Participation and Contingent Valuation of Danshui Basin Stakeholders

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Abstract

The issue of water quality in the Danshui Basin has been emphasized in recent decades. The authorities have made efforts to clean up river water, to set up criteria for wastewater discharge and so on. Consequently, water quality of Danshui Basin has improved. However, insufficient public participation and information disclosure raises people’s mistrust. By increasing public participation, trust can be increased.

This thesis focuses on stakeholder perception of existing approaches to water policy and residents' willingness to pay (WTP) for water quality improvement in Danshui Basin.

The results show that respondents think that the completion of sanitary sewage systems is the most useful approach to improve the water quality. Most respondents agree that good water quality will enhance human health and improve the tourism image. Moreover, they believe that good water quality is more important than industrial profits.

The WTP for water quality improvement is NT$222.3. And 60% of all respondents were willing to contribute to the improvement of the water quality.

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Chapter 1 Introduction

1.1 Background Information

Taiwan is a solitary island on the western edge of the Pacific Ocean. The total length from north to south is about 380 kilometers. At its widest point, it is roughly 140 kilometers and the total area is 35,915 square kilometers. Steep mountains over 1,000 meters high cover about 31 percent of the island's total land area. The annual rainfall reaches 2.500mm which is 2.5 times the world average. Three-fourths of the annual rainfall is concentrated in the months of May through October.

With the disparity in seasonal precipitation, it is difficult to arrange water allocation. Steep mountains and regular occurrences of typhoons add to the unpredictability of water flow and usability.

With economic development and industrial activity, the population grows rapidly. The population growth of Taiwan between 1975 and 2008 is shown in Figure 1. Therefore, the demand for water required by households, economic development and for industrial activities is increasing. The growing water demand has become a crucial issue. Governmental authorities have had to regulate and control the allocation of water.

Besides water quantity, water quality is also an issue. This issue arises due to prosperous economic activities. Factories discharge waste water into the rivers without treatment process; farmers improperly use fertilizers and allow animal waste to seep into the existing water sources; people illegally unload waste into the river system. The degradation of water quality destroys recreation areas, threatens the health of human beings, as well as flora and fauna. How

to provide clean and efficient water to all population was one of the main considerations for governmental authorities, hence Environmental Protection Bureaus (EPB) in each county was established in 1979. The Environmental Protection Administration (EPA) was set up as the national authority to manage the entire water pollution issue in August 1987.

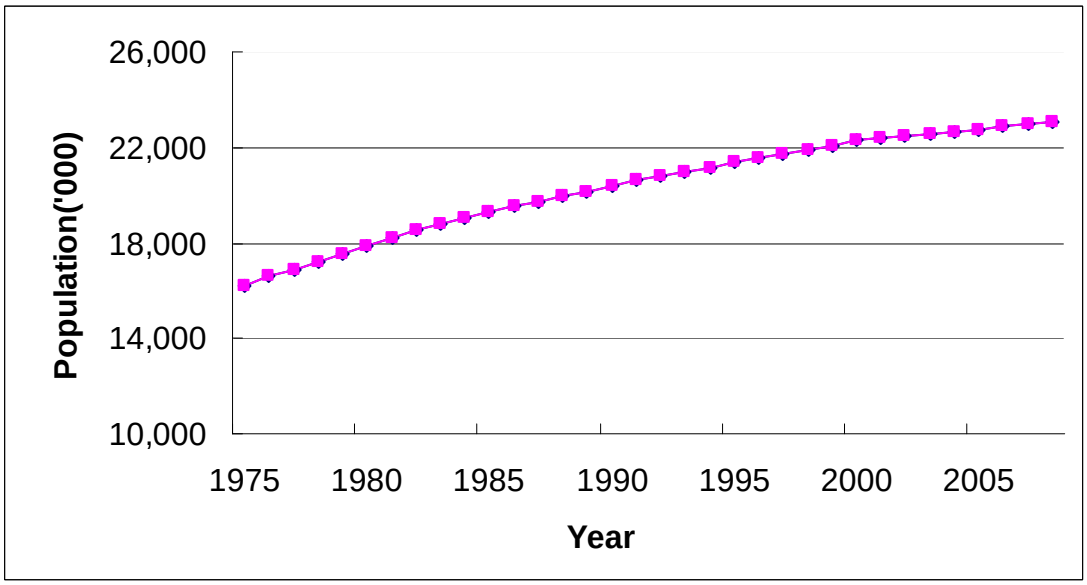


Table 1-1: Population of Taiwan, 1975 to 2008

Environmental authorities established effluent standards for all facilities to limit the concentration of specific pollutants. Fees are imposed to recoup the expense of water purification efforts. Discharging untreated sewage into rivers is no longer acceptable. Factories are inspected and required to install wastewater treatment facilities.

In addition, the governmental authorities have accelerated the work on sewage system construction facilities, improving garbage treatment and monitoring principal pollution sources continuing to improve water quality. The long-term goal of environmental regulation is to prohibit water pollution, ensure water quality, and maintain a healthy ecosystem, thereby improving the quality of life

for citizens.

Recently, Public Participation (PP) has become a primary component in water management (Mostert 2003). It says that citizens or relevant organizations have the right to be informed about environmental matters and to participate in the process of environmental decision-making. Many environmental international declarations and conventions require PP in the regulatory decision-making process, especially in water policy and water governance (Newig 2008).

There are many reasons and motivations to organize PP (Mostert 2003; Newig 2008). PP is generally believed to improve decision-making by enhancing effectiveness of the decisions (Newig 2008). Moreover, PP can increase public awareness of environmental issues; provide broader knowledge and experience of different stakeholders; reduce misunderstanding and enhance effective communication.

Public participation activities in the United States have been executed in regulatory decision-making since the late 1940's (Wyman 2008). The Environmental Protection Agency (EPA) even issued "Public Involvement Policy" for public participation in environmental decision-making to promote the public's level of participation after the 1960's. In the meantime, the public's awareness of environmental degradation was gradually increasing. In addition, the European Water Framework Directive (WFD) implemented PP practically by including PP provision for water resource management at the EU level in article 14 (Ker Rault and Jeffrey 2008).

Currently, the public's involvement in Taiwan is limited to public hearings or

comments from scholars and experts. Chen (2003) suggested that the Taiwanese government authorities should realize successful PP processes and set up the adequate procedure for public involvement.

In this thesis, the Danshui Basin was selected as the area for study because it is the most important basin in northern Taiwan. The Danshui Basin has played an essential role in Taiwan's history and natural environment. Taiwan's capital, Taipei City, is located in the Danshui Basin. It has been the hub of Taiwan's economy, politic, culture and transportation for hundreds of years. Danshui River, the main river of Danshui Basin, and the harbors at Dadaocheng and Beitou are important approaches for trade. More than 6 million people depend on the Basin for their domestic water and drinking water[,] because it provides huge amounts of water for agricultural irrigation and industrial purposes. The most important stakeholders in the Danshui Basin are:

1. Farmers
2. Factories
3. Local subsistence users
4. Government on the local, regional and national level
5. Protected Area Administration
6. (Environmental) NGOs on local, national and international level
7. Tourism operators and suppliers
8. Tourists

This thesis focuses on local residents and longtime inhabitants who have lived in the Danshui Basin area for more than two years and rely on the Danshui Basin for their domestic water use. The term 'stakeholders' will be used to refer to this group. This thesis focuses on stakeholder views on existing and available water policy strategies with respect to the Danshui Basin. Moreover, the Willingness To Pay (WTP) of stakeholders for water improvements in

Danshui Basin is investigated.

Policymakers need to understand the opinions of stakeholders to be able to effectively implement water quality improvements. Without the support from stakeholders, the government may have problems executing policies. To investigate stakeholder perceptions of the policy is one approach to bridge the gap between the government and the stakeholders. By knowing the stakeholder perceptions, the government may adjust policy regulation or adapt thoughts of citizens into policies. Stakeholders may have different opinions depending on their economic, social or cultural situation. However, their connection with issues of water quality or quantity might differ. By exchanging ideas through information supply and feedback on the relevant issues, the government and public may have better communication (Mostert, 2003).

Moreover, the willingness to pay for changes in water quality of Danshui Basin is assessed in a questionnaire. Contingent valuation is an economic method used to evaluate the price of environmental goods. By undertaking the contingent valuation survey, policymakers can estimate the value of improvement and know how socioeconomic characteristics of the respondents relate to their willingness to pay. Further, WTP can provide information about water charges or sewage charges to local inhabitants by water companies and municipalities.

In addition, the literature about the Water Framework Directive (WFD) water policies and approaches in the EU will be reviewed. By comparing the current policy strategies of the EU and Taiwan, we might come up with some suggestions about how to improve policy instruments used in Taiwan.

1.2 Purpose of Research

The purpose of this thesis is to increase understanding of stakeholders perceptions on existing water policies and to assess stakeholder's willingness to pay for water quality improvement in the Danshui Basin. Furthermore, the EU water policy experiences will be investigated, because they might provide water management concepts and possible policy instrument that Taiwanese water authorities could also use.

1.3 Research questions

1. What are the existing and available policy strategies concerning the Danshui Basin?
2. What are the policy instruments concerning water pollution in use today in developed countries?
3. What are feasible policies that can be used in Taiwan?
4. What are stakeholder perceptions about water policies?
5. What price are stakeholders willing to pay to improve the quality of the water in Danshui Basin?

1.4 Outline of the Thesis

Chapter 2 presents both European Water Framework Directive and the Taiwanese water policy process. By comparing the processes, the possible solutions or recommendations for Taiwan authorities for future water policy development in Taiwan are addressed. Chapter 3 introduces the concepts and application of public participation and Willingness to Pay (WTP). In chapter 4 the design of the survey and data collection procedures are described. Furthermore, the environmental economic model and possible explanatory

variables for the WTP are described in chapter 4. Chapter 5 presents summary statistics and econometric estimates based on the responses to the questionnaire. Finally, Chapter 6 summarizes the contents of this thesis and suggests some possible directions for future research, along with a brief discussion and conclusions.

Chapter 2 Overview Water Issue of EU and Taiwan

Water resource management has been emphasized for decades, many policy-maker and scholars expand their efforts on it (Shogren 2002). The European Water Framework Directive (WFD) is a milestone in the history of European water policy. The WFD established a framework for water management at the international level. All member states and candidate countries must adapt their water management system to WFD–requirements (Aubin 2002). The WFD brings several new concepts, such as “public participation”, “ecological status” and “river basin management”. Further, the WFD sets out a timetable for the implementation of requirements for EU member countries. To understand the WFD development process, it is useful to clarify the key elements of the success of the WFD implementation. In addition, the development of water policy in Taiwan will be stated below.

By comparing the EU, WFD and Taiwanese water policy development, this research suggests possible solutions or directions for water resource management the Taiwanese authorities could implement in the future.

2.1 WFD Development Process

The European Water Framework Directive set a framework for comprehensive management of water resources with common objectives and principles. The fundamental objective of the WFD is to prevent any deterioration in the existing status of all water bodies and to achieve the “good status” in 2015 for all water bodies. Instead of using traditional number concentrations or pollutant concentrations to classify the status, ecosystem indicators are used to describe the status, e.g. “composition and abundance of aquatic flora” or

“composition and abundance of benthic invertebrate fauna”.

The development of the European legislation for water resources can be separated into three phases:

- The first phase (1973-1988)

  Concern for water resource depletion in Europe was raised in the beginning of the 1970s. European water legislation mainly focused on the water protection of human activities by determining water quality standards for certain types of water bodies: bathing waters, fish and shellfish waters and drinking water. These emission standards are based on the assumption that water has the capacity of self-purification.

- The second phase (1988-1995)

  Because the water quality kept on deteriorating, the European water legislation focused on controlling emission levels to restrict the use of more specific pollutants, e.g. hazardous substances that cannot be diluted or decomposed by the environment.

- The third phase (1995-present)

  The European water legislation combines the previous approaches and provides a common framework for European Union (EU) water policy. The WFD entered into force in December 2000. It represented a breakthrough in the scope of water protection and in its implementation.

The WFD established a new legal framework for the protection of all waters inside the European Union at the river basin scale. The WFD considers all

water types as the same resource (including rivers, lakes, groundwater, coastal and transitional waters); all member states should then coordinate their environmental policy. The WFD has clear objectives regarding monitoring systems for groundwater and surface water, mandatory participation by citizens, stakeholders and NGOs, meeting environmental objectives…etc. The most remarkable objective is that all surface and ground waters in Europe must achieve “Good Ecological Status” by the year 2015. For the integrated management at the level of river basins, the member states have jointly established a management plan for the international district instead of focusing on the boundary confinement. Water management must protect the aquatic ecology, unique and valuable habitats, drinking water resources and bathing water based on river basins (WFD 2000/60/EC).

“Public Participation (PP)” is one of the essential factors for supporting the implementation of water policy. WFD places PP at the center stage of water management because PP is considered an approach to ensure the effective implementation and achievement of the environmental objectives of water management (Ker Rault and Jeffrey 2008). PP provides the public with detailed information on the WFD policy development and enhances public participation in policy decision-making. The public may provide knowledge, expertise or experience that is useful for the policy-making process.

The WFD is flexible in its concept, but has a precise schedule for environmental objectives. Member states can set their own institutional arrangement without strict confinements. At the same time, they must achieve successful and effective implementation of the WFD. The step-by-step timetable for WFD implementation includes “analysis of pressures and impacts

on all waters", "start of monitoring programmes", "programmes of measures to achieve framework objectives established", etc.

2.2 Water Policy History in Taiwan

Taiwanese water authorities used to put their efforts in flood damage reduction for safe guarding the citizen's life and property, utilizing the limited water resource for household, industry and agriculture.

With rapid population growth and industrial development in the 1970's, environment degradation generally accelerated. Because the public required authorities to remedy and control environmental pollution, the Environmental Protection Administration Executive Yuan (EPA) was established in 1987. After the establishment of EPA, each city and county government gradually set up the Environmental Protection Bureau (EPB) to enhance overall environmental protection work between 1988 and 1991. Moreover, a series of water pollution prevention strategies were spread out, e.g., "Study of pollution remediation on management systems in the Danshui River", "Drinking Water Source Water Quality Protection Guidelines" and "Phase One of River and Ocean Management in Taiwan (2001-2004)", etc. (Leu 2007).

EPA administered several important water projects. The main purposes of this last project are:

- To have sufficient oxygen during the dry season;
- To eliminate floating garbage on the river surface;
- To guarantee the quality of water in terms of chemistry, biology and nutrients;
- To have more riverside resorts along river banks for citizens.

To meet these objectives, environmental authorities set up several regulations and Acts to regulate pollution, e.g.[,] the Water Pollution Act, the Soil and Groundwater Pollution Remediation Act and the Waste Disposal Act. Rules were made to insure that the Acts would be enforced. The content of these Rules cover the following:

- Drafting, deliberation and interpretation of soil and groundwater pollution remediation laws and regulations;
- Supervision, assistance and approval of special authority;
- Licensing and management of pollution testing organizations;
- Remediation policies, programs and plans;
- Remediation personnel training work.

In order to assure the wastewater is treated before flowing back into original rivers, the EPA has provided funding for the construction of on-site wastewater treatment systems and sanitary sewage systems. In midstream and downstream sections, the EPA has built stations to intercept waterborne sewage from households without connection to public sewage system. This sewage is then directed to existing sewage treatment plants.

However, the authorities are separated into different water resource administrations. Separate government organizations oversee upstream, middle and downstream areas. The Forestry Bureau, The Council of Agriculture, and the Executive Yuan conduct the upstream section for forest management, preservation, administration, and investigation. These authorities have administration overlapped especially in water management. The Forestry Bureau maintains and protects water-catchment areas of the

forest, but the Council of Agriculture also has the authority to conserve the forest resource included the water resource.

In the upstream and middle stream areas, The Soil and Water Conservation Bureau (SWCB) takes charge of watershed conservation, erosion control and landslide conservation. It monitors and controls all water utilization. It is also responsible for rural community planning and development.

Downstream, the authorities are spread into different departments based on the realms. The Department of Water Quality Protection is in charge of water quality protection policies, the planning guidance and supervision of surface water, groundwater, wastewater or sewage discharge and controls. The Construction and Planning Agency Ministry of the Interior (CPAMI) implements storm sewage and sanitary systems and impels storm sewage system construction. If the river basin flows across different counties or cities, the management rights are also shared by different local governments. Given the complicated administration system, the crossover laws and regulations of river basin hamper the efficiency of the administrations.

Take Danshui Basin as an example: because of its wide scope, it is managed by the 10th River Management Office WRA MOEA, the Department of Environmental Protection (Taipei City Government), the Environmental Protection Bureau (Taipei County) and the Environmental Protection Administration Executive Yuan, Republic of China, Soil and Water Conservation Bureau, Council of Agriculture, Executive Yuan and other relevant authorities. Because so many institutions and government organizations are involved, the management of the Danshui River Basin is not very efficient.

Overlapping jurisdictions and conflicts of interest have interfered with the efficiency of the various authorities. Ambiguous regulations confuse the public and the overall management is inefficient. The administrative framework is inflexible and hardly keeps pace with changeable demands of industry and population (Liu 2003; Chen 2004). The administrative system does not recognize interdependencies among water resource plans, utilization of land and forest conservation.

In the past ten years, experts and researchers have made recommendations for efficient and consistent management of governmental water departments into the integrated river basin management, taking into consideration land-use and water-resource planning as preferable to traditional water management (Chan 2000). Up to now, this reconstruction has not taken place, though Executive Yuan evaluated the possibility and the framework of new administration (Liu 2003).

Besides, the public's role in the regulatory processes is limited to public hearings and giving comments. Citizens hardly find the process to be beneficial to improving water quality. One of the approaches is to join the river cruise teams belong to regional EPB. The river cruise teams are volunteer associations which can prevent environmental pollution, reduce the pollution withdrawal and improve the chaotic situation of river banks.

2.3 Possible water resource management solutions for Taiwan

The European Water Framework Directive (WFD) provides a framework for water management and protection in Europe. Each river basin is considered as a management unit because river basins combine with various fauna and flora resources jointly forming an ecosystem.

The WFD breaks the national boundaries and applies the concept of water management integration. Furthermore, the European water legislation develops a common implementation strategy and a clear objective for member states to restrain the water remediation process. Public participation is a supplementary tool to enhance the effectiveness of WFD implementation (O¨ zerol et al. 2008).

In Taiwan, the authorities focus their efforts on water environment remediation though they do not set clear objectives or set guidelines for river basin management. Also, the overlapped water resource management is cumbersome and complicated. The efficiency of water quality improvement is hindered by those overlapped authorities. In contrast to WFD, the administrative system of river basins should be integrated into one organization for efficient water management. Besides, there is no confined public participation in any regulations. There is no formal approach for public participation, so citizens often object to government policies. Taiwanese authorities have to enhance the portion of public participation when executing or developing policy approaches, thereby reducing the gap between the authorities and the public.

Chapter 3 Literature Review and Theoretical Background

This thesis is based on a review of available literature and data gathered via a survey of attitudes and opinions of stakeholders living in the Danshui Basin. The basic concepts and theories - Public Participation and Contingent Valuation Method - Willingness to Pay (WTP) are described below.

3.1 Public Participation

Abraham Lincoln said "… that government of the people, by the people, for the people, shall not perish from the earth" (Gettysburg Address 1863). Since the structure of government is based on the people, the government authorities should consider the needs of the people before making any decisions.

Government officials who are democratically elected have to take public opinion seriously because of their responsibility to citizens. Citizens have the right to express opinions about the way the government should work (Koontz et al., 2008). If the government makes decisions without hearing the opinions of the people, the government may not be trusted by the public. Public trust is positively associated with life satisfaction (Koehler and Koontz 2008). If the public does not trust the government, the society will be unstable and the public will feel unhappy (Jonsson 2009).

Therefore, Public participation (PP) is one of the important democratic approaches to decrease the gap between the government and the general public. PP has three main levels that can be distinguished: information supply, consultation and active involvement (Mostert 2003). The citizens may not only be limited to public hearings and contribute their knowledge and experience to relevant policy issues but also participate in the decision making process or

further activities (Newig 2008). Furthermore, the administrative authorities should ensure that every stakeholder has an equal opportunity to receive the information and to give feedback based on equality principles (Mostert 2003). PP can not only enhance the trust of the public in government but also raise the public's awareness on public affairs or environmental issues (Koehler and Koontz 2008).

In the United States, PP has been a component of regulatory decision making since the late 1940's. Nevertheless, the public executes the right to hold government regulators more accountable for their actions by voting (Wyman 2008). Though the public is involved in the policy process, the role is blurry. There is no appropriate structure for public participation. In 2003, the U.S. Environmental Protection Agency (EPA) has increased its use of public participation in the development policies so that the collaborative process will be more just and effective (Koontz, et al. 2008). Due to this structural feature, many interest groups are direct participants in the legislative process toward the adoption of environmental regulations. And the evaluation of collaborative process about environmental issues has been pursued for supporting the use of collaborative processes (Wyman, 2008).

The European Union Water Framework Directive (WFD) is successful in incorporating relevant stakeholders in decision-making process. The WFD involves the concepts of PP in the Article 14 to ensure the effective implementation with interested parties. In this Article, member states are encouraged to involve all interested parties in the implementation, and to equally offer information about a timetable and work programme to the public. During the process of making river basin management plans, member states

should provide the interim overview, the draft copies of the plan or those relevant background documents and information. The public is also allowed to make comments in the particular period.

In recent decades, Taiwanese are becoming increasingly aware of the environmental issues. The concept of public participation has been adopted by Taiwanese environmental management authorities. However, environmental authorities tend to design the process in the way that is convenient to implement and only allow little oversight for the public. The authorities lack appropriate methods to inform environmental organizations and local inhabitants.

Environmental organizations, such as The Society of Wilderness, Chinese Wild Bird Federation, Taiwan Environmental Protection Union, are devoted to protecting the environment through the education, action programs and community involvement. If the government tries to execute improper environmental policy, these organizations may fight against it. However, the domestic environmental groups and/or local inhabitants are seldom involved in drafting environmental regulations or in executing process (Chen 2002).

Even though the public was involved in some regulatory process, their role was cursory. Generally, the public was informed during the public hearings in most situations. The perceptions of environmental issues between the government and the public are sometimes disparate. Many scholars and environmental groups argue that an ideal environmental management should involve meaningful public participation for improving communication (Lin 2005).

For the purpose of clearing up misunderstanding surrounding the public, the government authorities should find a way to understand the public and incorporate public opinions into the environmental management systems. To understand the public thoughts can not only be an approach to eliminate misunderstandings but also to find out future movement to enhance people's environmental awareness and level of participation in policy implementation.

In this thesis, the public perception of Taiwanese current water policy approach in Danshui Basin is concentrated. A list of existing water policy approaches of Danshui Basin is provided for respondents. These policy approaches are partially in the process or in the evaluation situation.

The Cost and Effective Matrix can help policy makers identify the order in which changes should take place. It was inspired by Milgrom and Roberts (1990). Milgrom and Roberts (1990) show mathematically how interactions can make it possible to successfully implement a new, complex system in a decentralized fashion. Many managers plan a strategy that takes into account and coordinates the interactions among all the components of a business system.

In order to determine the most three feasible approaches, these existing water policy approaches are listed below and evaluated by cost-effective matrix. According to government information disclosure- 2006-2009 EPA Annual Performance Plan and Budget Overview and Budget Policy Statement 2005-2009(EPA; Directorate-General of Budget, Accounting and Statics, Executive Yuan), the evaluation of each item is rated by numerical rating scale. The scale is considered to indicate the different level as 0, 1, 3 and 9 points. In

contrast to the total score for individual water policy approach, the possibility of policy execution might be determined.

Item / Score	Importance**	Feasibility**	Cost**
0	Effects at the small scale level	Long Term: more than 10 years	More than NT$* 20 billions
1	Effects at the local level	Middle Term: 5 to 10 years	NT$10 to 20 billions
3	Effects at the regional level	Short Term: 1 to 5 years	NT$1 to 10 billions
9	Effects at the national level	Immediately: Less than 1 year	Less than 1 billion

Table 3-1: Definition of cost-effective evaluation criteria

* NT$: New Taiwan Dollar

** Importance: To measure the scale of effects on the performance of approaches after implementation.

Feasibility: To assess the possibility of implementing the approaches in the current situation.

Cost: The cost of implementing individual approach.

Existing Water Policy Approaches	Importance	Feasibility	Cost	Total Score
1. Sanitary sewage system	3	0	0	3
2. Water quality monitoring system	3	1	6	10
3. Environmental tax	9	3	9	21
4. Environmental subsidy for wastewater treatment	0	9	6	15
5. To set overall discharge standards	9	3	9	21
6. To supervise and control pollution	1	9	3	13

sources				
7. Improvement of garbage treatment	3	9	9	21
8. Integral water pollution control act	9	0	9	18
9. Flow cutoff[1]	3	3	3	9
10. Set the constructed wetland[2]	1	9	3	13

Table 3-2: Cost and Effective Matrix for existing water policy approaches

By combining the results of these investigations, the top 3 possible approaches are listed as follows:

(1) Environmental tax

(2) To set overall discharge standards

(3) Improvement of garbage treatment

These three water policy approaches cost less compared to other approaches. However, the government authorities currently focus on investments in sanitary sewage systems. The authorities might also use other approaches to achieve the overall improvement of water quality.

The perceptions of respondents with respect to these approaches are investigated. The remediation of Danshui Basin has been a highly challenging mission for a long time. Concurrently, the government is placing a greater emphasis on increasing accountability to the public. By knowing the thoughts of current water policy approach, the authorities may find out the approach to eliminate those misunderstandings and improve public perception of water management. Furthermore, the triggers of environmental action or awareness

[1] To cut off the untreated wastewater from river to the wastewater treatment plant in order to prevent pollution.

[2] The constructed wetland is an artificial marsh or swamp, built for disposing wastewater.

about water quality may be found. The authorities may properly establish or alter public participation process for different water management approaches.

Public participation provides opportunities for the people to participate in development programmes and projects. Though the proper level of participation is hard to define, PP is still a practical link between the public and government and it becomes an influential trend in policy-making process (Ker Rault and Jeffrey 2008). If PP is properly executed, authorities could reduce the public's dissatisfaction with environmental problems and enhance public trust in government. More and more nations could collaboratively implement PP, thus raising the effectiveness of environmental projects.

3.2 Contingent Valuation Method

“Natural and semi-natural ecosystems and landscapes provide benefits to human society, which are of great ecological, socio-cultural and economic value (de Groot 2006).” Unfortunately, these benefits are seldom fully considered in environmental planning and decision-making. Valuing the services derived from the environment is important because the valuation may help make the case for protecting the environmental in an efficient way.

The economic value of environmental goods has a composite nature. It is normally divided into two categories: “use values” and “non-values”. “Use values” are defined as those benefits that derive from the actual use of the environment, such as using herbs for medicinal purposes, walking in a forest or admiring the landscape. “Non-use values” are derived from attributes inherent to the ecosystem itself“(Hein, van Koppen et al. 2006). These values usually include socio-cultural perspectives, such as the beauty of nature, cultural traditions and recreational features.

In order to access the total value of environmental assets or some components of them, it is important to assign monetary values to different categories of economic value. Double counting environmental benefits must be avoided.

The market price of a marketable good is determined by supply and demand for it. It is difficult, however, to elicit values for non-market goods. Non-market goods are goods which are not traded on the market. A number of methods are developed for deriving values of non-market goods. The Contingent Valuation Method (CVM) is one of these methods. The objective of the CVM is to induce people to present their willingness to pay (WTP) for a change in the provision

of a non-market good such as an environmental quality. It is also possible to elicit the willingness to accept (WTA) to forgo the change in the non-market good. The maximum WTP is evaluated from people's responses to hypothetical questions about change in environmental quality improvement. In this thesis, the WTP for water quality improvement in Danshui Basin is investigated by adopting CVM. The reason for choosing the WTP-measure rather than the WTA is because people have a stronger tendency to pay for environmental improvement rather than to accept a change for environmental deterioration (Morrison 1997).

The origin and application of Contingent Valuation Method

Ciriacy-Wantrup (1947) introduced the use of Contingent Valuation Method (CVM) in an article about the evaluation of economic effects of preventing soil erosion. However, he did not implement the method. Davis (1963) proposed the first CVM design. He estimated the value of the recreational possibilities in the woods of Maine using a survey technique. Since then, the CVM has been widely applied to estimate a wide range of non-market goods and services. CVM has become one of the most important sources of information for decision-makers about values of environmental goods (Freeman 1993).

The CVM measures economic valuation by directly asking people's WTP or WTA through a survey. Respondents are asked to state their maximum WTP or minimum WTA for a hypothetical improvement or deterioration of an environmental good. Decision makers may use CVM as in a cost-benefit analysis. Moreover, based on a CVM study socioeconomic and other characteristics (gender, age, income, education level, preferences…) of the

respondents can also be related to WTP or WTA of respondents. The economic concepts of CVM are described below.

The Theory of Environmental Valuation

When a consumer buys a product at the market price, the price reveals a lower bound of his/her willingness to pay (WTP). On the other hand, if a person sells a product and receives the market price, the money received by the seller reveals an upper bound for his/her WTA. If there is no market for a product, there is no market price that displays people's WTP and WTA.

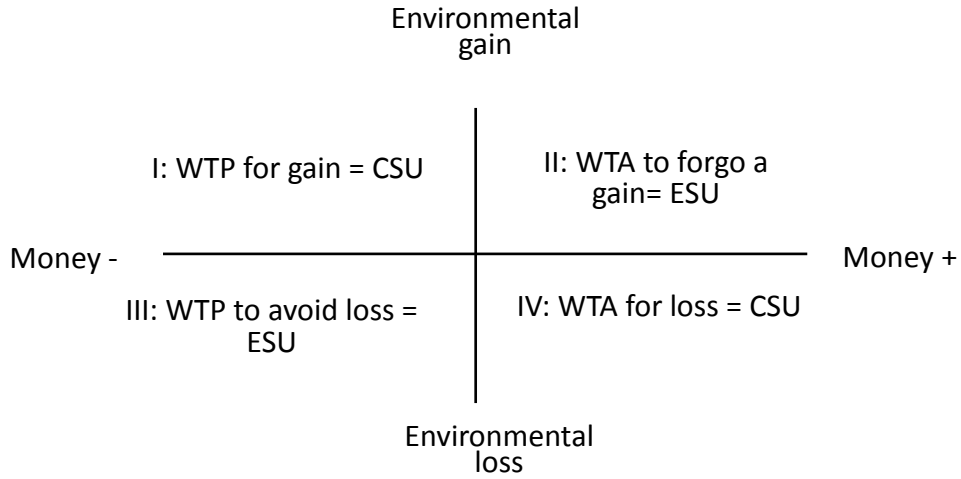
However, in an individual's utility function, environmental quality can appear either directly or indirectly. When an improvement of environmental quality increases utility, direct or indirect effects occur such as agricultural water use, recreation and tourism image, etc. Therefore, WTP and WTA can be interpreted as monetary indicators of individual welfare changes in case the environmental quality changes. WTP and WTA can be directly related to the economic concepts of compensating surplus (CSU) and equivalent surplus (ESU)[3].

The CSU is the amount of compensation to make the individual indifferent between the original situation and the new situation in order to offset the change in environmental quality. The CSU can be thought of as the maximum amount that individual would be willing to pay for an improvement in the environmental quality in order to maintain the previous utility (measure I in Figure 3-1). The CSU also reflects as minimum amount that must be paid to consumer to make he/she maintain the same utility as before an environmental

[3] This section draws extensively on Chapter 9 of Markandya et al. 2002.

damage occurred (measure IV in Figure 3-1).

For the environmental quality improvement, ESU can be described as the minimum additional income to be given to the consumer to bring him/her to the utility level he / she would have attained with the environmental quality improvement (measure II in Figure 3-1). For environmental damages, ESU is defined as the amount of money to be taken away from the consumer to bring him/her to the same level of utility he / she would have attained if the environmental damage would have occurred (measure III in Figure 3-1).



I < II/III < IV

Figure 3-1: The Divergence of WTA and WTP

Faced with an increase of the environmental quality, individuals' minimum WTA would be higher than WTP (see also Figure 3-1). The environmental theory suggests that the reasons for the disparity of WTP and WTA are economic and psychological (Shogren 2002). The goods a consumer can purchase are constrained by income, but compensation demanded to give up the goods is not. When the goods are tempting but the income constrains ability to pay, WTA may exceed WTP. Furthermore, many goods do not have

well-defined prices and are characterized by a range of possible values. The consumers always look to the lower end of this range and sellers will look to the higher end. This behavior will result in different WTP and WTA evaluations of goods.

Figure 3-2 can also be used to explain these different measures. If an environmental improvement occurs from Environmental quality E_0 to E_1, the consumer will enjoy the benefit the change of utility (U_0 to U_1). The increase from E_0 to E_1 needs to be compensated by reductions for consumption to keep the utility of the individual constant at U_0 (m_1 to m_0).This compensation is equal to the CSU measure in Figure 3-2.

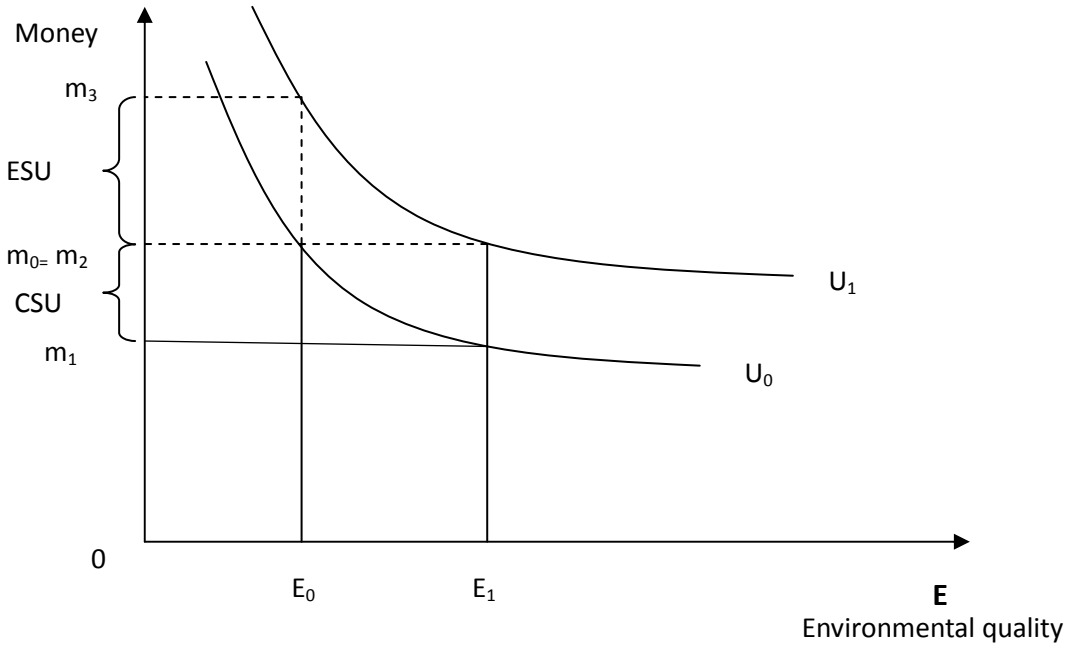


Figure 3-2: Environmental improvement: CSU and ESU

If an environmental improvement occurs from Environmental quality E_0 to E_1 and the additional income to be given to the consumer to bring him/her to the same level U_1, the level of compensation required in this case is the ESU. ESU is the additional income for the consumer; it can bring the consumer to reach the same level of utility as after the environmental quality change. ESU

corresponds to the consumer's minimum willingness-to accept as compensation to forego the environmental improvement.

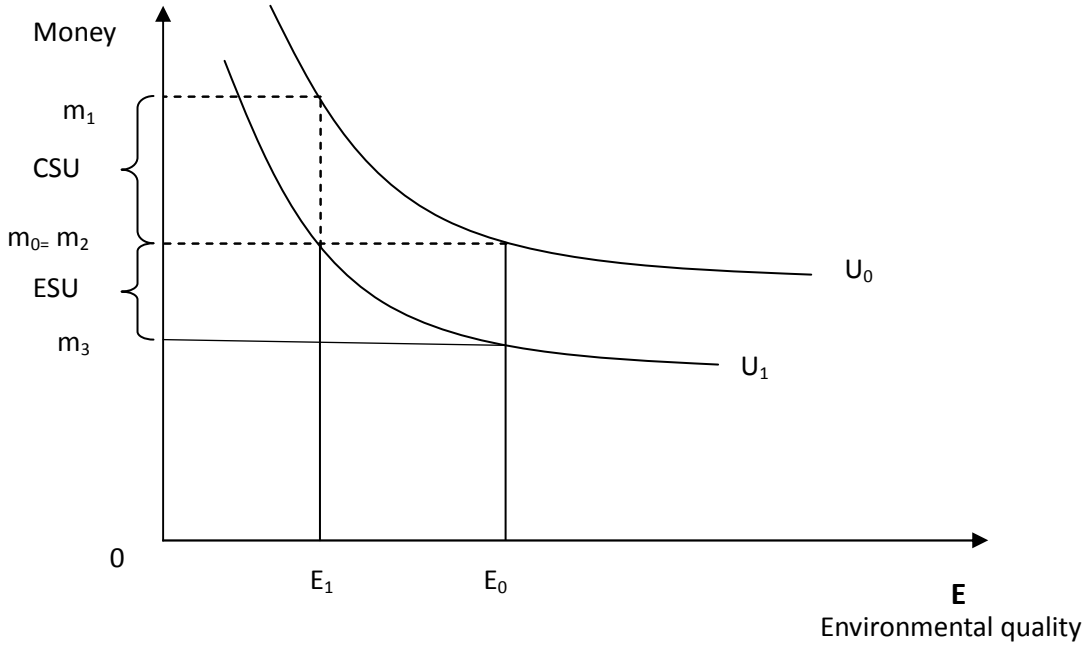


Figure 3-3: Environmental degradation: CSU and ESU

In the case of environmental degradation, the compensation is CSU which measures the minimum WTA to give up an environmental improvement (see Figure 3-3). If an environmental deterioration occurs from Environmental quality E_0 to E_1, the consumer will feel the welfare for the change of utility (U_0 to U_1). The decrease from E_1 to E_0 needs to be compensated by for consumption to keep the utility of the individual constant at U_0 (m_3 to m_2).

ESU for the environmental degradation is defined as the amount of money to be taken away from the consumer to bring him/her back to the same level of utility s/he with current income. ESU measures a consumer's maximum WTP to prevent environmental degradation (see Figure 3-3).

The concept of CSU is used in this thesis because the scenario for CVM in the questionnaire is "to increase water quality from level of Medium-pollution to

Non-pollution (River Pollution Index)". Therefore, the hypothetical scenario involves the Maximum WTP for an improvement of the water quality in the Danshui basin. In any thorough assessment of policies created to insure water-quality improvements, it is crucial to realize the benefits of improved water quality to its users.

It is believed that CVM can immediately reflect the monetary evaluation of respondent's preferences for use and non-use values; CVM also be used in evaluating the environmental quality changes which have not occurred (Genius et al., 2006).

Linear Regression

Linear regression aims to find a linear relationship between the independent and dependent variables. The multiple linear regression attempts to find a causal relationship between two or more predicator variables and a dependent variable by fitting a linear equation. A regression line allows a response variable y can be modeled as a linear function of one or more predictor variables. For instance, y (called a dependent variable) can be modeled as a linear function of explanatory random variables, x_i, with the equation

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots \quad (1)$$

where α is a constant. The coefficients β_i indicate how changes in the i-th independent variable affect the dependent variable. These coefficients are used to estimate the effect of the independent variables on the dependent variable. When the regression line slopes downward, it indicates a negative effect. When the regression line slopes upward, the variable is indicated as a positive effect. When there is no linear relationship between the variables, then the coefficient of x does not significantly differ from zero. By examining the magnitude of these regression coefficients, the effect of variables can be inferred.

WTP is considered a dependent variable in the theory; hence y in equation (1) is replaced by WTP. The independent variables are replaced by perception variables and socio-economic and demographic variables. Finally, the willingness to pay equation has been specified as the following conceptual model:

WTP= f (demographics, visit, perceptions of good water quality) (2)

The categorized variables mentioned in the equation (2) were hypothesized to affect WTP for water quality improvements including both continuous and dummy variables. The explanations of these categorized variables are listed below:

The explanations of demographic variables:

Age: Older people might be more sensitive to the future of the quality of the environment.

Education: People with higher education (University) might have more knowledge about environmental problems and might have greater concern about the environment.

Income: It is expected that income plays a major role in decisions concerning paying to support environmental issues. Respondents with higher incomes may be more likely to express a higher WTP.

The size of family:

People may care about the quality of environment circumstance if they have children or elders sharing the household.

The explanations of the frequency of visiting Danshui Basin variable:

Frequency of visiting Danshui Basin:

It is supposed that those who seldom or never visit the river(s) would be less willing to pay for water quality improvement. People who visit the Danshui Basin frequently might be willing to pay more for water quality remediation because they might feel a greater sense of satisfaction on seeing the improvements.

The explanations of perception of good water quality variables:

Perception of good water quality in life quality:

People who feel strongly that the quality of water is relevant to the quality of life may be willing to pay for access to high-quality water.

Perception of good water quality in human health:

People who agree that the quality of water has an effect on their overall health may be more willing to pay for water quality improvement.

Perception of good water quality in functions of recreation:

People who believe that water pollution affects the recreational sites may be willing to pay for improvements in water quality.

Perception of good water quality in agricultural water use:

People who agree that water pollution has an effect on agricultural products may be willing to pay for better water quality.

Perception of good water quality in industry profit:

Peoples' willingness to pay for water quality improvement may not be relevant to industry profit.

Perception of good water quality in tourism image:

Peoples' willingness to pay to the water quality improvement may not be estimated based on their perception of good water quality to tourist image.

It is assumed that WTP depends on the socio-economic and demographic at the study site and that analysis undertaking that study estimated the

relationship between WTP and these (explanatory) variables (Asenso-Okyere, Osei-Akoto et al. 1997; Smith and Von Haefen 1997; Mathiyazhagan 1998; Barnighausen, Liu et al. 2007; Linde-Rahr 2008). Therefore the analysis of contingent valuation surveys seeks to build a model to explain how different variables affect people's WTP. The socio-economic demographic characteristics of respondents are considered as the indicators for meaningful responses. Generally speaking, the willingness to pay is strongly affected by the level of income (Linde-Rahr 2008).

Chapter 4 Research Area and Data Collection

In this chapter the research area is described, including basic geography information and primary pollutions sources of Danshui Basin in section 4.1. The design of questionnaire and data collection method in this thesis are presented in section 4.2. Finally, the methods of questionnaire data analysis is described in section 4.3.

4.1 Research Area

Danshui basin includes seven main rivers which run through Taipei County, Taipei City, Taoyuan County and Hsinchui County. There are two main reservoirs -Shihmen Reservoir, Feitsui Reservoir and 14 smaller reservoirs in this Basin. At 159 kilometers long and coverage area of 2,726 square kilometers, the Danshui is the third longest river in Taiwan. The average annual precipitation is approximately 2939 millimeters and the average water flow is 6,600 million cubic meters per year. Figure 4.1 shows the Danshui Basin.

The Environmental Protection Administration (EPA) lists the primary sources of pollution in Danshui Basin below.

1. Domestic wastewater

   Thousands of homes and businesses discharge untreated wastewater into rivers and streams. An inadequate number of sewage treatment plants are ill-equipped to keep up with the demand. In addition, the sewage system is not designed to direct the total amount of wastewater

to the sewage treatment plants and if they where the system would be overwhelmed.

Figure 4-1: Danshui Basin in northern Taiwan (10th River Management Office, WRA, MOEA.)

2. Factory wastewater

   There are approximately one thousand mining operations and other factories within the Danshui Basin. The mining businesses use upstream clean and fresh river water and discharge turbid water. The wastewater from the dye, chemical, and electroplating industries also increases the level of turbidity.

3. Debris and its exuded water

   Some dumps are located close to rivers. Some debris is allowed to flow into the river by authorities during heavy rain storms. In addition, the

storm run-off contains hazardous materials and chemicals associated with the trash.

4. Animal husbandry wastewater

   Livestock production requires water for daily use and is therefore often located near rivers and streams. Without adequate safeguards the run-off from these farms contains animal waste and chemicals associated with production.

5. Non-point source

   During and following a heavy rain the run-off carries ground contaminants to the rivers and tributaries. At the same time, pollutants from the storm current are deposited in low lying areas. This is combined with the normal run-off that naturally flows downstream and creates sludge on river bottoms which can affect the flow and depth of the rivers.

Because of these primary pollution sources, water quality of Danshui Basin has been emphasized. Environmental Protection Administration (EPA) has long promoted programs to monitor and control major pollution sources from households, industrial waste and effluence from livestock breeding operations. The EPA’s projects include the construction of sewage systems and sewage treatment plants.

The Danshui Basin is a typical example of the current water management circumstances in Taiwan. The authorities lack an approach to effectively cooperate with the public. One of the intentions of the questionnaire is to provide the stakeholder perception on water policy approaches so that the stakeholder may realize the effect of propagation and the possibility of public

participation.

4.2 Design of Survey

Content of Survey

The questionnaire consisted of two main parts: Public perceptions of Stakeholders and Willingness to Pay (see Appendix A). In the first part of the questionnaire, the questions are designed to focus on the perceptions of existing policy instruments. The existing policy instruments are listed at the beginning of the questionnaire. The respondents were asked to choose which policies are more useful to improve the water quality of the Danshui Basin. Respondents answered the sub-questions in the sequence of chosen policies. The set of sub-questions use a 1-5 rating scale, (ranking the degree of disagreement or agreement with the statements) regarding the components of the quality of life, human health, functions of recreation, agricultural water use, industry profit and tourism image (see Appendix A). At the end of this section of the questionnaire, respondents were encouraged to provide their suggestions for a particular approach to improve the water quality.

The second part pertains to the WTP for the changes in water quality. By using the Contingent Valuation Method (CVM) to the basic of questionnaire techniques, the hypothetical improvement of the water quality in the Danshui river will be presented to respondents to elicit their WTP for such an improvement. The hypothetical scenario is formulated by positing an envisioned status for the water quality improvement project. Respondents can contribute with their one-time payment to a “Danshui Basin Conservation and Protection Fund”. This is the so-called payment vehicle used in the

hypothetical scenario. The definition of water quality is presented in the following paragraph. But these definitions where not precisely explained to the respondents of the questionnaire. First, the respondent was asked if they would like to contribute to the fund. If the response to this question was yes, then respondents were faced WTP question. If respondents answered no to the hypothetic fund then they were asked to give their reasons.

The last questionnaire section includes socio-economic characteristics of the respondents, such as age, gender, income, education level and household size.

Defining Water Quality for Respondents

This thesis develops survey-based estimation of WTP as a one-time payment for water quality improvement. In Taiwan, EPA uses a River Pollution Index (RPI) to indicate the seriousness of surface water pollution for planning as well as day-to-day management of surface water quality for the public. Calculation of the RPI based on concentration levels of four parameters: dissolved oxygen (DO), biochemical oxygen demand (BOD), suspended solids (SS) and ammonia nitrogen (NH3-N), each of which is ultimately converted to a four-state quality sub-index (1, 3, 6, and 10), also called scores. These four different scores are divided into four pollution levels: non or slightly polluted - 1, minor pollution - 3, moderate pollution - 6, and severe pollution -10 (See Table 4.1). The equation for the RPI is shown as following (*i* is used to indicate each of the four water quality parameters; S_i as the scores for each parameter):

$$RPI = \frac{1}{4}\sum_{i=1}^{4} S_i \qquad (2)$$

According to the RPI value, the results of the classification are presented below (See Table 4.1):

(A) Slightly polluted (RPI<2)

(B) Minor pollution (2≦RPI≦3)

(C) Moderate pollution (3<RPI≦6)

(D) Severe pollution (RPI>6)

Parameters	Non (slightly) Polluted	Minor Pollution	Moderate Pollution	Severe Pollution
DO	> 6.5	4.6~6.5	2.0~4.5	Below 2.0
BOD	< 3.0	3.0~4.9	5.0~15.0	Above 15.0
SS	< 20	20~49	50~100	Above 100
NH3-N	< 0.5	0.5~0.99	1.0~3.0	Above 1.0
scores	1	3	6	10
4 classes (Average scores)	A (<2.0)	B (2.0~3.0)	C (3.1~6.0)	D (>6.0)

Table 4-1: River Pollution Index (RPI) of All the Samples Used In Each Class

4.3 Data Gathering

The sampling method used was partly convenience sampling and partly based on the snowball principle. The survey was posted on the PTT Bulletin Board System (BBS) and it was e-mailed to residents of Danshui Basin from my friend list. I sent 45 surveys via e-mail and received 29 responses in Chinese version (see Appendix B). I also used snowball sampling to ask respondent if they know the people who have lived in Danshui Basin more than two years. Some of the respondents collected responses from their friends and the number of returned questionnaires was 27. The number of respondents from the PTT is 9. In total 65 responses were received by December 2008.

The qualification standards for participants are the following: a participant must be aged over twenty years old, and must be a long-term resident in Danshui Basin.

In order to adopt questionnaires among local inhabitants, only local inhabitants living more than two years in the region were interviewed. The goal is to obtain the stakeholder's opinions and attitudes concerning existing policies and their willingness to pay for improvements.

Chapter 5 Results of Questionnaire Analysis

The analysis from the survey data is presented here. First, summary statistics and graphs are presented. Next, the results of the regression model are discussed. Several socio-economic variables and other perception variables that could affect the mean WTP are available for regression.

5.1 Survey Results

Socio-economic characteristics

The survey collected data on socio-economic characteristics to study how these characteristics impact ~~on~~ willingness to pay for river water quality improvement.

The total number of respondents was 65. The economic and demographic characteristics include age, educational level, sex, household size, and personal income. Table 5-1 presents a summary of socio-economic variables. 60% of the respondents are female~~s~~. The respondents' average age is 29.86 years. The average income of respondents is between NT$[4]30,000 and NT$40,000 per month. 70 percent of respondents are single. The majority of respondents (95%) have higher education (Bachelor's degree or higher). Most respondents are employed full-time, with only 3% unemployed people, 1% housewives and 18 % students.

[4] NT$:New Taiwan Dollar

Variables		
Total number of individuals		65
Demographic variables		
Males		40%
Females		60%
Mean Age		29.86
Married		29.23%
Single		70.77%
Family size (mean)		3.93
Education:	Vocational training college	4.62%
	University/College Degree	49.23%
	Postgraduate Degree	44.62%
	PHD	1.54%
Economic variables		
Income:	Less than $20,000	18.46%
	$20,001-$30,000	21.54%
	$30,001~$40,000	26.15%
	$40,001~$50,000	20.00%
	$50,001~$60,000	9.23%
	more than $60,000	4.62%
Employment:	Employed Full time	75.38%
	Looking after house full time	1.54%
	Student	18.46%
	Unemployed	3.08%
	Other	1.54%

Table 5-1: Summary statistics of selected socio-economic variables

Stakeholder Perception of Water Policy

In summarizing the results, I counted three points for the first ranking water policy approach, two points for the second ranking, one point for the third. The top three most useful policy approaches identified by respondents are:

- To complete sanitary sewage system
- To supervise and control pollution sources
- To integrate the Water Pollution control Act

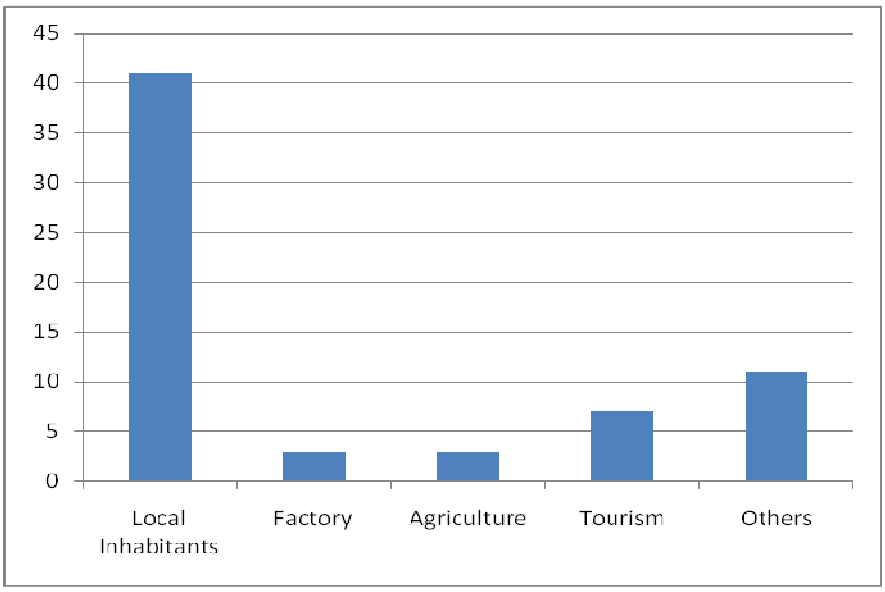
Respondents are more likely to prefer higher-level importance of water policy approaches when comparing results from questionnaire and cost-effective matrix. These three water policy approaches listed above are more tangible and visible compared to “Environmental Tax”, “To set overall discharge standards” and “Improvement of garbage treatment”. Respondents might anticipate government‘s focus on tangible approaches. On the other hand, the authorities prefer to put their efforts into highly visible acts because they want the public to feel satisfied with government’s performance. “Environmental Tax” and “To set overall discharge standards” aim mainly at enterprises. The general public may seldom realize or even notice the purpose and the importance of these two water policy approaches. Though the garbage treatment is important to environmental quality, the public may seldom make the connection between it and water quality.

Furthermore, the sanitary sewage system is the basic modern public construction. Many countries set sewage system as an important target for environment quality. The government’s goal is the public sanitary sewage served rate to reach 38% in 2014. Development of sewage system maintains positive public perception for respondents.

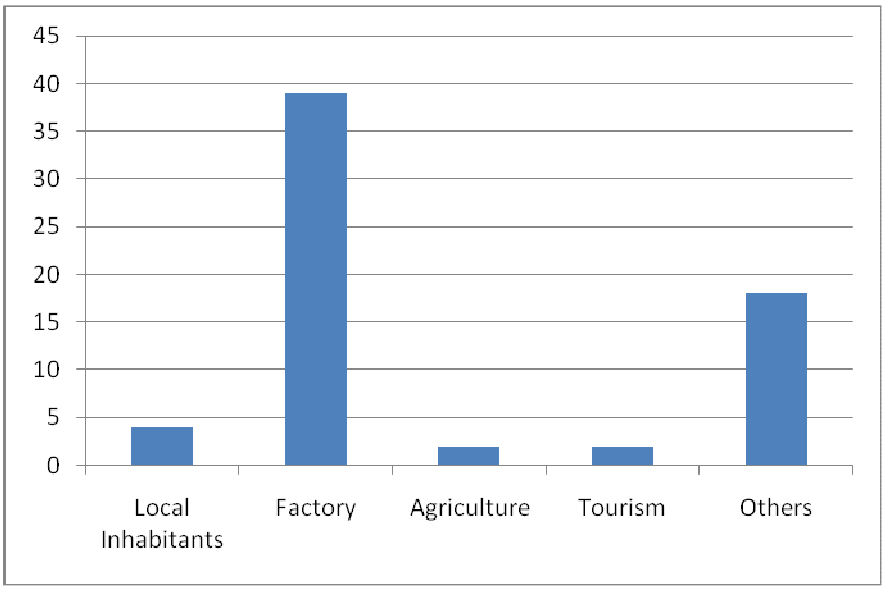
“To supervise and control pollution sources” ranks second as useful water policy approaches, probably because the public believes government has overall responsibility to monitor and control pollution. Water pollution may spread widely without supervision and control of pollution sources. Concerning water pollution: it is essential to supervise and control the sources of the pollution. Respondents agree that prevention is of the utmost importance.

Respondents also perceive that enforcement of existing water pollution control laws is complicated. Many people are still confused by the division of environmental law and convention, and they seldom have general sense about the function of different environmental management departments. To constitute an integral water pollution act could create more effective solutions to environmental protection problems.

63% of respondents think that local inhabitants can best take advantage of good water quality (see Graph 5-1). 60% of respondents believe that factories should take responsibility for a Danshui Basin clean-up (see Graph 5-2). Most respondents agree that good water quality will enhance human health and improve the tourism image; they believe that industry profit is less relevant than good water quality.



Graph 5-1: Which stakeholder can take the most advantage from good water quality?

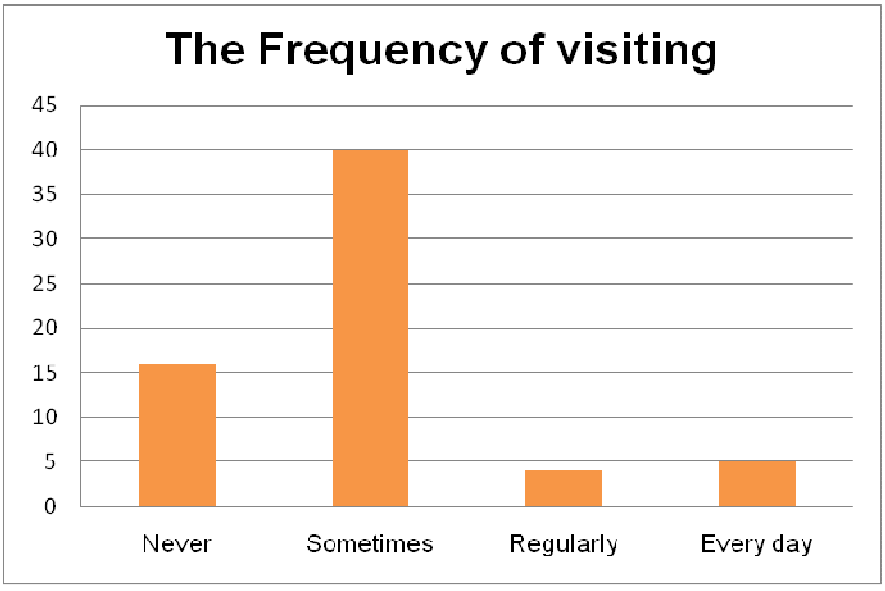


Graph 5-2: Which stakeholder should be responsible to clean up Danshui Basin?

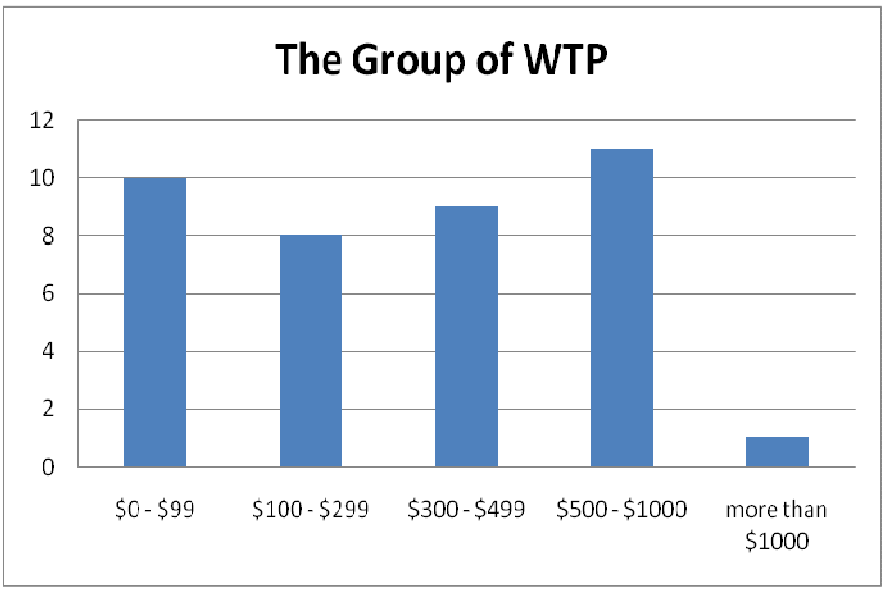
Willingness To Pay

The second part of questionnaire is about WTP. 61% of respondents visit Danshui Basin1~2 times per month (see Graph 5-3). 52% of respondents go to visit Danshui Basin primarily to enjoy the natural scenery. 40% of respondents replied “Don’t have enough time to visit Danshui Basin”, 38% of respondents replied “Because of the unpleasant odor, they do not visit Danshui Basin”. 80% of respondents are not satisfied with the current water quality of Danshui Basin.

The mean WTP for all respondents is NT$222.3 for one-time payment. There are 60% of respondents who were willing to pay for “Danshui Basin Conservation and Protection Fund”. Based on the direct responses to the valuation question, respondents who are willing to pay the fund are mostly located in the range of $0~$99 and the range of $500~$1000. Only 1 respondent had stated a WTP of over NT $1000 (see Graph 5-4).



Graph 5-3: How often do you visit Danshui Basin in a month do you reach?



Graph 5-4: The Amount People are Willing to Pay

About 40% of respondents who are not willing to pay for the fund chose the answer of “Other facilities are more required”. Some reasons for answering “no” were considered as a protest bid rather than as a zero-WTP value.

Verbatim from the questionnaires:

- “The authorities should supervise and control pollution sources. Further, the money for the remediation should be paid by polluters and the remaining part should be paid by tax (5 responses).”
- “I am not one of the beneficiaries (1 response).”
- ”First of all, the remediation fee should be charged from high polluting private organizations or companies. Second of all, the specific content of Conservation and Protection Fund is not clear. I cannot decide if I want to pay or not (1 response). ”

Linear Regression

Summary statistics of categorical variables are given in Table 5-2. The Frequency was significant at the 1% level. The perception of good water quality in functions of recreation (Perception 3) and perception of good water quality in tourism image (Perception 6) were significant at the 10% level. The variables having the largest impact on WTP were “Frequency”, “Perception 3” and “Perception 6”. Table 5-2, below, summarizes the variables used in the regression along with the hypotheses about the expected relationship between WTP and the covariates.

It is observed that those who more often visit Danshui Basin are willing to pay less. This seems contradictory, but probably respondents who are more frequent visitors to the Danshui Basin consider the water quality better than it was 20 years ago. Because the water quality of Danshui Basin is getting better in recent decades, they might not want to pay more for it.

Respondents who agree to the statement “Good water quality will increase the functions of recreation (Perception 3)” more of them are willing to pay more on average. The reason for this may be that they perceive the poor water quality can affect recreation in and on the water. More of the Respondents who agree “Good water quality will improve the tourism image (Perception 6)” are willing to pay less on average. It is probable that respondents perceive the enhancement of tourism image should be financially supported by the relevant authorities or individuals.

Economic theory suggests that income should be positively related to WTP. However, the WTP did not increase with monthly income as expected (see

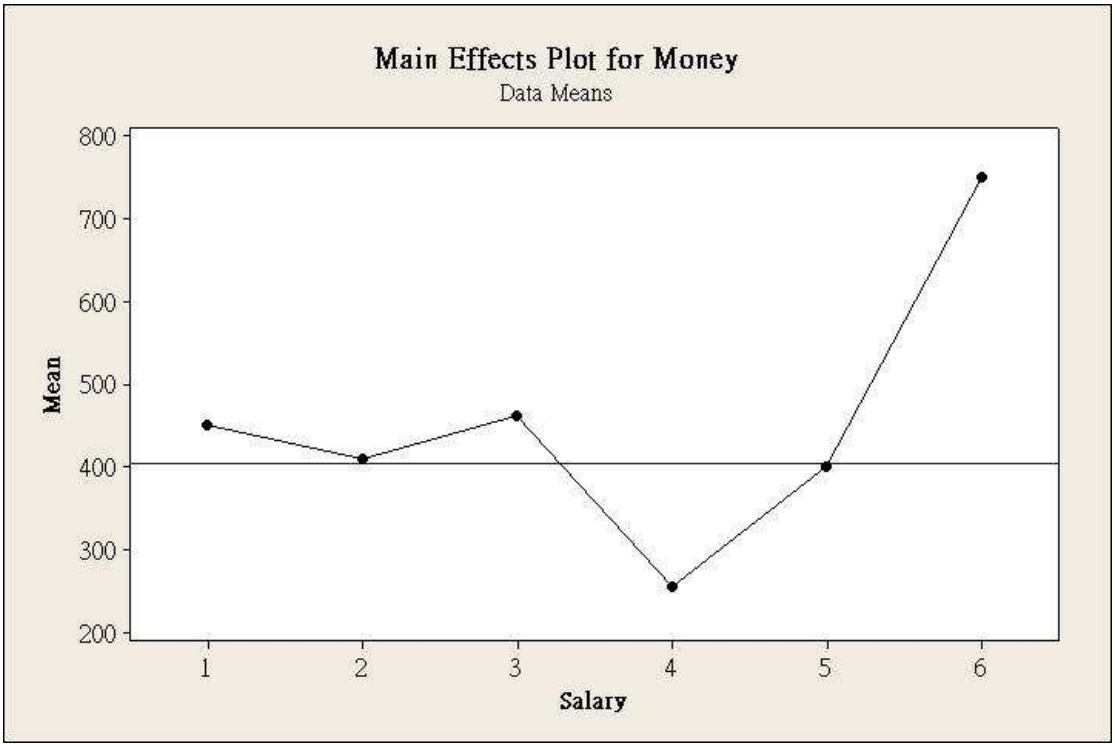
Graph 5-5 and Table 5-2). The regression result shows that the income does not significantly influence the WTP (coef. =-0.58 ;p value＞10%). Education was not statistically significant either (coef. =0.048; p value＞10%). These results were unexpected. It only indicates that individuals with vocational training college-level education are willing to pay higher price for water quality improvement in the main effects plots analysis (see Graph 5-6). It was hypothesized that the better educated respondents would be more aware of water quality problems and would have higher WTP. One possible explanation is that 95% of respondents are in higher education, the WTP preferences are similar in these education groups. So there is not a lot of variation in this explanatory variable.

The association between age and WTP is negative (coef. =-1.096; p value＞10%). The insignificance of the age variable might be caused also by the small variation in this explanatory variable, since 72% of respondents are in the age group of 26-35; hence they have similar WTP preferences.

In the main effects plot analysis, the family size of respondents affects WTP positively, which means that respondents have large families would like to pay higher price for water quality improvement (see Graph 5-7). Hence, the relationship between family size and WTP is expected. However, the family size had no statistically significant impact on WTP for water quality improvement (coef. =-1.633 ;p value＞10%).

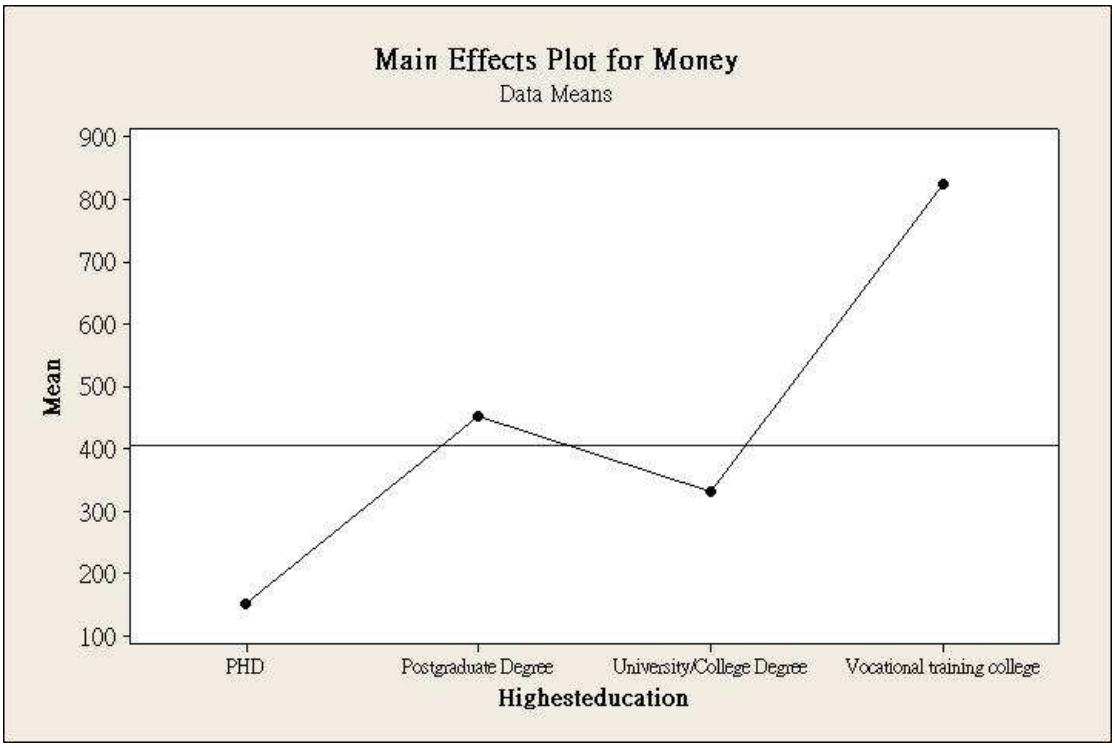
The other variables –“Perception of good water quality in life quality (Perception 1)”, “Perception of good water quality in human health (Perception 2)”, “Perception of good water quality in agricultural water use (Perception 4)” and “Perception of good water quality in industry profit (Perception 5)” are no

statistical significant impact on WTP as well (coef. =-1.046,0.306, -0.184, -0.201 ;p values $>$ 10%). The water quality perception about life quality (Perception 1) and human health (Perception 2) are not relevant to WTP are not expected. People would be willing to pay more if they think good water quality is relevant to life quality or human health. The perceptions about agricultural water use (Perception 4) and industry profit (Perception 5) do not affect the evaluation of WTP. The possibly explanation is that the vocations of the respondents are not related to agriculture and manufacture.

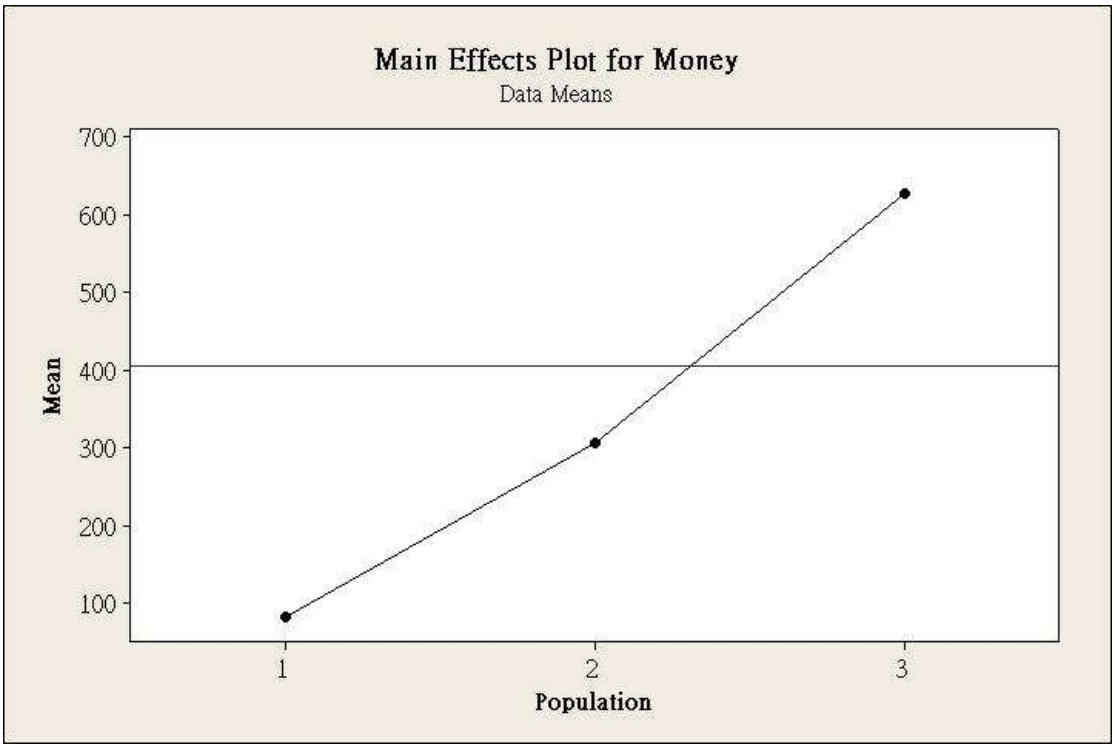


*Salary 1: Less than 20,000, Salary 2: NT$20,001 - NT$30,000,
Salary 3: NT$30,001 - NT$40,000, Salary 4: NT$40,001 - NT$50,000,
Salary 5: NT$50,001 - NT$60,000, Salary 6: More than NT$60,000

Graph 5-5: Main Effects Plot for Personal Income



Graph 5-6: Main Effects Plot for Highest Education



Graph 5-7: Main Effects Plot for Family Size

Variable	Coefficient	SE	T-stat
Good water quality will improve life quality (1:Strongly Disagree;5:Strongly Agree)	-1.046	1.2716	-0.82
Good water quality will enhance human health (1:Strongly Disagree;5:Strongly Agree)	0.306	1.1247	0.27
Good water quality will increase the functions of recreation(1:Strongly Disagree;5:Strongly Agree)	1.495**	0.6853	2.18
Good water quality will improve agricultural water use (1:Strongly Disagree;5:Strongly Agree)	-0.184	0.6901	-0.27
Good water quality will improve the industry profit (1:Strongly Disagree;5:Strongly Agree)	0.201	0.5287	0.38
Good water quality will improve the tourism image (1:Strongly Disagree;5:Strongly Agree)	-1.342**	0.8970	-1.50
Age of respondent	-0.548	0.7436	-0.74
The highest education level of respondent	0.048	0.5248	0.09
Monthly personal income	-0.290	0.3926	-0.74
Number of family members in respondent's household	-0.817	0.8335	-0.98
Frequency of visiting Danshui Basin	-1.153*	0.4211	-2.74
R-Squared:23.44%			

Notes:* significant at .01 level, **significant at.10 level.

Table 5-2: Regression Results

Chapter 6 Conclusion and Discussion

Conclusion

The thesis presents the results of a survey of stakeholder perception of current Taiwan water policy as well as an analysis of willingness to pay for water quality remediation in Danshui Basin.

Stakeholder perception is the level of public participation. A survey on public perception of water policy may provide information to the authorities for administration satisfaction and policy cognition. Respondents believe that to complete sanitary sewage system is the most useful approach for water quality improvement; and good water quality can enhance the quality of life and human health.

From the literature review, the tendency to integrate the water relevant authorities is expected. The European WFD breaks the national boundaries and considers each river basin as a management unit. Reversely to Taiwan, the overlapped water resource management reduces the efficiency of water policy implementation.

In the case of WTP, it is a survey based on the hypothetical scenario to estimate valuation for environment improving service. The valuation of water quality may provide basic information for policy-makers on public investments and policy instrumentation to control environmental pollution. Based on the results of the respondents, stakeholders are willing to pay on average NT$222.3 for an improvement of the water quality from medium-polluted to non-polluted. In the final estimation of the divergence between WTP responses, the independent variable: agreement to the statement “Good water quality will increase the functions of recreation” has an intriguing impact. The reason for

this may be that they perceive the poor water quality can affect recreation in and on the water.

Discussion

Due to the fact that the value of water varies over time and space, the valuation of water resources is challenging. Some drawbacks of the set-up chosen in this thesis will be discussed in this section.

In this thesis, the qualification standards for participants were defined: they must be at least twenty years old, and must have been a resident in Danshui Basin area for more than two years. However, the long or short-term residence may be also a variable to affect WTP. People may have much stronger emotional connections to Danshui Basin and are more concerned about river water quality if they dwell longer in the area. They possibly have a higher WTP than people who are not the long-term residents. Moreover, a comparison of stakeholder perception for the length of residence can be evaluated.

Furthermore, the age of respondents is centralized on the age group of 26 to 35; it is considered that the scope is limited to certain relevant stakeholders. Also, the main groups of highest education are located in “University/College Degree” and “Postgraduate Degree”, the distribution of education is higher than the average. This group of respondents is, on average, younger and better educated; and the economic situations of respondents focus only on personal income. Therefore, further expansions of research into different age groups and the detailed assessment of the economic situation, such as consumer behavior for daily goods or environmentally friendly goods, should be considered. In addition, it is also possible that relationships between

off-site and on-site river locations could be analyzed for comparing the WTP of water quality improvement.

Though the RPI (River Pollution Index) for measuring the level of river pollution has been used for a long time, people might not have fully realized the definition and meaning of this pollution index. Respondents might have been confused about the differences in those four pollution levels. Appropriate authorities might consider establishing a more suitable water quality index for the public and decision makers.

The reasons respondents are not willing to pay were not interpreted. These respondents may have serious concerns about the water quality of Danshui Basin, but they may be prejudiced by improper authority activities. It is possible that they distrust government. They may not have a clear understanding of the definition of WTP. These biases are not determined in the questionnaire. I cannot reconcile the estimated variables with a functional WTP.

Furthermore, the intervals for evaluation of WTP are not sufficiently fine to minimize the bias.

Generally speaking, it is hard to know the actual values of the whole population for their perception and WTP in this study area. Besides, Contingent Valuation can concentrate on other essential factors such as water consumption, quality and quantity, ability and affordability, technical and managerial, and political factors. There are many details that must be considered in the survey project. A further investigation for respondent concepts about WTP should take place and the results should be examined in greater detail.

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Appendix A: Questionnaire (English Version)

Date: _____

Questionnaire No: _____

Perception and WTP Survey for Stakeholders

Introduction to the Survey

The present survey is applied at stakeholders of Danshui Basin to assess the perceptions about the circumstances of Danshui Basin improvement and their willingness to pay to improve the water quality.

Part I: Perception Survey

I. Existing Policies

Taiwan government keeps striving to ameliorate water quality of Danshui Basin for a long time. In this year (2008), they have obtained good outcome. The water quality of Danshui Basin is the cleanest in past 30 years. Of course, we should still expect much better quality for the future. In your opinion, which existing policy you think is useful for water quality improvement? (Please choose 3 existing policies and rank them in order of their valuation: 1 = highly useful, 2= useful, 3= less useful)

- ❑ To complete sanitary sewage system
- ❑ To enhance water quality monitoring system
- ❑ To adopt environmental tax
- ❑ To adopt environmental subsidy for wastewater treatment
- ❑ To set overall discharge standards
- ❑ To supervise and control pollution sources
- ❑ Improvement of Garbage Treatment
- ❑ Set the integral Water Pollution control Act
- ❑ Flow Cutoff[5]
- ❑ Set the Constructed wetland[6]

[5] To cut off the untreated wastewater from river to the wastewater treatment plant in order to prevent pollution.

[6] The constructed wetland is an artificial marsh or swamp, built for disposing wastewater.

Please follow the sequence of the three policies you chose to answer the questions.

1. The first policy

The first policy you chose will improve life quality				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The first policy you chose will enhance human health				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The first policy you chose will increase the functions of recreation				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The first policy you chose will improve agricultural water use				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The first policy you chose will improve the industry profit				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The first policy you chose will improve the tourism image				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree

2. The second policy

The second policy you chose will improve life quality				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The second policy you chose will enhance human health				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The second policy you chose will increase the functions of recreation				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The second policy you chose will improve agricultural water use				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree

The second policy you chose will improve the industry profit				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The second policy you chose will improve the tourism image				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree

3. The third policy

The third policy you chose will improve life quality				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The third policy you chose will enhance human health				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The third policy you chose will increase the functions of recreation				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The third policy you chose will improve agricultural water use				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The second policy you chose will improve the industry profit				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree
The third policy you chose will improve the tourism image				
❑ Strongly disagree	❑ Disagree	❑ Neutral	❑ Agree	❑ Strongly agree

II. Responsibility of water quality

1. Which stakeholder can take the most advantage from good water quality?

❑ Local Inhabitants
❑ Factory
❑ Agriculture
❑ Tourism
❑ Others _____

2. Which stakeholder should be responsible to clean up Danshui Basin?

❑ Households
❑ Factory

❑ Agriculture
❑ Tourism
❑ Others _____

3. Which specific level of government represents their efforts on the Danshui Basin reformation best

❑ County Environmental Protection Bureau
❑ City Environmental Protection Bureau
❑ Environmental Protection Administration

III. Effects of water quality

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
1. Good water quality will improve life quality					
2. Good water quality will enhance human health					
3. Good water quality will increase the functions of recreation					
4. Good water quality will improve agricultural water use					
5. Good water quality will improve the industry profit					
6. Good water quality will improve the tourism image					

IV. Other suggestions about future

If you have any other suggestions for Danshui Basin *improvement* projects, please write down your opinions.

Part II: WTP Survey

1. What kind of functions of Danshui Basin do you think?

❑ Water Supply

❑ Climate Regulation

❑ Transportation

❑ Recreation/Tourism

2. How often do you visit Danshui Basin in a month do you reach?

❑ Never

❑ Sometimes (1 ~ 2 times)

❑ Regularly (3 times or more)

❑ Every day

3. What are the reasons for going?

❑ Go Exercise

❑ Get relax

❑ Take a Walk

❑ Go fishing

❑ Others _____

4. What are the reasons for not going?

❑ The unpleasant odor

❑ Unsuitable Infrastructures

❑ Don't have enough time

❑ Others _____

5. Are you satisfied with the current water quality of Danshui Basin?

❑ Yes ❑ No

Suppose the Danshui Basin is going to be executed an effective policy to increase water quality from Medium-polluted to Non-polluted[7], and we are going to establish a "Danshui Basin Conservation and Protection Fund". Would you be willing to pay in this fund?

❑ Yes ❑ No

If your answer is yes, please answer the following questions

How much you are willing to pay in this fund?

❑ $0 - $99

❑ $100 - $299

❑ $300 - $499

❑ $500 - $1000

[7] River Pollution Index (RPI) is used to rate river water quality. The pollution levels divided into four categories :Non-polluted (RPI＜2); Light-polluted(2≦RPI≦3); Medium-polluted(3.1≦RPI≦6); Heavy-polluted(RPI＞6)

❑ More than $1000 _____

Reasons for willing to pay

❑ Danshui Basin is required for me

❑ Danshui Basin is required for family

❑ Danshui Basin is required for the society

❑ Danshui Basin is required for the future generation

❑ The resources of Danshui Basin are essential

❑Want the environment of Danshui Bain to be more improved

❑ Others _____

If your answer is No, please answer the following question

Reasons for not willing to pay

❑ Danshui Basin is not required for me

❑ Danshui Basin is not required for family

❑ Danshui Basin is not required for the society

❑ People seldom use the source of Danshui Basin

❑ Other facilities are more required

❑ Others _____

To help us better understand your opinions, please answer the following

Gender: ❑ male ❑ female Age: _____

Marital Status: ❑ single ❑ married ❑ divorced❑ widowed

Household size: ❑ 1~2 ❑ 3~4 ❑ 5 or more

Highest Level of Education:

❑ Primary School

❑ High School

❑ Vocational training college

❑ University/College Degree

❑ Postgraduate Degree

Occupation:

❑ Employed full-time

❑ Employed part-time

❑ Looking after house full time

❑ Retired

❑ Unemployed

Total Monthly Household Income:

❑ Less than $20,000

❑ $20,001 - $30,000

❑ $30,001 - $40,000

❑ $40,001 - $50,000

❑ $50,001 - $60,000

❑ More than $60,000

Do not write your name on this questionnaire. Your responses will remain anonymous.

Thank you for your time.

Appendix B: Questionnaire (Chinese Version)

訪問日期：_____

問卷編號：_____

利益關係人認知評量及使用者付費意願評估

簡介

這份問卷調查的目的爲評估淡水河利益關係人對於淡水河改善環境的認知及其付費改善水質的意願評估。

第一部份：利益關係人認知評量

V.現行的環境政策

一、 台灣政府長期致力於整治淡水河。在今年(2008) 淡水河終於水質出現了30年以來最乾淨的狀態。當然，我們不能只滿意於現狀，還要期望更好的水質。在您的瞭解裡，您覺得那些現行的環境政策對於水質的改善有幫助？(請選出三個政策並依其重要性排序：1: 非常有幫助 2:有幫助 3:稍微有幫助)

☐ 加速完成興建污水下水道
☐ 加強水質監測系統
☐ 徵收環境稅(使用環境或造成污染所課之稅)
☐ 補助企業設置廢水處理設施
☐ 制定全面性排放水標準
☐ 監督及管制污染源
☐ 改善廢棄物處理方式
☐ 制定完整的水污染防治法
☐ 截流處理[8]
☐ 現地處理人工溼地[9]

[8] 將原本排入河川的污水截流至處理廠。

[9] 在汙染源附近設置人工溼地。藉著濕地本身水質淨化的功能，讓汙水淨化降低排放至河川的汙染量。

※ 請依照您所選取之三項政策的重要程度順序，依序回答下列問題。

1. 最重要/最有幫助的政策

您選的第一順位政策會改善生活品質				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第一順位政策會提升人體健康				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第一順位政策會增加休閒娛樂功能				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第一順位政策會改善農業用水				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第一順位政策會增進工業利益				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第一順位政策會提昇旅遊形象				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意

2. 次重要/次有幫助的政策

您選的第二順位政策會改善生活品質				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第二順位政策會提升人體健康				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第二順位政策會增加休閒娛樂功能				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第二順位政策會改善農業用水				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意

您選的第二順位政策會增進工業利益				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第二順位政策會提昇旅遊形象				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意

3. 重要/稍微有幫助的政策

您選的第三順位政策會改善生活品質				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第三順位政策會提升人體健康				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第三順位政策會增加休閒娛樂功能				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第三順位政策會改善農業用水				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第三順位政策會增進工業利益				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意
您選的第三順位政策會提昇旅遊形象				
☐ 非常不同意	☐ 不同意	☐ 沒有意見	☐ 同意	☐ 非常同意

二、水質責任

4. 你覺得那些利益關係人能由於好的水質得到利益？

☐ 當地居民
☐ 工業/廠
☐ 農業
☐ 旅遊業
☐ 其他_____

5. 你認爲那些利益關係人需要對清潔淡水河流域負責？

□ 當地住家
□ 工業/廠
□ 農業
□ 旅遊業
□ 其他_____

6. 你認爲那個政府部門對於改善淡水河的環境盡了最大的心力？

□ **臺北縣**政府環境保護局
□ **台北**市政府環境保護局
□ 行政院環境保護署

三、水質造成的影響

	非常不同意 1	不同意 2	沒有意見 3	同意 4	非常同意 5
7. 好的水質會改善生活品質					
8. 好的水質會提升人體健康					
9. 好的水質會增加休閒娛樂功能					
10. 好的水質會改善農業用水					
11. 好的水質會增進工業利益					
12. 好的水質會提昇旅遊形象					

VI. 其他建議

如果你有任何其他對於淡水河流域改善計劃的建議，請你寫下你的意見。

第二部份：民眾對良好水質之願付價格

1. 你認爲淡水河流域扮演著什麼樣的角色？

□ 供水 □ 氣候調節 □ 交通運輸 □ 休閒娛樂 □觀光

2. 請問你平均在一個月內去過淡水河幾次？

□ 從不 □偶爾(1~3 次) □ 常常(4 次以上) □ 每天

3. 請問去淡水河是爲了從事哪些活動？

□ 從事休閒娛樂活動 □ 欣賞風景 □ 其他_____

4. 請問下列哪些是您不想去淡水河的原因？

□ 令人不愉悅的氣味 □ 不合適的公共建設
□ 沒有足夠的時間 □ 其他_____

5. 請問你滿意淡水河流域現在的水質嗎？

□ 是 □ 否

假設淡水河域相關政府部門打算實行一個有效率的政策提升水質、減少污染；並將河川污染分類指標[10]由中度污染提昇至未受污染的狀態。但是這項政策需要設立”淡水河流域保育及保護基金”且由利益相關人支付。

6. 請問你願意支付該項基金嗎？

□ 是 □ 否

如果你的答案爲”是”，請回答A組問題。
如果你的答案爲”否”，請回答B組問題。

A 組

(1) 您願意支付多少金額？

□ $0 - $99
□ $100 - $299
□ $300 - $499
□ $500 - $1000
□ 高於1000元_____

(2) 請問基於何種原因您願意支付金額?

□ 淡水河流域對我來說是不可或缺的
□ 淡水河流域對我的家人來說是不可或缺的
□ 淡水河流域對社會來說是不可或缺的

[10] RPI(River Pollution Index)爲河川污染分類指標。根據其水質參數數據來對污染程度加以分類爲未受污染或稍受污染(2.0 以下)、輕度污染(2.0～3.0)、中度污染(3.1～6.0)亦或嚴重污染(6.0 以上)

B 組

(1) 請問您基於何種原因不願意支付金額?

□ 淡水河流域對我來說是不必需的
□ 淡水河流域對我的家人來說是不必需的
□ 淡水河流域對社會來說是不必需的
□ 人們不常使用到淡水河流域的資源
□ 其他的公共設施更需要改善
□ 其他_____

****

爲了幫助我們更了解您的意見，請填寫下列資料。

性別：□ 男 □ 女　年齡：_____

家庭狀況：□ 未婚 □ 已婚 □ 離婚

家庭人口數：□ 1~2 □ 3~4 □ 5 以上

最高學歷：□ 小學 □國中 □高中/職 □ 專科 □ 大學 □ 碩士 □ 博士

職業：

□ 全職 □ 兼職 □ 家庭管理 □ 學生 □ 退休 □ 待業中 □ 其他_____

平均月收入：

□ 20,000 以下
□ 20,001~30,000
□ 30,001~40,000
□ 40,001~50,000
□ 50,001~60,000
□ 60,001 以上

請不要填寫您的姓名，並且非常感謝您願意花寶貴的時間填寫此份問卷。