An Empirical Study on the Public Consciousness and the Willingness to Pay Regarding the Household Waste Charging Systems in Taiwan

Yu-Chi Weng, ***Hokkaido University, Japan***
Takeshi Fujiwara, ***Okayama University, Japan***
Sue-Jane Lin, ***National Cheng Kung University, Taiwan, R.O.C.***
Hwong-Wen Ma, ***National Taiwan University, Taiwan, R.O.C.***

CONTACT
Yu-Chi Weng
Division of Built Environment,
Graduate School of Engineering,
Hokkaido University, Sapporo, Japan
W8, N13, Sapporo, 060-8628, Japan
Tel: +81 11 706 7284.
Fax: +81 11 706 7287.
E-mail: weng@eng.hokudai.ac.jp

EXECUTIVE SUMMARY

This study made an attempt to conduce a questionnaire on the public consciousness regarding the household solid waste (HSW) charging systems in two cities, Taipei city and Tainan city, where the charging systems are on different bases. In addition, the citizens' willingness to pay (WTP) for HSW management services were investigated with regard to both internal and external management costs. From the survey results, the respondents regard that charging the waste treatment and disposal fee by waste volume, i.e. the Pay-as-You-Throw (PAYT), is more rational than by water consumption in both two cities. Afterward, a truncated regression approach is applied to establish the WTP functions in the two cities based on the respondent's household income level, personal education level and his/her acceptance of the payment for environmental costs of HSW management. However, the research outcomes indicate that the insufficient technical information and the cost structure of the HSW management services will lead to the uncertain WTP bidding in the questionnaire survey. Besides, some respondents think that the household waste treatment/disposal fees should not be charged because they claim that the municipalities should take all the responsibility tackling waste problems. Such result

implies that the “Polluter Pays Principle (PPP)” for the citizens should be further discussed and clarified in Taiwan. The research outcomes would be helpful for the municipalities to design and facilitate HSW charging systems.

INTRODUCTION

Insufficient and inadequate treatment/disposal of household solid waste (HSW) is a critical urban environmental problem and may bring about critical environmental pollution. The control of HSW generation is of great importance among the urban environmental management issues. HSW generation is expected to be eliminated by a series of economic instruments in line with the “Polluter Pays Principle (PPP).” For this reason, the charging on the HSW generators for waste treatment and disposal has been implemented in many countries (Chao, 2008; Reichenbach, 2008; Sakai et al., 2008; Weng and Fujiwara, 2010). Several types of waste charging systems for household solid waste (HSW) have been applied, e.g., the flat rate system and the container tag fee system (Bilitewski, 2008). In addition to the consideration of the PPP, the waste charging system aims at facilitating the behavior of waste generators in the context of waste reduction by using economic instruments. Conventionally the total fees would be equal to the administrative costs for MSW management services, mainly internal costs. The waste charging system could aid required financial funds for maintaining HSW management systems and, simultaneously, achieve the goal of waste reduction.

In the early 1980’s, the PPP was applied to environmental regulations in Taiwan (Weng et al., 2009). For most local municipalities, the waste treatment and disposal fee is charged with respect to the amount of water consumption. Nevertheless, such waste charging system seemed to be failed on waste reduction while not many citizens were aware of their paying for waste treatment and disposal. To deal with such deficiency, in Taiwan the PAYT system, charging the fee with respect to the waste volume, has been implemented firstly in Taipei City since July, 2000. Till today, however, only around 30 among near 320 municipalities have adopted this system for waste charging, and most of them just implemented PAYT since 2010. In order to promote and facilitate the waste charging in Taiwan, it is imperative to examine the feasibilities and policy effects of the operating PAYT systems. By using the intervention time series analysis model, the implementation of PAYT in Taipei City has been proved to reduce the HSW generation apparently (Chao, 2008; Weng and Fujiwara, 2010). While the PAYT charges the amount of HSW treatment and disposal, the measure also provides economic incentives on the HSW separation during the collection process and, thus, the citizens’ environmental consciousness are improved to some extent.

PAYT is expected to be applied to other regions in Taiwan, in substitution of the other waste charging systems, while its acceptability by citizens is still in question. By conducting questionnaire surveys to the citizens, based on the contingent valuation method (CVM), in two cities where different waste charging systems are launched, the first objective of this study was to know the citizens’ attitude about the feasible style of current waste charging systems in

Taiwan. In addition, as aforementioned, the conventional fee level of PAYT mainly account for the internal costs. The overall costs may be underestimated. Nevertheless, recently, the external costs are argued to be taken into consideration so that the overall impacts associated with waste management could be concerned (Weng and Fujiwara, 2011). In this sense, in order to reflect the real costs of household waste management, the second objective of this study was to investigate the citizens' WTP for HSW management services through the questionnaire survey. The WTP functions at two cities were established with regard to the respondents' socio-economic attributes. The research framework of this study is presented in Fig. 1. The findings from the questionnaire surveys as well as the established WTP functions would be used to examine the feasibility of PAYT and to improve the current waste charging systems. Besides, the adequate fee level would be suggested to improve the policy effect of the current waste charging systems in the case study areas.

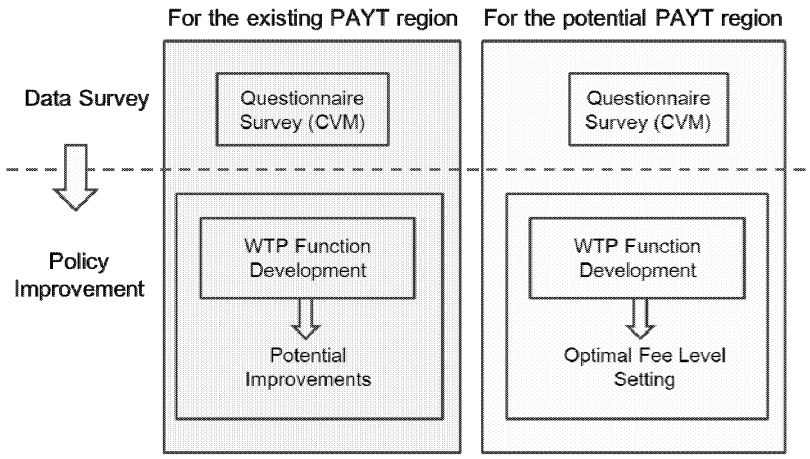


Fig. 1 The research framework of this study.

RESEARCH METHODS

Contingent valuation method (CVM) is a useful method to investigate the citizens' WTP for environmental services with multi-attribute economic values (Carson, 2000; Pearce et al., 2006). In this study, through conducting questionnaire surveys, the contingent valuation method is used to investigate the WTA for HSW management services and to seek for the optimal charging level. The total costs for HSW services were briefly described in the questionnaire from both the internal financial and external environmental perspectives. Regarding the investigation way, this study adopted post mails for the questionnaire survey while the respondents could have sufficient time to make the responses (Whittington et al., 1992).

Through the questionnaire surveys, the public opinions with regard to the waste charging systems would be obtained. Furthermore, the representative samples would be analyzed by the truncated regression model, in which a threshold of the WTP value would be assumed so as to prevent from the irrational responses (Sigelman and Zeng, 1999; Yoo et al., 2001; Bragato,

2004; Cho, 2005; Saz-Salazar and Rausell-K¨oster, 2008). In this study, only the rational WTP bidding samples, consistent with the respondent's attitude, would be considered in the model development. Based on the truncated regression model, the WTP functions based on at the study regions were developed by using the following equation (Bragato, 2004):

$$\boldsymbol{WTP_i} = \boldsymbol{\alpha} + \boldsymbol{X_i}\boldsymbol{\beta_i} \qquad for\ WTP_i \geq WTP_0 \tag{1}$$

where $\boldsymbol{WTP_i}$ is the vector of the *i* respondent's WTP; WTP_0 is a threshold value; $\boldsymbol{X_i}$ represents the vector of the respondent's personal attributes; $\boldsymbol{\alpha}$ and $\boldsymbol{\beta_i}$ are the vectors of the parameters.

The parameters of the equations were solved by using ordinary least squares (OLS) method with the R statistical software.

RESULTS AND DISSUSION

The surveys were made by delivering 1,000 post mails in Taipei City and Tainan City, respectively. The questionnaires were distributed and recovered during Dec. 14-27, 2010. Spatially random sampling was performed with regard to the population weight among the administrative wards. In addition, residential areas were particularly selected in the sampling process.

Consequently, the response rates are 10.4% in Taipei City, and 7.2% in Tainan City, respectively. In fact, the response rates are not large as expected in the post mail survey. In addition, there are some potential influential factors lowering the ratios:

(1) PAYT as a debate in the mayor election of Taipei City

The candidates hold opposite opinions on the PAYT in the mayor election last November. In order not to be influenced by the election, the questionnaire survey was postponed to some extent. However, it seems that some citizens may reject the politically sensitive investigation in this period.

(2) Doubt on mail fraud

In fact, some questionnaire receivers may criticize that if the questionnaire is a mail fraud or a CM because it is quite popular in Taiwan.

(3) Christmas season

In order to eliminate the political influences, the questionnaire survey is postponed. Therefore, the survey period is quite close to the Christmas card season so that the questionnaire receivers may neglect the replying.

Citizens' Attitudes on the Waste Charging Systems

Regarding the rationality of the PAYT, as shown in Fig. 2, both the respondents in Taipei and Tainan Cities agree with that charging the fee by waste volume is fairer than by other bases. However, few respondents think it would be convenient for charging by water or electricity consumption, though unreasonable.

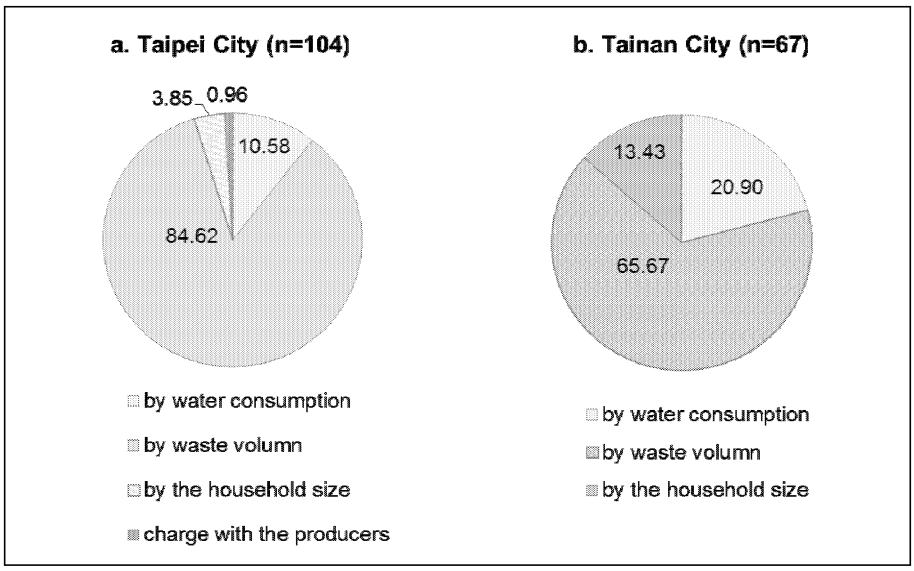


Fig. 2 The public opinion on the charging bases.
Note: n is the number of the respondents.

Though 65.27 % of the respondents in Tainan City approve that PAYT is rational, the opinions for the feasibility of the implementation of PAYT in Tainan City is quite contrary: around 45.6 % of the respondents think PAYT is feasible, while 28 %, infeasible (see Fig. 3). The reason may be that the respondents think the citizens are not willing to change the current pattern of waste charging system. Still, the local municipality could account for the installation of PAYT since the waste reduction effect of the PAYT in Taipei City is proved to be significant by the time series analysis by Weng and Fujiwara (2010).

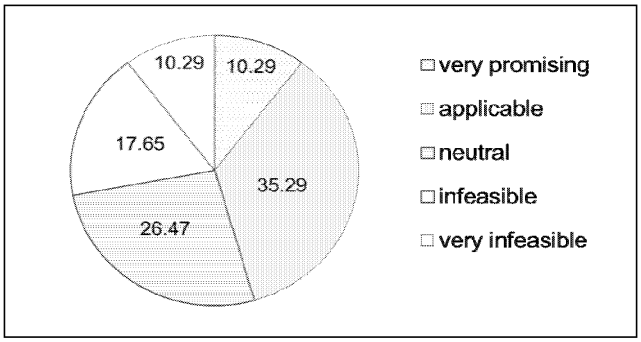


Fig. 3 The public opinion on the feasibility for implementing PAYT in Tainan City (n=68) (where PAYT system is not introduced now)

Also, the questionnaire makes an attempt to ask the respondents if they know how much the fee level is or not, before bidding for the potential external costs. As shown in Fig. 4, in fact, more than 50 % of the respondents in both cities do not know precisely about the fee level of the current charging systems, leading to the uncertainty of the CVM results. Actually, when CVM is

conducted, there would be a technical limitation that people are difficult to evaluate their WTP unless they are well realized the environmental impacts and the associated cost/benefit items.

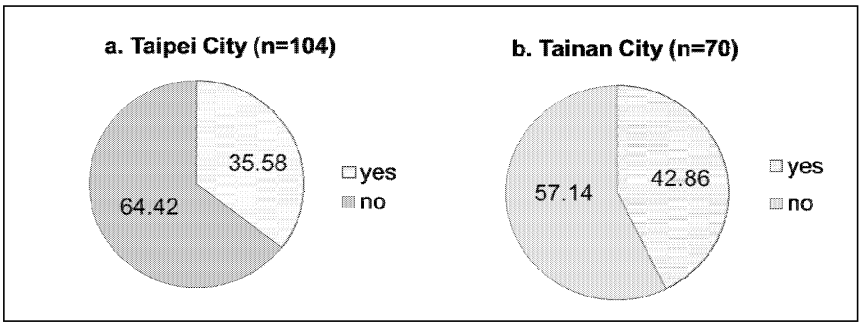


Fig. 4 The public awareness on the current fee level: Do they know how much they pay?

After informing the respondents about the current fee levels, the majority of the respondents express that the current fee levels are adequate in both cities, as shown in Fig. 5. However, the results indicate that around 20 % of the respondents argue that the fee should not be levied, indicating that the PPP is rejected by a portion of citizens. Those respondents think that the government should not charge the waste treatment/disposal because they claim that the municipalities should take all the responsibility tackling waste problems. Such result implies that the PPP for the citizens should be further discussed and clarified. The responsibility for the waste generators at the household side should be further emphasized. Still, the majority of the respondents approve that the household waste generators should take this responsibility, and the economic instruments could play positive roles in HSW reduction.

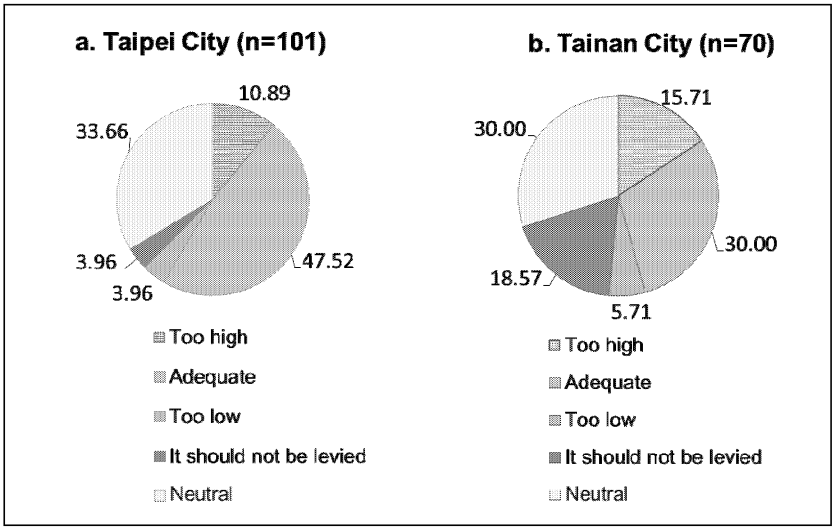


Fig. 5 The public opinions on the fee levels.

WTP Functions

Regarding the development of the WTP functions, firstly, it is required to confirm if the respondents are well known about the meaning of waste charging systems and the value of the payment. In fact, among the 104 replied questionnaires in Taipei City, where the PAYT is implemented, only 47 respondents provided concrete WTP data consistent with the answers. The main reason described is that most of the respondents cannot price the HSW management services until the cost structure is provided and well understood. Even, only 19 among the WTP providers did know the current charging fee level before the notification in the questionnaire was read. Meanwhile, in Tainan City, where the waste is charged with the water consumption, most respondents thought the current fee level is irrational and weakly related to HSW management. The same problem also occurred for the results in Tainan City. Only 23 among 72 respondents provided concrete and consistent WTP values, and mere 12 respondents knew the current charging fee level before receiving the information in the questionnaire. Such results imply that the municipalities should promote the public awareness on the related economic instruments on HSW management so that the policy objectives could be achieved.

Using the consistent data from the questionnaire survey, two WTP functions were established for the case study areas. The modeling results are shown as follows:

(1) Taipei City

$$WTP_{Taipei,i} = \underset{(2.19^{**})}{0.085} \times Income_i + \underset{(1.99^{*})}{0.110} \times Educ_i + \underset{(3.03^{***})}{0.287} \times EXCCon_i \quad \forall WTP_{Taipei,i} \geq 0.45$$

$R^2 = 0.877$; $F = 102.37^{***}$; $BP = 4.22^{**}$; $DW = 0.68$; 46 valid observations

(2) Tainan City

$$WTP_{Tainan,i} = \underset{(0.34)}{0.078} \times Income_i + \underset{(2.56^{**})}{0.923} \times Educ_i + \underset{(3.93^{***})}{2.984} \times EXCCon_i \quad \forall WTP_{Tainan,i} \geq 3.5$$

Adjusted $R^2 = 0.939$; $F = 118.79^{***}$; $BP = 1.37$; $DW = 1.26$; 23 valid observations

where $WTP_{Taipei,i}$ denotes the WTP value for the respondent *i* in Taipei City (New Taiwan Dollar (NT$) at 2010 prices per liter HSW);

$WTP_{Tainan,i}$ is the WTP value for the respondent *i* in Tainan City (NT$ at 2010 prices per 1m^3 water consumption);

$Income_i$ denotes the respondent *i* 's household monthly income level (0: 0~20,000 NT$ at 2010 prices; 1: 20,000~30,000 NT$ at 2010 prices; 2: 30,000~50,000 NT$ at 2010 prices; 3: 50,000~100,000 NT$ at 2010 prices; 4: > 100,000 NT$ at 2010 prices);

$Educ_i$ represents the respondent *i* 's education level (0: lower than high-school level; 1: high-school level; 2: undergraduate level; 3: graduate level);

$EXCCon_i$ is the degree that the respondent *i* agree with the payment for the potential external (environmental) cost associated with HSW management (1: favor / very favor; 0: neutral / disfavor);

values in the parentheses denote the *t* value;

*, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

In the model development, the WTP threshold values were set as the current fee levels of the two cities while the most valid samples approve the current fee level in which only the internal financial costs are considered. Thus, the influences of the respondent's personal attributes on the fee level regarding both internal and external costs could be identified in the functions. According to the modeling outcomes, significant and positive parameter estimates indicate that the respondent's household income level, personal education level and his/her acceptance for paying the HSW management costs that account for the financial and environmental costs, i.e. the "real" costs, would be influencing factors of their WTP for HSW management services. The increase of the income level, education level and the enhancement of the public acceptance of the payment of environmental costs are associated with the increase of the WTP bidding.

Regarding the statistic diagnostics, in particular, the Breusch-Pagan test and the Durbin-Watson test were performed to examine the problems for the heteroskedasticity and the serial correlation of the error terms. As for the outcomes in Taipei City, the significant *BP* statistics and the low *DW* statistics suggest the heteroskedasticity and the serial correlations may occur in the error terms. For the improvement of model estimation, as the aforementioned literature pointed out, other estimation algorithms, e.g. the maximum likelihood method and semi-parametric estimations, could be applied for such truncated regression models. In addition, detailed cost structure information of HSW management should be provided in the questionnaire so that the respondents could give a rational WTP value.

SUMMARY AND CONCLUSION

This study made an attempt to conduce a questionnaire on the public consciousness regarding the waste charging systems in two cities, Taipei city and Tainan city, where the charging systems are on different bases. In addition, the citizens' WTP for HSW management services were investigated with regard to both internal and external management costs. Afterward, a truncated regression approach was applied to establish the WTP functions in the two cities on the basis of the respondents' personal socio-economic attributes.

From the research outcomes, the respondents regard that charging the waste treatment and disposal fee by waste volume, i.e. the PAYT, is more rational and acceptable than by water consumption in both two cities. Moreover, the modeling results reveal that the increases on respondent's household income level, personal education level and his/her acceptance of the payment for environmental costs of HSW management are associated with the augment of the WTP bidding. However, it seems difficult to alter the fee level of PAYT systems while the some citizens are not happy with new changes. Besides, the research outcomes indicate that the insufficient technical information and the cost structure of the HSW management services will lead to the uncertain WTP bidding in the questionnaire survey. Therefore, CVM would be difficult to be implemented given that the required in-depth knowledge is informed to the respondents, but it could also serve as an education tool in the survey process. In addition, some respondents think that the waste treatment/disposal fees should not be charged because they claim that the

municipalities should take all the responsibility tackling waste problems. Such result implies that the PPP for the citizens should be further discussed and clarified in Taiwan. Also, the detailed internal and external cost/benefit items should be further studied. While only the fixed fee level, the unit pricing, is considered in the current PAYT systems, flexible fee levels could be further studied at the next step. The research outcomes would be helpful for the municipalities to design and facilitate HSW charging systems.

ACKNOWLEDGEMENTS

The authors are grateful to the financial support from the “Practical Research and Education of Solid Waste Management Based on the Partnerships among Universities and Governments in Asia and Pacific Countries” project adopted by the Ministry of Education, Culture, Sports, Science and Technology, Japan.

REFERENCES

Bilitewski, B. (2008): From traditional to modern fee systems. Waste Management. 28. 2760-2766.

Bragato, P.L. (2004): Regression analysis with truncated samples and its application to Ground-Motion attenuation studies. Bulletin of the Seismological Society of America. 94. 1369-1378.

Carson, R.T. (2000): Contingent valuation: a user’s guide. Environmental Science & Technology. 34. 1413-1418.

Chao, C.L. (2008): Time series analysis of the effects of refuse collection on recycling: Taiwan’s ‘‘Keep Trash Off the Ground’’ measure. Waste Management. 28. 859-869.

Cho, S.-H., Newman, D.H., & Bowker, J.M. (2005) Measuring rural homeowners’ willingness to pay for land conservation easements. Forest Policy and Economics. 7. 757-770.

Pearce, D., Atkinson, G., & Mourato, S., 2006. Cost Benefit Analysis and the Environment: Recent Developments. OECD Publishing, Paris.

Sakai, S., Ikematsu, T., Hirai, Y., & Yoshida, H. (2008): Unit-charging programs for municipal solid waste in Japan. Waste Management. 28. 2815-2825.

Saz-Salazar, S.D. & Rausell-K¨oster, P (2008): A Double-Hurdle model of urban green areas valuation: Dealing with zero responses. Landscape and Urban Planning. 84. 241-251.

Sigelman, L. & Zeng, L. (1999): Analyzing censored and sample selected data with Tobit and Heckit models. Political Analysis. 8. 167-182.

Weng, Y.C., Fujiwara, T., & Matsuoka, Y. (2009): Municipal solid waste management and short-term projection of the waste discard levels in Taiwan. Journal of Material Cycles and Waste Management. 11. 110-122.

Weng, Y.C. & Fujiwara, T. (2010): Intervention Time Series Analysis of the Household Solid Waste Generation in Taipei City. Proceedings of the 21th Annual Conference of the Japan Society of Material Cycles and Waste Management, Kanazawa, Japan, 623-624, Nov. 4-6.

Weng, Y.C. & Fujiwara, T. (2011): Examining the effectiveness of municipal solid waste

management systems: An integrated cost-benefit analysis perspective with a financial cost modeling in Taiwan. Waste Management. 31. 1393-1406.
Whittington, D., Smith, V. K., Okorafor, A., & Okore, A., Lui, J.-L. (1992): Giving respondents time to think in contingent valuation studies: a developing country application. Journal of Environmental Economics and Management. 22. 205-225.
Yoo, S.-H., Kim, T.-Y., & Lee, J.-K. (2001): Modeling zero response data from willingness to pay surveys: A semi-parametric estimation. Economics Letters. 71. 191-196.
Reichenbach, J. (2008): 2008-Status and prospects of pay-as-you-throw in Europe – A review of pilot research and implementation studies. Waste Management. 28. 2809-2814.

An Empirical Study on the Public Consciousness and the Willingness to Pay (WTP) Regarding the Household Waste Charging Systems in Taiwan

Yu-Chi Weng ○ (Hokkaido Univ., Japan)
Takeshi Fujiwara (Okayama Univ., Japan) ,
Sue-Jane Lin (National Cheng Kung Univ., Taiwan, R.O.C.)
Hwong-Wen Ma (National Taiwan Univ., Taiwan, R.O.C.)

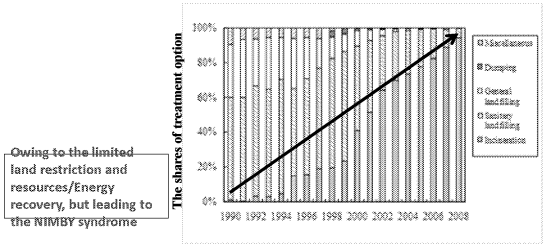
2011.10.18

Outline

- Background
- Research Objective
- Research Methods
- Case Study
- Conclusion

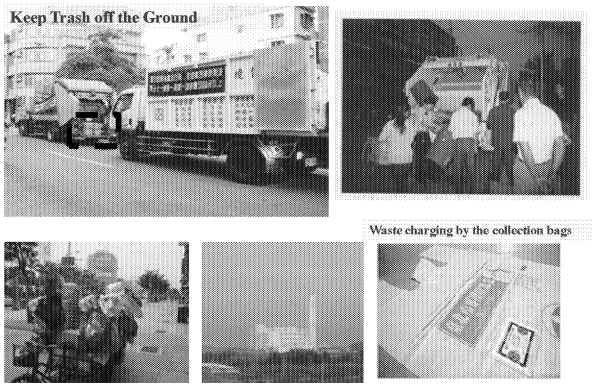
Background

- The main waste treatment technology is incineration due to the **limited land resources**.

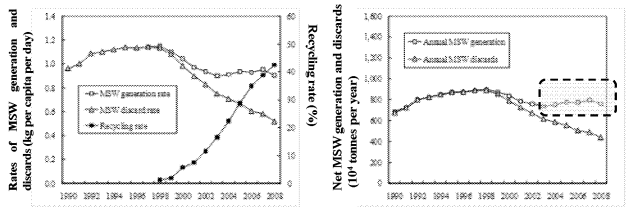


- Since the 1990's, the **3Rs (Reduce/Reuse/Recycling) principles** have been implemented to establish a "**zero-disposal**" society.

Municipal Solid Waste (MSW) Management Implementation in Taiwan



Historical Trend of the Municipal Solid Waste (MSW) Generation, Discards and Recycling Rate in Taiwan: 1990-2008



Household Solid Waste (HSW) Charging Systems

- Waste charging systems, charging waste generators with his/her waste volume, are based on the "**polluter pays principle** (PPP) ".
- It aims at supporting the financial budgets for SW services and facilitating the behavior of waste generators by using economic instruments.
- Some **charging bases** are adopted:
  - By waste volume (the Pay-as-You-Throw (PAYT))
  - By electricity consumption
  - By water consumption
  - By the household size
- The PAYT is getting popular **worldwide** and **proved efficient** in waste reduction, particularly in Japan (more than 50% municipalities).

The HSW Charging Systems in Taiwan

- In Taiwan, the revision of Waste Clean-up Act adopted the **PPP** in the regulations in 1991.
- Conventionally, in Taiwan, the HSW service fees is charged based on **water consumption** upon the administrative conveniences.
- Since 2000, only **3** among 161 municipalities attempt to change the counting basis by the waste volume, including **Taipei city** (12 wards since 2000), **NEW Taipei city** (27 wards since 2010), and the Sheng-Gane Ward in **Taichung city**.

Reconsiderations of the HSW Charging Systems

- Theoretically the total fees would be equal to the administrative costs for MSW management services, regarding both **internal** and **external costs**.
- Potential impacts and cost/benefit items of MSW systems

Perspective		Impact	Description	Cost/benefit item
Internal	Financial	Effectiveness of administrative governance (hardware performance)	Administrative costs and benefits for the construction, operation and maintenance (O&M) of waste facilities	Construction fees (cost);
				Manpower fees (cost);
				Land fees (cost);
				Collection and transportation fees (cost);
				Mechanic facility fees (cost);
				Water and electricity charges (cost);
				Compensation funds (cost);
				Recovery and remediation fees (cost);
				Electricity generation earnings (benefit);
				Revenue from material recovery (benefit);
				Miscellaneous costs and benefits
		Effectiveness of administrative governance (policy enforcement)	Administrative management costs and benefits	Manpower fees (cost);
				Collection and transportation fees (cost);
				Advertisement and media fees (cost);
				Revenue from 3Rs activities (benefit);
				Miscellaneous costs and benefits

Source: Weng and Fuijiwara, 2011.

Potential impacts and cost/benefit items of MSW systems (*cont.*)

Perspective		Impact	Description	Cost/benefit item
External	Environ-mental	Waste Reduction	Reduction of the quantity of MSW generation	Aversion of the environmental degradation due to the increased MSW quantity (benefit)
				Landfilling space saving (benefit);
		Resources recovery	Recycling of waste of resources	Aversion of the environmental costs of raw resources excavation (benefit)
			Energy recovery	Aversion of the environmental costs of pollutions from high-polluted energy production processes (benefit)
		Air pollution	Air pollution (including odor) from truck fleets, landfills, stacks and other waste facilities	Medical spending due to influenced human health (cost)
				Recovery costs of the global warming mitigation (cost)
				Changes of the values of neighboring real estate (cost)
		Wastewater	Wastewater pollution from waste treatment facilities or from illegal dumping	Remediation costs of polluted soils and waters (cost)
				Recovery costs of the affected ecosystems (cost);
				Medical spending due to the influenced human health (cost)
				Changes of the values of neighboring real estate (cost)
		Solid residual	Soil contamination from waste treatment facilities by incineration ash or sludge	Remediation costs of polluted soils and waters (cost)
				Recovery costs of the affected ecosystem services (cost)
				Medical spending due to the influenced human health (cost)
				Changes of the values of neighboring real estate (cost)
			Soil contamination from illegal dumping of waste	Remediation costs of polluted soils and waters (cost)
				Recovery costs of the affected ecosystem services (cost)
				Medical spending due to the influenced human health (cost)
				Changes of the values of neighboring real estate (cost)
			Infrastructure service level	Changes of the values of real estate (benefit)
			Risks of the urban safety	Changes of the values of neighboring real estate (cost)

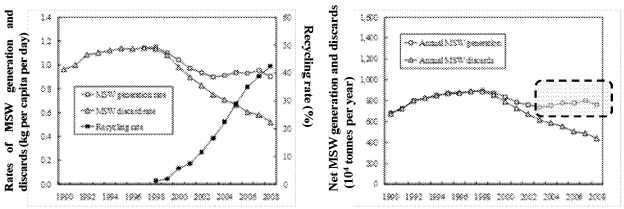
Source: Weng and Fuijiwara, 2011.

Potential impacts and cost/benefit items of MSW systems (*cont.*)

Perspective		Impact	Description	Cost/benefit item
External	Environmental	Landscape	Visual intrusion for the neighboring area	Changes of the values of neighboring real estate (cost)
			Remediation of a decommissioned landfill	Recreation values of the remediated site (benefit)
				Ecosystem service values of the remediated site (benefit)
				Changes of the values of neighboring real estate (benefit)
		Traffic	Disturbances from garbage trucks	Changes of the values of neighboring real estate (cost)
				Life and medical costs of the victims from the increased traffic accidents (cost)
		Noise	Noise nuisance from the machinery and operation of waste facilities	Medical spending due to influenced human health (cost)
				Changes of the values of neighboring real estate (cost)
	Social and macroeconomic	Regional development	Creation of job opportunities	Associated economic impacts owing to the increases of job opportunities (benefit)
			Infrastructure service level	Changes of the values of real estate (benefit)
			Risks of the urban safety	Changes of the values of neighboring real estate (cost)

Source: Weng, Y. C., Fujiwara, T., 2011. Examining the Effectiveness of Municipal Solid Waste Management Systems: An Integrated Cost-Benefit Analysis Perspective with a Financial Cost Modeling in Taiwan. *Waste Management* 31 (6), 1393-1406.

Historical Trend of the MSW Generation, Discards and Recycling Rate in Taiwan: 1990-2008



- **Most of the HSW service costs are supported by the governments.**
- **PPP does not play an important role in the current MSW management systems.**

Research Objective

- To understand the **public attitudes** on the HSW charging systems in Taiwan
- To exploit the **optimal fee level** for achieving efficient HSW reduction

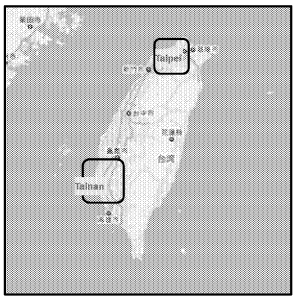
Research Methods

- **Data Collection**
  - **Hearing Survey** with the local civil servants
  - **Questionnaire** for the citizens for investigating their willingness to pay (WTP) in terms of the HSW management fee
- **Data Analysis**
  - **Econometric Analysis**

13

Case Study

- Taipei City where PAYT is launched and Tainan City (without PAYT) would be selected as the case study area.



Source: Google map, 2011.

14

CVM Questionnaire Survey

- The following CVM survey is to investigate the WTA for HSW service.
- The survey is conducted by **1,000 post mails** in Taipei City and Tainan City, respectively.
- The questionnaires are distributed and recovered during 14-27, Dec. 2010.
- **Spatially Random sampling** with regard to the **population weight** among administrative wards
- The respondent ratio is **10.4%** in Taipei City, and **7.2%** in Tainan City.
  - The mayor election
  - Doubt on mail fraud
  - Christmas season

15

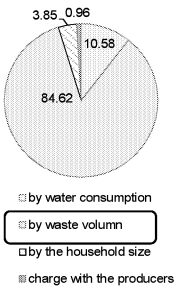
PAYT as a Debate in the Mayor Election of Taipei City

- The candidates hold opposite opinions on the PAYT in the mayor election **last November**.
- In order not to be influenced by the Mayer election, the questionnaire survey was **postponed**.

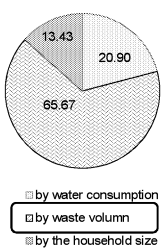
Results of the Questionnaire Survey (I) -

The public opinion on the charging basis

a. Taipei City (n=104)

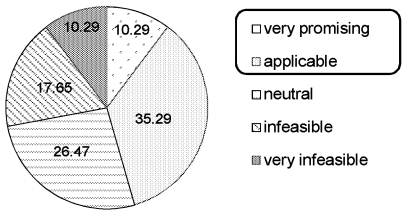


b. Tainan City (n=67)



Results of the Questionnaire Survey (II)-

The public opinion on the feasibility for implementing PAYT in Tainan City (n=68) (where PAYT system is not introduced now)

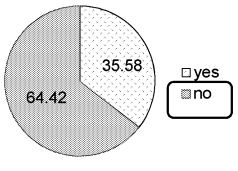


Results of the Questionnaire Survey (III)-

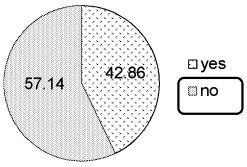
The public awareness on the current fee level :

Do they know how much they pay?

a. Taipei City (n=104)



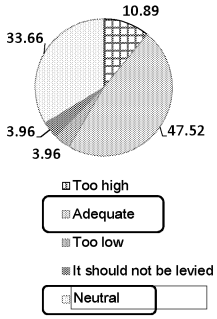
b. Tainan City (n=70)



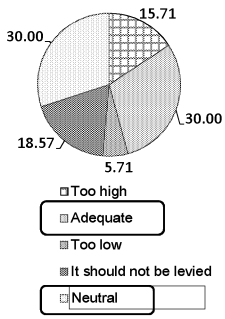
- When CVM is conducted, there would be a **technical limitation** that people are **difficult** to evaluate their WTP unless they are well realized the environmental impacts and the associated cost/benefit items.

Results of the Questionnaire Survey (IV) - Opinions on the fee level

a. Taipei City (n=101)



b. Tainan City (n=70)



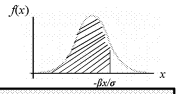
Preliminary Truncated Regression (Tobin) Analysis of the WTPs

- In this study, only the **rational** WTP bidding samples, consistent with the respondent's **attitude**, would be considered in the model development, implying that the range of the WTP variable is **restricted**.

$$WTP_i = \alpha + \beta_j \times x_{j,i} + \mu_i^* \qquad \forall WTP_i \geq WTP_0$$

$$\mu_i^* = \sigma \times \mu_i$$

Truncated normal distribution



where WTP_i is the vector of the i respondent's WTP;
WTP_0 is a **threshold value**;
$x_{j,i}$ represents the variables representing the **respondent's personal attributes**;
μ_i^* is a truncated normal distribution error term **with a non-zero mean**;
α, $\beta_{j,i}$ and σ are the parameters.

- In such a case, the ordinary least-squares method **could not** be used.
- The parameters of the equations were solved by using the **maximum likelihood method** with the **R** statistical software (version 2.13).

21

Preliminary Truncated Regression Analysis of the WTPs (II) -Descriptions of the variables

Variable	Description
$WTP_{Taipei,i}$	The WTP value for the respondent i in Taipei City (New Taiwan Dollar (NT$) at 2010 prices per liter HSW);
$WTP_{Tainan,i}$	The WTP value for the respondent i in Tainan City (NT$ at 2010 prices per 1m^3 water consumption);
$EXCCon_i$	The degree that the respondent i agree with the payment for the potential external (environmental) cost associated with HSW management (1: favor / very favor; 0: neutral / disfavor);
$Income_i$	The respondent i's household monthly income level (0: 0~20,000 NT$ at 2010 prices; 1: 20,000~30,000 NT$ at 2010 prices; 2: 30,000~50,000 NT$ at 2010 prices; 3: 50,000~100,000 NT$ at 2010 prices; 4: > 100,000 NT$ at 2010 prices);
$Educ_i$	The respondent i's education level (0: lower than high-school level; 1: high-school level; 2: undergraduate level; 3: graduate level);

22

CVM Results in Taipei city

- Regarding the development of the WTP functions, firstly, it is required to **confirm** if the respondents are well known about the meaning of waste charging systems and the value of the payment.
- In fact, among the **104** replied questionnaires in Taipei city, where the PAYT is implemented, only **47** respondents provided concrete WTP data consistent with the answers.
- The main reason described is that most of the respondents **cannot** price the HSW management services **until the cost structure is provided and well understood**.
- Even, only **19** among the WTP providers did know the current charging fee level before the notification in the questionnaire was read.

CVM Results in Tainan city

- In Tainan city, where the waste fee is charged with the water consumption, most respondents thought the current fee level is irrational and weakly related to HSW management. The same problem also occurred for the results in Tainan City.
- Only **23** among **72** respondents provided concrete and consistent WTP values, and mere 12 respondents knew the current charging fee level before receiving the information in the questionnaire.
- Such results imply that the municipalities should **promote the public awareness** on the related economic instruments on HSW management so that the policy objectives could be achieved.

Preliminary Truncated Regression Analysis of the WTPs (III)- The Maximum Likelihood Estimation Results

Taipei city:

$$\widehat{WTP}_{Taipei,i} = \underset{(20.52^{**})}{0.159} \times EXCCon_i + \underset{(9.24^{**})}{0.246} \times \mu$$

Log-Likelihood: -0.264 ; *N*= 47

Tainan city:

$$\widehat{WTP}_{Tainan,i} = \underset{(4.90^{**})}{0.865} \times EXCCon_i + \underset{(1.38)}{0.515} \times Income_{Tainan,i} + \underset{(6.76^{**})}{1.14} \times \mu$$

Log-Likelihood: -36.65 ; *N*= 23

Note: (1) Values in the parentheses denote the *t* statistics;
(2) * and ** denote significance at the 10% and 5% levels, respectively.

25

The SWOT analysis of the PAYT in Taiwan

- In SWOT analysis, **Strength** and **Weakness** analyze the **internal factors**, which influence the capacity and conditions for development
- On the other hand, **Opportunity** and **Threats** involves **external factors** that reflect the conditions of the circumstances.

Strengthens

- The PAYT system is proved to be effective in HSW reduction in the case study of Taipei city, and thus the related environmental burdens would be eliminated.
- The policy **arouses the public concern** on waste management issues effectively and thus the environmental awareness is promoted rapidly.

Weakness

- Frequent inspection is required for the policy implementation.
- **Much more waste separation** at sources is expected.
- Trans-county waste discarding, even **illegal dumping**, might be occur.
- **The inconvenience** of the PAYT is argued.
- The manpower of municipalities for the promotion of PAYT seems to be insufficient.
- Some citizens argue that the collection bags would contribute to the waste generation to some extent.

Opportunity

- Enhanced recycling activities with the PAYT would promote the **recycling/reuse industry**.

Threats

- **Fake collection bags** might appear in the market.
- The PPP is not well accepted by a part of citizen. (The clarification of responsibility)

Conclusion

- Both the citizens regard that the **PAYT** is a rational HSW charging system in Taiwan. However, it seems **difficult** to alter the fee level of PAYT systems while the some citizens are not happy with new changes.
- The CVM is difficult to be implemented unless the public is **well informed by the required in-depth knowledge**, but it could serve as **an education tool** as well.
- The degree that the citizens accept the concept of **external costs** of HSW is an influencing factor on the WTP bidding process.
- The detailed internal and external cost/benefit items should be further studied.

Thanks a lot for your kind attention and advices