific issues, the respondents were asked to rate their degree of concern of these problems caused by polluted water, with 1 indicating the lowest degree of concern and 10 indicating the highest degree of concern, and to prioritise the problems in a ranking order. The respondents identified three main problems caused by polluted water: health problems, a reduction in freshwater sources and a lower utility and safety of the water. There was little or no difference in the problems identified by the different groups of respondents. However, the intensity of the concerns of those living near a *klong* was significantly higher than that of respondents living away

Table 4
Preferred solutions to the wastewater problem

Solution	%
Centralised wastewater treatment	22.4
Education	22.4
Law enforcement	21.7
Minimise water consumption	14.4
Construction of on-site treatment system	10.8
Collect taxes or fees to clean the *klongs*	8.3
Total	100.0

from a *klong*. On the other hand, high-income respondents had a higher intensity of concern than the respondents with a medium or a low income, irrespective of the distance of their house to a *klong*; the same was true with regard to education. This is a further indication of the roles played by the direct experience of polluted water on the one hand, income and education in environmental awareness on the other.

The preferred solutions to the problem of wastewater (Table 4) are the construction of a centralised wastewater treatment system, the education of the population about the environment and the enforcement of the law against pollution (total: 66.5%). None of these preferred solutions carried an immediate implication of cost or effort for the common resident: a centralised wastewater treatment system is a government responsibility and education and law enforcement would not affect the respondents directly. Any solution that would affect the respondents financially or would affect their life style is less preferred: minimising water consumption, constructing an on-site system and paying taxes or fees (33.5%). Different income and education groups do not show any difference in their preference for a solution to the wastewater problem.

3. Acceptability of the centralised wastewater treatment project

The study distinguished six components for the wastewater treatment project: the type of treatment system, the cost recovery method, the payment rate, the fee-collection method, the fee-collecting agency and the amount to be paid by the users.

The study gauged the respondents' preference for a type of wastewater treatment system:

- a centralised treatment system that brings the wastewater from the households to one central plant for treatment before the effluent is discharged in the *klongs* and the river;
- a community plant, similar to a centralised system, but on a smaller, more local scale;
- an (extended aeration) package plant, on site-system, combining aerobic and anaerobic treatment;
- a conventional septic tank.

Similar to the preferred solution to the wastewater problems (see Table 4), a large majority of the respondents (72.6%) preferred a centralised system over the other three types of wastewater

treatment: community plant (15.1%), package plant (9.6%) and septic tanks (2.7%). Based on the discussion during the process of interview, most of the respondents seem to agree that the centralised system is the best possible way to solve the crisis of polluted water in Bangkok at the moment. The findings confirmed a broad support, in principle, among the respondents for the introduction of a centralised wastewater treatment system in Bangkok to replace the current system of on-site septic tanks.

- For the financing of the centralised wastewater treatment system, the study considered on a bipolar basic concept: a very strict polluter pays principle that concentrated on the users of the system to pay a specific fee or a softer method that all residents of Bangkok should pay for the system like a specific tax. Another concept that focused on public welfare was that the population of Thailand should pay for the system from the general revenues of the BMA and the general revenues of the central government. The respondents had four options:
- a specific fee to be paid by households connected to the system, based on the principle of *the polluter pays*;
- a specific tax to be paid by all residents of Bangkok, based on the principle that the beneficiaries (i.e. the population of Bangkok) should pay for the service;
- the general revenues of the Bangkok Metropolitan Administration, based on the principle that wastewater treatment is a local public good and that the benefits of the service are non-excludable; and
- the general revenues of the central government, based on the principle that wastewater treatment is a public good and that because Bangkok is the capital city, the benefits directly or indirectly extend to the entire population of Thailand.

The preferences of the respondents were split over three of the four options: a specific tax to the residents of the BMA (33.5%), a specific fee paid by households in the BMA (31.6%) and the general revenues of the central government (21.2%). It is nevertheless clear that a majority of the respondents expected the beneficiaries of the wastewater treatment, i.e. the Bangkok population in general or the users of the system in particular, to pay for the system.

The polluter-pays principle is an environmental concept that is applied generally for wastewater treatment projects. Another principle is the use of a progressive scale for wastewater treatment rates, i.e. "the more pollution one produces, the higher the rate per unit one has to pay". The problem of charging for wastewater treatment is that it is difficult to measure the volume and the quality of the wastewater generated by a household. The volume of wastewater generated by a household is assumed to be 80% of the water consumption of the household. The study has devised three ways to calculate the wastewater treatment charge: (1) the BOD loading which consists of the degree of pollution generated by a household, the type of on-site system in use in the house and the number of household members; (2) the volume of the water consumption of the household which consists of a flat unit rate for the volume of water consumed and a progressive unit rate for the volume of water consumed; and an arbitrary fixed amount per household.

In view of the above considerations, the respondents had six options for the calculation of the wastewater treatment charge:

- a fixed amount per household;
- an amount based on the number of household members;

- an amount based on the BOD loading representing the level of pollution generated;
- an amount based on the type of on-site system in use in the house;
- a flat unit rate for the volume of water consumed;
- a progressive unit rate for the volume of water consumed.

The majority of the respondents expressed a preference for a volumetric system (56.6%) with a preference for a flat volumetric rate (34.4%) rather than a progressive volumetric rate (22.2%) that would give big polluters a higher rate to pay.

- The study considered two types of fee collection: a separate collection of the wastewater treatment charge or the inclusion of the wastewater treatment charge in the water bill. The inclusion of the wastewater treatment charge in the water bill is more efficient, but the advantage of a separate collection is that the payer can clearly see what he or she is paying for, another application of the *polluter-pays* principle. Almost two-thirds of the respondents (63.2%) preferred a separate collection system. A majority of the high-income respondents (55.1%) preferred the inclusion in the water bill, but low-income and middle-income respondents preferred separate bills (68.8 and 72.7%, respectively).

The respondents were offered four options for a fee-collecting agency: the Bangkok Metropolitan Administration (BMA), the Metropolitan Waterworks Authority (MWA), the Wastewater Management Authority (WMA) or a private company. The BMA is the agency that has to operate the wastewater treatment plant. The Metropolitan Waterworks Authority is the agency, which supplies the water in Bangkok and collects the water charges. The Wastewater Management Authority is a recently established agency to handle wastewater treatment projects throughout the country, with the exception of Bangkok. Privatisation is a general trend in the world and greater efficiency might be achieved, if a private company collects the wastewater treatment charges. The respondents had a preference for the BMA (38.7%) over the WMA (27.0%) and the MWA (26.7%). Possibly this is because the BMA is the agency that operates the wastewater treatment plant. Moreover, the BMA is also headed by an elected governor and is therefore more sensitive to public opinion than the two state enterprises or the private company.

4. Willingness to pay

It is not easy to measure the willingness to pay for a pubic good that has no market value. The willingness of the respondents to pay for wastewater treatment was, therefore, determined through a number of steps. In order to understand the value of wastewater treatment, the sample population was first provided with information about the problems associated with polluted water and about the benefits to be gained from treating wastewater. The benefits were classified into three categories: direct personal benefits (such as improved health), indirect personal benefits (such as increased property values) and societal benefits (such as aggregate attractiveness of the Chao Phraya River). The study defined "willingness to pay" as the amount people are willing to pay for these three categories of benefits (Table 5).

Table 5
Willingness to pay per month for three types of benefits

Amount willing to pay (Baht)	Personal benefits				Societal benefits	
	Direct		Indirect			
	f^a	%	f^a	%	f^a	%
0	81	22.1	182	49.6	49	13.4
1–25	100	27.2	97	26.4	145	39.5
26–50	101	27.5	71	19.3	100	27.2
51–100	75	20.5	17	4.7	62	16.9
> 100	10	2.7	—	—	11	3.1
Total	367	100.0	367	100.0	367	100.0
Average amount willing to pay (Baht)		36.23		15.53		35.16

[a]Number of respondents.

Table 6
Total willingness to pay per month for wastewater treatment

Amount willing to pay (Baht)	f^a	%
0	1	0.3
1–25	68	18.5
26–50	84	22.9
51–100	114	31.1
101–150	43	15.7
151–200	36	9.8
201–300	21	5.8
Total	367	100.0
Average of willingness to pay (Baht)	86.87	

[a]Number of respondents.

The respondents were shown three cards, one card for each category of benefits, and each card listing the possible benefits of that particular type. The respondents were asked to mark the listed benefits they considered most important. Next, the respondents were asked to state the amount they were willing to pay per month for the selected direct personal benefits, indirect personal benefits and societal benefits. To avoid excessive amounts, the amounts had to be within the range of Baht 10–100. The respondent could also decide not to pay for any of the benefits. Once the respondent had given the three amounts, their values were combined into a single amount the respondent was willing to pay for the benefits of treated water.

As shown in Table 6, the highest average amount the respondents were willing to pay was for direct personal benefits (Baht 36.23), followed by societal benefits (Baht 35.16) and indirect personal benefits (Baht 15.53). The amounts the respondents were willing to pay were combined to establish

Table 7
Willingness to pay for wastewater treatment per m^3

Amount willing to pay per m^3 (Baht)	f^a	%	Cumulative (%)	Average amount (Baht)
0.01–1.00	69	22.0	22.0	2.07
1.01–2.00	64	20.4	42.5	
2.01–3.00	58	18.5	61.0	
3.01–4.00	42	13.4	74.4	
4.01–5.00	25	8.0	82.4	
5.01–7.00	22	7.0	89.5	2.39
7.01–10.00	18	5.8	95.2	2.75
10.01–20.00	15	4.8	100.0	3.29
Total	313	100.0		

[a] Number of respondents.

the total willingness to pay for wastewater treatment. The average total willingness to pay for wastewater treatment of the respondents was Baht 86.87 per month.

The respondents had also been asked to state the amount they were currently paying per month for water. This amount indicates the volume of water they consumed. Based on the assumption that 80% of the water consumed is returned as wastewater, the volume of wastewater generated by the respondent household could be calculated. The total willingness to pay for wastewater treatment and the calculated volume of wastewater generated by the respondent's household was used to calculate the amount per m^3 the respondents were willing to pay for wastewater treatment. The overall willingness to pay for wastewater treatment was Baht 3.29 per m^3, but the amounts varied widely. The average amount that the lowest 89.5% of the respondents with the lowest willingness to pay were willing to pay was Baht 2.39 per m^3 and for the lowest 95.2% of the respondents, the preferred payment was Baht 2.75 m^3. The Bangkok Metropolitan Administration proposed a rate of Baht 3.50 per m^3 (see Table 7).

5. Factors affecting the acceptability of a wastewater treatment system

The study had assumed that three sets of independent variables would have an impact on the acceptability of a wastewater treatment system in Bangkok:

- the socio-economic characteristics of the respondents (in particular their level of education and household income);
- water and wastewater-related attributes of the respondents (in particular the location of the house in relation to the *klong*);
- the environmental awareness of the respondents (in particular their knowledge about the conditions of water quality, their concerns regarding the environment).

Even the different income and education groups did not show any difference in their preference for the solution to the wastewater problem, but the preference for a centralised system increased

with increases in monthly household income and level of education. The study found that 89.7 per cent of the high-income respondents and 70.8 percent of the middle-income respondents, preferred a centralised system, 60.1 percent of the low-income respondents preferred such a system. The study also found a similar pattern for the level of education: a centralised system was preferred by 91.5 percent of the respondents with a high level of education, 63.7 percent of those with a medium level of education and 61.2 percent of those with a low level of education. It should be remembered that respondents with a higher income and a higher level of education also had a better environmental knowledge and stronger concerns about the broader environment.

Respondents who prefer a centralised system express a greater concern for secondary and societal environmental problems than respondents who prefer another system; the latter are more focused on immediate environmental problems that affect them directly. Preference for a centralised treatment system is also most pronounced among respondents who feel that the Bangkok population and the BMA are responsible for wastewater treatment rather than the central government or private industry. Respondents who prefer centralised wastewater treatment had higher expectations of the treatment process than those who preferred another system. According to the question about "what use do you expect to be able to make of treated wastewater?" that was asked to the Bangkok respondents, the answer of those who prefer centralised wastewater treatment expected to be able to use the treated water for watering (25.6%) or bathing (33.6%). Many of those who preferred another system (42.4%) expected to be able to use the treated water just for watering.

Support for a specific fee to be paid to the BMA increases with income, from 22.4% for the lowest-income group to 44.8% for the highest income group. Similarly, support for financing of the wastewater treatment plant from the general revenues of the central government gains support with a decrease in income. Respondents who have broader (i.e. secondary or societal) environmental concerns were more likely to support the "polluter-pays" principle (i.e. a specific fee to the BMA) than other forms of cost recovery. However, statistical testing did not show a significant correlation between the environmental knowledge and concern of the respondents and their preference for a particular cost recovery system.

More than two-thirds of the respondents with a low monthly household income and almost three-quarters of those with a medium monthly household income preferred a separate cost collection system. A majority of the respondents with a high monthly household income preferred inclusion of the wastewater fee or tax in the water bill. If one has enough income, inclusion of the wastewater bill in the water bill is convenient, because it requires only a single payment. Low- and middle-income respondents were, however, concerned about a high water bill that includes wastewater treatment charges. If the wastewater bill comes separately, they will be able to put the bill aside, if they do not have enough money. That is more difficult, if wastewater charges are included in the water bill; non-payment of the water bill would result in disconnection of the water supply.

As expected, the level of monthly household income had an impact on the willingness to pay of the respondents. A majority of the respondents with a monthly household income of Baht 8000 or less (58.3%) was willing to pay Baht 2.00 or less per m^3. A majority (51.1%) of the respondents with a monthly household income of Baht 25,000 or more was prepared to pay more than Baht 3.00 per m^3. Overall, the average willingness to pay of low-income respondents was Baht 2.50 per m^3, of medium-income respondents was Baht 3.64 per m^3 and of high-income respondents was Baht 3.88

per m^3. Statistical tests found a significant difference in the willingness to pay between the different income groups. The study looked at other possible factors determining the willingness to pay of the respondents. It found no significant difference in the willingness to pay of respondents with different levels of knowledge about surface water conditions and environmental concerns.

6. Conclusions

Water is indispensable for life, but a shortage of freshwater is developing all over the world. In addition to being more economical with water, it is also essential to reduce pollution of freshwater sources. However, this will require considerable investments in water-related infrastructure and a change in life style. This study used the construction of a wastewater treatment plant in Bangkok as a test case to gauge the willingness of a small sample of the population to accept a wastewater treatment plant and its costs. The study found that there is may be public support for a centralised wastewater treatment system in Bangkok and that the population is concerned about the shortage of clean fresh water and the effects of wastewater on their health.

The study had assumed that the direct experience of polluted surface water would enhance the interest of a small sample of the population in environmental issues and that it would enhance their willingness to make financial and other sacrifices for the cleaning of the water in the *klong* of Bangkok. The study could not find supporting evidence for this assumption, despite the higher concern of respondents living near a *klong* for the impacts of polluted water.

Environmental knowledge and awareness are important conditions for environmental action, but they come with increased income and better education rather than with direct confrontation with pollution. Campaigns by the government and non-governmental organisations to raise the awareness of the population about environmental issues is important, but a good income and a good education create opportunities for awareness raising.

There is no more powerful way to measure people's satisfaction than the measurement of their willingness to pay. In the context of Thailand or other developing countries and considering that wastewater treatment is a rather unfamiliar activity, it was necessary to apply the WTP technique with some adjustments. When the WTP was applied, scenarios are needed to provide information and the bidding games are important to improve respondent accuracy. The study found that when cards and explanations were used to clarify the context of the study, most respondents could understand the purpose of the interview.

Eventually, environmental improvements will require sacrifices in terms of financial contributions and changes in life style. Such sacrifices are not popular among a small sample of the population despite their environmental knowledge and awareness. The respondents of this study are prepared to make financial sacrifices provided they have the income to do so, showing how economic development is seen as a prerequisite for environmental improvement.

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