

A Study on the Public Identity for the Sustainable Water Resource Use for the Taichung Metropolis

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Abstract—With the need of environmental conservation and the global climate change, the issue of water resource use becomes one of the main environmental problems. Based on the pre-studies for sustainable human habitats by using the expert questionnaires, the water resources and public perception are the most two main factors to influence the sustainability of metropolitan area at Taiwan. Therefore, the study focuses on the public identity for understanding of the water resource, including recycling, reuse and household uses, at Taichung. It also pays attention to survey the public identity for the satisfactions for the present water policies and the future possible sustainable utilization strategies. The user willingness to pay for the sustainable water resource use is valued by using the contingent valuation method and the results is showed as the public supporting standard for the possible strategies. For the research process, there are 574 valid questionnaires by using the face to face survey and structural questionnaires, and the pre-test is suitable for the final survey. The major results show that the government need pay more attention for the improvement of related works and the efficiency, although the people feel more satisfied with the late improvement strategies from the Taichung metropolitan authority. In addition, the public has more abnegation for the water recycling, re-use, and the water fee advance for the household using without the information that the water strategies may be related with the climate change. Otherwise, they have general acceptance and the identification of policy supporting. However, more than 70% people report the government cannot show the enough information to gain the public supporting by mass media. In addition, the CVM model is quite suitable for the future predict for metropolitan sustainable water use.

Keywords—public identity, Taichung metropolitan area, water resource management, contingent valuation method (CVM), willingness to pay

I. INTRODUCTION

With the trend of sustainable development and global climate change, the issue of water resource use becomes one of the main environmental problems. Many countries try to improve the sustainable water resources and look forward to an alternative way to overcome the water supply problems [1] [2] [3], especially the countries, they lack of water resources.

Taiwan is in the water crisis, especially south Taiwan. The water supplies at Taiwan's major urban areas are dwindling after successive years of below-average rainfall, coupled with escalating pressure from increasing population and the dominant policy response to this crisis has been the combination of den-land management initiatives and increasing supply through seeking other sources of water, especially reclaimed water technically feasible. Overall of the world, several national and international sustainable water projects have failed due to a lack of community support [4] [5].

Based on the pre-study for sustainable human habitat at Taiwan metropolitan area by using the AHP and Delphi methods, the water resources and public identity are the most two main factors to influence the sustainability of metropolitan area at Taiwan. The situation shows that the water resource plays an important role for the living environment for the public identity, and the related policies need public supporting.

Therefore, the study focuses on the public identity for better understanding of the water resource, including recycling, reuse and household uses, at Taichung. It also pays attention to survey the public identity for the satisfactions for the present water policies and the future possible sustainable utilization strategies. The user willingness to pay for the sustainable water resource use is valued by using the contingent valuation method and the results is showed as the public supporting standard for the possible strategies.

II. RESEARCH METHOD

A. Theoretical Basis

The theoretical basis for the present study is that behavior can be predicted well by respondent's behavioral intentions which are explained by conviction, communal criterion and attitude. Convictions are evaluations of the behavior under study. Selective captures the evaluation of the behavior by respondents which matter to the individual under study. Attitude represents the ability of an individual to actually engage in the behavior under study. As such it captures hindering factors.

The value for each of these three dimensions is computed by combining two underlying aspects: in the case of conviction, one aspect is whether the individual thinks that the behavior will have certain consequences. The effect of communal criterion on behaviors consists of the individual's assessment of important peer's evaluation of the behavior and the extent to which it matters what peers think. Attitude is composed from the assessment of various factors facilitating or inhibiting the behavior and the extent to which this is the case. The locations for the study were chosen based on contrasting water situations, representative of the variety of the South Taiwan circumstances. Based on the literature review the study framework is following as Figure 1:

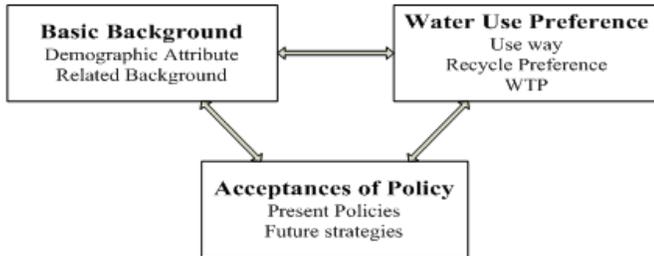


FIGURE 1. RESEARCH FRAMEWORK

B. Contingent Valuation Method

The comprehensive perception of sustainable water resource use is abstractive and not means for transaction. For the valuation of those kinds of none-market resources, Ciriacy-Wantrup (1947) first proposed the Contingent Valuation Method (CVM) as a survey-based economic technique [6]. This method offers an imaginative pricing system to trace the demand curve for a public good unavailable from market data [7]. This system referred to as a preference model helps us recognize what are worth to people [8]. Portney (1994) argued that the approach of CVM must first “contain a scenario or description of the (hypothetical or real) policy or program for the respondents to value or vote upon [9].” Second, “the survey must contain a mechanism for eliciting value or a choice from the respondents”, typically with open-ended questions such as how much money people would be willing to pay for ...? Two guidelines for the application of CVM are that personal interviews, rather than telephone interviews, should be conducted to improve face validity, and follow-up questions should be asked to ensure that respondents understand the choices they are being asked to make and to discover the reasons for their answers. These two guidelines were followed in the study. CVM is now used in research throughout the world in a variety of fields, including transportation, sanitation, health, the arts, education and environmental studies [10]. For general respondents, CVM offers a simple way for them to express their degrees of preference.

The questionnaire of CVM used in the study measured a 10-item group for “Water resource use perception”, one 11-item-group for “Perception of Present water policy,” one 6-item-group for “Future possible strategies,” one 3-item-group for “Willingness to pay,” and a 10-item group for “Demographic Attributes.” The items, “Willingness to pay,” “Age” and “Annual Income”, were set to be open-ended as interval measures. They were interviewed through the

qualitative process and acted as the “subject matter expert rater” to check every item of the questionnaire in a yes-or-no referendum format. Each qualified item was approved by more than half of the panelists. To make sure the survey was clear and understandable; it was given as a pilot study to 100 dwellers that live respectively. The reliability and internal consistency of the survey were assessed by using Cronbach’s coefficient alpha.

TABLE 1. THE PERCEPTION CONTENT OF QUESTIONNAIRE

Group ^o	Main Content ^o	Measure ^o
Water resource use perception ^o	1. Identification for lack of water resources at Taiwan/ Taichung ^o	Interval ^o
	2. Present water use ways ^o	Interval ^o
	3. Preference for government policy ^o	Interval ^o
	4. Acceptance of reclaimed water ^o	Interval ^o
	5. Preference not for "close-to-body" use of reclaimed water ^o	Interval ^o
	6. Preference for "close-to-body" use of reclaimed water ^o	Interval ^o
	7. Safety of reclaimed water ^o	Interval ^o
	8. Acceptance of reclaimed water under fully safety ^o	Interval ^o
	9. Who can influence the acceptance of reclaimed water ^o	Nominal ^o
	10. Reasons to influence the acceptance of reclaimed water ^o	Nominal ^o
Present Policy ^o	11. Satisfaction of policy ^o	Interval ^o
	12. Satisfaction of local government policy ^o	Interval ^o
	13. Rationality of water bill ^o	Interval ^o
	14. Preference of water bill ^o	Interval ^o
	15. Order of water use ^o	Prior Order ^o
	16. Preference in Public Construction ^o	Interval ^o
	17. Preference in economic development ^o	Interval ^o
	18. Preference in industrial development ^o	Interval ^o
	19. Preference in domestic use ^o	Interval ^o
	20. Perception of present policy ^o	Interval ^o
Future strategies ^o	21. Acceptance of government for water resource conservation ^o	Interval ^o
	22. Improvement of Green Architecture ^o	Interval ^o
	23. Acceptance of household waste water reuse ^o	Interval ^o
	24. Acceptance of water desalination ^o	Interval ^o
	25. Increasing water bill ^o	Interval ^o
	26. Water limitation ^o	Interval ^o
	27. More brassbound policy ^o	Interval ^o
Willing to Pay and Following up Question ^o	28. Willingness to Pay (in NTS per year) for sustainable water use ^o	Interval ^o (open ended) ^o
	29. Willingness to Pay (in NTS per year) for maintaining the same using level without changing habits ^o	Interval ^o (open ended) ^o
	30. Willingness to Pay (in NTS per year) for water-saving facilities ^o	Interval ^o (open ended) ^o
Demographic Attributes ^o	31. Gender ^o	Nominal ^o
	32. Residential area ^o	Nominal ^o
	33. Age ^o	Interval ^o
	34. Education ^o	Nominal ^o
	35. Occupation ^o	Nominal ^o
	36. Family Income ^o	Interval ^o
	37. Annual Income ^o	Interval ^o
	38. Environmental professional background ^o	Nominal ^o
	39. Origin of information ^o	Nominal ^o
	40. Information enough level ^o	Interval ^o

C. Sampling

Because the aim of the study is to explore the role of communal criterion and attitude on water-related behavioral intentions-as opposed to making statements about population proportions who share certain perspective or intentions-it is not necessary for the sample to be representative. Rather, it is important that input from a highly heterogeneous group of respondents is captured.

The face to face survey was conducted in January, 2014, through 574 questionnaires using five-point Likert-type scale designed to identify respondents’ preferences regarding the sustainable water resource use. Interviewers had been trained previously and were ready to administer the surveys. Survey participants were interviewed through a convenient sampling approach in the Taichung metropolitan areas with sample sizes conforming to the population ratio of each region. Respondents were asked to complete every item in the questionnaire. A total of 32 respondents stated that they didn’t have time to finish the survey or refused to complete it, and 30 stated that they had never known the sustainable water use, leaving a qualified

sample size of 512, or a response rate of 89.2%. T-test and ANOVA tests were used to identify the differentiation of different groups. Principle component analysis, the contingent valuation method, and general linear regression analysis with the stepwise method were used to analyze the effects of the perception factors and reveal a preference model.

III. RESULTS AND DISCUSSION

A. *Characteristics of Respondents*

The socio-demographic attribute was noteworthy that 64.7% (34.4%+30.3%) of the respondents were within the age range of 20-to-40, an active and latent future conservation source. More of them were unmarried, educated at the college or junior-college level, bourgeois, or service-industry employees, and had an income level from US\$10,908 to US\$21,621 per year. T-testing on gender and marital status showed no significant difference in WTP. ANOVA on "Environmental professional background," "Visiting Frequency," "Residential Area," "Education," and "Occupation" showed no significant difference in WTP. "Age," "Monthly Income" and "Annual Income" showed no significant correlation between WTP and themselves.

In the "Environmental professional background," 23.50% chose "related education background," 29.50% chose "Participation with the related courses," 16.79% chose "Media with environmental education," and 30.22% chose "not related background." In the "understanding of government policy," 38.85% said they has often listened about the related policy descriptions, 24.26% said they has listened, 17.71% said they has some image to know that, 19.18% said they has no idea about that.

B. *The Perception of Water Use (Recycling And Reuse)*

A total of 30.79% (most agreed) and 29.42% (agreed) of the respondents listed their agreement for the fact that there is lack of water resource. Most of them feel they have better ways for water-saving than before, and not satisfy the government water policy.

Respondents were asked how they felt about using reclaimed water. The question aimed at eliciting general conviction. The unconditional acceptance of reclaimed water for using was higher than expected given the low acceptance levels reported in previous quantitative studies. One third of the respondents said that would have no problem with using reclaimed water and another 26 would be willing to use it if a condition would be met. Only a small number of respondents stated that they would require more information. However, as will be shown later, the general level of recognition about reclaimed water is extremely low in the population. 8 percent were undecided and expressed feelings of caution and skepticism. 18 percent would not use reclaimed water (for example some find it disgusting, some have health concerns).

One third of respondents denied that anyone would have any effect at all; one fifth stated that information provided by expert would be influential. Other, less frequently mentioned, sources of effect included experts in general, media, previous users, the water authority, local government, the local and general public, workers in reclaiming plants and one

respondent from Taichung reported that their child's scout leader provided information that effected their vote on the reclaimed water referendum. It can be concluded that while a wide range of respondents effect their conviction towards reclaimed water as well as their behavioral intention expert have a special role to play in the information transfer relating to substitute water sources.

Interestingly, when asked who effected their decision not to use reclaimed water respondents did not provide the same responses, indicating that supportive information and critical information are likely to come from different communal contexts. One fifth of respondents believe that nobody would affect them. Twelve percent state that friends and family would play a major role, followed by only 8% who named expert in the non-using context. Experts and doctors were named by 4% each. Other one-off statements included the public, the government, the health authority, media, politicians, prior users and public health experts. Factual recognition was mentioned more frequently in the context of influencing respondents to use reclaimed water; however opinions appear to play a bigger role in convincing them to be cautious and not to use reclaimed water.

C. *Satisfaction and Acceptance for Policy*

More than 60% (40.63%+21.09%) respondents illustrate the un-satisfaction for the present policy of water resource use, and they also cannot satisfy the local policy from local government. The respondents from Taichung prove they feel much better for the water resource use although the site has the worst water quality before. For the water bill, the conflict is existed naturally, because the respondents show they are wondering the rationality of water bill, but they do not expect the increase of water bill. For the prior order of water use, most of them explain the domestic use is more important than others, economic use, industrial use and public construction, and the individual preference results are proved as well. Overall, the respondents cannot identify the present policy, no matter center or local government.

Most of the future strategies are confirmed by most respondents, and the supporting standard are more than 60%, expect for the increase of water fee (only 32.03%). The household waste water reuse and water desalination earn even more than 70% (73.05% and 70.31%) supporting, and the nearly 65% respondents show they accept more brassbound policy for metropolitan water use. Otherwise, for the respondents at Taichung, they have more acceptances for the water reuse, because they have done so.

D. *The Inter-Relationship Between Demographic Attributes and Perception of Water Use*

Through the analysis, several variables in demographic attributes are related with the some items, belonging to the perception of water use. For the residential area, the "Present water use ways", "Preference for government policy", "Acceptance of reclaimed water", "Preference not for close-to-body use of reclaimed water", and "Preference for close-to-body use of reclaimed water" have a significantly correlation, and the results show different metropolitan area have different identification for the water use. Moreover, "Education" is significant correlated with "Identification for lack of water

resources at Taiwan”, “Preference for “close-to-body” use of reclaimed water”, and “Safety of reclaimed water”, and then the situation illustrates the respondents with higher education care more about the safety for the reclaimed water and its extension issues. “Professional background” is significantly correlated with “Preference for government policy”, “Acceptance of reclaimed water”, “Who can influence the acceptance of reclaimed water”, and “Reasons to influence the acceptance of reclaimed water”, so that the environmental professional background may have some differences for water use perception. By using Pearson product-moment correlation, “Acceptance of reclaimed water”, “Preference not for close-to-body use of reclaimed water and “Preference for close-to-body use of reclaimed water” have significantly positive correlations with the both of income is significant respectively, and the results can match the education partly.

E. The Inter-Relationship between Demographic Attributes and Policy Perception

For the correlation analysis, some variables in demographic attributes are related with the some items in the policy perceptions. “Residential area” is significantly correlated with “Satisfaction of policy”, “Satisfaction of local government policy”, “Rationality of water bill”, “Preference of water bill”, “Order of water use”, “Preference in Public Construction”, “Preference in economic development” and “Acceptance of government for water resource conservation”, and it means the different living city should have different problems and regulations for sustainable water use to influence the public identification. In addition, there is a significant correlation between “Education” and some of them, such as “Satisfaction of policy”, “Satisfaction of local government policy”, “Preference of water bill”, “Preference in economic development”, “and Preference in industrial development”.

F. WTP for Metropolitan Sustainable Water Use

Based on the WTP approach, the model of public preferences regarding metropolitan sustainable water resource use is shown as below (with un-standardized coefficients) by using simple linear regression analysis and stepwise regression analysis: (see Eq(1), Eq(2))

A. Normal Model (simple linear regression)

$$\text{WTP} = 1023 + 16.84 \times (1) + 1.72 \times (2) + 0.081 \times (3) + 1.02 \times (4) - 2.13 \times (5) + 0.15 \times (6) + 1.23 \times (7) - 23.1 \times (8) - 5.42 \times (11) + 22.27 \times (12) + 0.25 \times (13) + 0.45 \times (14) - 0.02 \times (21) + 0.11 \times (23) + 1.25 \times (24) - 7.21 \times (25) + 1.25 \times (26) + 0.05 \times (33) \quad (1)$$

The Numbers of () is followed as Table 1

B. Economic Model (stepwise regression)

$$\text{WTP} = 4285.03 + 16.84 \times (2) + 10.72 \times (4) - 0.81 \times (23) + 0.06 \times (37) \quad (2)$$

The Numbers of () is followed as Table 1

The mean of the price that respondents are willing to pay (WTP) for metropolitan sustainable water use is NT 3202 per year, and the values through Eq(1) and Eq(2) are NT\$ 3208 per year and NT\$ 3214 per year (about US\$100 per year). The

three results are very similar and the models are suitable for predict (The R square values for the equations are 0.64 and 0.71).

The mean of the price that respondents are willing to pay (WTP) for maintaining the same using level without changing habits is NT\$3241 per year (about US\$100 per year). In addition, the mean of the price those respondents are willing to pay (WTP) for water-saving facilities are NT\$6718 per year (about US\$ 202 per year). Based on the three WTP results, it shows that the respondents expect not only keep the same life quality, but also like to pay more for sustainable use of water resource. The original life style and water-saving facilities are not enough to support their need.

IV. CONCLUSION

To sum up, the policy acceptance for sustainable water use at Taichung are general higher than before, and it means they have better preference for environmental issues and try to accept some new ideas, such as the utilization of reclaimed water and the more brassbound policy, for the sustainable future, even they may meet some uncomfortable situations. In addition, the perceptions in different areas are different with the different demographic structure during the study process.

For the present policy, most of respondents identify that the government need pay more attention for the improvement of related works and the efficiency, and more than 70% people report the government cannot show the enough information to gain the public supporting by mass media. In terms of public, they expect the domestic use preempts others, but the practical situation is contradictory. In addition, they always know the plan of water use well for local government thought the place has been one of the worst water quality sites in Taiwan.

Based on the WTP, the result shows the respondents are able to pay more for the sustainability of water use, and the payment may be located on even one-tenth annual income. In other words, people are willing to spend more money to ensure the future water use, but the more detail of policy information from government are needed.

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